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Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-91-OR21949

Post-Remedial Action Report for the Former Baker Brothers Site

Toledo, Ohio

February 1997

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POST-REMEDIAL ACTION REPORT

FOR THE

REMEDIAL ACTION AT THE

FORMER BAKER BROTHERS SITE

TOLEDO, OHIO

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United States Department of Energy

Oak Ridge Operations Office

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CONTENTS

FIGURES

TABLES

ACRONYMS

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
BNI	Bechtel National, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DCG	derived concentration guide
DOE	U.S. Department of Energy
FUSRAP	Formerly Utilized Sites Remedial Action Program
HEPA	high-efficiency particulate air
HSP	health and safety plan
IVC	Independent Verification Contractor
LLRW	low-level radioactive waste
LSA	low-specific-activity
MDA	minimum detectable activity
MED	Manhattan Engineer District
NCP	National Contingency Plan
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
PMC	project management contractor
PPE	personal protective equipment
RSS	radiological support subcontractor
TN	Thermo NUtech, Inc. (formerly TMA)

UNITS OF MEASURE

cm	centimeter
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
g	gram
h	hour
L	liter
m	meter
µCi	microcurie
µR	microroentgen
ml	milliliter
mrem	millirem
pCi	picocurie
yd	yard
yr	year

1.0 INTRODUCTION

1.1 BACKGROUND

This report documents the remedial action conducted from April to September 1995 at the former Baker Brothers, Inc. property located at 2551-2555 Harleau Place and 1000 Post Street, Toledo, Ohio (Figure 1-1). This cleanup was conducted as a removal action in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and its implementing regulations found in the National Contingency Plan (NCP) at 40 CFR Part 300. In compliance with the NCP, an engineering evaluation/cost analysis was prepared, and an administrative record was established.

Remedial activities at the former Baker Brothers site were performed as part of the U.S. Department of Energy's (DOE's) Formerly Utilized Sites Remedial Action Program (FUSRAP) in accordance with DOE protocols and procedures for implementing remedial actions.

The objectives of FUSRAP, as they apply to the former Baker Brothers site, are to

- identify and evaluate sites used to support nuclear development activities for the U.S. Army Corps of Engineers, Manhattan Engineer District (MED) and the U.S. Atomic Energy Commission (AEC), predecessor agencies of DOE;
- remove or otherwise control contamination on sites identified as contaminated above current DOE guidelines;
- achieve and maintain compliance with applicable criteria for the protection of human health and the environment; and
- certify the site, to the extent practicable, for use without radiological restrictions after remediation.

The primary legislation authorizing FUSRAP is the Atomic Energy Act of 1954. FUSRAP was established in 1974, and major remedial actions began at FUSRAP sites in 1981. Administered by the Former Sites Restoration Division of DOE's Office of Environmental Management, FUSRAP currently includes 46 sites in 14 states.

Bechtel National, Inc. (BNI) was the project management contractor (PMC) for the FUSRAP work at the former Baker Brothers site. Thermo NUtech (TN), the radiological support subcontractor (RSS), provided laboratory and health physics support for the remedial action. Oak Ridge Institution for Science and Education (ORISE), the FUSRAP independent verification contractor (IVC), performed independent verification surveys and has issued a report of its post-remedial action verification survey results

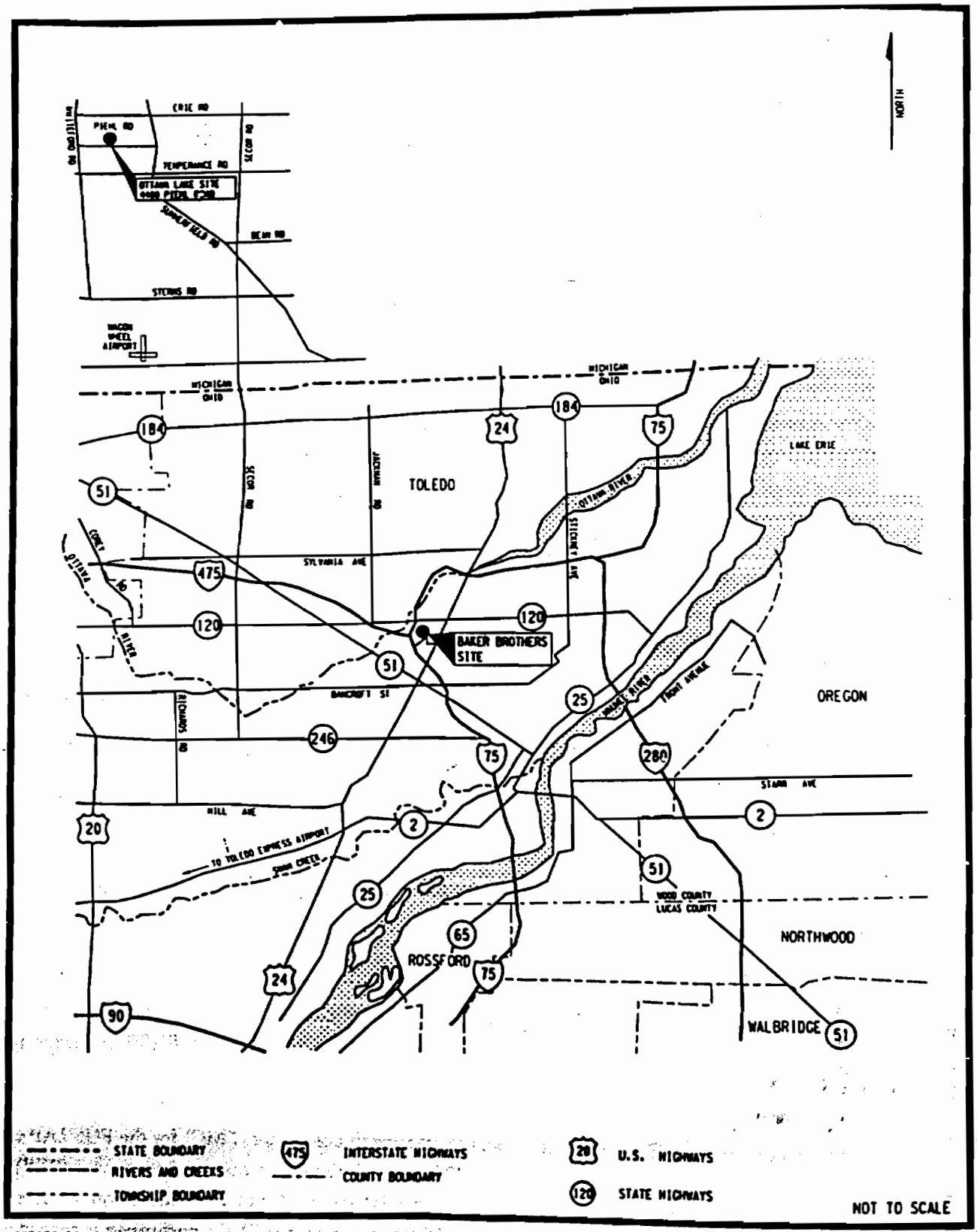

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Figure 1-1
General Site Location
Former Baker Brothers Site, Toledo, Ohio

(ORISE 1996). Oak Ridge National Laboratory (ORNL) conducted the designation surveys for the site and was the IVC for the Baker Brothers vicinity property in Ottawa Lake, Michigan; ORNL issued the post-remedial action survey report for that property (ORNL 1996).

1.2 HISTORY

Under the jurisdiction of the Army Corps of Engineers in the early 1940s, MED was established as the lead agency in the development of nuclear energy for defense-related projects. Raw materials containing uranium ores were procured, stored, and processed into various uranium oxides, salts, and metals. Fabricators were contracted as needed to roll and machine the metal into various shapes for nuclear reactor and weapon components. At contract termination, sites used by contractors were decontaminated in accordance with the criteria and health guidelines then in use. The radiological criteria for releasing sites were generally site specific and clearly defined. In some instances, however, documentation of decontamination was limited or nonexistent, and conditions at these sites after contract termination were unknown. Therefore, it was necessary to reevaluate the current radiological conditions at these sites under FUSRAP. FUSRAP was established to identify and clean up or otherwise control sites where residual radioactive contamination (exceeding current guidelines) remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. The former Baker Brothers site is a non-DOE-owned FUSRAP site.

During the early and mid-1940s, Baker Brothers, Inc., in Toledo, Ohio, machined natural (neither enriched nor depleted) uranium metal slugs from processed uranium metals under subcontract to MED for both Clinton Semi-Works in eastern Tennessee and the Hanford Nuclear Reactor in Washington State. The amount of material machined by Baker Brothers was estimated from historical documents to be between 90 and 300 tons.

The Baker Brothers property consisted of several buildings and grounds covered with asphalt or concrete, except for a gravel courtyard at the northwestern end of the site (Figure 1-2). After the subcontract ended in 1944, the Baker Brothers property was decontaminated in compliance with guidelines in effect at the time. Because the Baker Brothers uranium metal machining was related to AEC activities, a preliminary survey of existing conditions was conducted in 1989 by members of the ORNL Measurement Applications and Development Group at the request of DOE. Results of that survey indicated localized areas of residual uranium contamination. Consequently, the Baker Brothers property was resurveyed on September 20 and 21, 1992, and recommended for inclusion in FUSRAP (ORNL 1992).

In 1944, when the Baker Brothers' assets were liquidated, the machinery and equipment were sold at a public auction, and the property was divided and sold to two independent interests. The northern part of the property was resold in the summer of 1992. The new owner of this portion of the property contacted ORNL and inquired about the radiological status of his property. Through this conversation, ORNL learned that soil and debris potentially contaminated with residual uranium had been moved from the former Baker Brothers site to 4400 Piehl Road in Ottawa Lake, Michigan (Figure 1-1), for use as fill material.

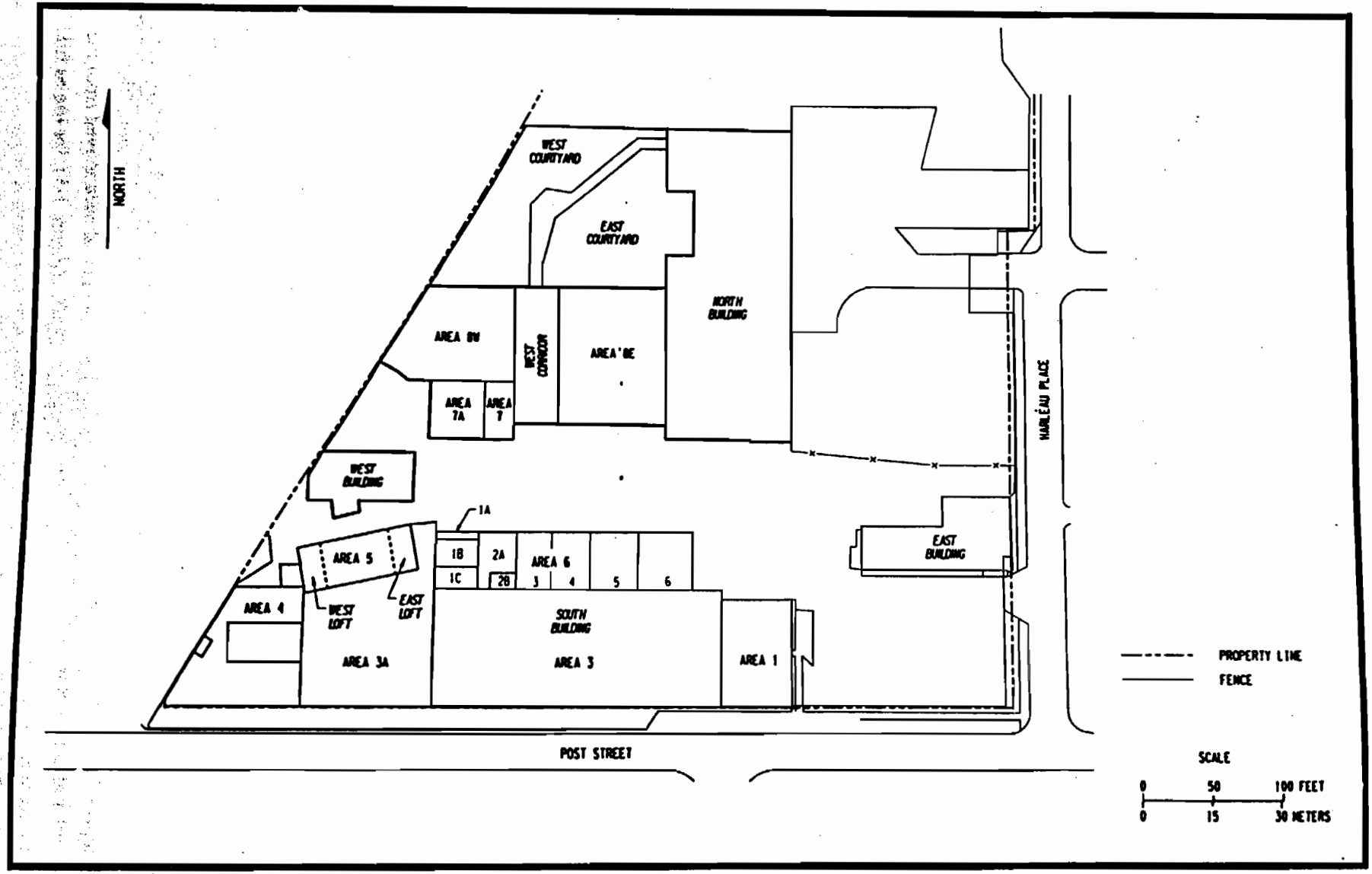

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Figure 1-2
General Site Plan
Former Baker Brothers Site

Results of a survey of the Ottawa Lake property indicated that remediation was required; the property was remediated from October 1994 to January 1995. Approximately 1,470 m^3 (1,920 yd^3) of radioactively contaminated material was removed and transported for disposal at Envirocare of Utah, a licensed low-level radioactive waste disposal facility. A separate report describing and documenting the remedial action and post-remedial action status of the Ottawa Lake site has been issued (BNI 1996).

1.3 SITE DESCRIPTION

The commercial property of the former Baker Brothers site consisted of several buildings and grounds located at the intersection of Harleau Place and Post Street (Figure 1-2). In the 1920s, the North building was erected with concrete floors, brick walls, and a saw-tooth roof. Areas 3A and 4 have original wooden floors. All exterior ground cover is asphalt or concrete except the gravel courtyard north of building Area 8.

Figure 1-2 shows the current site layout. Three of the buildings (South, West, and East) at this location are currently owned by Romanoff Industries. The South building, located at 1000 Post Street, contains Areas 1, 3, 3A, 4, 5, and 6. This 4,180-m^2 (45,000-ft^2) building is used for offices and electrical motor repairs. Areas 3 and 6 were completely refurbished following a fire. Areas 1, 3, and 6 are leased to Industrial Motor Company; the rest of this building is vacant or used for storage. The East building, at 2551 Harleau Place, is a two-story, unoccupied, 740-m^2 (8,000-ft^2) structure formerly used for offices. The West building, which contained the power house for the property, is a two-story, one-floor, 930-m^2 (10,000-ft^2) warehouse.

A fourth building, the North building, at 2555 Harleau Place, is owned by Doug Beat but leased to a used motor brokerage. This building includes 3,720 m^2 (40,000 ft^2) and contains Areas 7 through 8E.

2.0 REMEDIAL ACTION GUIDELINES

The source of contamination on the former Baker Brothers property was residues produced during the machining of natural uranium slugs from processed uranium metals. The residual radioactive contamination guidelines governing the release of properties for future use are included in DOE Order 5400.5, "Radiation Protection of the Public and Environment" (DOE 1993), and are listed in Table 2-1. The remedial action guidelines for alpha activity (from natural uranium, uranium-235, uranium-238, and associated decay products) on structural surfaces are 5,000 dpm/100 cm^2 average; 15,000 dpm/100 cm^2 maximum; and 1,000 dpm/100 cm^2 removable. Because only trace concentrations of radium and thorium exist in uranium metal after processing, only extremely low concentrations of these two radionuclides were detected in characterization samples. Only the uranium isotopes contributed significantly to the contamination of the site. The site-specific criterion for residual radioactive soil contamination was determined to be 35 pCi/g for total uranium (the sum of the activity contributed by all the uranium isotopes) averaged over any 15-cm- (6-in.)-thick layer of soil. The guideline was determined by applying the as-low-as-reasonably-achievable (ALARA) principle to three scenarios developed by Argonne National Laboratory (ANL) (ANL 1995).

Table 2-1
Summary of DOE Guidelines for Residual Radioactive Contamination

Basic Dose Limits

The basic limit for the annual radiation dose (excluding radon) received by an individual member of the general public is 100 mrem/yr. In implementing this limit, DOE applies the ALARA principle to establish site-specific guidelines (DOE 1990).

Indoor External Gamma Exposure Limit

The external gamma exposure rate for habitable structures must not exceed background levels of gamma radiation by more than 20 μR/h (DOE 1990).

Site-Specific Soil Guidelines

The site-specific criterion for soil is 35 pCi/g for total uranium (DOE 1995).

Indoor/Outdoor Structure Surface Contamination

The residual contamination guidelines for fixed and transferable radioactive contamination (dpm/100 cm^2) (DOE 5400.5) are

Radionuclide	Average	Maximum	Removable
Natural uranium, uranium-235, uranium-238, and associated decay products	5,000 (alpha)	15,000 (alpha)	1,000 (alpha)
Beta/gamma emitters (radionuclides with decay modes other than alpha emissions)	5,000 (beta/gamma)	15,000 (beta/gamma)	1,000 (beta/gamma)

3.0 REMEDIAL ACTION

3.1 CLEANUP AND DECONTAMINATION ACTIVITIES

Before remedial action began, the site was surveyed and additional samples were collected to more accurately define the boundaries of radioactive contamination. The information was used to classify the waste that would be generated during remediation, before its acceptance at the low-level radioactive waste (LLRW) disposal facility, Envirocare of Utah, in Clive, Utah.

Approximately 270 m^3 (356 yd^3) of LLRW was generated from the remedial action performed at the former Baker Brothers facility. Approximately 4 m^3 (5 yd^3) of contaminated materials, including building debris, contaminated personal protective equipment (PPE), and excavated soil, was also packaged for final disposal at Envirocare of Utah; therefore, the total volume of waste sent to Envirocare for disposal was 274 m^3 (361 yd^3). A summary of the waste minimization methods used during remedial action and of mixed waste disposition is provided in Appendix A.

Areas requiring remediation were identified on the basis of the residual radioactive contamination discovered during the characterization and boundary delineation activities and during decontamination and verification activities. These areas (shown in Figures 3-1, 3-2, and 3-3) include

Interior Areas

South Building:

- the floor of the eastern and western lofts of Area 5, and main floor beneath the eastern loft
- the shelves on the eastern wall of the eastern loft of Area 5
- the concrete floor of Area 6-2A
- the manhole cover in Area 3A

North Building:

- the concrete floor, southern and western partial walls, and overhead structures in Area 8W
- subslab contamination directly beneath the expansion joints in Area 8W and the West Corridor
- the northern wall and subslab contamination in the northeastern corner of Area 7A
- the concrete floor and the Toledo® scale in the western corridor
- the concrete floor of Area 8E
- the southern wall in Area 7

Exterior Areas

- the concrete bins in the courtyard
- exposed vertical sides of the northern, western, and southern walls of the courtyard
- the concrete pad and manholes and the area underneath the concrete walkway in the courtyard
- Area A — soil at the corner of Post Street and Harleau Place

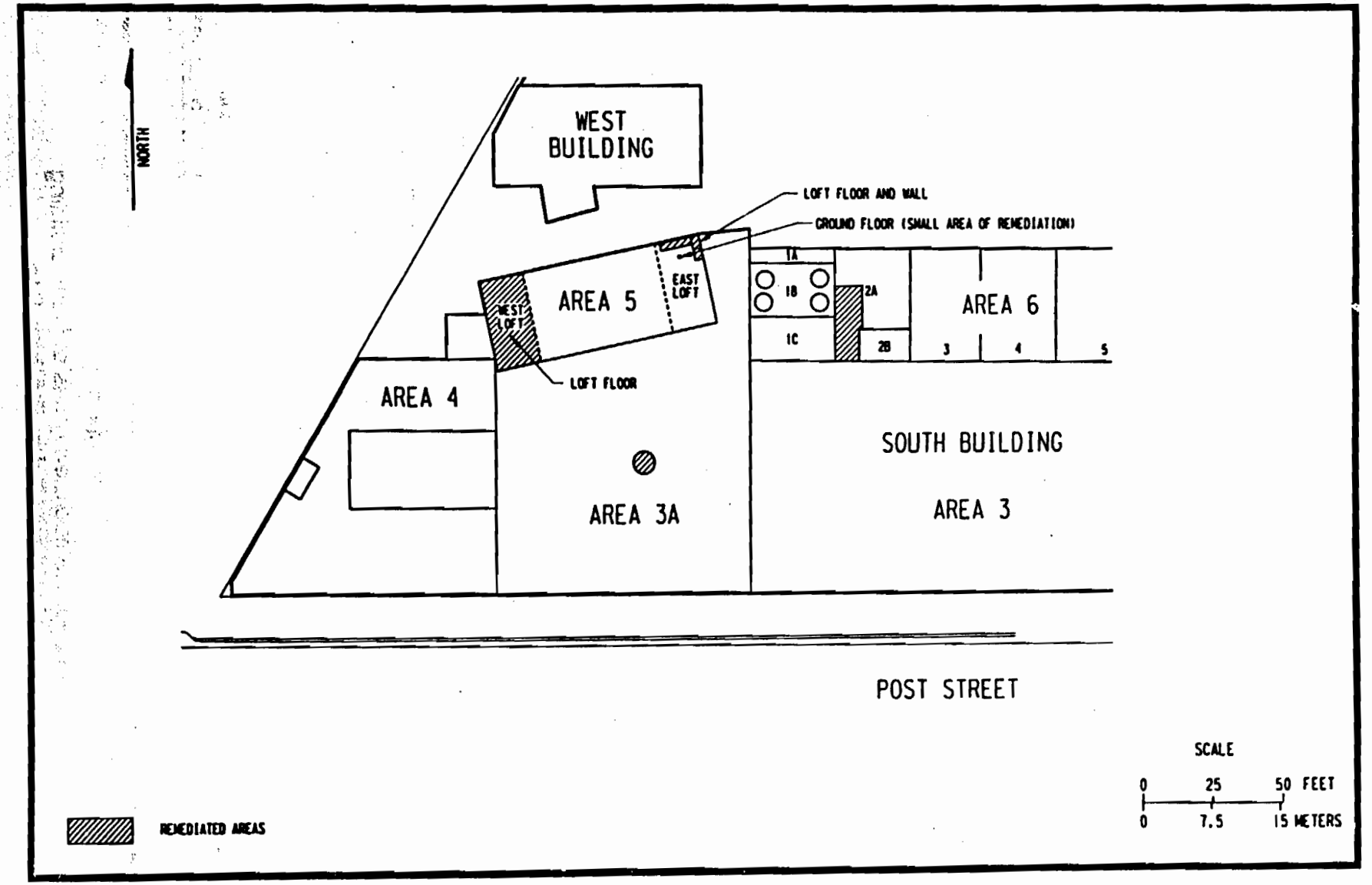

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Figure 3-1
Interior Remediated Areas of South Building
Former Baker Brothers Site

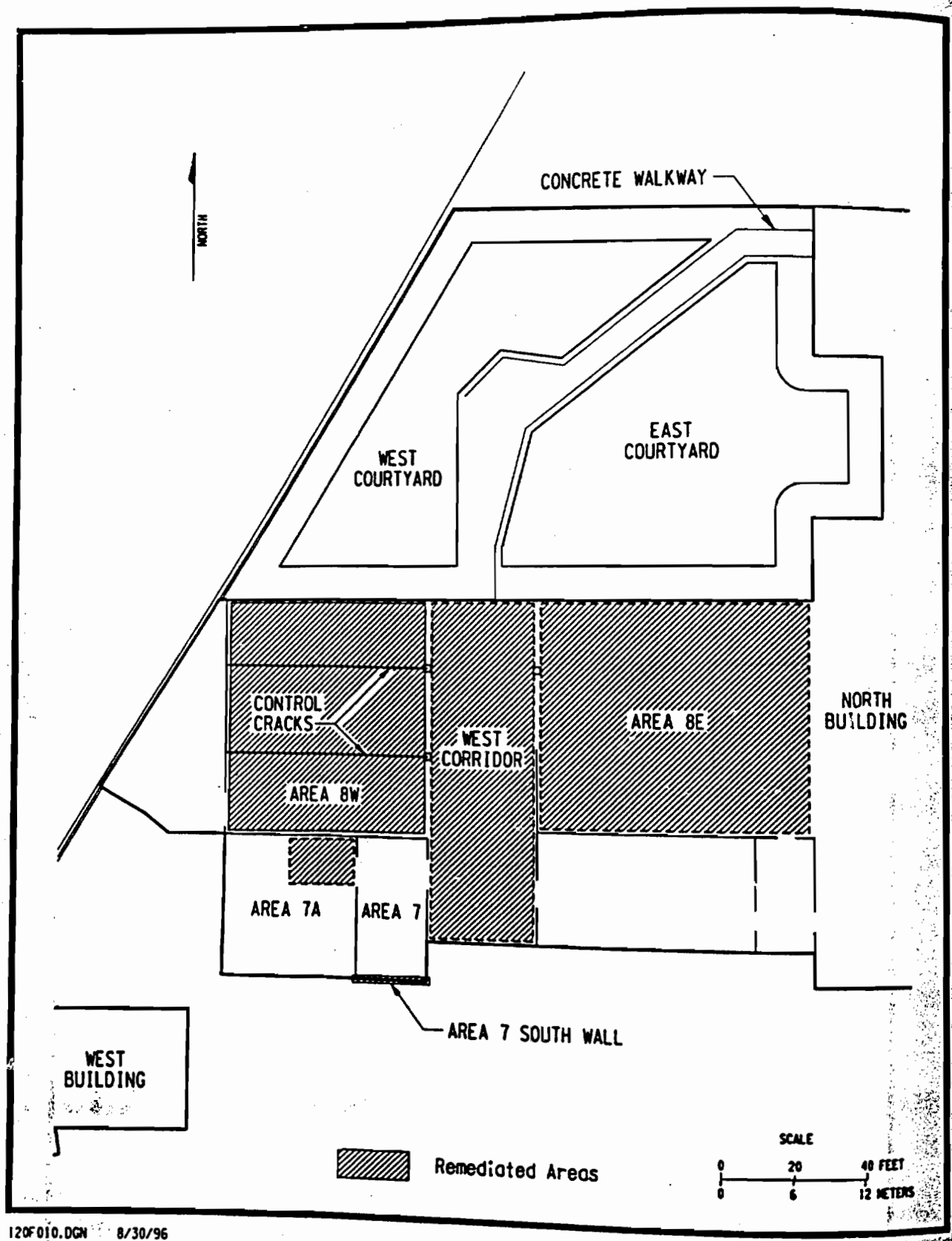

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Figure 3-2
Interior Remediated Areas of North Building
Former Baker Brothers Site

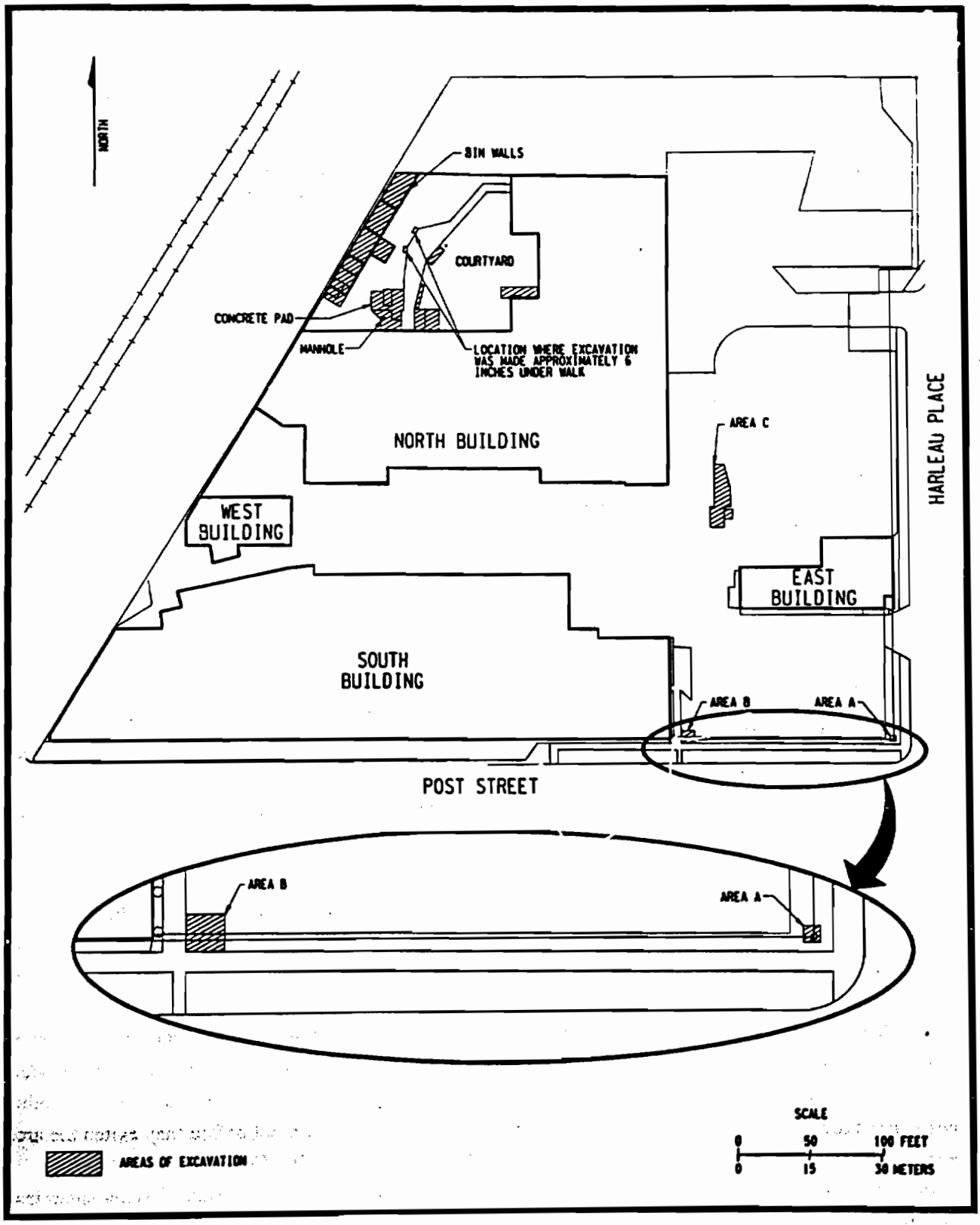

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Figure 3-3
Exterior Areas of Remediation
Former Baker Brothers Site

- Area B — soil along Post Street near the southeastern corner of the South building, adjacent to the walkway
- Area C — soil along the southern property line between the North and East buildings
- Area 7 (outside) —soil immediately south of the removed southern wall

Each area was decontaminated with different techniques as necessary, such as using a Vacublast™ to remove a contaminated layer of concrete, chipping contaminated concrete with a chipping hammer, or using a grinder or needle gun. Table 3-1 describes the techniques used at the Baker Brothers site.

As the remedial action was completed in each interior and exterior area, direct surface contamination measurements (for interior areas) and exposure rate measurements and composite soil samples (for exterior areas) were collected to confirm that all residual radioactive contamination above the current DOE guidelines had been removed. The IVC then verified that contamination had been remediated to below the guideline level, and the remediated areas were returned to a condition agreeable to both DOE and the property owners.

3.2 CONTAMINATION CONTROL DURING THE CLEANUP

During the remedial action, engineering controls, administrative controls, health physics and industrial hygiene practices, and monitoring were used to protect remediation workers and members of the general public from potential exposure to radiation in excess of applicable standards. These controls are outlined in the health and safety instructions for the former Baker Brothers site.

All personnel working in contaminated areas were required to wear disposable coveralls, safety glasses, disposable rubber boots, gloves, and hard hats. If conditions warranted, additional protective clothing and equipment such as hoods and respirators were required and were specified on the hazardous work permit for the site.

Workers exiting radioactively contaminated work areas were subjected to a whole-body scan (frisked) at the control point by a health physics technician, or properly qualified workforce member, with a hand-held radiation detection instrument. This procedure ensured that the protective clothing was not contaminated and eliminated the potential for spread of contamination to clean areas. A frisk is simply a search for radioactive material that may have rubbed off onto the clothing of individuals inside the work area. The hand-held radiation detection instrument is held approximately 1.3 cm (0.5 in.) from the area to be "frisked" and moved slowly [about 6 cm (2 in.) per second] to scan the portion of the body or clothing being checked. Personnel were resurveyed after they removed their PPE but before they exited the area to ensure that they had not become contaminated while removing their PPE. Contaminated PPE was disposed of properly at Envirocare of Utah. The uncontaminated PPE was disposed of as uncontaminated "clean" trash in the local landfill.

Table 3-1

Decontamination Techniques Used at the Former Baker Brothers Site

Technique	Description
HEPA vacuuming	High-efficiency particulate air (HEPA)-filtered vacuum cleaners were used to remove loose contamination, primarily in overhead areas and on floor surfaces.
Hand tools	Various hand tools, such as hammers, chisels, needle guns, grinders, and jackhammers, were used to remove contamination from concrete and other building surfaces.
Mechanical shot blasting	Two commercially available shot-blast systems, the BlasTrac™ and VacuBlast™ decontamination systems with self-contained dust collection systems, were used to clean "hot spots" on the floor and wall surfaces, respectively, by using abrasive metallic material on the work surface and removing incremental layers of contaminated material.
Mechanical grinding	Saw-Tec® Grinder was used on localized "hot spots," on the concrete floor, and on the bin walls in the courtyard.
Cutting with a pneumatic saw	A pneumatic saw with a concrete cutting blade, vented to the exterior of the building, was used to remove sections of contaminated concrete.
Demolition and excavation	The southern wall in area 7A was demolished, and all material was disposed of as LLRW. The contaminated soil under the building and any detected migration (including exterior areas) indicated by sampling were excavated and disposed of in the same manner. (See Figure 3-3.)

The primary potential pathways for exposure to radioactive material for members of the general public were inhalation and ingestion of radioactively contaminated airborne dust generated during the decontamination of interior areas and the excavation of contaminated soils. During the remedial action, the potential for contaminant migration was minimized by

- applying wet dust suppression (using a fine water mist) during decontamination and excavation activities;
- using intermodal containers with attached lids to prevent loss of contents; and
- placing large sheets of plastic around interior contaminated work areas (loading area, access control point, etc.) where practicable.

Perimeter air particulate sampling was performed adjacent to areas being remediated to ensure that no member of the general public was exposed to airborne radioactivity above DOE basic guidelines or the derived concentration guides (DCGs) contained in DOE Order 5400.5. A DCG is the concentration of a particular radionuclide that would yield a committed effective dose equivalent of the DOE basic dose limit, 100 mrem/yr, to an individual continuously exposed to the radionuclide by one pathway for an entire year. This guideline was established to protect members of the general public and the environment against undue risk from radiation. High-volume air samplers were used to collect samples of air to measure the air particulate concentration within that area. The filters were accumulated daily and counted after sufficient time was allowed for radon progeny decay. Concentrations of uranium-238 collected by area particulate air samplers ranged from 7.1×10^{-13} µCi/ml (0.00071 pCi/L) to 7.7×10^{-13} µCi/ml (0.00077 pCi/L), less than half the DCG of 2.0×10^{-12} µCi/ml (0.002 pCi/L) for uranium-238.

4.0 POST-REMEDIAL ACTION MEASUREMENTS

Before any post-remedial action data were collected, measurements and samples were obtained from remote background locations in the vicinity of the Baker Brothers site (Figure 4-1). Because they present information on typical conditions for the area, background data provide a frame of reference for evaluating data obtained during remediation of the site. Soil samples from locations unaffected by past operations at the former Baker Brothers site were analyzed for uranium-238. The external gamma radiation exposure rate was also measured. These data are presented in Table 4-1.

Techniques used during the post-remedial action surveys included measurements of direct and transferable surface contamination (where appropriate), walkover gamma scans, exposure rate measurements, and soil sampling.

Direct surface contamination is the total amount of radioactive contamination on a surface; therefore, a survey of direct surface contamination will quantify both fixed and removable portions of the contamination. Transferable contamination is removable and could conceivably be picked up on clothing or skin upon contact.

To quantify direct surface contamination, radiation detection instrumentation is placed directly over the surface to measure the radioactivity emitted. Direct alpha radiation is measured with an alpha scintillation detector connected to a scaler, an instrument that counts the number of radioactive disintegrations (decays) detected in a specified amount of time. Direct beta/gamma radiation measurements are obtained with a Geiger-Mueller probe attached to a scaler. The probe is placed over the surface to be surveyed, and pulses are allowed to accumulate for one minute on the scaler, resulting in a measurement of counts per minute (cpm) for the surface area. These measurements are then converted, with appropriate calibration and conversion factors, to disintegrations per minute per 100 square centimeters (dpm/100 cm^2), a common unit of measurement in health physics.

Transferable contamination is the unattached radioactive material that can be removed from a surface when it is "swiped" or "smeared" with a soft absorbent paper. The smear is placed in a portable smear counter, and alpha and beta/gamma radiation are each counted for one minute. The resulting measurements in counts per minute are then readily converted to dpm/100 cm^2.

The external gamma radiation exposure rates were measured using a pressurized ionization chamber. The measurement is taken at a height of 1 m (3 ft). Readings collected at this elevation provide an estimate of the potential exposure from gamma radiation to the human body.

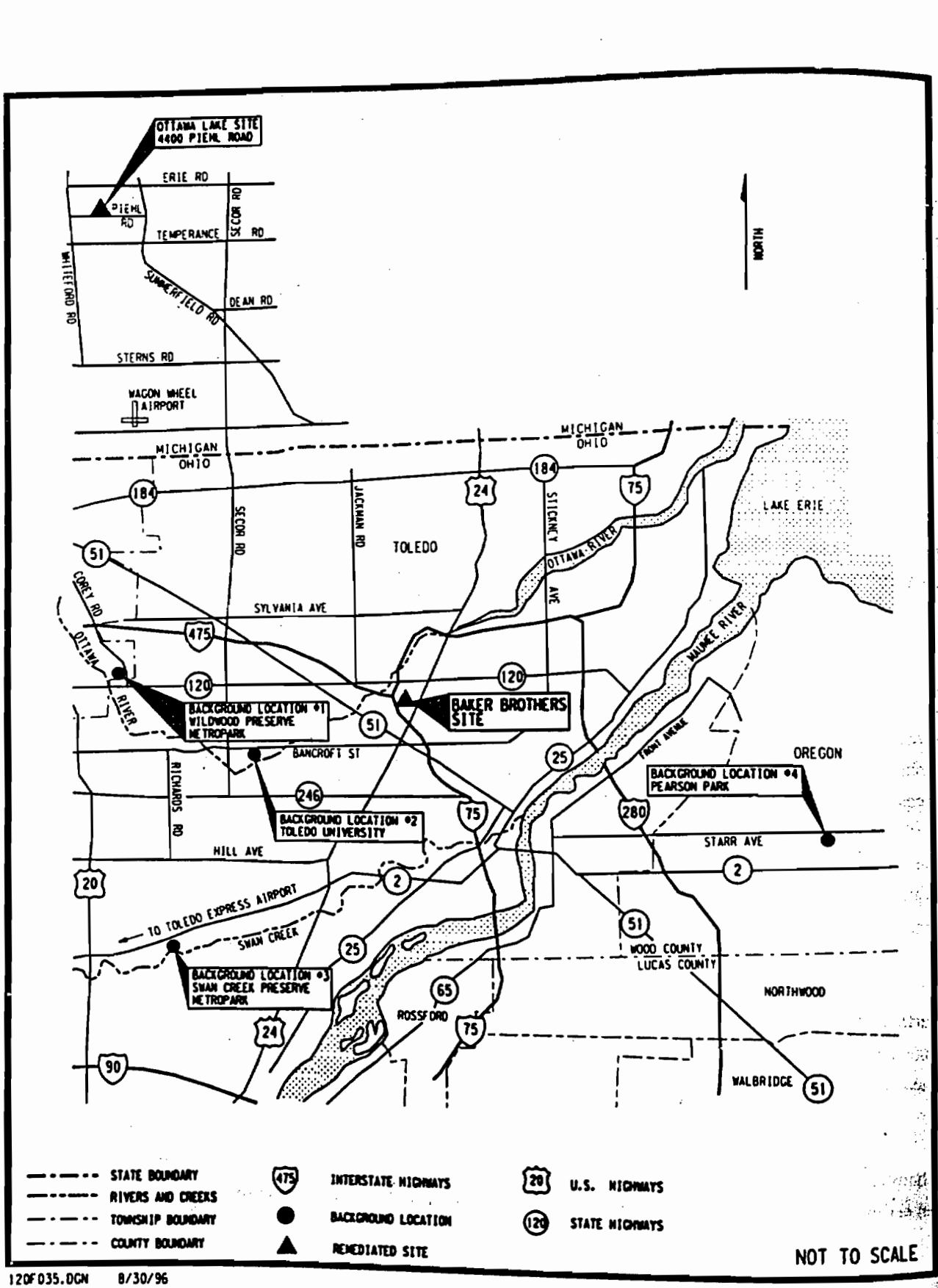

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Figure 4-1
Background Locations
Former Baker Brothers Site

Table 4-1

Uranium-238 Concentrations and External Gamma Radiation Exposure Rates at Background Locations

	Location	Distance from Baker Brothers Property	Uranium-238 (pCi/g)	Total Uranium (pCi/g) [a]	External Gamma Exposure Rate (μR/h)
1.	Wildwood Preserve Metropark, Central Ave., northwest of site	5 mi	0.89	1.78	8.20
2.	Toledo University, Bancroft Street, west of site	2.3 mi	0.89	1.78	—[b]
3.	Swan Creek Preserve Metropark, Airport Highway, southwest of site	5.3 mi	0.81	1.62	8.30
4.	Pearson Park, Starr Ave and Lallendorf Road, southeast of site	7.2 mi	1.56	3.12	8.30
Average Background Radioactivity			1.04	2.08	8.27

Refer to Figure 4-1 for approximate background locations.

[a] Total uranium concentration may be estimated by doubling the concentration of uranium-238 in a sample.
[b] Measurement not taken at this location.

The soil samples from each area of the site were collected systematically by laying out a 10- × 10-m (33- × 33-ft) grid over each remediated area and establishing site coordinates for each grid (labeled with north and east coordinates). This provides a reliable and reproducible method of sampling an area of concern. Twenty-five equally spaced samples, 2.5 cm (1 in.) in diameter and 15 cm (6 in.) deep, were collected from each 100-m^2 (1,100-ft^2) grid block. These 25 samples were composited and analyzed as a single sample representing the average for the surface soil of the remediated area. In some cases where the remediated area was less than 100 m^2 (1,100 ft^2), the post-remedial action grid was only as large as the actual size of the remediated area, and proportionally fewer samples were collected for the composite at a frequency (or spacing) of one sample per 4 m^2 (43 ft^2) of remediated area.

The survey techniques used for the post-remedial action surveys are described in the *Baker Brothers Site Post-Remedial Action Survey Plan,* which is included as Appendix B of this report. The RSS provided the health physics support and the laboratory functions for analyzing the collected samples. The IVC performed independent verification surveys and collected soil samples of the remediated areas using similar survey and sampling techniques. The IVC verification report has been issued separately by ORISE (ORISE 1996).

4.1 DIRECT AND TRANSFERABLE SURFACE CONTAMINATION

Table 4-2 provides the data for the post-remedial action surveys for direct and transferable surface contamination and shows that all survey results were well below the DOE guidelines. Figures 3-1, 3-2, and 3-3 show the following locations where post-remedial action surveys were conducted:

Interior Areas

South Building:

- the floor of the eastern and western lofts of Area 5, and main floor beneath the eastern loft
- the wall of the eastern loft of Area 5, adjacent to the former location of the wooden shelves
- the concrete floor of Area 6-2A
- the manhole cover in Area 3A

North Building:

- the concrete floor, southern and western walls, pipechase, and overhead structures in Area 8W
- the northern wall and subslab contamination in the northeastern corner of Area 7A
- the opening in Area 7 where the southern wall was removed
- the concrete floor of the western corridor
- the concrete floor and Toledo® scale in the western corridor
- the concrete floor of Area 8E

Exterior Areas

- the concrete bin walls in the courtyard
- exposed vertical sides of the northern, western, and southern walls of the courtyard
- the concrete pad and manhole and the area underneath the concrete walkway in the courtyard

4.2 EXTERNAL GAMMA RADIATION EXPOSURE SURVEY

Table 4-3 lists the results of the gamma radiation exposure survey conducted in each remediated area. All exposure rates were well below the DOE guideline, which specifies 20 μR/h above background as the maximum acceptable average exposure rate inside a building or habitable structure.

4.3 SOIL SAMPLES

To confirm that all soils with residual radioactive contamination exceeding the site-specific cleanup criterion of 35 pCi/g total uranium had been removed, soil samples were collected and analyzed for uranium-238 (Table 4-4). For natural uranium, with the isotopes of uranium present in natural abundances, the total uranium concentration for a sample is approximately equal to double the uranium-238 concentration; therefore, the site-specific cleanup criterion is 17.5 pCi/g of uranium-238. Contaminated soils were removed from the following areas (Figure 3-3):

- Area A — at the corner of Post Street and Harleau Place
- Area B — along Post Street near the southeastern corner of the South building, adjacent to the walkway
- Area C — along the northern property line between the North and East buildings
- Area 7A — subslab contamination in the northeastern corner of the room
- Area 8W and West Corridor — subslab contamination directly beneath the expansion joints
- Area 7 (outside) — immediately south of the removed southern wall
- Area C — along the southern property line between the North and East buildings
- Courtyard — along the perimeter of the courtyard and adjacent to the walkway

Table 4-2

Summary of Results of Post-Remedial Action Survey of Direct and Transferable Radiation

Room/Location	Direct Surface Contamination (above background)				Transferable Contamination (above background)[a]			
	Alpha		Beta/Gamma		Alpha		Beta/Gamma	
	Survey Activity Range (dpm/100 cm^2)	Number of Measurements/ Number below criteria[b]	Survey Activity Range (dpm/100 cm^2)	Number of Measurements/ Number below criteria[b]	Survey Activity Range (dpm/100 cm^2)	Number of Measurements/ Number below criteria[b]	Survey Activity Range (dpm/100 cm^2)	Number of Measurements/ Number below Criteria[b]
Area 5, eastern loft floor[c]	0 - 85	27/27	0 - 753	27/27	a	a	a	a
Area 5, eastern loft, east wall[c]	0 - 113	30/30	0 - 706	30/30	a	a	a	a
Area 5, western loft, floor (spot)	0 - 15	5/5	0 - 514	5/5	a	a	a	a
Area 5, northeastern corner ground floor (spot)	0 - 15	5/5	0	5/5	a	a	a	a
Area 3A, manhole cover[c]	0 - 50	4/4	0 - 447	4/4	0	2/2	0	2/2
Area 6-2A, floor[c]	0 - 169	81/81	0 - 3,287	81/81	0 - 5	17/17	0 - 48	17/17
NORTH BUILDING								
Area 7 - southern wall scar (generated by wall removal)	<-5 - 40	19/19	84 - 1,431	19/19	<-1 - 5	4/4	<-30 - 25	4/4
Area 7A - northern wall	<-6 - 397	68/68	<-195 - 2,921	68/68	<0 - 5	20/20	<-37 - <23	20/20
Area 8E - floor	<-16 - 66	91/91	<353 - 1,563	91/91	<-1 - 8	33/33	<-2 - 52	33/33
Area 8W - overhead structures	<-11 - 106	519/519	<-561 - 4,723	519/519	<-1 - 13	40/40	<-31 - 66	40/40

Table 4-2
(continued)

Room/Location	Direct Surface Contamination (above background)				Transferable Contamination (above background)[a]			
	Alpha		Beta/Gamma		Alpha		Beta/Gamma	
	Survey Activity Range (dpm/100 cm^2)	Number of Measurements/ Number below criteria[b]	Survey Activity Range (dpm/100 cm^2)	Number of Measurements/ Number below criteria[b]	Survey Activity Range (dpm/100 cm^2)	Number of Measurements/ Number below criteria[b]	Survey Activity Range (dpm/100 cm^2)	Number of Measurements/ Number below Criteria[b]
Area 8W - walls	<-20 - 128	168/168	<-219 - 2,319	168/168	<-1 - 5	55/55	<-39 - 62	55/55
Area 8W - floor	<-20 - 144	818/818	<-281 - 4,320	818/818	<-1 - 5	145/145	<-55 - 67	145/145
Area 8W - pipe chase	<-11 - 82	42/42	<-227 - 3,805	46/46	<-1 - 5	12/12	<-47 - 87	12/12
Corridor, Toledo Scale Area	<-11 - 89	161/161	<-303 - 1,941	161/161	<-1 - 5	50/50	<-65 - 66	50/50
COURTYARD								
Walls	<-16 - 216	378/378	<-196 - 2,160	378/378	<-1 - 8	16/16	<-38 - 66	16/16
Concrete pads, manholes	<-21 - 298	290/290	<-24 - 2,337	290/290	<-1 - 5	43/43	<-38 - 33	43/43
DOE Guideline[c]	5,000		5,000		1,000		1,000	

[a]A transferable measurement is taken only when the direct measurement exceeds 1,000 dpm/100 cm^2.
[b]A measurement that is below criteria is judged to be clean.
[c]The guidelines presented are extracted from DOE Order 5400.5, "Radiation Protection of the Public and the Environment," and represent the average allowable surface residual contamination (over a 1-m^2 area).

NOTE: The "<" sign indicates that the measurement is less than the minimum detectable activity (MDA). The "<-" sign indicates that the measurement was less than the MDA and that after background was subtracted, the numerical value was negative [i.e., <MDA result minus background (>MDA) = negative result indicated by "<-"].

Table 4-3
Summary of Post-Remedial Action External Gamma Radiation Exposure Rates

Room or Area	Exposure Rate (μR/h)	Number of Measurements	Number Exceeding Indoor Exposure Limit [a]
Area 5	10.52	1	0
Area 6-2A	12.81	1	0
Area C Excavation	10 [b]	2	0
Area 7 Excavation	10-12 [b]	15	0
Courtyard	7-15 [b]	62	0
Area 7A	9-13 [b]	15	0
Area 8W	11-12 [b]	8	0
Area 8E	10-12 [b]	10	0
Corridor	11-12 [b]	15	0
DOE guideline	[a]		

[a]The guideline is extracted from DOE Order 5400.5, "Radiation Protection of the Public and the Environment," which states that the average external gamma radiation exposure rate inside a building on a site that has no radiological restrictions on its use must not exceed the background level by more than 20 μR/h.

[b]ORISE exposure rate measurements and samples (ORISE 1996).

Table 4-4
Summary of Post-Remedial Action Soil Sampling Results

Area	Average Exposure Rate (μR/h)	Uranium-238 Results (pCi/g)	Total Uranium (pCi/g) [a]	Number of Samples in Composite [b]
Interior Areas of Excavation:				
Area 7A	9-13 [c]	<5.79	<11.58	32
Area 8W				
southern expansion joint	11-12 [c]	<1.67	<3.34	9
northern expansion joint	11-12 [c]	<1.53	<3.06	9
Corridor - expansion joint	11-12 [c]	<2.15	<4.30	25
Exterior Areas of Excavation:				
Area A - Corner of Post Street and Harleau Place	9.1	10.51	21.02	6
Area B- Post Street along walkway	9.4	<3.29	<6.58	6
Area C- Along northern property line, between North and East Buildings	10 [c]	<4.64	<9.28	30
Area 7 - south of southern wall [d]	10-12 [c]	<2.81	<5.62	5
Courtyard	7-15 [c]	12.08	24.16	8
Average outdoor background	8.27	1.04	2.08	N/A
Applicable guideline	[d]	17.5 pCi/g	35 pCi/g	N/A

[a] The site-specific guideline for residual uranium in soil is 35 pCi/g total uranium. Total uranium concentration can be estimated by doubling the uranium-238 concentration.

[b] Soil samples collected from each location were composited and analyzed as a single sample.

[c] ORISE exposure rate measurements and samples (ORISE 1996).

[d] The guideline is extracted from DOE Order 5400.5, "Radiation Protection of the Public and the Environment," which states that the average external gamma radiation exposure rate inside a building on a site that has no radiological restrictions on its use must not exceed the background level by more than 20 μR/h. For exterior areas, the DOE limit of 100 mrem/yr is applied and can be converted to 11 μR/h above background.

NOTE: The "<" sign indicates that the measurement is less than the minimum detectable activity (MDA). The "<-" sign indicates that the measurement was less than the MDA and that after background was subtracted, the numerical value was negative [i.e., <MDA result minus background (>MDA) = negative result indicated by "<-"].

5.0 POST-REMEDIAL ACTION STATUS

The post-remedial action survey data indicated that all areas of the former Baker Brothers site determined during characterization surveys to be contaminated with residual radioactive contamination above the DOE site-specific criteria are now in compliance with applicable DOE guidelines. After review of post-remedial action measurements, survey procedures, and quality assurance data, the IVC confirmed that the site was decontaminated to the radiological guidelines established for the site.

Upon completion of verification activities, the IVC notified DOE-Headquarters, Division of Facility and Site Decommissioning, and DOE-Oak Ridge Operations, Former Sites Restoration Division, of its findings and recommendations. DOE reviewed the data to determine whether the remedial action was successful (ORISE 1996). Based on this review, radiological conditions at the site were determined to be in compliance with DOE decontamination criteria and standards to protect health, safety, and the environment, and DOE certified the site as appropriate for release and use without radiological restrictions.

6.0 REFERENCES

Argonne National Laboratory (ANL), 1995. *Derivation of Guidelines for Uranium Residual Radioactive Material in Soil at the Former Baker Brothers, Inc., Site, Toledo, Ohio*, Argonne, Ill. (March).

Bechtel National, Inc. (BNI), 1996. *Post-Remedial Action Report for the Ottawa Lake Vicinity Property, Ottawa Lake, Michigan*, DOE/OR/21949-392, Oak Ridge, Tenn. (July).

U.S. Department of Energy (DOE), 1993. *Radiation Protection of the Public and Environment*, Washington, D.C., DOE Order 5400.5.

DOE, 1995. Memorandum from J. Wagoner to L. Price, "Uranium Guidelines for the Baker Brothers Site, Toledo, Ohio," CCN 132244 (July 10).

Oak Ridge Institute for Science and Education (ORISE), 1996. *Verification Survey of the Former Baker Brothers, Inc. Site, Toledo, Ohio* (May).

Oak Ridge National Laboratory (ORNL), 1992. *Radiological Survey at the Former Baker Brothers, Inc. Site, 2551-2555 Harleau Place, Toledo, Ohio*, ORNL/RASA-90/8, Oak Ridge, Tenn. (March).

ORNL, 1996. *Results of the Independent Radiological Verification Survey at 4400 Piehl Road, Ottawa Lake, Michigan (BTO002)*, ORNL/RASA-95/16, Oak Ridge, Tenn. (May).

Science Applications International Corporation (SAIC), 1995. *Engineering Evaluation/Cost Analysis for the Baker Brothers Site, Toledo, Ohio*, DOE/OR/21950-1002, Oak Ridge, Tenn. (June).

GLOSSARY

Alpha-emitting - See **Radiation.**

Ambient background radiation - Ambient background radiation refers to naturally occurring radiation emitted from either cosmic (e.g., from the sun) or terrestrial (i.e., from the earth) sources. Exposure to this type of radiation is unavoidable, and its level varies greatly depending on geographic location. For example, New Jersey typically receives 100 millirem per year (mrem/yr), Colorado receives about 115 mrem/yr, and some areas in South America receive up to 7,000 mrem/yr. Naturally occurring terrestrial radionuclides include uranium, radium, potassium, and thorium (see **Radionuclide**). The dose levels do not include the concentrations of naturally occurring radon inside buildings.

Beta/gamma-emitting - See **Radiation.**

Centimeter - A centimeter (cm) is a metric unit of measurement for length; 1 inch is equal to 2.54 cm; 1 foot is equal to approximately 30 cm.

Contamination - The term "contamination" is used generally to mean a concentration of one or more radioactive materials that exceeds naturally occurring levels. Contamination may or may not exceed the DOE cleanup guidelines.

Disintegrations per minute - Disintegrations per minute (dpm) is the measurement indicating the amount of radiation being released from a substance per minute.

Dose - As used in this report, dose is actually dose equivalent and is used to relate absorbed dose (mrad) to an effect on the body. Dose is measured in mrem. For comparison, a dose of 500,000 mrem to the whole body within a short time causes death in 50 percent of the people who receive it; a dose of 5,000,000 mrem may be delivered to a cancerous tumor during radiation treatment; normal background radiation at or near sea level results in an annual dose of about 100 mrem; DOE radiation protection standards limit the dose that may be received by members of the general public to 100 mrem/yr above background levels; living in a brick house typically results in a dose of about 75 mrem/yr above the background level.

Exposure rate - Exposure rate is the rate at which radiation imparts energy to the air. Exposure is typically measured in microroentgens (μR), and exposure rate is typically expressed as μR/h. The dose to the whole body can be approximated by multiplying the exposure rate by the number of hours of exposure. For example, if an individual were exposed to gamma radiation at a rate of 20 μR/h for 168 h/week (continuous exposure) for 52 weeks/yr, the whole-body dose would be approximately 175 mrem/yr.

Gamma radiation - See **Radiation.**

Meter - A meter (m) is a metric unit of length; 1 m is equal to approximately 39 inches.

Microroentgen - A microroentgen (μR) is a unit used to measure radiation exposure. For further information, see **Exposure rate**.

Millirem - The millirem (mrem) is the unit used to measure radiation dose to man. The DOE dose limit is 100 mrem above background radiation levels within any one-year period for members of the general public. Naturally occurring radioactive substances in the ground result in a yearly exposure of about 100 mrem to each member of the population. To date, no difference can be detected between the health of population groups exposed to 100 mrem/yr above background and the health of groups who are not exposed.

Natural background radiation - Natural background radiation refers to radiation emitted from the naturally occurring radionuclides found in manmade materials. The concentrations of the radionuclide, and thus the radiation, will vary widely because of variations in the composition of the materials.

Radiation - There are three primary types of radiation: alpha, beta, and gamma. Alpha radiation travels less than an inch in air before it stops, and it cannot penetrate the outer layers of human skin. Beta radiation can penetrate the outer layers of skin but cannot reach the internal organs. Gamma radiation, the most penetrating type, can usually reach the internal organs.

Radionuclide - Radioactive elements are also referred to as radionuclides. For example, uranium-235 is a radionuclide, uranium-238 is another, thorium-232 is another, and so on.

Remedial action - Remedial action is a general term used to mean "cleanup of contamination that exceeds DOE guidelines." It refers to any action required so that a property may be certified as being in compliance with guidelines and may therefore be released for future use. Remedial action also includes restoring remediated properties to their original conditions as far as possible.

Uranium - Uranium is a naturally occurring radioactive element. The principal use of refined uranium is for the production of fuel for nuclear reactors. Uranium in its natural form is not suitable for use as a fuel source.

APPENDIX A

WASTE MINIMIZATION SUMMARY
FOR THE FORMER BAKER BROTHERS SITE

WASTE MINIMIZATION SUMMARY
FOR THE FORMER BAKER BROTHERS SITE

The decontamination of the former Baker Brothers site was conducted in a manner that prevented the overexpenditure of funds while expediting the remedial action process. The volume and waste streams that resulted from the remediation of the former Baker Brothers site are listed in Table A-1. This table shows that the total volume shipped for disposal and the total volume of waste generated are the same. All waste was disposed of at Envirocare of Utah.

Waste management techniques used at the site include macroencapsulation (for the lead), stabilization (for the asbestos insulation), and steam reformation of mixed wastes at an offsite commercial treatment facility, Scientific Ecology Group, to render the waste nonhazardous. All materials were packaged for final disposal at the Envirocare facility.

TABLE A-1
REMEDIAL ACTION SUMMARY

WBS 120
SITE Baker Brothers

OWNER Mr. Jack Romanoff (South)
Mr. Doug Beat (North)
SITE ADDRESS 2551-2555 Harleau Place
CITY, STATE Toledo, Ohio

REMEDIATION AUTHORITY
☒ NEPA/CERCLA
☐ SUPERFUND
☐ RCRA

ACTION	DATE	RESPONSIBLE ENTITY	DOCUMENT
DESIGNATION	07-1992	DOE/ORNL	Designation/Authorization Report
CHARACTERIZATION	05-1995	ORNL	Results of Radiological Survey at the Former Baker Brothers Site, Toledo, Ohio
CHARACTERIZATION	07-1995	BNI	Characterization Results for the Roof of the North Building at the Former Baker Brothers Site, Toledo, Ohio.
FINAL RA	09-1996	DOE / ORNL / BNI	Post-Remedial Action Report for the Former Baker Brothers, Inc. Site, Toledo, Ohio

TOTAL VOLUME 361 yd^3
To Remain In Situ 0
Volume Reduction 0
Net Disposal 361 yd^3

Documentation Used: N/A

TYPE OF WASTE FOR NET DISPOSAL:

REGULATORY		VOLUME	DISPOSAL SITE
☒	LLRW	355.8 yd^3	Clive, Utah
☐	11(E)2		
☒	MIXED Lead	5.2 yd^3	Clive, Utah
☐	CHEMICAL		
PHYSICAL			
☒	BUILDING RUBBLE		
☒	SOIL		
☐	LIQUID		
☐	OTHER		

TREATMENT TECHNOLOGIES APPLIED AT THE SITE:
Steam reformation of mixed wastes offsite at Scientific Ecology Group to render nonhazardous, stabilization, and macroencapsulation.

APPENDIX B

FORMER BAKER BROTHERS SITE POST-REMEDIAL ACTION SURVEY PLAN

FORMER BAKER BROTHERS SITE
POST-REMEDIAL ACTION SURVEY PLAN

PURPOSE

The purpose of this plan is to describe the methodologies that the Formerly Utilized Sites Remedial Action Program (FUSRAP) will use for post-remedial action radiological surveys, sampling, and analysis to document the final condition of the Former Baker Brothers Site as free of radioactive contamination above the release standards of Department of Energy (DOE) Order 5400.5 (reference 1). Nothing herein is intended to compromise the independence of the Independent Verification Contractor (IVC); the purpose is to document the Prime Management Contractor's (PMC's) plans to conduct post-remedial action surveying/sampling and the plans for coordinating effectively with the IVC. The plan addresses the DOE protocol for verification and certification of sites under FUSRAP (reference 2).

Bechtel National, Inc. (BNI) will be the FUSRAP PMC, and the Oak Ridge Institute for Science and Education (ORISE) will act as the IVC.

REFERENCES

(1) DOE Order 5400.5, Radiation Protection of the Public and Environment, Washington, D.C.

(2) DOE, 1990. Verification and Certification Protocol for the Office of Environmental Restoration FUSRAP and D&D Program, Revision 3, November.

(3) ORNL, 1992. Radiological Survey of the Former Baker Brothers, Inc. Site, 2551-2555 Harleau Place, Toledo, Ohio (BY0001), ORNL/RASA-60/8, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, March 1992.

(4) BNI, 1995. BKB - Trip Report - Sanborn Map Research and Interview with Former Employee, (Bechtel National Interoffice Memorandum, CCN 128532)

(5) BNI, 1995. Characterization Report for the Former Baker Brothers Site, Toledo, Ohio

(6) Williams, W. A., 1992. "Authority Review for the Former Baker Brothers, Incorporated Site, Toledo, Ohio" Memorandum from W. A. Williams to File DOE-095790, June 4.

(7) Adler, D. G., 1994. "Baker Brothers and B and T Metals Sites - Uranium Soil Guidelines." Memorandum from Adler to J. W. Wagoner (CCN 131598, June 27).

(8) Argonne National Laboratory, 1995. Derivation of Guidelines for Uranium Residual Radioactive Material in Soil at the Former Baker Brothers, Inc. Site, Toledo, Ohio (Draft)

(9) BNI, 1994. Work Instruction for Analysis of Soil Samples by High Resolution Gamma Spectroscopy.

(10) BNI, 1993. Instruction Guide for Post-Remediation Radiological Survey of Structures, 191-IG-031.

(11) BNI, 1993. Instruction Guide for Post-Remediation Survey of Soil, 191-IG-032.

(12) ThermoAnalytical (TMA), Health Physics Operational Procedures Manual
- A) 3C.2 "Determination of Background"
- B) 3B.1 "Delineation of Survey Areas in Open Land"
- C) 3B.3 "Gamma Ray Exposure Rate Surveys at 1-Meter in Open and Enclosed Areas"
- D) 3A.2 "Direct Surface Contamination Survey"
- E) 3A.3 "Transferable Surface Contamination Survey"
- F) 4A.1 "Systematic and Bias Surface Soil Sampling (Radiological)"

(13) DOE/CH/8901. A Manual For Implementing Residual Radioactive Material Guidelines, June 1989.

(14) BNI, 1992. Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites, 191-IG-011, Revision 5

(15) BNI, 1993. Instruction Guide for Surface Water and Sediment Sampling Activities, 191-IG-028, Revision 0.

(16) BNI, 1994. How to Ship Samples from a FUSRAP Site, PI R4.7, Revision 2.

(17) BNI, 1995. Site Specific Health and Safety Plan for the Former Baker Brothers Site, Toledo, Ohio (WI-95-102, CCN 128220).

BACKGROUND

From mid-1943 to July 1944, the Baker Brothers site was contracted under the authority of the Manhattan Engineer District (MED) to machine natural uranium metal for the nation's early atomic energy program. Although historical information is limited, a 1943 report by the University of Chicago Metallurgical Laboratory Health Division stated that four lathes used in machining uranium rods produced heavy fumes. In addition, the pyrophoric uranium cuttings were reported to have spontaneously ignited in the lathe pans and scrap metal containers (reference 3). An interview with a former worker (reference 4) revealed that the uranium machining work was conducted solely in the north building of the property, allegedly in Area 7. The machined billets were thought to have been unloaded from a railroad spur between the north and south building, carted into the north building through a large roll up door, and stored in the heavily guarded courtyard. Data collected during characterization activities conducted in Spring 1995 corroborate that the north building was the site of the machining activities (reference 5).

The MED contract with Baker Brothers was discontinued in 1944 when machining operations were transferred to the Hanford site in Washington State. Following contract termination, the facility was decontaminated according to the existing health guidelines; however, no record of a final inspection and cleanup has been located (reference 6). The Baker Brothers assets were eventually liquidated, and the facility was sold.

Currently, site ownership is divided between two entities. The North building and land east and north of the building is owned and operated by the Doug Beat Company. The remaining buildings and land south of the North building is owned by Romanoff Industries. Areas of the South building are currently being leased (reference 5).

RESIDUAL CONTAMINATION GUIDELINES

The source of contamination of the designated property was natural uranium metal milling operations. Contamination in the building is the result of migration of that material by such mechanisms as disposal (sweeping or washing), tracking on shoes and clothing, and deposition of smoke from ignition of the pyrophoric metal or fumes generated during machining. The DOE primary standard of 100 mrem/yr above background will be the public dose limit, with remedial action rendering the dose limit as low as reasonably achievable (ALARA). The average level of gamma radiation inside a building or habitable structure on a site to be released without restrictions shall not exceed the background level by more than 20 μR/hr and shall comply with the basic dose limit when an "appropriate-use" scenario is considered (reference 1).

- The residual contamination guidelines for fixed and transferable radioactive contamination (dpm/100 cm^2) (reference 1):

Radionuclide	Average	Maximum	Removable
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters	5,000	15,000	1,000

- The site-specific contamination guideline for soil is as follows (identified in Reference 7; determined as a conservative fraction of the concentration derived in Reference 8)

Radionuclide	Soil Concentration
Total Uranium	35 pCi/g (above background)

DECONTAMINATION ACTIVITIES

Appropriate design drawings include: 120-DD460-C06 (Site Plan Layout), 120-DD460-C07 (Remedial Action Plan, Sections, and Details), and 120-DD460-C08 (Area 7 South Wall Dismantlement and Area 8W Roof Remediation Plan and Details).

A Real Estate Instrument for each affected property shall be in place prior to the initiation of remediation activities.

At a minimum, remediation of the site will consist of decontamination and/or removal of structures exceeding the DOE guidelines for fixed and transferable radioactive contamination as well as excavation and disposal of radioactively contaminated soil exceeding the anticipated 35 pCi/g site-specific guideline for uranium.

Consequently, post-remedial action and verification surveys, as well as soil sampling, will focus on confirming that after remedial action, residual radioactive contamination is not present at concentrations exceeding applicable guidelines. Areas where remediation activities will be conducted will include, but not be limited to, those identified during site characterization activities (reference 5). To the extent necessary, equipment used during the decontamination activity will be cleaned and surveyed for surficial contamination prior to release.

POST-REMEDIATION SURVEYS AND SAMPLING

The FUSRAP Radiological Support Subcontractor (RSS), is Thermo Nuclear Services, a division of ThermoAnalytical (TMA). Following remediation, TMA will perform post-remedial action surveys and sampling to determine the completeness of the remedial action and to document that the site now complies with the applicable criteria.

Survey Equipment

The recommended equipment for use by FUSRAP for release of equipment and materials from the site includes, but is not limited to:

- Alpha Scintillation detector (Eberline AC-3 or equivalent; calibration source: Th-230)
- Beta/Gamma Pancake GM detector (7 mg/cm^2 mylar shielded, Eberline HP-210 or equivalent; calibration source: Sr-90, Y-90)
- Alpha Scintillation Counter (Eberline SAC-4 or equivalent; calibration source: Th-230)

The recommended equipment for use by FUSRAP for Post-RA survey and verification includes, but is not limited to:

- Canberra 96-6697 Procount gamma spectroscopy system (calibrated according to instruction in Reference 9)
- Portable Ratemeter/Scaler (Eberline PRS-1 or equivalent)
- Gamma Scintillation Detector (Eberline SPA-3 or equivalent), or low range/high range HP-270 or equivalent (calibration source: Cs-137)
- Reuter-Stokes Pressurized Ion Chamber (PIC) (calibrated by manufacturer)
- Field Instrument for Detection of Low-Energy X-Rays (FIDLER) (calibration source: Am-241)
- HP-260 or equivalent pancake GM detector (calibration source: Sr-90, Y-90)

Similar types of calibration sources (i.e., same radionuclide) and methods for instrument calibration will be used by TMA and ORISE to insure compatibility and reproducibility of survey results.

The Canberra 96-6697 Procount field gamma spectroscopy system may be used to analyze the soil samples and will be operated in accordance with WI-95-034 (reference 9). Of those samples analyzed in the field, 10% will then be shipped to the TMA laboratory in Oak Ridge for analysis for list 1 by gamma spectroscopy. Laboratory and field gamma spectroscopy results should agree within 20%. If the field gamma spectroscopy system is not employed, all post-RA soil samples will be analyzed by gamma spectroscopy (list 1) in the Oak Ridge laboratory.

Background Measurements

Prior to performing post-remedial action surveys, TMA will obtain site-specific background measurements. These measurements may be obtained from three remote background locations in the general vicinity of the site (0.5 to 3 miles) according to TMA procedure 3C.2 (reference 12A). If similar materials (concrete, mortar, brick, etc.) cannot be found within 0.5 to 3 miles of the facility, then interior (non-surface) samples of materials taken from

uncontaminated portions of the facility may be used for determining background. The locations for background measurements will be determined by TMA. Background measurements will be made at each location by TMA and ORISE.

Post-RA Surveys

After completion of decontamination, TMA shall conduct post-remedial action surveys to document the satisfactory decontamination of the building (reference 10). The structures left after remediation will be surveyed for alpha and beta/gamma direct and transferable contamination according to TMA procedures 3A.2 and 3A.3 (references 11D and 11E). Gamma exposure rate measurements shall be obtained according to TMA procedure 3B.3 (reference 12C).

Once remediation of floor and wall areas is complete, if a floor/wall monitor (or equivalent) is available, the entire floor/wall area will be scanned to obtain initial confirmation that no small, isolated areas of contamination were missed during remedial action.

Following methods in reference 10, post-RA direct measurements will be collected, biased within specific 1-m^2 (10.75-ft^2) areas to demonstrate that previously contaminated areas are no longer contaminated above criteria. Direct readings will also be taken in adjacent areas within 0.5 m (1.6 ft) of the formerly contaminated areas to verify that contamination had not spread to previously clean areas during the removal activities.

Transferable (removable) alpha and beta/gamma contamination will also be measured, at a minimum, at any location that exhibits direct alpha or beta/gamma contamination above the guideline for removable contamination (1,000 dpm/cm^2) (reference 10).

Post-RA Soil Sampling

Soil samples will be collected from an approximately 100 m^2 grid (10m by 10m where practical) as directed in 191-IG-032 (reference 11) and TMA procedure 4A.1 (reference 12F). When deviating from the 10 m by 10 m dimensions (due to irregularities in the area of contamination), total area shall not exceed 100 m^2. The approximate depth to the bottom of the excavation for each grid will be recorded in the sampling logbook.

Point sources ("Hot Spots") will be evaluated using the averaging criteria contained in A Manual for Implementing Residual Radioactive Material Guidelines (reference 13) and DOE Order 5400.5, Chapter IV, Section 4. Where appropriate, a hybrid grid made up of portions of one or more site grids will be implemented to bound and assign the area (in square meters) to each "hot spot" in question. Composite samples of the soil will be taken from each sample grid. Composite samples will be collected by taking individual samples (25 per

100 m^2) from each sample grid at 0.5' depths and compositing these individual samples into one composite sample for that grid (reference 11). ORISE may collect samples concurrently.

Samples from each grid shall be collected using properly decontaminated sampling equipment (reference 14).

TMA samples shall be handled using the same custody and labeling methodology described for sediment samples in the "Instruction Guide for Surface Water and Sediment Sampling Activities" 191-IG-028 (reference 15) and the sample surveying, packaging, and shipping methodology in PI R4.7 "How to Ship Samples from a FUSRAP Site" (reference 16).

Soil Sampling from Excavation Face

In areas with a vertical excavation face where above-criteria contamination has been identified under the road, sidewalk, or other structure to be left in place, take one sample per grid, biased to areas associated with increased instrument count rates if present. In areas with a sloped excavation face adjacent to the roadbed or other structure, material must be removed with a hand shovel in order to create a vertical face, and then the sample should be collected as described above. These samples should not be composites. All samples should be obtained from most probable areas of contamination. If survey instruments do not indicate count rates above background, the samples should be obtained from areas adjacent to excavated areas where activity significantly above background was known to exist prior to excavation.

Safety and Health

Safety and Health risks associated with tasks described herein have been identified and addressed by the **Site Specific Health and Safety Plan for the Baker Brothers Site** (reference 17).

The work will be performed under a Hazardous Work Permit specific to the survey activities.

Quality Assurance/Quality Control

QA/QC field duplicate samples and measurements shall be collected at a frequency of one additional sample/measurement for each 20 collected.

Rinse blanks from decontaminated sampling equipment shall be collected at the rate of one rinse per day of sampling. Rinse blanks shall be collected according to the recommendations in 191-IG-028 (reference 15).

Data Quality Objectives

The minimum detectable activity (MDA) for analysis of uranium-238 by field gamma spectrometry shall be less than 5 pCi/g. The MDA for laboratory gamma spectrometry shall be less than 3 pCi/g. Quality indicator goals shall be as follows: Precision, ± 2 sigma; completeness, 90%; Accuracy, ± 25%). QA/QC samples are discussed in the previous section.

BECHTEL/ORISE COORDINATION

Bechtel is the contractor responsible for completing the remedial action and will have the responsibility for decontamination. Upon completion of these decontamination activities (phased approach, by zones), ORISE will commence verification of the remediation of the former Baker Brothers site property. ORISE will perform a walkover survey using a FIDLER or equivalent to measure beta-gamma radiation directly. The result of this walkover survey shall be used to determine whether there are areas requiring additional remediation. This survey is expected to include all areas previously identified as being contaminated on the former Baker Brothers site property. Bechtel will assist ORISE in this survey by interfacing with the property owner in advance to secure their approval for property access.

Remediation and verification will be conducted concurrently, to the extent that the two activities do not interfere with each other. Bechtel will provide ORISE access to remediation results as they become available. The Bechtel Site Superintendent will notify ORISE when remediation of an area is complete, and ORISE will perform final independent verification surveys of the area. ORISE may collect soil sample splits concurrent with Bechtel sampling efforts. When ORISE has collected all of the samples and instrument readings needed for their independent verification of the site, they will sign the "Findings of Independent Verification Survey" form (Attachment 1).

Remedial action will continue until ORISE agrees decontamination is complete. Final site conditions must meet cleanup objectives. Measurements taken by Bechtel and ORISE at identical locations should agree within the 95 percent confidence interval for the analytical methods used (reference 2). For consistency and ease of data comparison, Bechtel and ORISE shall utilize the same type of calibration techniques, calibration sources, and survey techniques in conducting the surveys. Bechtel and ORISE shall establish a mutually agreeable survey grid across the decontaminated areas and shall conduct their surveys referring to that grid.

Upon agreement by both parties that the site is decontaminated, ORISE will then demobilize, and Bechtel will remain to restore the site to the condition agreed upon by the property owner(s).

Bechtel will provide final verified sample results to ORISE as soon as they are available. Bechtel will prepare a post-remedial action report (PRAR) for DOE review (copy to ORISE) within 3 months following demobilization, and then complete preparation of the Certification Docket. ORISE will issue a preliminary verification letter report to DOE (copy to Bechtel) following demobilization.

FORMER BAKER BROTHERS SITE

FINDINGS OF INDEPENDENT VERIFICATION SURVEY

PROPERTY _____ AREA _____
SURVEY DATE(S) _____
SURVEYOR(S) _____ , _____ , _____

PRELIMINARY FIELD DATA REVIEW:

_____ No Discrepancies _____ Discrepancies Identified

MEASUREMENT PERFORMED:

_____ Beta/Gamma _____ Removable Activity Smear
_____ Other (describe) _____ Direct Measurements

SAMPLES COLLECTED:

_____ Systematic _____ Bias

APPLICABLE GUIDELINES:

Radionuclide	Soil Concentration Above Background
Total Uranium	35 pCi/g, any depth

For fixed and transferrable radioactive contamination (U-238):
5000 dpm/100 cm^2, average total
15,000 dpm/100 cm^2, maximum total
1000 dpm/100 cm^2, removable

STATUS:

_____ Meets Guidelines _____ Does Not Meet Guidelines

Explain Discrepancies: _____

Remarks: _____

I acknowledge that all the samples and instrument readings needed to verify this area as clean have been taken.

Prepared by: _____ Date: _____

Attachment 1