BJC/OR-1360/R1

DRAFT FOR PUBLIC REVIEW

Environmental Baseline Survey Report for the Title Transfer of the K-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

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BECHTEL JACOBS COMPANY LLC
managing the
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East Tennessee Technology Park
Oak Ridge Y-12 Plant   Oak Ridge National Laboratory
Paducah Gaseous Diffusion Plant   Portsmouth Gaseous Diffusion Plant
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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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FIGURES

TABLES

ACRONYMS

bgs	below ground surface
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
cpm	counts per minute
DCE	dichloroethene
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
H_o	null hypothesis
H_a	alternative hypothesis
HP	health physicist
ISU	interior survey unit
LAW	large area wipe
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
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
TCE	trichloroethene
TRU	transuranic
TVA	Tennessee Valley Authority
U	uranium
UST	underground storage tank
VOC	volatile organic compound

EXECUTIVE SUMMARY

This environmental baseline survey (EBS) documents the baseline environmental conditions of the U. S. Department of Energy's (DOE's) K-1580 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-1580 Building is located in the southern portion of ETTP. It is a 38,211-ft^2 (12,737 ft^2 on each of the three floors), three-story structure that was built in 1980 as an office building for ETTP Engineering personnel. Building K-1580 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 and south sides of the building.

The area proposed for title transfer includes the K-1580 building, exterior electrical and air-conditioning equipment, and underlying property, also known as 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[1] 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 of. Radiological surveys were conducted to assess the building's radiological condition. 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-1580 for one or more years.

- The only identified asbestos-containing material in the building is 16 linear ft of clay rope-type insulation. The vinyl floor tiles are assumed to contain asbestos; the floor tiles are in good condition.

- 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-1580.

- The building interior, exterior, and furnishings were radiologically surveyed in accordance with the survey plan (Appendix C). The data were analyzed using the Sign test, a non-parametric statistical test, to determine if any residual radiological 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-1580 study area had no areas of elevated residual radioactivity present above DOE contamination limits or the DCGL [total alpha, 5000 disintegrations per minute (dpm)/100 cm^2; removable alpha, 1000 dpm/100 cm^2; total beta-gamma, 5000 dpm/100 cm^2; and removable beta-gamma, 1000 dpm/100 cm^2] and, therefore, can be released without radiological restrictions. The radiological survey results are discussed in Sect. 6.3 of this report.

- No soil sampling was conducted for this report.

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[1]Personal communications with J. R. Russell, T. G. Ramsey, and L. D. Charles (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 Building K-1580*, DOE recommends the following:

1. Due to the uncertainty associated with the nature of the on-site groundwater, and its need to be evaluated and possibly addressed in the future, DOE recommends that the transfer of Bldg. K-1580 be achieved by a covenant deferral per Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Sect. 120(h)(3)(c), et seq.

2. Assumed asbestos-containing materials identified in Sect. 5.2 of this report should be periodically inspected to ensure that the asbestos does not become friable. Disposal of the materials, notwithstanding their condition, must be conducted pursuant to applicable regulations.

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-1580 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 2002b). 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. Those changes 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-1580 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-1580 is located within the ETTP perimeter fence. Figure 1.1 is a map showing the relationship of Bldg. K-1580 to ETTP, and Fig. 1.2 is an ortho image showing the footprint of the K-1580 study area. Figure 1.3 is an aerial photograph showing the location of K-1580 in relation to ETTP.

The area proposed for title transfer includes the K-1580 building, 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.

[2]Personal communications with J. R. Russell and L. D. Charles (either previously or currently employed at the East Tennessee Technology Park).

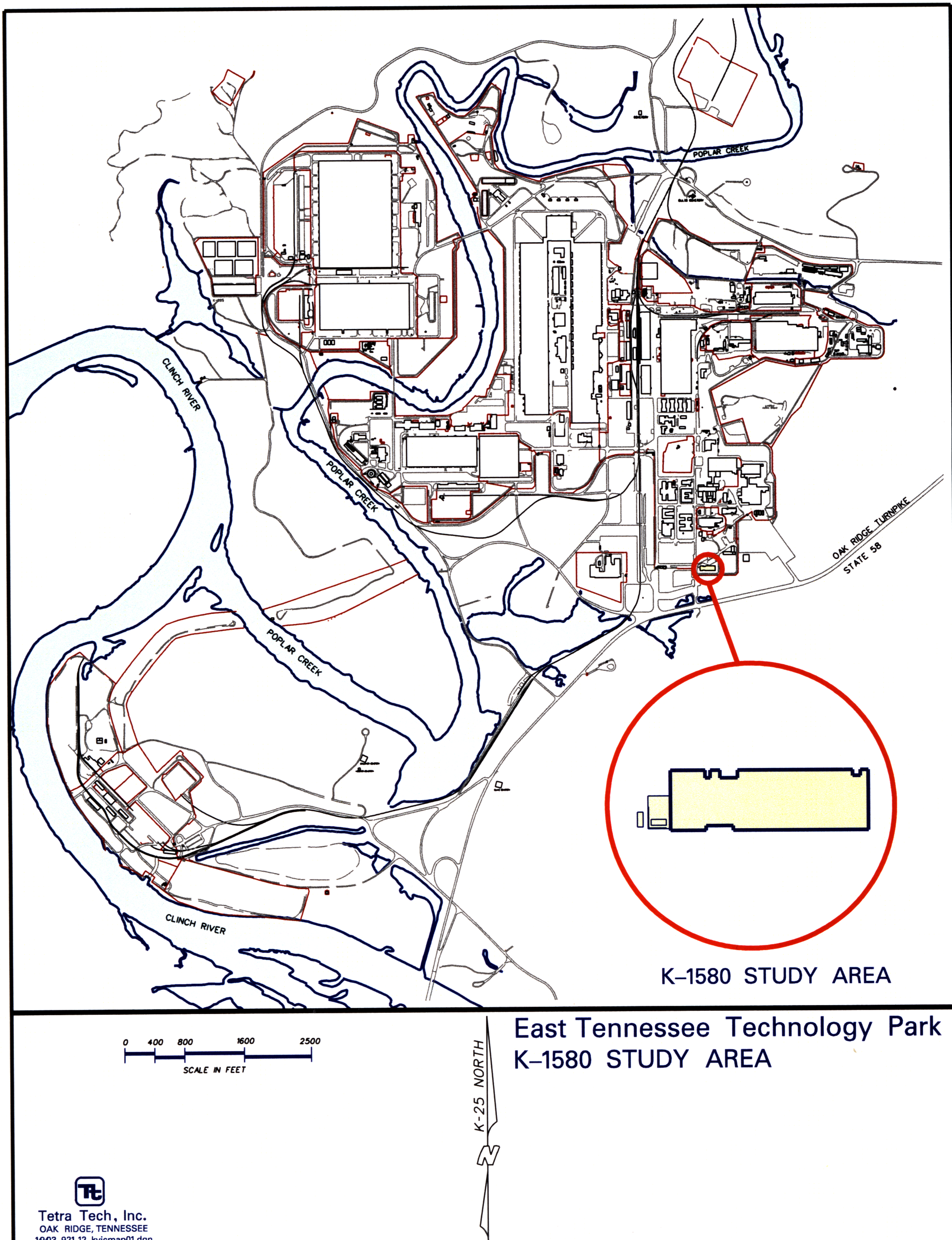

Fig. 1.1. Location map of the K-1580 study area.

Fig. 1.2. Ortho image of the K-1580 study area.

Fig. 1.3. 2001 aerial photograph of Bldg. K-1580 from the south.

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-1580 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 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 land tract H-720 where Bldg. K-1580 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

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

map and real estate map are maintained in the BJC Real Estate Office and the DOE-ORO Real Estate Office.

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-1580 occurred under DOE's own authority, without external regulation. The facility manager was interviewed[4] and records for the time that DOE has been externally regulated were checked for information about spills, permits, or violations. No records were identified that provide information about spills, permits, or permit violations. In addition, the former underground storage tank (UST) manager stated that there are no regulated USTs associated with Bldg. K-1580. There are water treatment tanks associated with the chiller, but these tanks are not regulated.[5]

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[4]Personal communication with J. R. Russell (either previously or currently employed at the East Tennessee Technology Park).

[5]Email communication from S. T. Goodpasture, (either previously or currently employed at the East Tennessee Technology Park).

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). During the construction of the Oak Ridge Gaseous Diffusion Plant (ORGDP), the K-1580 area was an undeveloped field outside the perimeter fence and remained as such until the K-1580 building was constructed in 1980. The perimeter fence was moved and K-1580 is inside the fence.

K-1580 was constructed in 1980 as an office building for Engineering personnel. In the 1990s, engineering personnel moved from the building, and other organizations have occupied the building for offices.

As discussed in Sect. 1.0, interviews with current and former employees of K-1580 were conducted to identify any areas on the property where hazardous substances and/or petroleum products were stored for one year or more, known to have been released, or disposed.

Based on record searches and interviews, no underground tanks existed on this property. There are floor drains in the bathrooms. These have not been plugged because they go to the sanitary sewer. There are labels that state no hazardous materials are to be disposed of in the drains. There are no records that the drains have been sampled. There is also a drain in the elevator pit that has been plugged because it goes to the storm sewer. Floor drains were plugged in the early 1990s as part of the side wide drain plugging program. (The program was initiated to ensure that floor drains connected to the storm drain system were permanently plugged or rerouted to prevent discharge of materials into the storm drain system and to limit the potential for National Pollutant Discharge Elimination System permit[6] non-compliance.)

4.2 PAST AND PRESENT ACTIVITIES FOR THE ADJACENT PROPERTY

The study area is located in the southern portion of ETTP to the east of the former K-1001 Administration Building. 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.

The closest facility to K-1580 is the K-1320 Office Building. Building K-1320 was constructed in 1982 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-1580 that are potential areas of contamination. The closest environmental restoration area is the Recirculating Cooling Water (RCW) Lines Leak Sites 500 ft to the north. 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 used a chromate/zinc/phosphate treatment until 1977, when it was replaced by a phosphate treatment system. The cooling tower was demolished in the 1990s. 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

[6] Email communication from J. Murphy of CDM Federal (currently employed at ETTP).

Appendix C of the Federal Facility Agreement (FFA).[7] [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 presented, vapor intrusion information is a data gap and will be addressed in a future version of this document.

Building K-1580 is located in the southern portion of ETTP, which is underlain by bedrock of the Chickamauga Supergroup. The Chickamauga Supergroup formations in this area include the Carters Limestone and the Hermitage Formation (Lemiszki 1994). Although less prone to karst development than the Knox Group rocks in the vicinity of the 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 Bldg. K-1580 with the axis of this structure located just north of the building and trending northeast–southwest. Bedding in the Chickamauga generally dips northwestward on the north side of this axis and southeastward on the south side of this axis. Building K-1580 is located on the south side of the anticline axis; thus, bedding is expected to dip primarily to the southeast. The approximate location of the axis of the anticline 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 Bldg. K-1580 generally consist of thick to massive beds of limestone with some thin to medium beds and occasional interbedded argillaceous limestone and calcareous shales. Some pods and lenses of chert are present in the lower and middle parts of the Carters Limestone. Although exposures were not observed during the geologic mapping of ETTP, the middle part of the Carters Limestone also contains two distinctive metabentonite beds, which range from 1 to 3 ft in thickness. Irregular, cobbly, and fossiliferous beds characterize the Hermitage Formation. Generally, both 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. Thirty-one percent of the monitoring wells that have been completed in the Chickamauga at ETTP encountered cavities ranging in size from a few inches up to 7 ft. Although pre-construction topographic maps do not indicate the occurrence of sinkholes in the immediate vicinity of Bldg. K-1580, sinkholes were identified to the southwest within the geologic formations, which underlie Bldg. K-1580. Groundwater flow through bedrock at ETTP is primarily controlled by fractures, bedding planes, and hydraulic gradient.

Hydrogeologic characterization data for K-1580 are limited because, currently, no groundwater monitoring wells exist in the immediate vicinity of the building. Five bedrock monitoring wells have been installed approximately 300 to 400 ft north of Bldg. K-1580. The hydrogeologic characterization data presented below for K-1580 are partly based on the data from these wells and partly based on interpolation from available ETTP site-wide information.

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[7]DOE 1992. *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014, U. S. Environmental Protection Agency Region 4, U. S. Department of Energy, and Tennessee Department of Environment and Conservation, Washington, D.C.

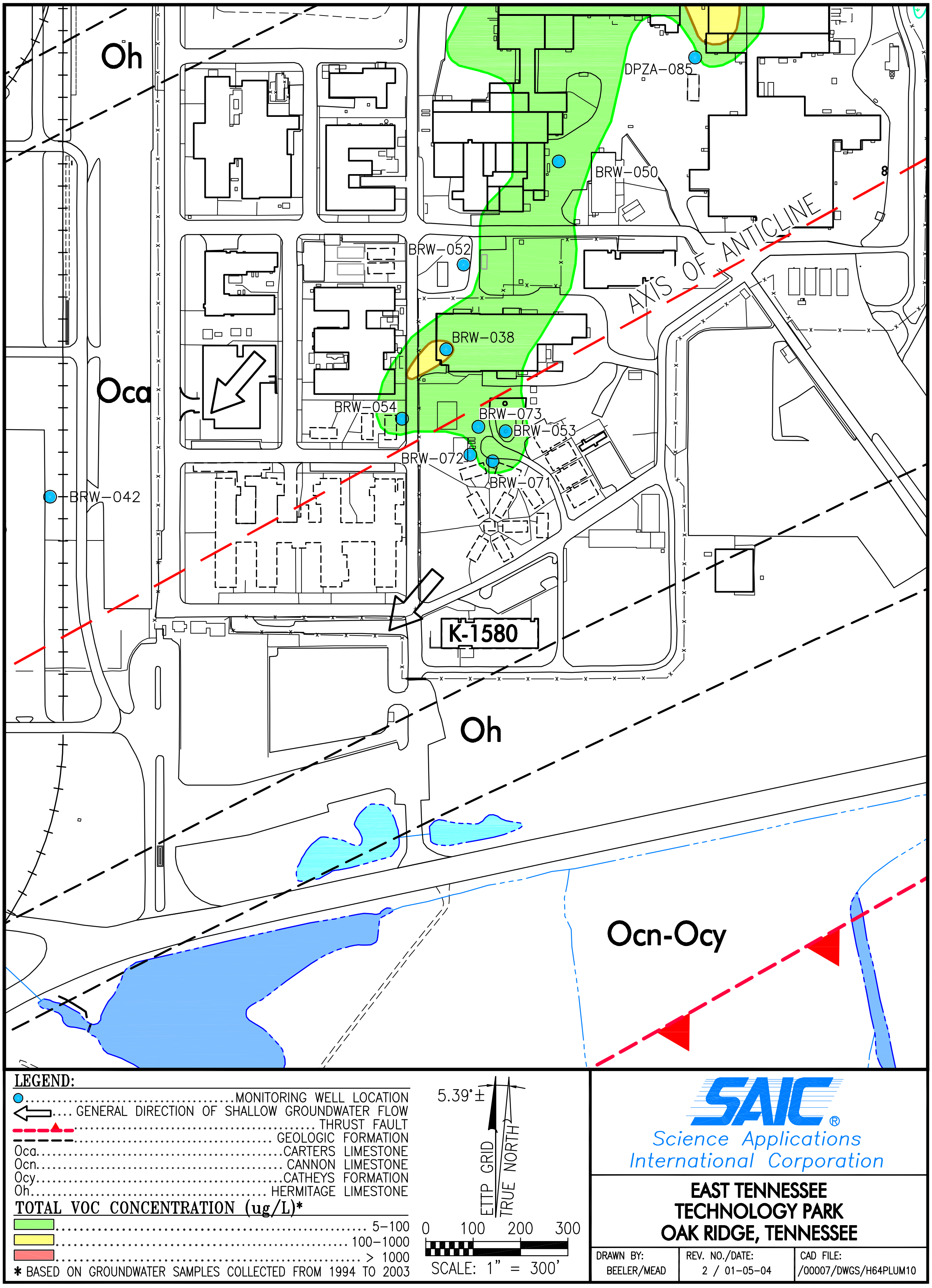

Fig. 4.1. Groundwater VOC concentrations in the vicinity of K-1580.

Because no monitoring points exist, depth to bedrock and depth to groundwater can only be interpolated from available data. Based on pre-construction topographic maps, it appears that as much as 10 ft of fill material may have been placed in the area of K-1580 during construction of ETTP. This fill was placed under a portion of K-1580, primarily along a slope at the eastern end of the building. Depth to bedrock, interpolated from data in the general vicinity of K-1580, is expected to be from 2 to 20 ft below ground surface (bgs), likely being shallower on the south side of the building where fill material was not placed. The depth to groundwater, interpolated from the ETTP site-wide potentiometric map, is expected to range from 8 to 20 ft bgs. Shallow groundwater flow is anticipated to be to the south–southwest toward the shallow ponds south of ETTP. Hydrologic parameters, such as hydraulic conductivity and hydraulic gradient, 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 Bldg. K-1580.

Table 4.1. Summary of hydrogeologic conditions at Bldg. K-1580

Parameter	Site conditions
Is a groundwater plume present beneath the facility?	None identified
Distance from facility to nearest upgradient plume (ft)	320[a]
Is karst present?	Yes
Depth to bedrock (ft)	2-20[b]
Depth to groundwater (ft)	12-20[b]
Are fill materials present at the facility?	Yes
Composition of overburden materials present.	Silty clay[b]
Shallow groundwater flow direction	SW
Hydraulic conductivity of overburden materials (cm/s)	1.15E-03[c]
Hydraulic conductivity of bedrock (cm/s)	4.08E-03[d]
Hydraulic gradient at the facility (ft/ft)	0.03[b]
Is a perched water table present at the site?	Unknown

[a]Based on anticipated flow direction, movement of the nearest identified plume is not likely to be toward Bldg. K-1580.

[b]Represents interpolated value based on available data.

[c]Represents average hydraulic conductivity of bedrock at East Tennessee Technology Park (ETTP) based on slug tests of wells completed in overburden developed above Chickamauga bedrock.

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

A groundwater plume has not been identified beneath Bldg. K-1580. However, there are data gaps with respect to groundwater movement in bedrock at ETTP. Groundwater flowpaths in bedrock are a significant unknown due to the complex geology and geologic structure underlying ETTP. An identified groundwater plume does exist within 350 ft upgradient of K-1580. This plume occurs in bedrock, and the possibility of transport through bedrock flowpaths toward K-1580, although unlikely, cannot be completely discounted based on available data. Table 4.2 summarizes the analytical results for the volatile organic compounds (VOCs) detected in groundwater samples collected from the six bedrock wells

Table 4.2. Summary of VOCs detected in groundwater samples from bedrock monitoring wells north of Bldg. K-1580

Analyte (µg/L)	MCL	BRW-038			BRW-053						BRW-054				
		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
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
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
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
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**
Trichloroethene	5	**170**	**35**	**120**	200 U	**99**	**44**	**50**	**87**	**100**	**13**	**17**	**13**	**15**	**20 J**
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

Analyte (µg/L)	MCL	BRW-071					BRW-072					BRW-073				
		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.

located north of K-1580 (BRW-038, BRW-053, BRW-054, BRW-071, BRW-072, and BRW-073). It should be noted that these concentrations do not represent groundwater beneath Bldg. K-1580 but have been included to provide characterization data for the known plume nearest to the building. In addition, monitoring well BRW-053 is the only well in the vicinity of K-1580 that has been sampled since 1998; however, this well was not sampled between 1994 and 2000. Well BRW-038 has not been sampled since 1995 and the remaining wells have not been sampled since 1998. The VOCs that have been detected above a federal drinking water maximum contaminant level (MCL) at these monitoring wells include 1,2-dichloroethene (DCE); tetrachloroethene; trichloroethene (TCE); and vinyl chloride. Concentrations of TCE have remained relatively steady over the sampling events of record at these wells. TCE has only been detected in one of five sampling events at BRW-072, which is located only 50 ft west of BRW-071 (see Fig. 4.1 for well locations), since 1994.

Although contemporaneous sampling of the monitoring wells in the vicinity of K-1580 has not been conducted, it can be seen in Table 4.2 that TCE concentrations are significantly lower at wells BRW-054, BRW-071, BRW-072, and BRW-073 as compared to BRW-053, which is located upgradient of these wells. TCE concentrations drop from an average of 76 μg/L over the five most recent sampling events at BRW-053 to an average of 6 μg/L (using one-half the detection limit for nondetect values) over the five most recent sampling events at BRW-071 and less than 5 μg/L at BRW-072. This represents a ten-fold decline in TCE concentration over a distance of approximately 75 ft in both a southern and western direction from BRW-053. TCE has only been detected once, at an estimated concentration of 4 μg/L, over the five most recent sampling events at BRW-072, which is located approximately 100 ft downgradient of BRW-053. Concentrations of 1,2-DCE show a similar relationship with an order of magnitude decline from BRW-053 (average of 61 μg/L) to the downgradient wells BRW-071 (average of 3 μg/L) and BRW-073 (average of 4 μg/L) and no detects at BRW-072. Natural attenuation may account for the decline in VOC concentrations observed in wells downgradient of BRW-053.

Although, as stated previously, groundwater flow in the bedrock at ETTP cannot be reliably predicted; based on observed concentration distributions and trends, age of the source releases, and hydrogeologic controls, it appears unlikely that VOCs would be transported via groundwater flow to the area of Bldg. K-1580. However, given the natural attenuation processes that would affect the concentrations of VOCs in groundwater, if the transport of contaminated groundwater from the nearest plume to K-1580 did occur, it is likely that concentrations would not exceed those observed at BRW-071. Concentrations of TCE and 1,2-dichloroethene have ranged from 6 to 10 μg/L and 2 to 4 μg/L, respectively, between 1994 and 1998 at this well.

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 February 2003, a walkdown of the K-1580 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 1st, 2nd, and 3rd floor plans for Bldg. K-1580 are shown in Fig. 5.1. The building is a rectangular-shaped, three-story structure with 12,737 ft^2 on each floor for a total of 38,211 ft^2. It is constructed of reinforced concrete with pre-cast concrete siding.

The floors in the offices, conference rooms, and most of the corridors are carpeted. The stairwells, remaining portions of corridors, and several storage rooms are covered with vinyl floor tiles. The restrooms and janitors' closets have ceramic floor tile. The ceilings are suspended, man-made mineral fiber panels with fluorescent light fixture insets. There is a stairwell on each end of the building, and an elevator is located in the northwest corner.

Due to the date of construction of the building (built in 1980), the fluorescent light fixtures are not suspected to contain polychlorinated biphenyls in the ballast. All insulation in the building is man-made mineral fiber or rubber foam except for 16 linear ft of clay rope-type insulation. A 1994 asbestos survey[8] of the K-1580 building reported the only asbestos-containing materials in the building to be the 16 linear ft of clay rope-type insulation It is located in the second- and third-floor vaults on the east end of the building. Also, the 2165 ft^2 of 12-in. by 12-in. vinyl floor tile in the building are assumed to contain asbestos. These tiles are in good condition. Due to the fact that the building was recently built, it is improbable that lead-based paint exists in the building.

There have been no chemical sampling events in the interior of the building to evaluate potential chemical contamination inside the building. Given the use of the facility as an office building since its construction, no sampling was deemed necessary.

Building K-1580 is equipped with a recirculating air-exchange ventilation system. The building is cooled with a chilled water system and heated by a hot-water-circulating heating system located in the Mechanical Room (Room 167) on the 1st floor. A water-cooling tower chills the water for the cooling system, and steam generated by the K-1501 Steam Plant supplies the heat for the hot water system. The water is circulated by pumps to registers throughout 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 used in the building are janitorial supplies, the hydraulic fluid for the elevator, and glycol in the water of the heating and cooling system.

Also included in the title transfer are two electrical transformers and a water-cooling tower associated with the chilled-water cooling system of the building. They are located on the west end of K-1580. Electricity for K-1580 is provided through two 13.8-kV transformers. The transformers are a dry type and contain no oil.

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[8]Radian Corporation 1994. *Oak Ridge K-25 Site Building K-1580 Asbestos Survey*, September.

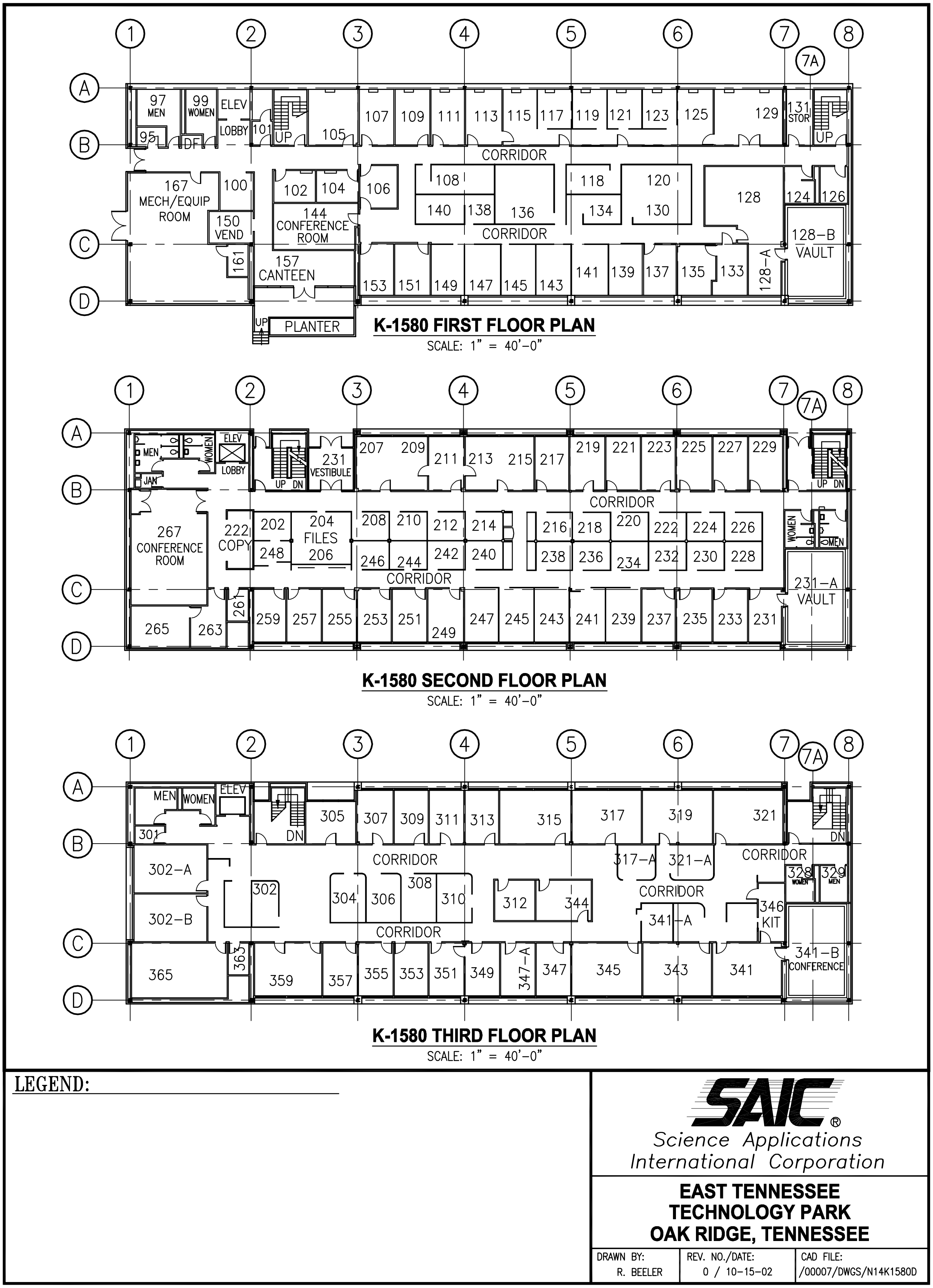

Fig. 5.1. K-1580 first, second, and third floor plans.

5.2 VISUAL AND PHYSICAL INSPECTION OF ADJACENT PROPERTY

The areas adjacent to K-1580 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 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-1320 Office Building is the nearest structure to K-1580. It is located to the northeast of K-1580 and 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-1580

The facility proposed for title transfer includes the K-1580 building, the electrical transformers and water-cooling tower to the west, and the underlying property, also known as the underlying fee. No exterior laydown, parking, or soil areas are associated with the title transfer footprint other than the exterior patio and sidewalks. The K-1580 building has been used for office space since its construction in 1980 and has three floors (12,737 ft^2 on each of the three floors for a total of 38,211 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-1580 property and adjacent areas, there is no indication that the area has been contaminated from past activities; therefore, no soil 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-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-1411 (BJC 2004).

6.3 RADIOLOGICAL SURVEYS

Radiological surveys were conducted on the interior and exterior surfaces of K-1580, the building contents, the exterior sidewalk, the electrical transformers, and the water-cooling tower. See Figs. 6.1 and 6.2 for the interior and exterior survey areas, respectively. This section presents and discusses the current radiological survey data that have been collected and reported in ETTP/PEM-0223, *Radiological Survey Report for the Transfer of the K-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee, to the Community Reuse Organization of East Tennessee* (BJC 2003b). 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 results.

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-1580 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 range between 0.2 to 5.0%. Most facilities could be potentially contaminated via tracking from enrichments of less than 3%.[9] As this, however, 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 the Oak Ridge National Laboratory or from the Hanford and Savannah River reactor returns uranium

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

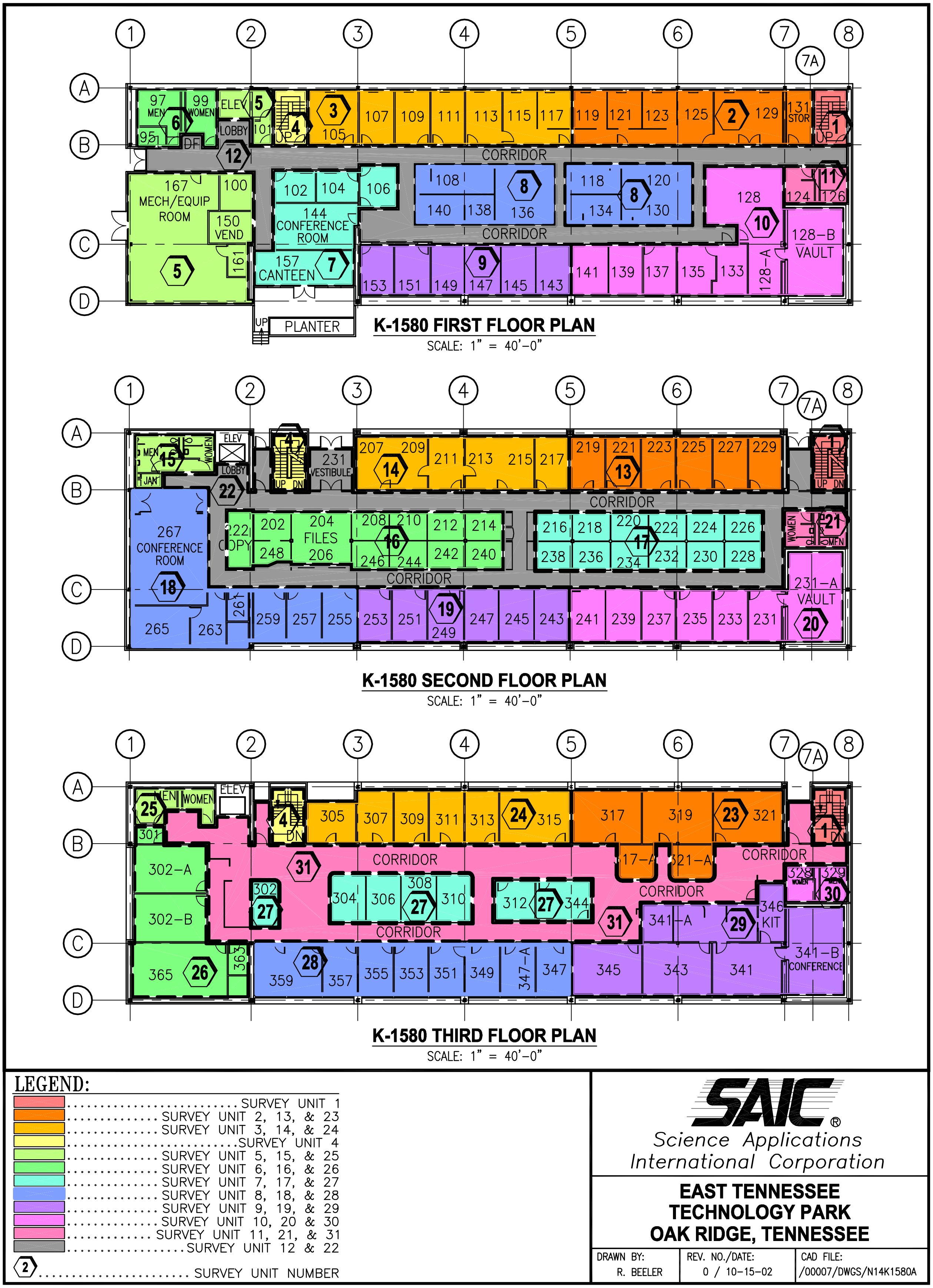

Fig. 6.1. K-1580 interior survey units.

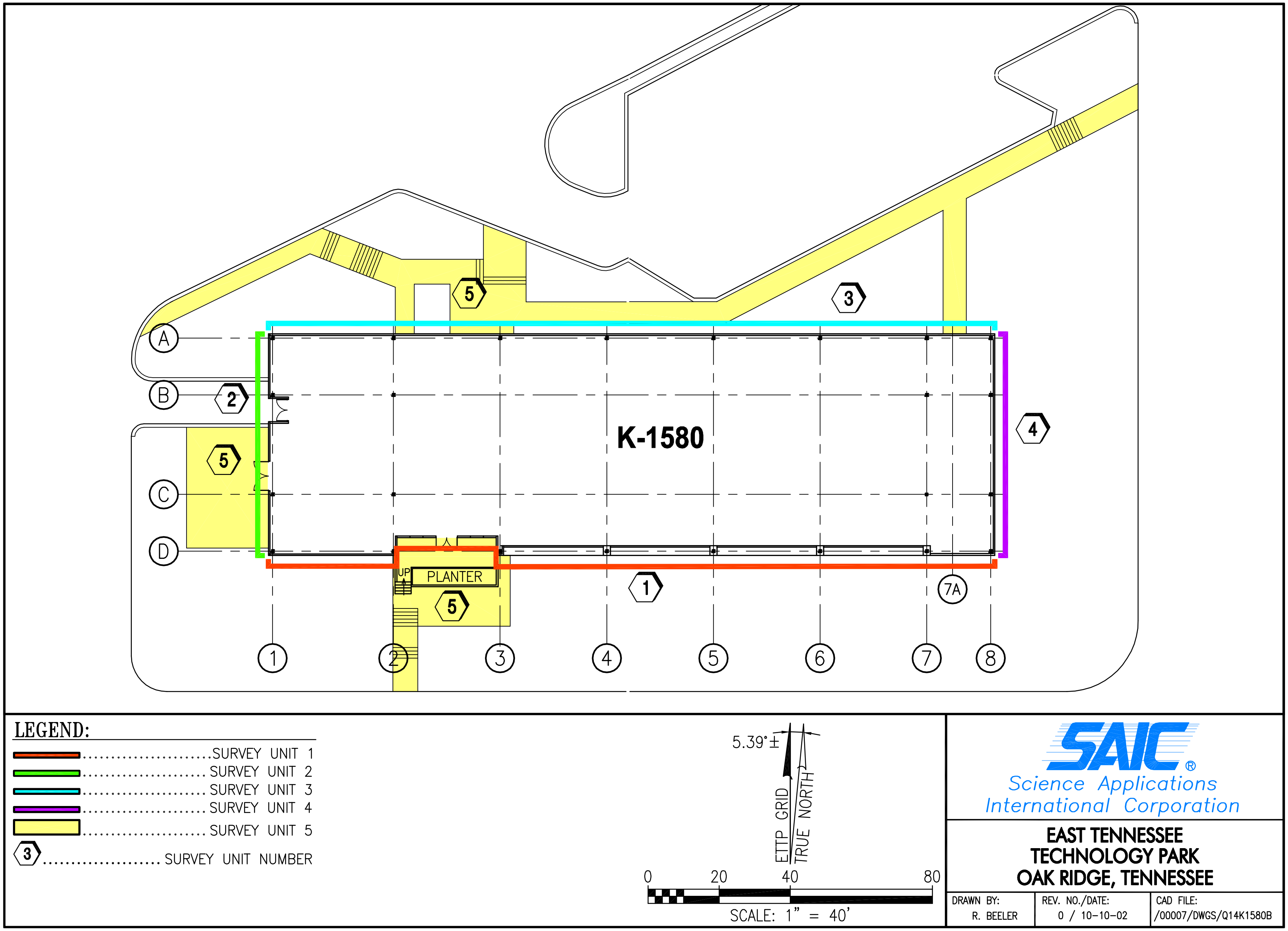

Fig 6.2. K-1580 exterior survey units.

reprocessing program; however, these radionuclides are expected to be found in much lower quantities than uranium and to be undetectable in the vicinity of K-1580, based upon its history as an administrative facility. If they were present, it is assumed that these other radionuclides 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].[10]

6.3.1 Historical Surveys

A search of the BJC Radiation Control (RADCON) electronic survey data collected since 1996 indicated that five radiological surveys have been performed inside the building. A review of these surveys provided a basis for the classification of the individual survey units, and the results are provided for informational purposes only.

Two surveys were conducted in the building on the third floor, one in 1996 and the other in 1998 because of the presence of pregnant workers. No activity was detected above background levels, and the dose equivalent rates ranged from 3 to 5 µrem/h (microrem per hour). A survey on the third floor was conducted in July 1998 after a safe that had been moved to another building from K-1580 was found to have removable contamination on its base. No radioactivity was detected above background levels, and the dose equivalent rates ranged from 4 to 7 µrem/h. The identification of the radioisotopes making up the contamination was not evaluated. In 1999, during a scoping survey of several buildings for another project, large area wipes (LAWs) over an approximate area of 1 m^2 were taken at all entrances of the building, and dose rates were taken throughout the hallways. No activity above background levels was detected on the LAWs. The dose equivalent rates ranged from 3 to 5 µrem/h.

Also in 1999, a survey of the floors of the building was performed using a computerized, position-sensitive detector system by Shonka and Associates.[11] The maximum surface activity level measured by the Shonka survey was 1671 alpha dpm/100 cm^2; for comparison, the acceptable DOE uranium surface activity level for non-radiological facilities is 5000 alpha dpm/100 cm^2. The highest activity level was associated with tape on newly installed carpet. Gross gamma scans of doorways, halls, and other main traffic areas were also performed at this time; these scans did not identify locations of potential contamination and indicated equivalent gamma exposure rates in the approximate range of 4 to 10 µrem/h, which is consistent with previous survey findings and comparable to typical ambient background levels inside masonry structures.

A total of 35 equipment/furnishings surveys were performed in the K-1580 building. This included surveys of desks, chairs, computer equipment, carpet, and various hand tools. No activity was detected above background levels for all surveys. In 1999, as a part of the scoping survey of several buildings by another project, two statistical surveys of the furnishings were performed, with the readings given in gross (uncorrected for background) counts per minute. All readings associated with these surveys were at background levels.

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[10] *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.

[11] "Rollback Program: Survey of the Twenty-Eight Discreet Areas," Shonka Research Associates, Inc., and Millenium Services, Inc., November 1999.

6.3.2 Current Surveys

A total of 105 surveys (including all associated QA/QC surveys) were conducted in the study area (Table 6.1). See Fig. 6.1 for the locations of the first, second, and third floor interior survey units (ISUs) [12] and Fig. 6.2 for the exterior survey units (ESUs). These surveys were performed from November 27 to December 20, 2002, in accordance with ETTP RADCON procedures,[13] the survey design document (hereafter referred to as the "design document"), and the survey plan (see Appendix D). These surveys also include a supplemental survey of ancillary equipment (transformers and a cooling tower that support the operation of the building), located at the exterior of K-1580, which was performed on December 19, 2002.

Radiological survey procedures and area survey units are 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.

Table 6.1. ETTP current radiological survey numbers

20021127KA36145001	20021205KA36155002	20021209PA01388005	20021213KA36145001
200212020020826004	20021205KA36155003	20021209PA01388008	20021213PA01388001
200212020020826005	20021205KA36155004	20021210PA01388001	20021213PA01388002
200212020020826006	20021205KA36155005	20021210PA01388002	20021213PA01388003
20021202PA01388001	20021205KA36155007	20021210XA50370001	20021213T3TDESK001
20021202PA01388002	20021205KA36155008	20021211KA36145001	20021213XA50370001
20021202PA01388004	20021205PA01388001	20021211KA36145002	20021213XA50370002
20021202PA01388005	20021205PA01388002	20021211KA36145003	20021216KA36145001
20021202PA01388006	20021205XA50370001	20021211KA36145004	20021216KA36145002
20021202XA50370001	20021206KA36145002	20021211KA36155001	20021216KA36145003
20021202XA50370002	20021206KA36155001	20021211KA36155002	20021216KA36145004
20021202XA50370003	20021206KA36155002	20021211PA01388001	20021216KA36145005
20021202XA50370004	20021206KA36155003	20021211PA01388002	20021217KA36145001
20021203KA36145001	20021206KA36155004	20021211PA01388003	20021217KA36145002
20021203KA36145002	20021206PA01388001	20021211XA50370001	20021217KA36145003
20021203KA36145003	20021206PA01388002	20021211XA50370002	20021217KA36145005
20021203KA36155003	20021206PA01388003	20021212PA01388001	20021217KA36145008
20021203PA01388001	200212092029335004	20021212PA01388002	20021217PA01388001
20021203PA01388002	200212093CEDESK001	20021212PA01388003	20021217PA01388002
20021203PA01388003	20021209KA36155001	20021212PA01388004	20021217PA01388003
20021203XA50370001	20021209KA36155002	20021212PA01388005	20021217PA01388004
20021204KA36155001	20021209KA36155003	20021212PA01388006	20021217XA50370001
20021204PA01388001	20021209KA36155004	20021212XA50370001	200212183CEDESK001
20021204XA50370001	20021209PA01388002	20021212XA50370002	20021219PA01388002
200212050020826004	20021209PA01388003	20021212XA50370003	200212203CEDESK001
20021205KA36145002	20021209PA01388004	20021212XA50370004	200212203CEDESK002
20021205KA36155001			

[12]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.

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

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* 835[14] and DOE Order 5400.5[15] 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	5,000	1,250	15,000
Removable alpha	1,000	250	N/A
Total beta-gamma	5,000	1,250	15,000
Removable beta-gamma	1,000	250	N/A

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

Each survey unit dataset was first evaluated by comparing the maximum result, after subtracting background, 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 [i.e., the null hypothesis, (H_o), that the residual contamination in each of the individual survey units exceeds the survey unit DCGL, was rejected]. 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 m^2 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-1580 building were classified as Class 3. 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; 11 measurements of total and removable contamination, at a minimum, were 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,[16] 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

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

[15] 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.

[16] 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.

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.

Six of the ISUs had results above 25% of the DCGL. All six had maximum total beta-gamma activities above 1250 dpm/100 cm^2. The highest value obtained was 1926 dpm/100 cm^2. All of these results were obtained in restrooms or other rooms that contained a glazed, clay-tile floor. Some of the elevated readings were also obtained on porcelain sinks. The screening limit established in the survey plan is 3500 dpm/100 cm^2 for such materials. Therefore, all results were less than the screening level for Class 3 areas. 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, including QA/QC surveys, all total activities were less than 550 dpm/100 cm^2 total alpha and 1930 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 8.1 dpm/100 cm^2 removable alpha and 74.8 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 7 μrem/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 initially classified as Class 3 ESUs 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 for which that the survey technician's professional judgment would indicate a higher probability of finding elevated readings. The building exterior walls and roof were covered under the survey plan. In addition, there are two pieces of ancillary equipment located on the exterior of K-1580 that support the operation of the building and will be included in the title transfer. This equipment, an electrical transformer and a water coolant tower, was included in a supplemental survey conducted in December 2002 and will be designated as ESU-Transformer and ESU-Water Coolant Tower. Another transformer was included as a furnishings survey unit (FSU). 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. Tissue-equivalent dose rates were required every 20 ft 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 test was determined using the actual number of data points for each survey unit and an alpha error (Type I error) of 0.05.

Most beta-gamma readings taken on the exterior of the building were less than 1250 dpm/100 cm^2 total activity. However, there were several locations on the roof that had a total beta-gamma activity that exceeded 1250 dpm/100 cm^2. The highest result obtained was 2432 dpm/100 cm^2. Therefore, the roof was reclassified as Class 2, and additional surveys were performed with a scan coverage percentage of 50% and 11 static measurements made according to a systematic survey grid starting at a random point (see Fig. 6.3). The highest result obtained from the Class 2 survey was 1301 dpm/100 cm^2. Because all results were less than the screening level for Class 3 and Class 2 units, no further statistical analysis was performed. From an inspection of the individual surveys, including QA/QC surveys, all total activities were less than 150 dpm/100 cm^2 total alpha and 2440 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 10 dpm/100 cm^2 removable alpha (from a QA/QC measurement) and 70 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 7 μrem/h. See Table 6.3 for the summary of the survey results for all ESUs.

Table 6.3. Summary of contamination and dose rates for the K-1580 study area

Location	Alpha total (dpm/100 cm²) Min	Alpha total (dpm/100 cm²) Max	Alpha removable (dpm/100 cm²) Min	Alpha removable (dpm/100 cm²) Max	Beta-gamma total (dpm/100 cm²) Min	Beta-gamma total (dpm/100 cm²) Max	Beta-gamma removable (dpm/100 cm²) Min	Beta-gamma removable (dpm/100 cm²) Max	Dose equivalent rate (mrem/h)
Interior Survey Units									
ISU 1	< 0	46.62	< -2.69	2.69	< -372.36	310.3	< -11.1	21.52	.003 – .004
ISU 2	< 0	43.95	< 0	5	< -293.85	359.15	< -2.77	64.0	.003 –.005
ISU 3	14.65	542	< 0	5.0	< -848.9	< -97.95	< -2.77	55.0	.003 –.005
ISU 4	< 0	59	< 0	2.69	< -32.65	718	5.54	44.0	.003 –.004
ISU 5	< 0	88	< -2.69	< 2.69	< -97.95	555	< -13.9	< 24.93	.002 –.004
ISU 6	< -30.2	136.0	< 0	5	< -63.18	1800	< -69.25	< 22.16	.004 –.005
ISU 7	< 0	58.6	< 0	< 2.69	< -489.75	< 261.2	< -47.1	< 13.85	.003 –.004
ISU 8	< 14.65	163	< -5.38	< 2.69	< -587.7	< 195.9	< -47.1	< -8.31	.002 –.004
ISU 9	< -14.65	< 29.39	< -5	5	< -261.2	490	< -47.1	< 19.39	.003 –.005
ISU 10	< 14.65	87.9	< 0	< 2.69	< -32.65	783.6	< -27.7	< 27.7	.003 –.006
ISU 11	29.3	117.2	< -5.38	< 0	97.95	1534.6	< -52.6	< -16.6	.005
ISU 12	< 14.65	74	< -5.38	< 0	< -326.5	< 489.25	< -33.2	< 0	.003 –.004
ISU 13	< -14.65	44	< -8.07	2.69	< -457.1	< 424.45	< -38.8	< -2.77	.003 –.005
ISU 14	< 0	43.95	< 0	< 2.69	< -261.2	< 359.15	< -58.2	< -8.31	.002 –.005
ISU 15	< 0	58.6	< -2.69	< 2.69	< 424.45	1828.4	< -52.63	< 74.79	.003 –.005
ISU 16	< 0	58.6	< -2.69	< 2.69	< -359.15	< 228.55	< -74.8	< 16.62	.003 –.005
ISU 17	< 14.65	59	< -8.07	< 0	< -261.2	< 195.9	< -47.1	< 0	.003 –.005
ISU 18	< 0	59	< -5.38	< 0	< -97.95	< 359.15	< -33.2	< 8.31	.004 –.005
ISU 19	< 0	59	< 0	8	< -457.1	< 195.9	< -5.54	< 41.55	.003 –.004
ISU 20	< 0	59	< 0	5.0	< -65.3	522	< -33.24	66	.002 –.005
ISU 21	< 14.65	73.25	< 0	< 5.38	< 391.8	946.85	< 2.77	< 38.78	.004
ISU 22	< 0	44	< -2.69	5.0	< -457.1	< 97.95	< -16.0	< 30.47	.002 –.004
ISU 23	< 0	59	< -2.69	5.0	< -97.95	620	< -5.54	61.0	.003 –.005
ISU 24	< 14.65	58.6	< -2.69	< 2.69	< -130.6	< 326.5	< -5.54	< 44.32	.003 –.004
ISU 25	< 29.3	147	< -2.69	< 0	718	1535	< 13.85	55.4	.005
ISU 26	< 0	59	< -5.38	< 2.69	< -326.5	1600	< -36.01	< 16.62	.003 –.005
ISU 27	< -14.65	< 0	< -5.38	8.07	< -228.55	< 195.9	< -38.8	< 24.93	.003 –.005
ISU 28	< 14.65	44	< -5.38	8.0	< -293.85	555	< -38.8	< 16.62	.003 –.005
ISU 29	< -14.65	< 43.95	< -5.38	< 2.69	< -457.1	< 359.15	< -24.9	< 19.39	.003 –.004
ISU 30	< 14.65	< 29.3	< -5.38	< 2.69	1273.4	1926.4	< -33.24	< 16.62	.004 –.005
ISU 31	< -14.65	< 29.3	< -5.38	< 2.69	< -555.05	< 326.5	< -44.3	< 27.7	.003 –.004

Table 6.3. Summary of contamination and dose rates for the K-1580 study area (continued)

Location	Alpha total (dpm/100 cm²)		Alpha removable (dpm/100 cm²)		Beta-gamma total (dpm/100 cm²)		Beta-gamma removable (dpm/100 cm²)		Dose equivalent rate (mrem/h)
	Min	Max	Min	Max	Min	Max	Min	Max	
					Exterior Survey Units				
ESU 1	< 0	58.6	< -8.07	< 0	< -97.95	588	< 0	64	.004 – .006
ESU 2	< 0	14.65	< -8.07	< 0	< -293.85	359.15	2.77	36.01	.003 – .005
ESU 3	< 0	< 29.3	< -5.38	2.69	< -32.65	< 293.85	< 5.54	< 36.01	.003 – .005.
ESU 4	< 0	< 0	< -5.38	< 0	< -130.6	< 424.45	< -19.4	<44.32	004 – .007
ESU 5	< 14.65	102.55	< -8.07	< 2.69	< -97.95	< 522.4	< -5.54	< 30.47	.003 – .005
ESU Roof	< 0	105	< 0	< 2.43	< 13.59	2432	< -33.0	< 35.88	.002 – .005
ESU Roof – Class 2	< 0	106	< 0	8.0	479	1301	< -32.3	< 8.31	.002 – .005
ESU Transformer	< 0	44	< -2.69	5.0	< -555	588	< -38.8	< 24.93	NR[a]
Water Coolant Tower	< 0	147	< -2.69	< 2.69	< -555.05	718	< -30.5	< 36.01	.003 – .004
					Furnishings Survey Units – Class 3				
FSU 2	< -14.7	44	< 0	< 2.43	< -549.1	< 86.7	< 0	84	NR[b]
FSU 3	< -29.4	< 14.7	< 0	< 2.43	< -375.7	< 404.6	< -8.97	65.78	NR[b]
FSU 5	< 0	58.8	< 0	< 2.43	< -606.9	< 0	< 20.93	50.83	NR[b]
FSU 7	< -15.1	< 15.1	< 0	5.0	< -284.31	< 473.85	< -24.93	< 13.85	NR[b]
FSU 8	< -15.1	60	< 0	5.0	< -315.9	< 252.72	< -30.47	< 27.7	NR[b]
FSU 9	< -15.1	30	< 0	9.72	< -315.9	600	< -38.87	< 26.93	NR[b]
FSU 10	< -15.1	106	< 0	8.0	< -379.08	< 126.36	< -30.47	< 16.62	NR[b]
FSU 12	< 0	< 46.62	< -5.38	< 2.69	< -217.21	< 186.18	< -24.93	< 33.24	NR[b]
FSU 13	< -31.08	< 62.16	< -5.38	< 0	< -310.3	< 186.18	< -24.93	52.63	NR[b]
FSU 14	< 0	62.16	< -5.38	< 2.69	< -186.18	< 248.24	< -16.62	< 27.7	NR[b]
FSU 16	< 14.65	73.25	< -2.69	< 0	< -391.8	< 359.15	< -33.24	< 11.08	NR[b]
FSU 17-1	< -15.54	62.16	< -5.38	< 2.69	< -217.21	403.39	< -22.16	47.09	NR[b]
FSU 17-2 Offices	< 0	< 29.3	< -2.69	< 2.69	< -228.55	< 457.1	< -27.7	< 33.24	NR[b]
FSU 18	< 0	< 46.62	< -2.69	5.38	< -248.24	558.54	< -22.16	< 30.47	NR[b]
FSU19	< 0	< 46.62	< -2.69	5.38	< -837.81	< 217.21	< -24.93	< 44.32	NR[b]
FSU 20	< -15.54	< 31.08	< -2.69	< 2.69	< -341.33	< 310.3	< -36.01	< 24.93	NR[b]
FSU 22	< -14.65	43.95	< -2.69	2.69	< -97.95	457.1	< -38.78	38.78	NR[b]
FSU 23	< 14.65	< 29.3	< -2.69	< 0	< -424.45	< 130.6	< -47.89	< 36.01	NR[b]
FSU 24	< 0	< 29.3	< -2.69	5.0	< -261.2	< 163.25	< -49.86	< 24.93	NR[b]
FSU 26	< 0	73	< -2.69	< 2.69	< -163.25	620	< -44.32	< 30.47	NR[b]
FSU 27	< -29.3	103	< -2.69	< 0	< -359.15	< 228.58	< -44.32	< -8.31	NR[b]
FSU 28	< 14.65	103	< -2.69	< 0	< -195.9	< 228.55	< -38.78	< 0	NR[b]
FSU 29	< 0	58.6	< -5.38	< 2.69	< -685.65	< 32.65	< -60.94	< 19.39	NR[b]
FSU 31	< -14.65	59	< -2.69	5.0	< -457.1	< 163.25	< -49.86	< 36.01	NR[b]
Transformer	< -13.26	< 13.26	< 0	< 2.69	< 171.2	< 308.16	< 8.31	< 24.93	NR[b]

Table 6.3. Summary of contamination and dose rates for the K-1580 study area (continued)

Location	Alpha total (dpm/100 cm^2)		Alpha removable (dpm/100 cm^2)		Beta-gamma total (dpm/100 cm^2)		Beta-gamma removable (dpm/100 cm^2)		Dose equivalent rate (mrem/h)
	Min	Max	Min	Max	Min	Max	Min	Max	
					Furnishings Survey Units – Class 2				
FSU 2	< -46.68	< 15.56	< -2.69	< 2.69	< 56.52	508.68	< -19.39	< 41.55	NR[b]
FSU 3	< -46.68	< 31.12	< -2.69	< 2.69	< -367.38	480.42	< -24.93	< 38.78	NR[b]
FSU 5	< -31.12	< 31.12	< -2.69	< 2.69	< -339.12	< 254.34	< -19.39	< 27.7	NR[b]
FSU 7	< -15.1	30	< 0	5.0	< -189.54	< 284.31	< -24.93	< 16.62	NR[b]
FSU 8	< -15.1	60	< 0	< 2.69	< -284.3	< 252.71	< -33.24	< 30.47	NR[b]
FSU 9	< -15.1	30	< 0	5.0	< -379.08	< 189.54	< -26.91	< 8.97	NR[b]
FSU 10	< 0	45	< 0	5.0	< -379.08	< 157.95	< -19.39	< 19.39	NR[b]
FSU second Floor	< 0	44	< -2.69	< 2.69	< 0	424	< -22.16	< 24.93	NR[b]
FSU third Floor	< 0	59	< -2.69	< 2.69	< -522.4	< -97.95	< -27.7	< 38.78	NR[b]
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.
This table does not include results from quality assurance/quality control surveys.
DOE = U. S. Department of Energy.
ESU = exterior survey unit.
FSU = furnishings survey unit.
ISU = interior survey unit.
NR = no reading (was taken).
*a*The transformer is immediately adjacent to the cooling tower; therefore, the cooling tower data applies to the transformer as well.
*b*Dose rate measurements for furnishings are part of the dose rates for the individual survey units that contain the furnishings.

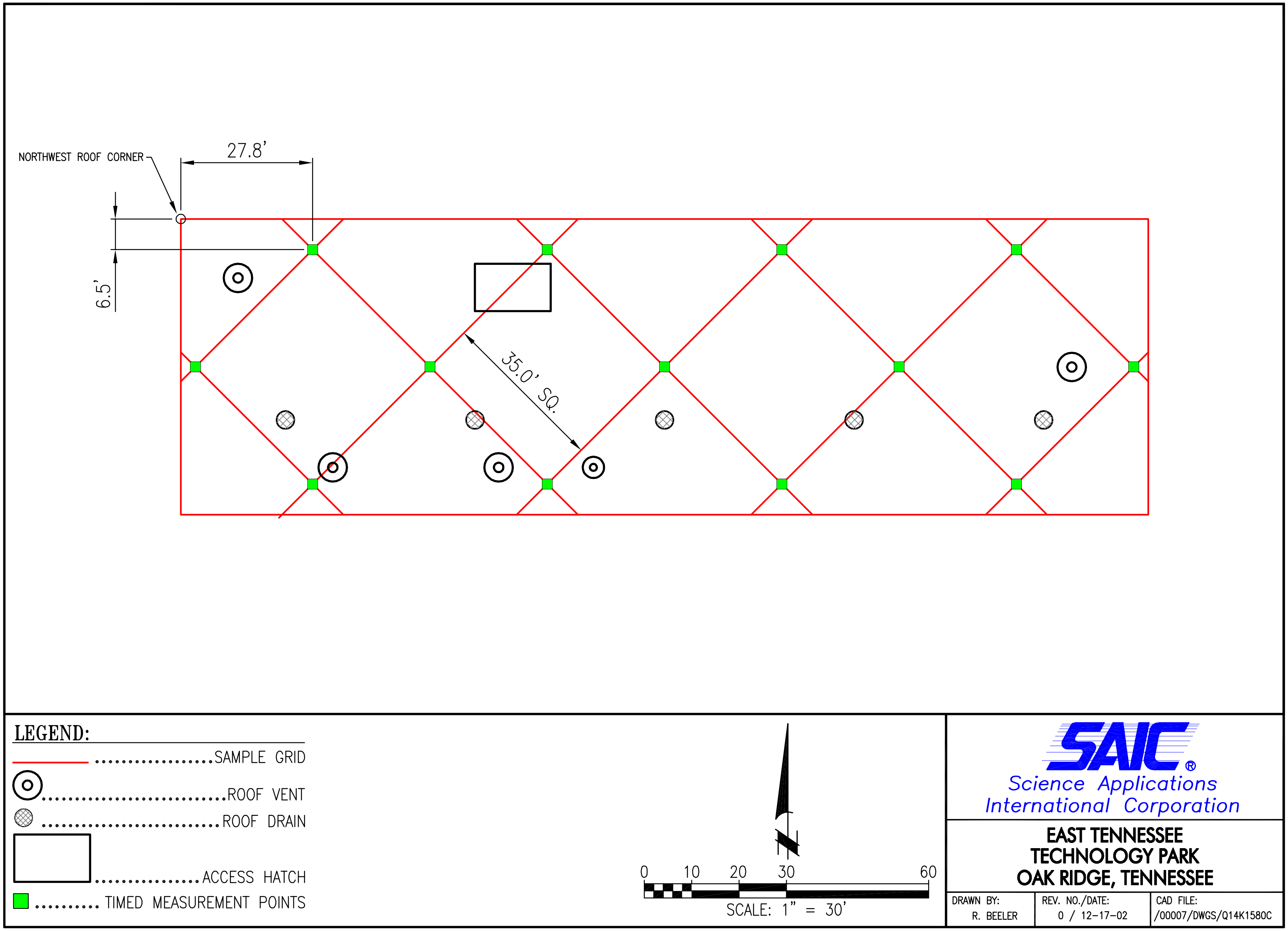

Fig. 6.3. K-1580 roof survey grid.

6.3.2.3 Furnishings survey units

All 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. 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. Because of the low volume of Class 2 furnishings, all Class 2 furnishings on the first and second floors were combined into one Class 2 FSU. A minimum of 11 data points were collected from each FSU at the areas of the highest activity, as determined during the scan survey. No dose rates were required per the survey plan for furnishings.

No FSU had any result above 25% of the DCGL. Since all results were less than the screening level for Class 3 units, no further statistical analysis was performed. Activities were less than 113 dpm/100 cm^2 total alpha and 630 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 15 dpm/100 cm^2 removable alpha and 90 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 within the uncertainty of the measurements.

6.3.3 Survey Data Review and Analysis

All of these survey data were reviewed by a health physicist prior to use in this report. All surveys were conducted in accordance with the survey plan per the BJC team health physicist (correct number of survey units, data points per survey unit, instrumentation data, QA/QC survey performed, etc.).

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 based upon the non-parametrical statistical Sign test. Therefore, the alternative hypothesis (H_a) is accepted, which states that the residual radioactivity in each of the survey units does not exceed the DCGL and, therefore, can be released without radiological restrictions.

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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.

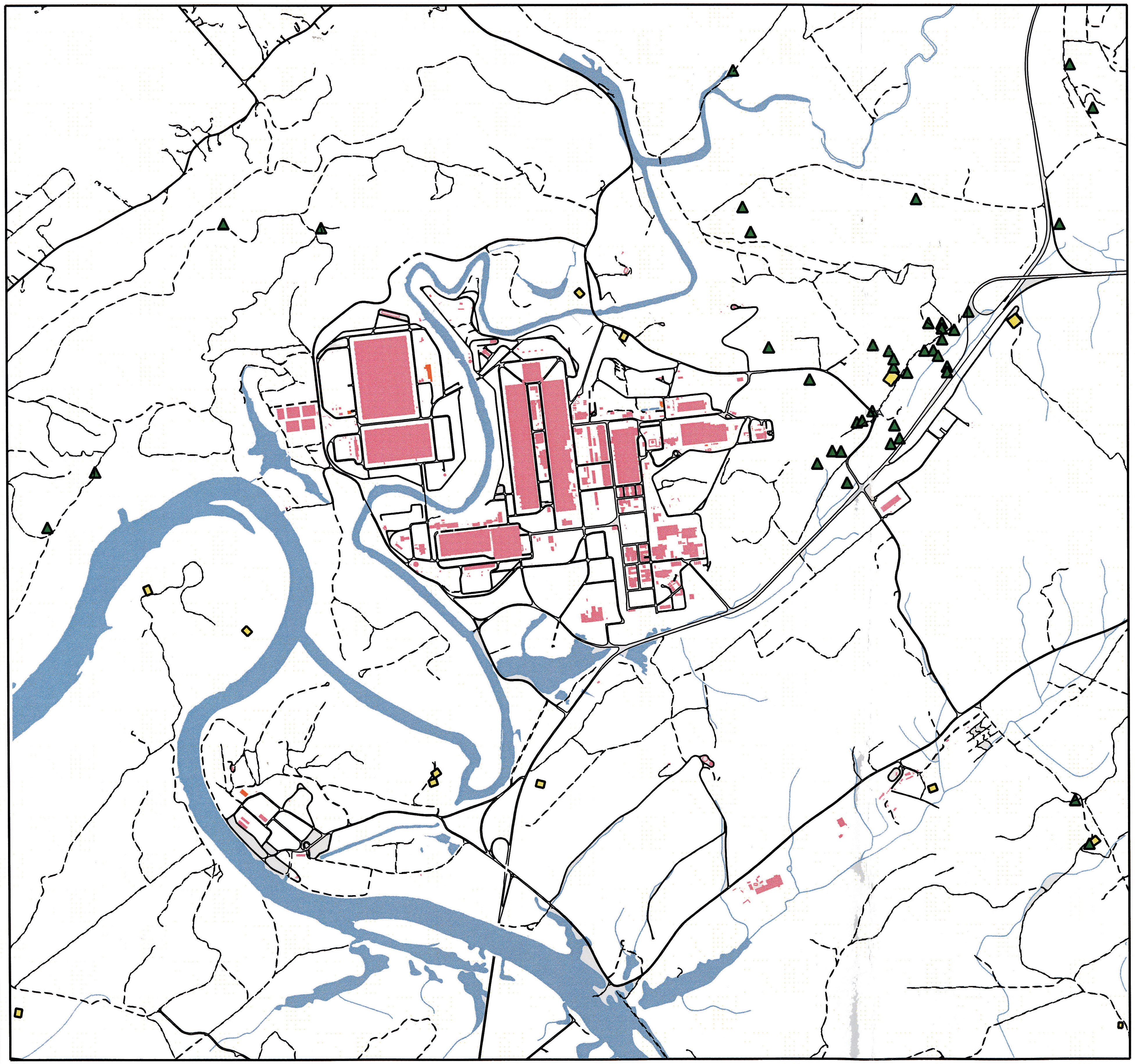
Katy Kates

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

Attachment-Plat Exhibit

APPENDIX B

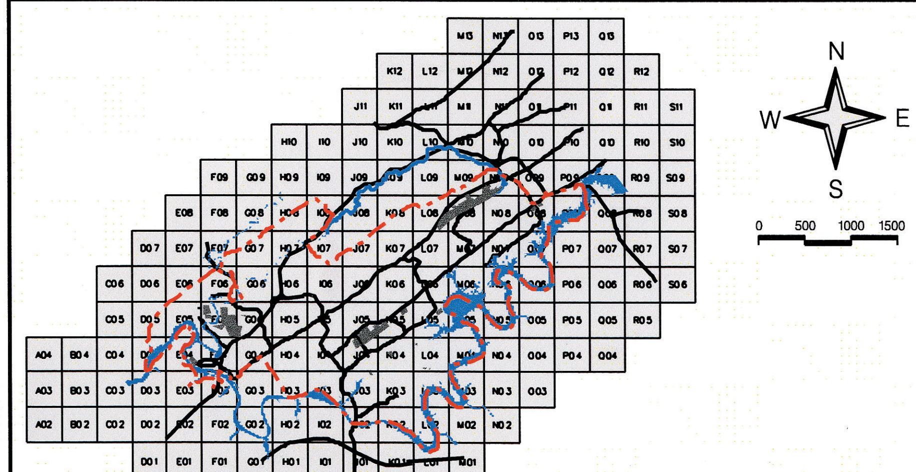
STUDY AREA MAPS FROM RECORDS SEARCH



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



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. 2/10/01

KMAPS ORO HISTORIC MAP GSL

APPENDIX C

SAMPLING AND ANALYSIS PLAN FOR THE K-1580 STUDY AREA

Sampling and Analysis Plan for Collection of Groundwater, Air, and Soil Vapor Samples for the K-1580 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

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

BJC/OR-1713

Sampling and Analysis Plan for Collection of Groundwater, Air, and Soil Vapor Samples for the K-1580 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

CONTENTS

FIGURES

TABLES

ACRONYMS

bgs	below ground surface
COPC	chemical of potential concern
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
ORGDP	Oak Ridge Gaseous Diffusion Plant
PRG	preliminary remediation goal
PSS	Park Shift Superintendent
QC	quality control
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	1,1,1-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 in order to determine whether subsurface contamination from volatile organic compounds (VOCs) has resulted in organic vapors entering the K-1580 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.

During the construction of the Oak Ridge Gaseous Diffusion Plant (ORGDP), the K-1580 area was an undeveloped field outside the perimeter fence and remained as such until the K-1580 building was constructed in 1980. The perimeter fence was moved and K-1580 is inside the fence.

The K-1580 building is located in the southern portion of ETTP. It is a 38,211-ft^2, three-story structure (12,737 ft^2 on each of the three floors) that was built in 1980 as an office building for ETTP Engineering personnel. Building K-1580 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 and south sides of the building.

This SAP presents the rationale and details of air sampling to be conducted in the ETTP K-1580 building. These sampling activities are being conducted 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 present in the shallow bedrock groundwater plume located 300 to 350 ft north of Bldg. K-1580.

2. OPERATIONS CONDUCTED WITHIN PROXIMITY OF THE K-1580 BUILDING

The closest facility to K-1580 is the K-1320 Office Building. Building K-1320 was constructed in 1982 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-1580 that are potential areas of contamination. The closest environmental restoration area is the Recirculating Cooling Water (RCW) Lines Leak Sites 500 ft to the north. The RCW lines, in conjunction with a cooling tower, served as a process support building from the mid-1950s to 1984. The makeup water for the system used a chromate/zinc/phosphate treatment until 1977, when it was replaced by a phosphate treatment system. The cooling tower was demolished in the 1990s. 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 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

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[1]DOE 1992. *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014, U. S. Environmental Protection Agency Region 4, U. S. Department of Energy, and Tennessee Department of Environment and Conservation, Washington, D.C.

at specific sites within the Oak Ridge Reservation. The specific facilities to which the FFA applies are listed in Appendix C of the FFA.]

3. EXISTING/HISTORICAL DATA

Hydrogeologic characterization data for K-1580 are limited because no groundwater monitoring wells exist in its immediate vicinity. Much of the hydrogeologic characterization data have been interpolated from available ETTP-wide information. Based on pre-construction topographic maps, it appears that up to 10 ft of fill material may have been placed in the area of K-1580 during construction of the ORGDP. A portion of this fill extends beneath the eastern edge of the K-1580 building. Depth to bedrock (interpolated) is expected to be from 2 to 20 ft below ground surface (bgs). Bedrock is likely to be encountered at more shallow depths on the south side of the building where fill was not placed. The interpolated depth to groundwater is from 12 to 20 ft bgs. Shallow groundwater flow is expected to be to the south-southwest toward the shallow ponds south of ETTP.

Although a groundwater plume has not been identified beneath K-1580, there are data gaps regarding possible groundwater contamination beneath this building. Groundwater flowpaths in bedrock at ETTP are a significant unknown due to the complex geology and geologic structure underlying ETTP. As shown in Fig. 3.1, an identified groundwater plume exists ~ 320 ft upgradient from K-1580. 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, trichloroethene (TCE), 1,2-dichloroethene (DCE), vinyl chloride, methylene chloride and benzene. Although 1,1-DCE and 1,1-dichloroethane 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 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 300 ft north of K-1580 (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 ~ 375 ft upgradient from K-1580, represents the most contaminated well near the building. 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 north of Bldg. K-1580 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 five sampling events declined from 76 μg/l at well BRW-053 to 6 μg/l at well BRW-071. Over the past five sampling events, the average concentration of 1,2-DCE declined from 61 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-1580, the age of original source releases,

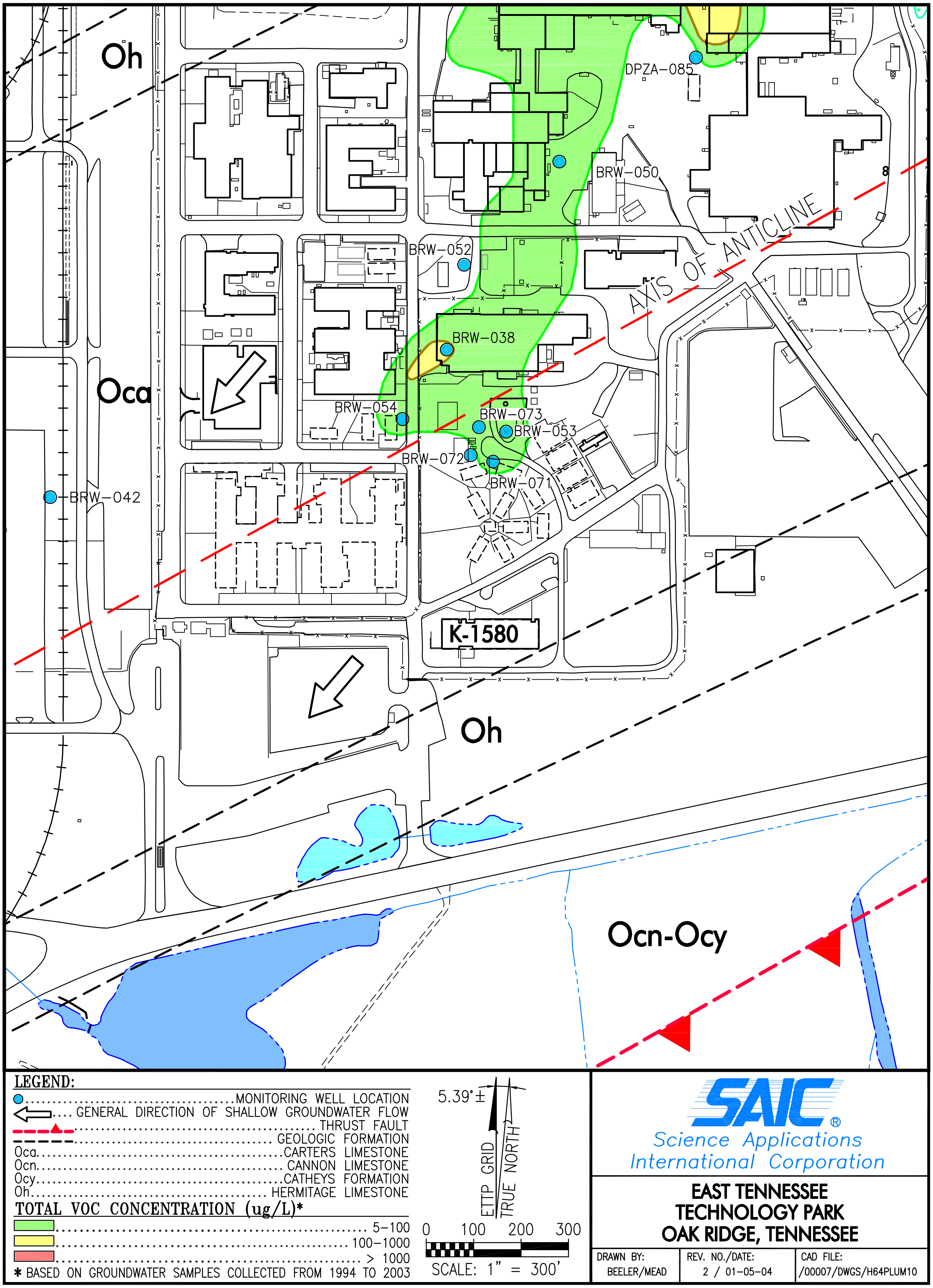

Fig. 3.1. Groundwater VOC concentrations in the vicinity of K-1580.

and natural attenuation effects, it appears unlikely that concentrations of TCE in groundwater at K-1580, if transported to this building, would exceed those observed at monitoring well BRW-071.

4. SCOPE

The overall scope of this SAP is to determine VOC concentrations in the soil vapor directly beneath the K-1580 building slab and in the building indoor air at normal breathing zone heights 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 VOC concentrations in the soil gas directly beneath the building slab exceed trigger levels specified in this SAP, indoor air samples will be collected at normal breathing zone height from within the building to determine exposure concentrations. Indoor air samples will also be collected using EPA-approved methods with detection limits that are sufficient to support 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* (SPA 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, eliminate 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.

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

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 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 indoor air.

As previously stated, EPA Region 4 has raised concerns regarding the potential for vapor intrusion of VOCs from shallow groundwater into buildings at 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 the 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 DOE may obtain an upgradient soil gas sample to establish current conditions;

- Soil vapor concentrations of VOCs directly beneath the floor slab 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 from beneath the building 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 from beneath the building 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 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-1580. 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-1580 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-1580 is provided in Table 5.1. Any VOCs that are currently analyzed by the groundwater program that are detected will also be reported.

Table 5.1. Preliminary analytes of interest and respective indoor air PRGs[a] for the vapor intrusion pathway at Bldg. K-1580

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	4.60E-01
2-Butanone	7.31E-01

[a]PRGs = Preliminary Remediation Goals

[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

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.

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 building's 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. This groundwater sample will be collected from the upgradient monitoring well that has historically exhibited the most elevated concentrations of VOCs. As an option to groundwater sampling, a soil gas sample may be collected from a location upgradient of the building. Data obtained from groundwater or upgradient soil gas samples 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. The second phase of sampling would be implemented only if the soil vapor trigger levels were exceeded in the first phase samples.

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

During the first phase, five soil vapor samples will be collected directly beneath the first floor or foundation slab of Bldg. K-1580. 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 five 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) collected using 5L pre-evacuated SUMMA canisters. The preliminary analytes 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-1580 the groundwater sample shall be collected from well BRW-071. 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-1580 are ~ 400 ft north of the building. Therefore, as an option to groundwater sampling, an upgradient soil gas sample 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 from beneath the building exceed the site-specific soil vapor trigger levels. Proposed site-specific soil vapor trigger levels are presented in Table 5.2.

Five 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 five indoor air samples will 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 five indoor samples are discussed in Chap. 6.

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.

6. FIELD SAMPLING PLAN

Soil vapor and ambient air sampling activities at K-1580 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 oven at 100° C for 12 to 24 h.

During the first phase of sampling, soil vapor samples will be collected from directly beneath the first floor slab of the building. A groundwater sample will also be collected from monitoring well BRW-071 during the first phase of sampling. As an option to groundwater sampling, a soil gas monitoring well may be installed in the vicinity of Bldg. K-1580 to obtain an upgradient soil gas sample. The data from the upgradient groundwater or soil gas samples will be used to assess current conditions and provide a basis for monitoring changes in subsurface conditions in the future.

The sampling systems for soil vapor shall be 5L sub-atmospheric SUMMA canisters. For collection of the soil vapor samples, 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.

Five 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 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 (~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 manufacturers 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.

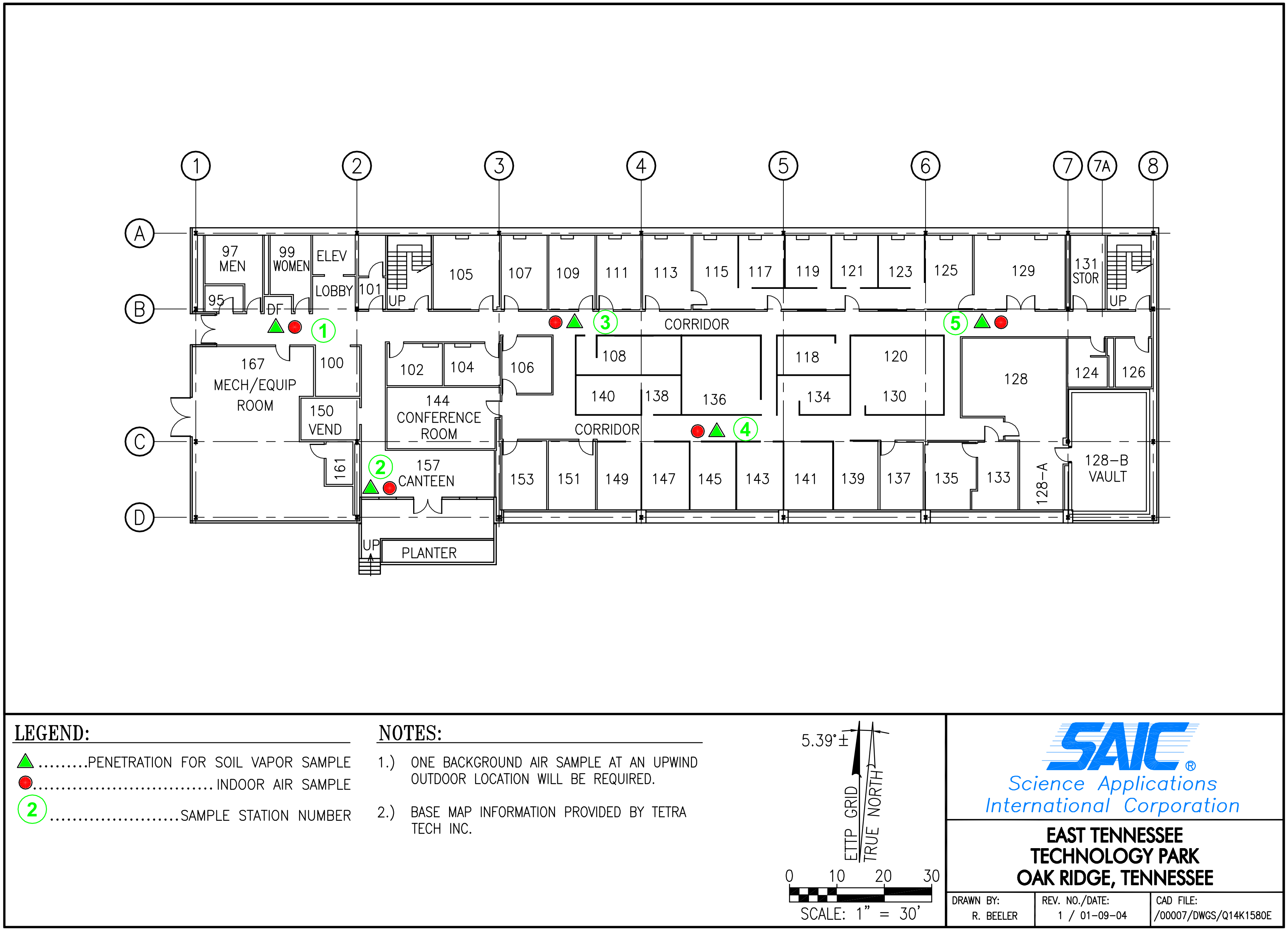

Fig. 6.1. Builidng K-1580 soil vapor and indoor air sampling locations.

Groundwater samples shall be collected from well BRW-071 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 photo ionized detector. Water levels in the well should be measured 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 an option to sampling groundwater well BRW-071, a soil gas monitoring station may be installed upgradient from the building and sampled to assess current conditions. The location for this soil gas monitoring well (piezometer) is presented in Fig. 6.2. The borehole for installation of this 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.

After completion of the borehole, the 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 piezometer 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 piezometer. This concrete collar will have a minimum thickness of 4.0 in.

The piezometer 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 soil gas monitoring well. 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

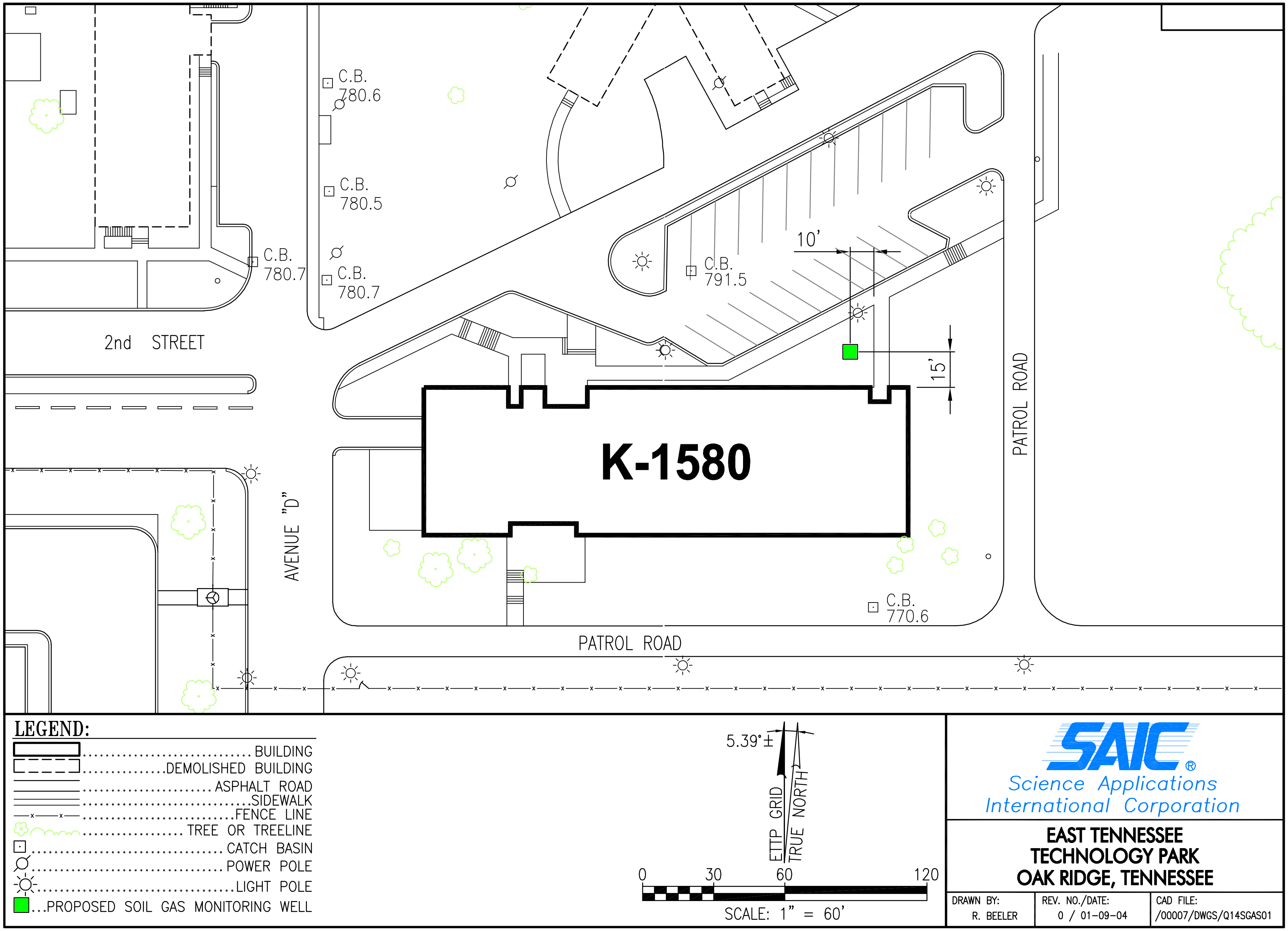

Fig. 6.2. Proposed location for K-1580 soil gas monitoring well.

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 seconds. Flow restriction shall be provided by a critical orifice set to charge the canister to the desired end pressure over this sample collection period. Upon collection of the samples, the final pressure shall be checked and recorded. The final system pressure should be ~ 88 KPa(90-100 mmHg of vacuum).

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 SUMMA canister, it shall be labeled as required by the SSC's 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.

If the average concentrations of any of the VOCs detected in the soil vapor samples from beneath the floor slab exceed their site-specific trigger levels, indoor air samples will be collected in a second phase of sampling. 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. In order 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.

An outdoor ambient air sample will be collected in Phase 2 to identify any contribution of VOCs from fugitive sources. 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 sub-atmospheric 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 ambient air sample will be provided by an electronic mass flow controller and magnelatch valve as described by Method TO-15. As described above for indoor air samples, a practice canister shall be used to verify the system fill rate and absence of leakage prior to actual sample collection. Once the system has been determined to be leak tight and properly calibrated, a clean certified canister shall be attached to the system for sampling, the system valves opened, and the timer set for initiating the sampling period.

The only field quality control (QC) samples required for the soil vapor and air samples are field equipment blanks and one duplicate. These QC samples are required only for the second sampling event. 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 summarized 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 compounds (TICs). Quantitation of VOCs in air samples shall meet the 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.

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-Oak Ridge 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.

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-01-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-02-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-03-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-04-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-05-41-1580-V	Soil vapor-grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-00-41-1580-G	Soil gas upgradient-grab[c]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
01	AU-00-41-1580-W	Groundwater[c]	Volatile organics[b]	OLM03.1VOA	3×40 ml VIA vials	HCl to pH < 2 Cool 4°C	14 d
01	AU-93-41-1580-B	Field blank	Volatile organics[b]	OLM03.1VOA	3×40 ml VIA vials	Prepreserved	14 d
02	AU-01-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-02-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-03-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-04-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-05-42-1580-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-05-42-1580-D	Indoor air duplicate: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-06-42-1580-A	Outdoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-91-42-1580-B	Air Field Blank	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d
02	AU-92-42-1580-B	Air Field Blank	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 d

[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 K-1580 include tetrachloroethene; trichloroethene; 1,2-dichloroethene; vinyl chloride; 1,1,1-trichloroethane; 1,1-dichloroethene; 1,1-dichloroethane; carbon tetrachloride; chloroform; methylene chloride; chloromethane; and benzene.

[c]As an option to groundwater sampling at well BRW-071, a soil gas well may be installed upgradient of K-1580 and sampled.

[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.

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APPENDIX D

RADIOLOGICAL SURVEY PLAN FOR THE K-1580 STUDY AREA

1. AREA TO BE SURVEYED

The area to be surveyed is the K-1580 building (both interior and exterior surfaces), the building contents, and the exterior sidewalk immediately adjacent to 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 other than the exterior patio and sidewalks. The K-1580 building has been primarily used as office space for different groups and has three floors (12,737 ft^2 on each of the floors for a total of 38,211 ft^2). The building exterior is pre-cast concrete siding over reinforced concrete, and the facility is primarily carpeted throughout. See Figs. 1 and 2 in this appendix for the survey area.

2. HISTORY OF THE AREA

K-1580 was built in 1980 to provide offices for K-25 engineering personnel. An elevator is located in the northwest corner and a stairway on each end of the building. During the 1990s, engineering personnel moved from the building and other organizations including Bechtel Jacobs Company LLC (BJC) Reindustrialization, Environmental Management, and Waste Management, as well as U. S. Department of Energy (DOE) site management, have occupied the building for offices. The building has always been inside the control fence area of the plant and no radioactive material or contamination incidents are known to have occurred within the building or immediate area.

Radiological contamination, if present, is expected to be a small percentage of the applicable DOE surface contamination limits due to the results of the prior surveys performed in the area (which are discussed in the following sections), but mainly due to the historical usage of the facility. In general, no radioactive contamination has been found within the survey area that has exceeded the DOE limits.

3. EXISTING SURVEY DATA SUMMARY

A search of the BJC Radiation Control (RADCON) electronic survey data collected since 1996 revealed that five radiological surveys have been performed inside the building. A review of these surveys provided a basis for the classification of the individual survey units.

Two pregnancy surveys were conducted in the building on the third floor, one in 1996, the other in 1998. No activity was detected above background levels, and the dose equivalent rates ranged from 3 to 5 μrem/h. A survey on the third floor was conducted in July 1998 after a safe that had been moved to another building from K-1580 was found to have removable contamination on the bottom of it. No radioactivity was detected above background levels, and the dose equivalent rates ranged from 4 to 7 μrem/h. The identification of the radioisotopes making up the contamination was not evaluated. In 1999, during a scoping survey of several buildings for another project, large area wipes (LAWs) over an approximate area of 1 m^2 were taken at all entrances of the building, and dose rates were taken throughout the hallways. No activity above background levels was detected on the LAWs. The dose equivalent rates ranged from 3 to 5 μrem/h. Also in 1999, a survey of the floors of the building was performed using a computerized position sensitive detector system by Shonka and Associates for the "Release Project." The gross alpha reading ranged from 1 to 85 counts per minute (cpm), the gross beta readings ranged from 1032 to 1618 cpm, and the gross gamma readings ranged from 3599 to 10262 cpm. The highest readings were found on tape that was on some new carpet. The data, however, were normally distributed.

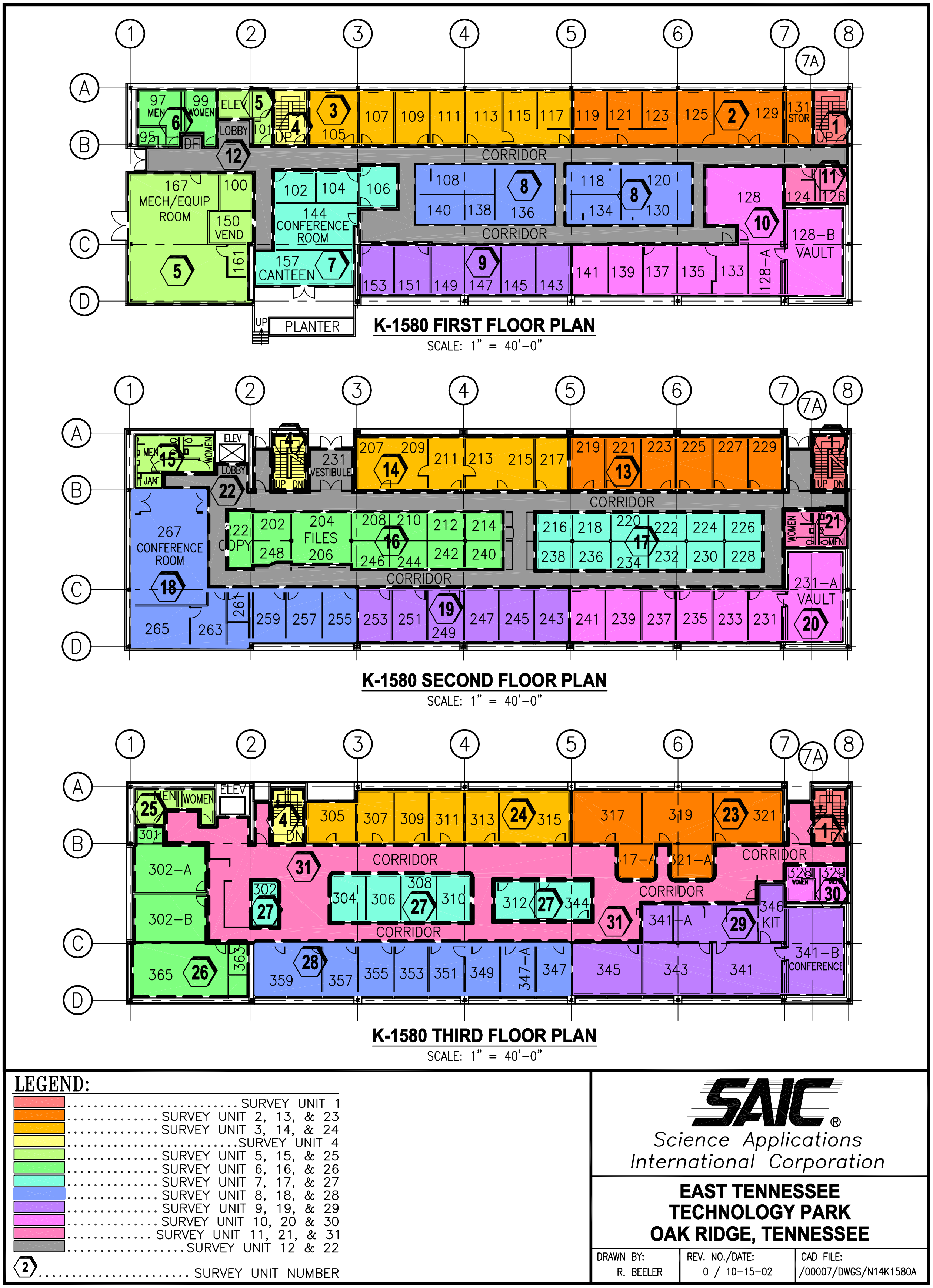

Fig. 1. K-1580 interior survey units.

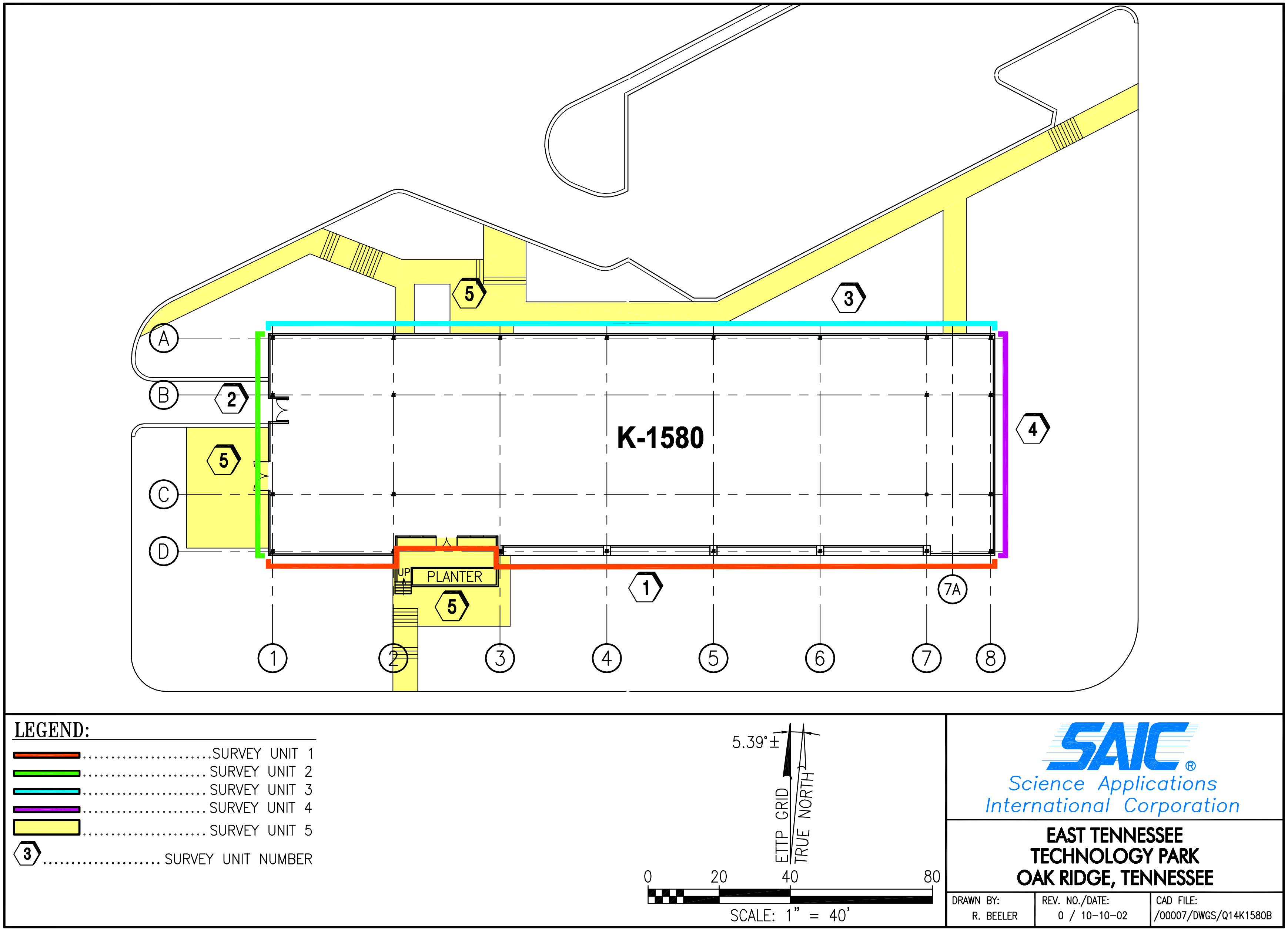

Fig 2. K-1580 exterior survey units.

A total of 35 equipment surveys were performed in the K-1580 building. This included surveys of desks, chairs, computer equipment, carpet, and various hand tools. No activity was detected above background levels for all surveys. In 1999, as a part of the scoping survey of several buildings by another project, two statistical surveys of the furnishings were performed, with the readings given in gross (uncorrected for background) counts per minute. All readings associated with these surveys were at background levels.

4. DATA QUALITY OBJECTIVES/PURPOSE

The purpose of this survey plan is to obtain additional radiological survey data to determine the presence and quantity of residual contamination in the area. The data gathered will be used to make a decision regarding the release of the K-1580 building and contents to CROET.

5. MEASUREMENT TECHNIQUES/SURVEY APPROACH

5.1 RADIONUCLIDES OF CONCERN

Process history of the East Tennessee Technology Park (ETTP) site indicates that uranium (whether natural, depleted, or enriched) would be the most prominent radiological contaminant potentially present in the K-1580 building. Its introduction into the building would have been 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 and 5.0%. If contamination is located in Bldg. 1580, it is expected that enrichments of less than 3% would be present.[17] As, however, 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) also have been detected on-site at ETTP. These other radionuclides originated from the introduction of contaminated materials from Oak Ridge National Laboratory 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)[18] (both ratios are process buildings weighted averages).[19]

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

[18]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.

[19]*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.

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[20] and also in DOE Order 5400.5,[21] is less than that from the dose and risk criteria, as explained in the Design of Radiological Surveys document[22] (hereafter referred to as the "design document"). (See Appendix A of the design document.) 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 $level_{elevated\ measurement\ comparison}$ ($DCGL_{EMC}$), normally is 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. The $DCGL_{EMC}$, however, will be set to three times the appropriate contamination limit, which equates to the contamination averaging criteria as set forth by DOE Order 5400.5 for an elevated reading within a 1 square meter (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 $level_{elevated\ measurement\ comparison}$.
dpm = disintegrations per minute.
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 materials or areas.

5.3 IDENTIFICATION OF BUILDING 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, for example, a survey unit cannot contain both asphalt and soil. 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

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

[21]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."

[22]*Design of Radiological Surveys of Potential Lease Space at East Tennessee Technology Park*, Oak Ridge, Tennessee (BJC/OR-554).

levels above the DCGL prior to any historical remediation. Based upon the historical usage, process knowledge, and previous radiological surveys conducted for the facility, all areas are initially classified as Class 3 areas. The K-1580 building will be composed of a total of 37 Class 3 survey units, as shown in Table 2 in this appendix. See Fig. 1 in this appendix for the locations of the first, second, and third floor interior survey units (ISUs) and Fig. 2 in this appendix for the exterior survey units (ESUs).

Table 2. Survey units classification

Area	Class	
	Interior areas	Exterior areas
K-1580, 1st floor, northeast stairway up to third floor (ISU 1)	Class 3	N/A
K-1580, 1st floor, northeast corner by NE stairway (ISU 2)	Class 3	N/A
K-1580, 1st floor, middle offices north side by northwestern stairway (ISU 3)	Class 3	N/A
K-1580, 1st floor, northwestern stairway up to third floor (ISU 4)	Class 3	N/A
K-1580, 1st floor, elevator, vending, and mechanical room areas (ISU 5)	Class 3	N/A
K-1580, 1st floor, northwestern restrooms (ISU 6)	Class 3	N/A
K-1580, 1st floor, offices and canteen north of patio (ISU 7)	Class 3	N/A
K-1580, 1st floor, center cubicles (configuration shown not exact) (ISU 8)	Class 3	N/A
K-1580, 1st floor, south central offices (ISU 9)	Class 3	N/A
K-1580, 1st floor, southeastern offices and vault (ISU 10)	Class 3	N/A
K-1580, 1st floor, southeastern restrooms (ISU 11)	Class 3	N/A
K-1580, 1st floor, hallways and corridor (ISU 12)	Class 3	N/A
K-1580, 2nd floor, northeastern offices (ISU 13)	Class 3	N/A
K-1580, 2nd floor, northwestern offices by vestibule (ISU 14)	Class 3	N/A
K-1580, 2nd floor, northwestern restrooms (ISU 15)	Class 3	N/A
K-1580, 2nd floor, west center cubicles (ISU 16)	Class 3	N/A
K-1580, 2nd floor, east center cubicles (ISU 17)	Class 3	N/A
K-1580, 2nd floor, southwestern offices and conference room (ISU 18)	Class 3	N/A
K-1580, 2nd floor, south central offices (ISU 19)	Class 3	N/A
K-1580, 2nd floor, southeastern offices and vault (ISU 20)	Class 3	N/A
K-1580, 2nd floor, eastern restrooms (ISU 21)	Class 3	N/A
K-1580, 2nd floor, hallways and corridor (ISU 22)	Class 3	N/A
K-1580, 3rd floor, northeastern offices (ISU 23)	Class 3	N/A
K-1580, 3rd floor, north central offices by NW stairway (ISU 24)	Class 3	N/A
K-1580, 3rd floor, northwestern restrooms (ISU 25)	Class 3	N/A
K-1580, 3rd floor, southwestern offices (ISU 26)	Class 3	N/A
K-1580, 3rd floor, center cubicles (ISU 27)	Class 3	N/A
K-1580, 3rd floor, south center offices (ISU 28)	Class 3	N/A
K-1580, 3rd floor, northwestern offices (ISU 29)	Class 3	N/A
K-1580, 3rd floor, eastern restrooms (ISU 30)	Class 3	N/A
K-1580, 3rd floor, hallways and corridor (ISU 31)	Class 3	N/A
K-1580 building exterior walls (entire wall) (ESUs 1 through 4)	N/A	Class 3
K-1580 building sidewalk and patio areas (entire walk) (ESU 5)	N/A	Class 3
K-1580 building roof (ESU 6 – not pictured)	N/A	Class 3

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

5.4 INSTRUMENTATION SELECTION AND SURVEY TECHNIQUES

See 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 many of the scan surveys as possible, including the primary work surfaces, walls, and ceilings. Sodium iodide (NaI) meters and Bicron MicroRem® meters[23] also will be used, as specified in this survey plan. Removable contamination surveys (i.e., smear surveys) will be conducted at all locations where a fixed or 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.

For Class 3 areas, a minimum of 10% judgmental surface scan surveys will be performed over the primary traffic and work surfaces of the entire survey unit, as accessible. In Class 2 areas, 100% of the accessible floor area will be scanned, if any are determined to be present in the building. Other surfaces that are classified as Class 2 areas, such as walls, ceilings, or overhead areas, will have a scan coverage that varies in accordance with how close the expected activity levels are to the DCGLs. Class 1 survey units will have a 100% scan of all surfaces, if any are determined to be present in the building. Emphasis will be placed upon entrances and high-traffic areas, suspect areas, and professional judgment for all scan surveys. (*Note*: A 10% scan survey is not interpretable as surveying 100% of 10% of the offices in a particular survey unit and not performing any surveys in the other 90%; 10% of all floors, of all walls, and of all ceilings will be scanned, as accessible.)

All surveys will be performed in accordance with established the DOE contractor RADCON procedures (i.e., scan rate, probe distance, source checks). Presently, the ETTP DOE contractor is BJC.

5.5 AREA PREPARATION

All areas will be surveyed in an "as-found" condition. Materials may be rearranged or moved to allow for survey access to areas covered by material or equipment.

5.6 REFERENCE COORDINATE SYSTEM FOR SURVEY

Class 3 areas do not require a sample grid. A reference coordinate system will be used in each survey unit to reference measurements so they can be relocated or verified as needed, unless the measurement is at an easily identifiable location, such as "Room 201, 4 ft up on west wall, approximately 2 ft from south wall." The starting point of the reference grid, if needed, will be the southwest corner of each survey unit, with the distance north being Y and the distance east being X in an X-Y coordinate system, i.e., (X,Y), with the units in feet.

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[23]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.

If any of the Class 3 survey units have to be upgraded to Class 2 or Class 1 survey units, a sample grid and systematic measurements taken based upon a random starting point would be required. These survey grids are based upon the survey unit's area and number of systematic sample measurements required in each.

If a survey unit has to be reclassified to a higher classification and survey requirements, a revision to this survey plan will be issued containing the sample grids of the reclassified survey units.

6. SURVEY DESIGN

6.1 QUANTIFY DATA QUALITY OBJECTIVES

The null hypothesis (H_o) for each survey unit is that the residual contamination exceeds the DCGL. The alternative hypothesis (H_a) is that the survey unit meets the DCGL. Decision error levels, as set forth in the design document, are 0.05 for Type I (α) errors and 0.10 for Type II (β) errors in all survey units as the building is expected to be releasable without remediation. The Lower Bound of the Gray Region (LBGR) is initially set to 50% of the DCGL. These parameters apply to all survey units, regardless of their classification. The design document discusses the data quality objective (DQO) process and specific DQOs in greater detail.

6.2 DETERMINATION OF THE NUMBER OF DATA POINTS

Using the prescribed statistical testing methodology found in the design document (Sign test), a Δ/σ value (also known as the "relative shift") was computed (7.33) using the historical survey results, where Δ is the DCGL – LBGR, the LBGR is 50% of the DCGL, and σ is the standard deviation of the data. (*Note*: The majority of the readings were less than the instrument's L_c, the critical value at which there is 95% confidence that the value can be distinguished from background, or were recorded as "NEAD" (No Elevated Activity Detected); therefore, σ was assigned the value of the highest L_c value for the set of instruments divided by 1.65). The *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)[24] recommends, however, that the relative shift be between one and three; however, adjusting the LBGR so as to obtain a relative shift that follows the MARSSIM recommendation results in an alpha LBGR of 4900 dpm/100 cm^2 (2.55 relative shift) and a beta LBGR of 4300 dpm/100 cm^2 (2.83 relative shift). These values are approaching levels that are very difficult to distinguish from the DCGL; therefore, the default values suggested in the design document were used to determine the number of survey data points per survey unit. Since the facility has always been used as office space and has existing historical area survey data that for the vast majority was below background levels, it was determined that using the default values found in the design document, in lieu of actual data, was appropriate. Using the prescribed statistical testing methodology found in the design document (Sign test), a Δ/σ value (relative shift) of three (3), and an LBGR set at 50% of the DCGL (2500 dpm/100 cm^2), were chosen. The Sign test was utilized, as the residual contamination present within the survey units should be at a very small fraction of the DCGL. For all survey units, 11 survey data points (total and removable readings) are needed, at a minimum, not including any tool, furniture, or equipment surveys.

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[24](NRC 1997a). Nuclear Regulatory Commission, Nuclear Regulatory Guide (NUREG)-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Final Edition*, December 1997.

6.3 SURVEY PROCEDURES

All surveys are to be performed in accordance with this survey plan, the design document, and the DOE contractor RADCON procedures. *Note*: Survey technique is covered in the design document and will not be repeated in this plan. Variations or clarifications of the design document, however, will be included.

In any area where the scan survey indicates activity exceeding 5000 dpm/100 cm^2, notify the Project Health Physicist for approval to apply the DOE Order 5400.5 averaging release criteria. If approval is given, direct alpha and beta-gamma measurements will be made following the establishment of a 1-m^2 grid. If the area or equipment still exceeds the $DCGL_{EMC}$, the DOE contractor RADCON procedures will be followed for posting of the immediate area. In addition, any contamination survey location found in excess of two times the DCGL will also have a dose rate measurement taken at a distance of 3 ft.

Any activity in excess of 25% of the DCGL will require that a Class 3 survey unit be reclassified as Class 2 and surveyed appropriately. *Note*: If the area exceeding 25% of the DCGL is on a glazed clay tile floor and is less than 3500 dpm/100 cm^2 total beta-gamma (or 2800 dpm/100 cm^2 total beta-gamma for a red clay brick[25]) with no alpha contamination above 25% of the DCGL, then no upgrading of the unit is required. This level of radioactivity is within that of the naturally occurring radioactive materials (NORMs) contained in the glazed clay tile/brick matrix. Any activity in excess of the DCGL will require that a Class 3 or 2 survey unit be reclassified as Class 1 and surveyed appropriately. Notify the RADCON supervisor so the project radiological engineer can make any appropriate changes to this survey plan.

Comparison to background levels is required because only a gross signal will be measured. Topographical considerations should be weighed for background comparison. Furthermore, material specific backgrounds might be necessary for material such as tile, brick, concrete, and cinderblock, because these materials contain elevated levels of naturally occurring radionuclides. For this reason, survey units might have to be subdivided by material type.

A summary of the requirements for each type of survey unit is found in Table 3 in this appendix, and a survey technician summary is found in Table 4 in this appendix.

6.3.1 Interior Survey Units

Any asbestos-controlled areas will be identified with any pertinent information on whether radiological contamination is suspected (e.g., ventilation hoods, exhaust vents, posted radiological area) but not entered as part of this survey. No surveys will be performed above suspended ceiling tiles, in the elevator shaft, or under elevated flooring. Any ventilation exhausts and air intakes in the survey footprint also will be surveyed for contamination. At least one tissue-equivalent dose rate will be taken in each office or open area.

6.3.1.1 Class 3 interior survey units

See Fig 1 in this appendix for the first, second, and third floor survey units. Ten percent of each of the survey units, including the primary traffic areas, work surfaces, walls, and ceilings will be scanned with floor monitors, NaI meters, 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. The emphasis will be placed on the primary traffic areas and the work

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[25]Values computed based upon the beta-gamma background levels for brick and ceramic tile found in Table 5.1 of NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, December 1997 (NRC 1997c), and an average beta-gamma Geiger-Müeller (GM) correction factor of 34 (dpm per 100 cm^2)/cpm for a planar radiation source.

Table 3. Summary of survey unit requirements

Survey unit type	Class 3	Class 2	Class 1
Interior	• 10% scan of all accessible surfaces • 11 total and removable readings, at a minimum per survey unit • Reading locations based on professional judgment and scan survey • Dose rate walkover survey in each survey unit • Minimum of 1 dose rate reading per office or open space • 1 dose rate reading per every 20 ft of hallway • Upgrade to Class 2 if activity > 25% DCGL • Upgrade to Class 1 if activity > DCGL	• 100% scan of primary traffic and work spaces • Scan of walls, overhead areas with scan % = % of DCGL • 11 total and removable readings, at a minimum per survey unit • Reading locations based upon a grid to be determined as needed • Dose rate walkover survey in each survey unit • Minimum of 1 dose rate reading per office or open space • 1 dose rate reading per every 20 ft of hallway • Upgrade to Class 1 if activity > DCGL	• 100% scan of primary traffic and work spaces • 11 total and removable readings, at a minimum per survey unit • Reading locations based upon a grid to be determined as needed • Dose rate walkover survey in each survey unit • Minimum of 1 dose rate reading per office or open space • 1 dose rate reading per every 20 ft of hallway
Exterior	• 10% scan of accessible surfaces • Scan walls up to at least 8 ft • 11 total and removable readings, at a minimum per survey unit • Reading locations based on professional judgment and scan survey • Dose rate walkover survey in/on each survey unit • 1 dose rate reading per every 20 ft • Upgrade to Class 2 if activity > 25% DCGL • Upgrade to Class 1 if activity > DCGL	• Scan of surfaces with scan % = % of DCGL • Scan walls up to at least 8 ft • 11 total and removable readings, at a minimum per survey unit • Reading locations based upon a grid to be determined as needed • Dose rate walkover survey in/on each survey unit • 1 dose rate reading per every 20 ft • Upgrade to Class 1 if activity > DCGL	• 100% scan of all surfaces • Scan walls up to at least 8 ft • 11 total and removable readings, at a minimum per survey unit • Reading locations based upon a grid to be determined as needed • Dose rate walkover survey in/on each survey unit • 1 dose rate reading per every 20 ft
Furnishings	• 10% scan of all accessible surfaces • Maximum total surface area < 5000 m^2 • Activity > 25% of DCGL, remove that item and all other similar items to be placed in a new Class 2 survey unit	• 10% scan of all accessible surfaces • Maximum total surface area < 1000 m^2 • Activity > DCGL, remove item and all other similar items to be placed in a new Class 1 survey unit	• 100% scan of all accessible surfaces • Maximum total surface area < 100 m^2

DCGL = derived concentration guideline level.

Table 4. Survey technician summary of survey requirements

Class 3	Class 2	Class 1
• 10% scan all accessible surfaces, 10% of exterior accessible surfaces, and 10% of furnishings accessible surfaces • Scan exterior walls up to at least 8 ft • 11 (minimum) total and removable readings • Dose rate walkover survey in each survey unit (minimum of 1 reading/office or open space, 1/20 ft of hallway or exterior) • Furnishings activity > 25% of DCGL, remove that item and all other similar items to be placed in a new Class 2 survey unit • Notify Supervisor if activity > 25% DCGL	• 100% scan interior floor/primary work areas • Scan of walls, overhead areas with scan % = % of DCGL (TBD) • Furnishings scan 10% accessible surfaces • Scan exterior walls up to at least 8 ft • 11 (minimum) total and removable readings • Reading locations based upon a grid TBD • Dose rate walkover survey in each survey unit (minimum of 1 reading/ office or open space, 1/20 ft of hallway or exterior) • Notify Supervisor if activity > DCGL • Furnishings activity > DCGL, remove item and all other similar items to be placed in a new Class 1 survey unit	• 100% scan all surfaces • Scan exterior walls up to at least 8 ft • 11 (minimum) total and removable readings • Reading locations based upon a grid (TBD) • Dose rate walkover survey in each survey unit (minimum of 1 reading/office or open space, 1/20 ft of hallway or exterior)

DCGL = derived concentration guideline level.
TBD = to be determined.

areas, i.e., floor areas. Tools, office furniture, and equipment will be a separate survey unit and surveyed per the guidance found in Sect. 6.3.6. No removal of suspended ceiling tiles or floor panels will be required for this survey, unless the NaI scan survey indicates areas of elevated activity that require additional investigation. Eleven measurements of total and removable contamination, at a minimum, will be 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, will be performed to determine if any variations exist in the penetrating radiation dose rate. If variations exist, then the location, distance the dose rate was taken from the wall or floor, and dose rate at that location are to be recorded. Dose rate measurements will be obtained at a minimum of every 20 ft in hallways and large rooms.

6.3.1.2 Class 2 interior survey units

Although there currently are no Class 2 areas, the potential exists for having a Class 3 area upgraded to a Class 2. Class 2 survey protocols are as follows: 100% of the accessible floor surface will be scan surveyed using a floor monitor or hand-held meters, as appropriate, and with an NaI meter; other surfaces (such as walls, overhead areas, and ceilings) will be scanned according to what percent of the DCGL was found; if the data show that a maximum of 35% of the DCGL was detected, then the scan percentage is 35%. The measurement locations will be chosen systematically per the design document. No removal of suspended ceiling tiles or floor panels will be required for this survey, unless the NaI scan survey indicates areas of elevated activity that would require additional investigation.

6.3.1.3 Class 1 interior survey units

While there currently are no Class 1 areas, the potential exists for having a Class 3 or 2 area upgraded to a Class 1. Class 1 survey units follow the Class 2 survey protocols, with the exception that all surfaces (not just the accessible ones) are surveyed 100%.

6.3.2 Exterior Survey Units

All exterior wall areas will be surveyed with hand-held meters or with a gas-proportional probe and with an NaI meter up to a minimum height of 8 ft. The building sidewalks will be scanned using a floor monitor or hand-held meters. No exterior grass or parking areas are covered under this survey plan. Emphasis is to be placed upon air vents and intakes, windowsills, gutter downspouts, and wherever professional judgment would indicate a higher probability of finding elevated readings. A tissue-equivalent dose rate survey will be performed over the survey units, with readings being taken every 20 ft.

6.3.2.1 Class 3 exterior survey units

Refer to Fig. 2 in this appendix for the exterior wall survey units (there is no figure for the roof survey unit). Class 3 exterior surveys will have 10% of the accessible surfaces scanned with hand-held meters or with gas-proportional probes, as appropriate, and with an NaI meter. Eleven measurements of total and removable contamination, at a minimum, will be recorded within each survey unit at locations determined during the scan survey to have the highest activity. Any air intakes will need to be turned off, preferably overnight, to allow for the decay of radon and thoron daughters prior to the survey.

6.3.2.2 Class 2 exterior survey units

While there currently are no Class 2 areas, the potential exists for having a Class 3 area upgraded to a Class 2. Class 2 survey protocols are as follows: walls, up to 8 ft, will be scan surveyed using hand-held meters or gas-proportional meters (if possible), and with an NaI meter, with the scan percentage being equal to the maximum percentage of the DCGL found prior to the reclassification as a Class 2 survey unit.

6.3.2.3 Class 1 exterior survey units

Although there currently are no Class 1 areas, the potential exists for having a Class 3 or 2 area upgraded to a Class 1. Class 1 survey units follow the Class 2 survey protocols, with the exception that 100% of the accessible surface will be surveyed.

6.3.3 Equipment and Furniture (Furnishings) Surveys

The survey of equipment and furnishings will be performed along the lines of the survey protocol developed by Safety and Ecology Corporation (SEC) for the release of materials from the K-1001-A, -B, -C, and -D buildings prior to their demolition.[26] The K-1001-A, -B, -C, and -D, and the design document requirements that affect the number of survey data points, are shown in Table 5 in this appendix.

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

Table 5. Comparison of parameters for computing number of samples

Parameter	SEC K-1001-A, -B, -C, and -D furnishings survey plan	Survey design document
Type I error rate (α)	0.05	0.05
Type II error rate (β)	0.05	0.10
Non-parametrical statistical test	Wilcoxon-Rank Sum (WRS)	Sign[27]
LBGR	2500 dpm/100 cm^2	2500 dpm/100 cm^2
Number of data points per survey unit	20 (10 in each survey unit, 10 in each reference background survey unit)	11

dpm = disintegrations per minute.
LBGR = Lower Bound of the Gray Region.
SEC = Safety and Ecology Corporation.

6.3.3.1 Determination of the number of data points

The existing K-1580 survey dataset was unusable to determine the number of measurements required independently because of the minimum amount of actual data available. Based upon the historical survey data and facility usage, the default values from the design document will be used instead. Setting the LBGR at 50% of the DCGL and choosing the Δ/σ value (relative shift) to be three (3) results in 11 data points needed for alpha or beta-gamma measurements. This results in a 5% probability that the survey unit will be incorrectly determined to not need additional surveys (i.e., released) when it actually does (Type I error, α) and in a 10% probability that the survey unit will be incorrectly determined to need additional surveys when it does not (Type II error, β). Using the existing limited dataset (alpha and beta-gamma data averages of 27.8 dpm/100 cm^2 and 547.8 dpm/100 cm^2, respectively, with alpha and beta-gamma standard deviations of 45.9 dpm/100 cm^2 and 903.9 dpm/100 cm^2, respectively),[28] there is 95% confidence that the alpha readings will be within the interval -63 to 118 dpm/100 cm^2 and that the beta-gamma readings will be within the interval of -1224 to 2320 dpm/100 cm^2, of which the upper bounds of the 95% confidence intervals for both are well below the DCGL.

6.3.3.2 Furnishings – survey unit classifications and survey procedures

As stated in Sect. 5.3, survey units are classified as either Class 1, 2, or 3, based upon historical data and process knowledge, which provides information on the contamination potential for the unit. Furnishings (which includes all furniture, equipment racks, and equipment, for the purposes of this portion of the survey) are considered to have a low potential for residual contamination being present. All survey units will have NaI, alpha, and beta-gamma scan surveys performed on them, with the areas covered by the scans determined by professional judgment. In addition, direct and removable alpha and beta-gamma measurements will be taken, with the locations being the areas with the highest readings as determined during the scan surveys. A detailed listing of all the items within the survey unit is not required; a generalized item listing of survey unit classification and number, NaI scan results, and the individual survey data points is the minimum data reporting requirement.

Each building ISU (Table 2 in this appendix) is to be the basis for the furnishings survey unit (FSU); therefore, there is the potential for each building survey unit to have up to three different FSUs. The sole exception to this is if there are very few items to make up a survey unit of a particular class; in that case,

[27]The WRS statistical test is for usage when the primary contaminants are found in background. The Sign test is to be used when the contaminant is not found in background or when the contaminants are in background, but at a small fraction of the DCGL. The Sign test will be used for this survey.

[28]The alpha and beta-gamma average values quoted are actually the averages of the instrumentation's L_c values, as the readings were denoted as "No Elevated Activity Detected" (i.e., the radioactivity levels were essentially background).

the items can be combined from the entire building to make a survey unit. The individual FSUs will be designated in a manner similar to the following example to identify the ISU and the FSU: ISU 4 FSU C3, which designates that the data are from the interior survey unit 4 (ISU 4) furnishings survey unit Class 3 (FSU C3).

6.3.3.2.1 Class 3 Furnishings Survey Units

All newer furnishings will be grouped together in batches (survey units) and classified as Class 3, as they have a very low potential for having been used in other facilities or areas that are potentially contaminated. The total surface area of each Class 3 survey unit will not exceed 5000 m^2. The surface scan surveys will cover 10% of all accessible areas.

6.3.3.2.2 Class 2 Furnishings Survey Units

Older furnishings, which might have been used in other buildings or areas, will be grouped into survey units and classified as Class 2. The total surface area of a Class 2 FSU will not exceed 1000 m^2. The surface scan surveys will cover 10% of all accessible areas.

6.3.3.2.3 Class 1 Furnishings Survey Units

Only furnishings that have exceeded the Class 2 criteria, above, will be classified and surveyed as a Class 1 survey unit. The total surface area of a Class 1 FSU will not exceed 100 m^2. The surface scan surveys will cover 100% of all accessible areas.

All furnishings survey data results (in each survey unit) that meet the above criteria will be evaluated against the Sign test criteria to determine if the items can be released. The null hypothesis, H_o, to be tested is that the residual radioactivity in the survey unit exceeds the DCGL. If the null hypothesis is rejected based upon the non-parametrical statistical test, then the alternative hypothesis (H_a), which states that the residual radioactivity in the survey unit does not exceed the DCGL and, therefore, can be released, is accepted.

6.3.4 Survey Unit Reclassification

Any interior or exterior Class 3 areas that exceed 25% of the DCGL will be reclassified as Class 2 areas and resurveyed accordingly. Any Class 3 or 2 areas that exceed the DCGL will be reclassified as Class 1 areas and resurveyed accordingly. All reclassified areas will be discussed in the revision to this survey plan, the Radiological Survey Report, and the Environmental Baseline Summary (EBS) for the building.

Within the Class 3 FSUs, if residual radioactivity is found in excess of 25% of the DCGL, the item with the residual activity, and all items of a similar type and history in that survey unit, will be removed from that survey unit, reclassified as a separate Class 2 FSU, and resurveyed accordingly. If residual radioactivity is found in excess of the DCGL in an FSU, the item with the residual activity, and all items of a similar type and history in that survey unit, will be removed from that survey unit, reclassified as a separate Class 1 FSU, and resurveyed accordingly.

6.4 SPECIFICATION OF SAMPLING LOCATIONS

All recorded survey measurement locations are to be on a judgmental basis for Class 3 survey units, per the design document, and should include entrances, primary traffic areas, air vents, and primary workspaces; these are the areas that would be expected to have the highest probability of having elevated readings. Survey locations for any survey unit upgraded to Class 2 or 1 will be provided as needed.

6.5 DATA EVALUATION

All data will be evaluated using the Sign non-parametrical statistical test, as outlined in the design document, to assist in the decision to release the facility.

7. DOCUMENTATION

Survey data will be documented in accordance with the procedures and reviews required by the DOE contractor. A report will be prepared, describing the survey methods, results, and evaluation. The report will include the findings of the assessment, along with a description of the materials surveyed, their condition, and a justification for the potential contamination classification assigned. The data evaluation will be included, along with the assessment of the quality assurance/quality control (QA/QC) documentation.

This report, or a summary of the report, also will be included and referenced in the facility's baseline environmental conditions documentation.

8. QUALITY ASSURANCE

All appropriate QA/QC reviews to ensure the quality of the data gathered will be performed and documented.

Survey instruments and methods specified in applicable RADCON operating and technical procedures have been documented as to their ability to provide a 95% confidence level in the detection of surface contamination at levels that meet the requirements of this protocol. Supporting data are provided on each survey form.

For additional verification of survey results, Radiological Control Technicians not involved in the execution of this protocol will repeat approximately 5% of the direct and removable activity measurements on items destined for unrestricted release. To satisfy the release criteria, the results must confirm the initial findings.

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