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U.S. Department of Energy
Grand Junction Projects Office Remedial Action Project

Final Report of the Decontamination and Decommissioning of Building 18 at the Grand Junction Projects Office Facility

August 1996

U.S. Department of Energy
Grand Junction Projects Office

MASTER

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Final Report of the Decontamination and Decommissioning of Building 18 at the Grand Junction Projects Office Facility

August 1996

Prepared for
U.S. Department of Energy
Albuquerque Operations Office
Grand Junction Projects Office

Prepared by
Rust Geotech
Grand Junction, Colorado

Technical Coordination and Reports Project Number TCR–031–0010–00–000
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Rust Geotech has been granted authorization to conduct remedial action under the Decontamination and Decommissioning Program. Remedial action was conducted in accordance with all applicable or relevant and appropriate requirements.

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Abstract

The U.S. Department of Energy (DOE) Grand Junction Projects Office (GJPO) occupies a 61.7-acre facility along the Gunnison River near Grand Junction, Colorado. This site was contaminated with uranium ore and mill tailings during uranium refining activities of the Manhattan Engineer District and during pilot milling experiments conducted for the U.S. Atomic Energy Commission's domestic uranium procurement program. The DOE Defense Decontamination and Decommissioning Program established the GJPO Remedial Action Project to clean up and restore the facility lands, improvements, and the underlying aquifer. The site contractor for the facility, Rust Geotech, also is the remedial action contractor.

The soil beneath Building 18 was found to be radiologically contaminated; the building was not contaminated. The soil was remediated in accordance with identified standards. Building 18 and the underlying soil can be released for unlimited exposure and unrestricted use. This document was prepared in response to a DOE request for an individual final report for each contaminated GJPO building.

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Contents

Figures

Tables

Appendices

Acronyms

AEC	U. S. Atomic Energy Commission
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*U.S. Code of Federal Regulations*
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
FUSRAP	Formerly Utilized Sites Remedial Action Program
GJPO	Grand Junction Projects Office
GJPORAP	Grand Junction Projects Office Remedial Action Project
IVC	independent verification contractor
LTSM	long-term surveillance and maintenance
QA	quality assurance
RAC	remedial action contractor
RDC	radon decay-product concentration
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SFMP	Surplus Facilities Management Program
U.S.C.	United States Code
V-area	verification area

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I. Introduction and Background

This report summarizes the results of the remedial action associated with Building 18 at the U.S. Department of Energy Grand Junction Projects Office (DOE-GJPO) facility. The building was not contaminated. The soil beneath the building was radiologically contaminated and was remediated in 1995 along with soil associated with adjacent fenceposts. The soil within these areas complies with applicable regulations and can be released for unrestricted use and unlimited exposure. After all Grand Junction Projects Office Remedial Action Project (GJPORAP) remedial action is completed, the facility is expected to be transferred to the Long-Term Surveillance and Maintenance (LTSM) Program to allow restoration of the underlying aquifer. The remediation of the exterior land areas and the other buildings and associated utilities on the DOE–GJPO facility will be summarized in separate reports.

Description of Facility

The DOE–GJPO facility is located approximately 0.6 mile (1 kilometer) south and west of populated areas of the city of Grand Junction in Sections 26 and 27, Township 1 South, Range 1 West, Ute Principal Meridian, Mesa County, Colorado (Figure 1). The facility occupies 61.7 acres* (25 hectares) of floodplain within an accretionary bend along the east bank of the Gunnison River.

The elevation of the DOE–GJPO facility is approximately 4,560 feet, or 1,390 meters (m). The facility is situated on silty sandy gravel underlain by mudstone bedrock. Two bodies of water with associated wetlands are located on the DOE–GJPO facility: the North Pond and the South Pond. A freshwater alluvial aquifer underlying the facility is in direct hydraulic contact with the ponds and the Gunnison River. A semiarid climate prevails.

Access to the occupied portion of the facility is restricted by security personnel and a fence. There are approximately 40 structures on the facility. Beyond the fence are vehicle parking lots to the east and an earthen dike along the Gunnison River to the west and north. The area adjacent to the facility to the north was formerly Black Bridge Park, now owned by DOE. The facility is bordered on the east by the Southern Pacific Railroad (formerly the Denver and Rio Grande Western Railroad) right-of-way.

DOE–GJPO facility lands were acquired by the U.S. War Department in 1943 for the Manhattan Engineer District. A refinery was operated on the site from 1943 to 1946 to treat and concentrate uranium oxide. The U.S. Atomic Energy Commission (AEC) operated a uranium-concentrate sampling plant and assay laboratory on the site until 1974. Pilot-scale uranium ore mills were operated from 1953 to 1958, processing 30,000 tons (27,200 metric tons) of ore (DOE 1987a). Mill operations were the primary source of contaminated materials at the DOE–GJPO facility, resulting in the on-site burial of approximately 247,000 cubic yards (yd^3), or 189,000 cubic meters (m^3), of uranium ore mill tailings. Other potential sources of contamination included laboratory and vehicle-maintenance wastes and byproducts, and activities related to sampling and stockpiling uranium concentrates. Approximately 22 acres (8.9 hectares) of open land and 19 buildings were contaminated.

Description of Project

In 1984, the DOE–GJPO facility was accepted into the DOE Surplus Facilities Management Program (SFMP) for the purpose of eliminating health hazards resulting from uranium mill tailings and associated contaminated materials at the facility; and to bring contaminated portions of the facility, including the underlying aquifer, into compliance with applicable environmental regulations. In 1988, the facility was transferred to the DOE Decontamination and Decommissioning (D&D) Program. The D&D Program is responsible for the surveillance and maintenance of surplus DOE facilities, and performing any necessary decontamination and decommissioning activities.

*Previous to the reacquisition of Black Bridge Park, the facility occupied approximately 56.4 acres.

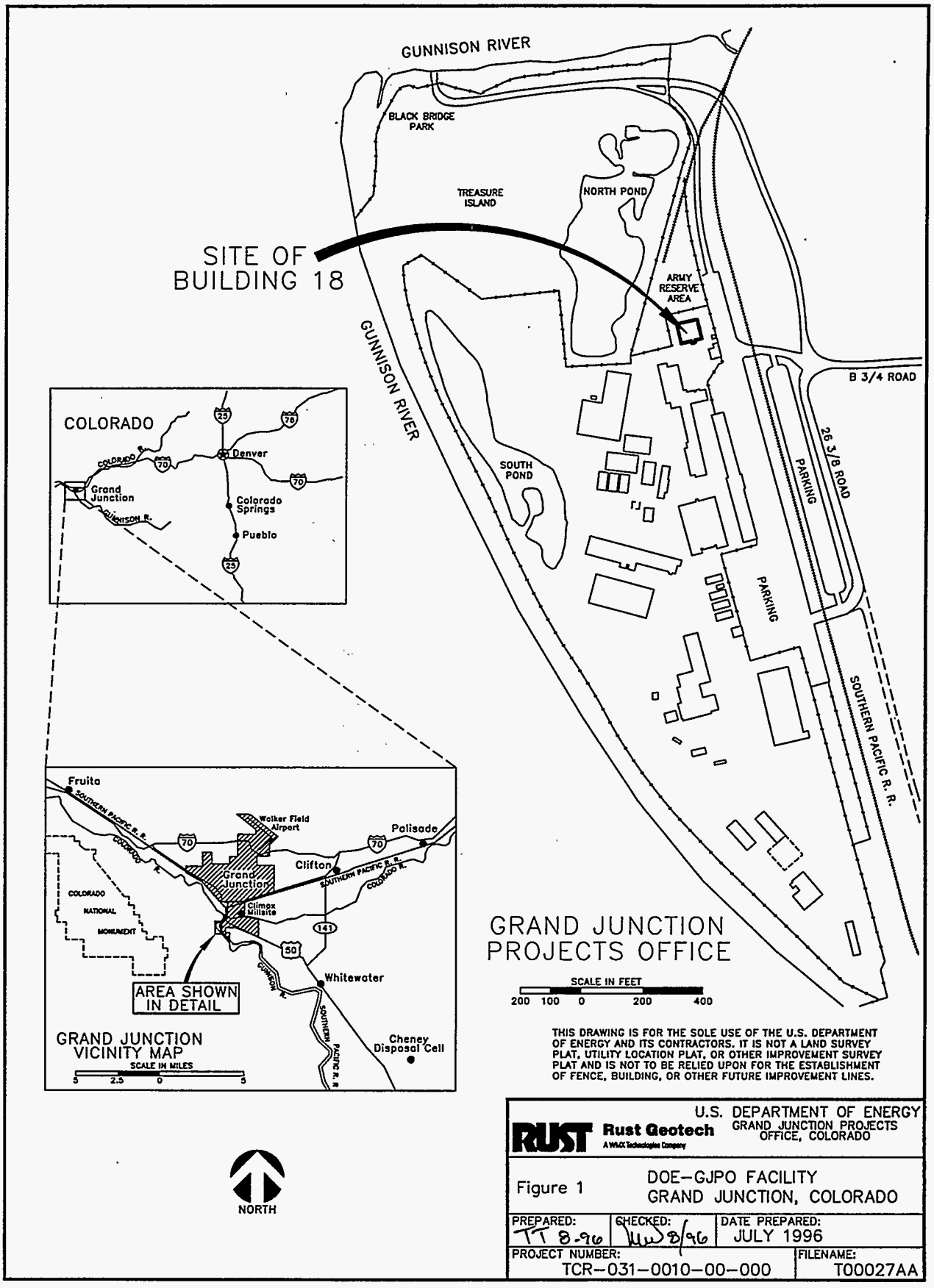

Figure 1. Site Map of the DOE–GJPO Facility, Grand Junction, Colorado

DOE–GJPO has specific responsibility for GJPORAP under the D&D Program.

Rust Geotech is the Remedial action contractor (RAC) for GJPORAP. The GJPORAP organization and implementation strategy was defined in the *Grand Junction Projects Office Remedial Action Project Remedial Action Plan* (DOE 1990d).

Description of Building 18

Building 18 consists of five modular units assembled on the GJPO facility in 1975. The building has a footprint of approximately 4,550-square feet (ft^2), or 423 square meters (m^2), and has been used as office space since assembly on the facility. The building is of wood frame construction set on cinder block piers and concrete footings. Interior partitions are constructed of wood framing and gypsum board. The building has wood siding and a pitched roof sheathed with asphalt shingles. Building 18 was connected to a sanitary sewer in 1981.

Warehouses used by AEC and the U.S. Geological Survey occupied the site in the vicinity of Building 18 in the 1950s. One of these structures was reported to have been used for sampling uranium concentrates. (DOE-1987a). Bulk uranium ore may have been stockpiled on occasion in this area (Rust 1995e). In the 1960s and early 1970s the site of Building 18 was used for storing drums of uranium oxide or vanadium oxide concentrate; some vanadium concentrate was noted to have elevated radium–226 (Ra-226) concentrations (DOE-1987a).

Basis for Remedial Action

In 1980, the U.S. Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 *United States Code* [U.S.C.] 9601). In 1986, Congress amended CERCLA with the Superfund Amendments and Reauthorization Act (SARA). Section 120 of SARA and Executive Order 12580, *Superfund Implementation*, directed DOE to coordinate with the U.S. Environmental Protection Agency to respond to actual or potentially imminent releases of hazardous substances into the environment at federally owned DOE facilities. D&D Program policy specifies that remedial action will be conducted in accordance with DOE Order 5480.1B, *Environment, Safety, and Health Program for Department of Energy Operations*, and all other applicable environmental regulations.

The DOE–GJPO facility was evaluated using the CERCLA Hazard Ranking System. Although the resulting score of 14.6 (DOE 1989b) did not qualify the facility for placement on the National Priorities List, remedial action under GJPORAP conformed to the applicable provisions of CERCLA, as amended by SARA, the Uranium Mill Tailings Radiation Control Act (42 U.S.C. 7901), the National Environmental Policy Act (42 U.S.C. 4321), and other applicable Federal and State regulations. Remedial action was conducted with an emphasis on maintaining all health and safety risks as low as reasonably achievable.

II. Decommissioning Criteria, Objectives, and Work Scope

Applicable Guidelines and Standards

Table 1 presents the guidelines that specify the authorized limits for GJPORAP. Remedial action activities were conducted in accordance with the Rust *Quality Assurance* [QA] *Manual* (Manual 101) and approved plans and procedures (Appendix A), which incorporate the applicable provisions of Title 10, *U. S. Code of Federal Regulations*, Part 830 (10 CFR 830), Section 120, "Quality Assurance Requirements."

III. Work Performed

Remedial Investigation/Feasibility Study and Record of Decision

The Remedial Investigation/Feasibility Study –Environmental Assessment for GJPORAP was released in 1989 (DOE 1989a). Building 18 was not included in this study because it was outside the original scope of GJPORAP. Consequently,

Table 1. Applicable or Relevant and Appropriate Standards

Type of Occurrence	Standard
Contamination in Soil	40 CFR 192[a] FUSRAP/SFMP Guidelines[b] DOE Order 5400.5[c]
Surface Activity (structural surfaces)	FUSRAP/SFMP Guidelines[b] DOE Order 5400.5[c]
Gamma Exposure Rate (interior areas only)	40 CFR 192[a] FUSRAP/SFMP Guidelines[b] DOE Order 5400.5[c]
Radon Decay-Product Concentration (interior areas only)	40 CFR 192[a] FUSRAP/SFMP Guidelines[b] DOE Order 5400.5[c]

[a]40 CFR 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."
[b]*Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program* [FUSRAP] *and Remote Surplus Facilities Management Program Sites* (DOE 1987b).
[c]DOE Order 5400.5, *Radiation Protection of the Public and the Environment.*

remediation of this building was not addressed in the Record of Decision (ROD) (DOE 1990a).

Post-ROD Changes—An Explanation of Significant Differences will be prepared at the conclusion of GJPORAP remedial action activities to address departures from the ROD, including the remediation of Building 18.

Characterization

Radon decay-product concentrations (RDCs) measured in 1990 were 0.016 working levels (WL) in Room 103 and 0.014 WL in Room 110 of Building 18 (DOE 1990c).

Building 18 was included in the 1993 comprehensive survey of the structures at the DOE-GJPO facility. The results of over 1,000 direct beta-gamma measurements and 350 smears in the occupied portion of the building indicated no surface activity in excess of background levels (Chem-Nuclear Geotech, Inc. 1993b). Alpha activity measurements were not taken because any alpha-emitting contaminant at this site would also emit a detectable beta particle. The crawl space was inaccessible and no soil samples were collected (Chem-Nuclear Geotech, Inc. 1993a).

The results of 23 direct measurements of beta-gamma activity on the roof shingles averaged 6,817 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) (Chem-Nuclear Geotech, Inc. 1993a). Representative samples of roof shingle material were analyzed by the analytical laboratory in 1995. The activity in the shingles was determined to be due to naturally occurring radioactive material (Rust 1995c).

In 1995, 1,883 direct beta-gamma measurements were taken in the attic. Measured activities did not exceed background (Rust 1995b). Also in 1995, seven test holes on the east, west, and north sides of Building 18 were driven to a depth of 72 inches (183 centimeters). The results of gross gamma logging of these holes indicated that the soils intercepted by the holes were not contaminated with Ra-226 (Rust 1995a).

Tests for lead based paint on the exterior surfaces were negative (UNC Geotech, Inc. 1991). Building 18 was surveyed for nonradiological hazardous materials in April 1995; no such materials were identified (Rust~1995d).

In 1990, elevated beta-gamma surface activities ranging as high as 61,908 dpm/100 cm^2 were detected on the evaporative cooler on the north side of Building 18 (UNC Geotech, Inc. 1990). The elevated activity was determined to be due to radon progeny, and the cooler was unconditionally released in 1991 (UNC Geotech, Inc. 1991).

Radiological Contamination—Gamma exposure rates measured on the ground floor ranged from 10 to 21~microroentgens per hour (μR/h); two localized regions of elevated activity were suspected to be associated with discrete pieces of uranium ore in the crawl space soil (Chem-Nuclear Geotech, Inc. 1993a). The crawl space could not be accessed.

Remedial Design

The design initially called for accessing the crawl space by removing portions of the floor or skirting and hand-excavating the two areas of soil contamination. A revised design called for moving the building off the foundation to allow access to the contaminated soil by mechanical equipment (DOE 1995a). Upon attaining compliance with project guidelines, the excavations were backfilled and the building was returned to its original position. Uncontaminated materials were unconditionally released for salvage or disposal at the Mesa County Landfill. Radiologically contaminated materials were disposed at the Cheney Disposal Cell.

Decontamination Operations

Summary of Remedial Action—Contaminated soil assessed in 1989 in the exterior areas adjacent to Building 18 was remediated in 1991 during Construction Phase IB (DOE~1995b).

Remedial action on Building 18 began in March 1995 and concluded in October 1995. Initially, approximately 1 yd^3 (0.8 m^3) of contaminated soil was removed by hand from the crawl space. Excavation was halted when the contamination was determined to be more extensive than originally estimated and access to the contamination was found to be inadequate. After moving the building off the foundation, mechanical equipment was used to remove contaminated material. Additional radiologically-contaminated soil, identified east and southwest of the foundation and around fence posts west of the building, was removed. Excavation continued until scans and sample analysis results indicated that all radiological contamination was removed to below guideline values. Radiologically contaminated materials were hauled by truck to the Cheney Disposal Cell. Uncontaminated materials, including air ducts removed from the attic and crawlspace, were surveyed in accordance with the Rust *Health and Safety Desktop Procedures Manual* (Manual 303), unconditionally released, and either salvaged or disposed at the Mesa County Landfill.

Radiological Contamination—Radiologically contaminated soil was removed from the area of Building 18, as indicated by the results of soil sample analyses and gamma exposure rate measurements (Appendix B, Table B–1).

IV. Final Release Survey

The excavated areas beneath and adjacent to Building 18 were classified as affected because of identified contamination in the soil. One survey unit of 482 m^2 (5,186 ft^2) was established, consisting of the postremediation soil surfaces. This area was surveyed and sampled in September 1995 (Figure 2 and Appendix B, Table B–1).

The building surfaces were classified as unaffected areas because existing survey data and the history of the building indicated a low potential for contamination. Three survey units were established: the interior ceilings and upper walls (wall surfaces greater than 2 meters (m) above the floor), and floor and lower walls; and exterior vertical surfaces (Figures B–1 through B–4). These areas were surveyed in July 1996 following a plan for using existing data as part of the release survey (Rust 1996b) and the results were analyzed in accordance with the *Survey Plan for Releasing the Buildings at the Grand Junction Projects Office for Unrestricted Use* (DOE 1995c).

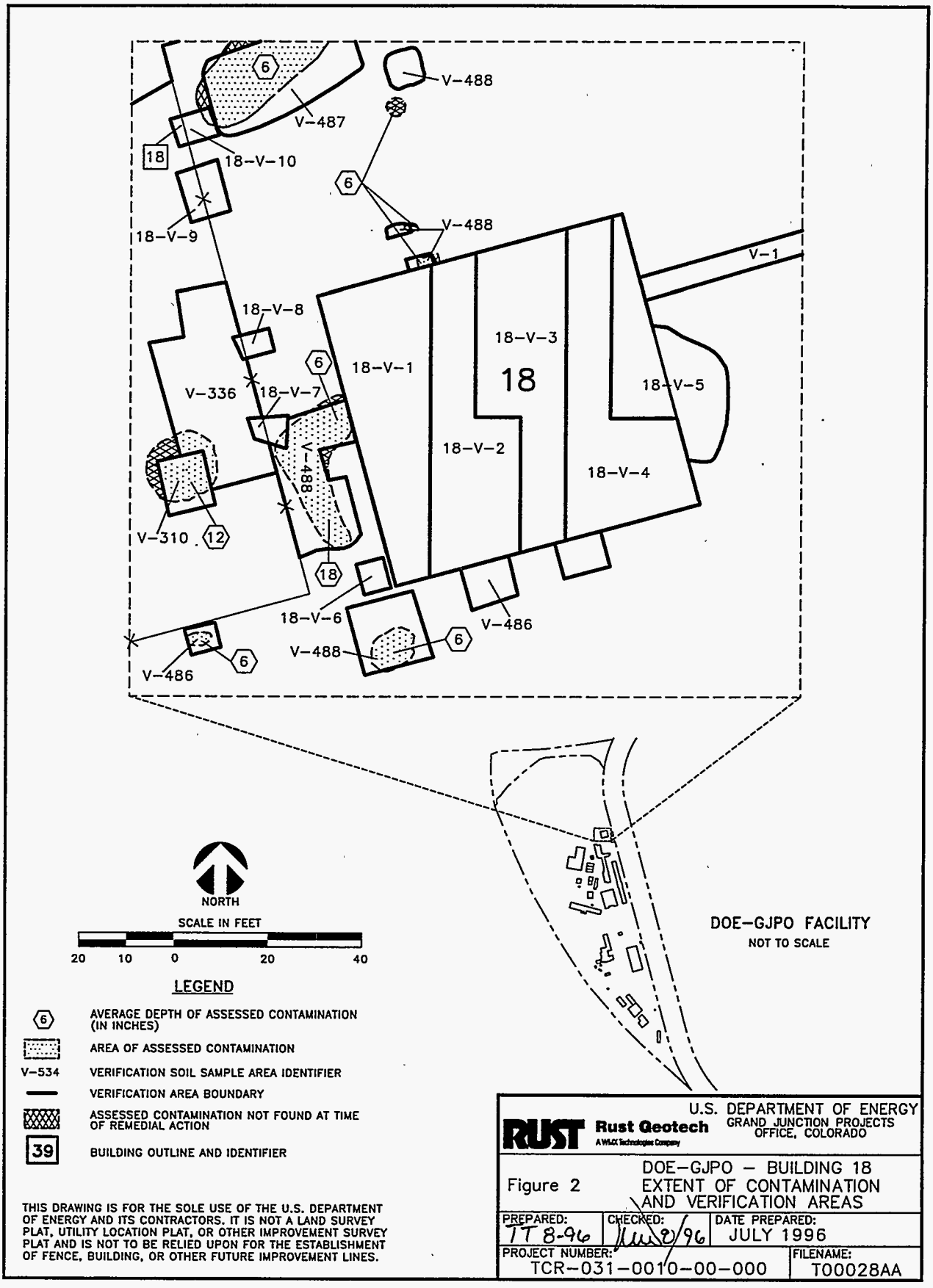

Figure 2. Extent of Soil Contamination and Verification Areas

The roof, foundation elements, attic, and the underside of the floor (including the structural components of the floor system) were all unaffected areas and were unconditionally released following surveys performed in accordance with standard personnel and material survey procedures specified in the Rust *Health and Safety Desktop Procedures* (Manual 303) and the RADCON Manual, which is incorporated at the DOE-GJPO facility as the Rust *Health and Safety Manual* (Manual 103), Volume 2 (Rust 1995f).

Oak Ridge National Laboratory at Grand Junction was the independent verification contractor (IVC) for GJPORAP. Oversight activities were conducted by representatives of the RAC QA group and the Colorado Department of Public Health and Environment.

Instrumentation

Radiation detection instruments were calibrated and used in accordance with the Rust *Field Assessments Procedures Manual* or *Health and Safety Desktop Procedures Manual.* The instruments were checked for current calibration and proper operation before and after each survey. Calibrations used traceable standards and complied with 10 CFR 835, "Occupational Radiation Protection" and DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards.*

Background Determinations

Background values determined for the DOE–GJPO facility are summarized in Table 2. Specific background values for the unaffected survey units in Building 18 are presented in Appendix B, Table B–2.

Reference Grids

A 10- by 10-foot survey grid, tied to the GJPO facility survey grid, was established over the excavated area beneath the building. The smaller affected areas outside the building footprint were not gridded. Ten verification areas (V-areas), each 100 m^2 or less, were defined on the excavated soil surface. The unaffected structural surfaces were surveyed by reference to maps prepared with a 1- by 1-m grid.

Scanning Results

One hundred percent of the floor and the exposed soil surface were scanned for gamma activity. Gross gamma exposure rates ranged from 10 to 21 µR/h for the floor (characterization data—see Chem-Nuclear Geotech, Inc. 1993b) and 14 to 19 µR/h for the soil surfaces (Appendix B, Table B–3). Ten percent of the building surfaces (unaffected areas) were scanned for combined alpha and beta-gamma activity; locations of the 1-m^2 blocks were randomly selected. Observed activities did not exceed authorized limits.

Direct Measurements

Beta-gamma measurements were taken on the underside of the floor system (30 direct measurements and 30 100-cm^2 smears), on the floor structural members in the vicinity of the access opening in the floor (52 direct measurements), and on the cinder block columns beneath the building (128 direct measurements). All surface activity levels were at or below background; numerical results were not recorded. All measurements were taken on uncoated surfaces. Locations were selected, such as horizontal surfaces, that exhibited the highest

Table 2. Background Values for the DOE–GJPO Facility

Criterion	Background Value	Source of Data
Gamma Exposure Rate—Exterior	14 µR/h	DOE 1986
Radium-226 Concentration in Soil	1.0 pCi/g	DOE 1990b
Thorium-230 Concentration in Soil	2.0 pCi/g	DOE 1990b
Total Uranium Concentration in Soil	2.0 pCi/g	DOE 1990b

Key: µR/h = microroentgens per hour; pCi/g = picocuries per gram

potential for contamination. These measurements were taken while the building was supported on cribbing off the foundation.

Thirty direct alpha and beta-gamma measurements were taken systematically in each of the three unaffected-area survey units defined for the building surfaces (Appendix B, Table~B–4). The projected upper limit of the mean activity, calculated at the 95 percent confidence level, indicated that the surface activity in these areas does not exceed the guideline. Smears were taken where direct measurement results exceeded 250~dpm/100 cm^2; no measurable contamination exceeding the guidelines was detected (Appendix B, Table B–5).

Sample Results

Soil sample aliquots representing the top 15~cm layer of the excavation floor were collected systematically and combined into composite soil samples representing Areas~18–V–1 through 18–V–6. Individual soil samples were collected at the point of highest gamma activity for Areas 18–V–7 through 18–V–10. The samples were analyzed for Ra-226, thorium-230 (Th-230), and total uranium (Appendix B, Table B–1). The soil sample and gamma scan results for the V-areas demonstrate that the radionuclide concentrations in the remediated area do not exceed the guidelines for radionuclide concentrations averaged over 100 m^2 or the hot spot criteria.

Exposure Rates

During the 1993 comprehensive survey, over 100 gamma exposure rate measurements were taken 1 m above the floor, ranging from 10 to 19~μR/h (Chem-Nuclear Geotech, Inc 1993b).

Gamma exposure rates were measured 1 m above ground level at the center of each 10- by 10-ft. (3.0- by 3.0-m) block on the excavated soil surface beneath Building 18 and at the soil sample collection points in the remainder of the affected areas. The 61 measurements ranged from 14 to 19 μR/h, with a mean exposure rate of 16 μR/h (Appendix B, Table B–3).

Other Results

Five boreholes were each augered to a depth of 3~feet (91.4 cm) in the remediated area beneath Building 18. The gamma logs of these holes indicated that no contamination was intercepted by the holes (Rust 1995a).

The result of a two-month-long RDC measurement in 1996 was 0.0017 WL. This measurement, conducted from March to May and following the Rust *Field Assessment Procedures Manual*, was qualitative because of the shortened exposure time, but confirmed that RDCs in Building 18 were below the authorized limit.

V. Cost and Schedule

Project costs and the schedule for remediation of Building 18 will be presented in a summary final report of the GJPORAP remediation of the interior areas.

VI. Occupational Exposure

Results of personnel and area monitoring indicate that GJPORAP activities created no above-background emissions of radioparticulates, radon daughters, ionizing radiation, or nonradiological hazards.

VII. Waste Volumes

The remediation of Building 18 generated a total of 367 tons (333 metric tons) of contaminated materials, representing a volume of approximately 230 yd^3 (175 m^3) of contaminated material (Rust 1996a). This material was disposed at the Cheney Disposal Cell.

VIII. Final Condition

All cleanup requirements identified for GJPORAP have been met for Building 18 (Table 3). The IVC will issue a Statement of Verification to signify concurrence that this

portion of remedial action has achieved program objectives.

Radiologically contaminated material has been removed, and all remediated areas comply with the applicable provisions of 40 CFR 192, FUSRAP/SFMP guidelines, and DOE Order 5400.5. Suspected occurrences of nonradiological contamination were investigated; no such contamination was identified.

Remediated areas were restored to comply with floodplain permits, the Endangered Species Act, and other applicable regulations. Groundwater sampling under the LTSM Program will provide further assurance that contaminated materials currently managed on site will not pose any threat to human health or the environment. Sufficient data have been collected to document the final site conditions and to demonstrate that the cleanup levels specified in the ROD were attained. These data and associated information are available to the public and will be archived in the Certification Docket.

Because of the limitations of current technology and procedures for identifying and remediating radiologically contaminated materials, unknown deposits of contamination may be found in the future. The potential for encountering contamination during future construction activities will be determined and at-risk activities will be monitored for radiological and nonradiological contamination. The DOE–GJPO facility is routinely surveyed for radiation and other hazards.

No assessed hazardous substances were left in the remediated area; therefore, the area can be released for unrestricted use and unlimited exposure. At the time of this report, contamination is still present in other interior areas of the DOE–GJPO facility; access to these areas is controlled and will be addressed by future GJPORAP remedial actions. Once the interior remedial action is completed, the facility will be managed as an LTSM site by DOE until restoration of the alluvial aquifer by natural flushing occurs.

IX. Lessons Learned

Lessons learned during remediation of Building 18 have been incorporated into subsequent operations. These lessons will be presented in a summary final report of the GJPORAP remediation of the interior areas.

Table 3. Building 18 Certification Summary

Survey Unit: Building 18 Excavation (affected area, soil surface)			
Certification Criteria	**Authorized Limit**	**Number of Observations**	**Results**
Gamma Exposure Rate (habitable areas only)	< 20 µR/h above background.[a]	None	Not applicable (no habitable areas).
Radon Decay-Product Concentration (habitable areas only)	Annual average shall not exceed 0.02 WL, to the extent practicable, and in no case shall exceed 0.03 WL.	None	Not applicable (no habitable areas).
Scans	Elevated activity will be investigated.	Gamma: scanned 100 percent of surface Alpha and beta-gamma: none	Gamma: exposure rate range was 10 to 20 µR/h.[b] Alpha and beta-gamma: not applicable (no structural surfaces).
Surface Activity (structural surfaces only)	Alpha or beta-gamma activity shall not exceed 5,000 dpm/100 cm^2 fixed, 1,000 dpm/100 cm^2 removable, averaged over 1 m^2.	None	Not applicable (no structural surfaces).
Radionuclide Concentrations (soil surfaces only)	Ra-226 and Th-230: Shall not exceed 5 pCi/g above background[a] in the 15-cm surface layer, averaged over 100 m^2. Shall not exceed 15 pCi/g above background[a] in any 15-cm-thick soil layer more than 15 cm below the surface, averaged over 100 m^2.	None 6 composite samples, each comprising at least 5 aliquots, and 4 individual samples.	Not applicable (excavation > 15 cm deep). Ra-226: 3.2 pCi/g maximum.[b, c] Th-230: 2.2 pCi/g maximum.[b, c]
	Total uranium: Shall not exceed 106 pCi/g above background[a] in any 15-cm–thick layer, averaged over 100 m^2.	6 composite samples, each comprising at least 5 aliquots, and 4 individual samples.	17.0 pCi/g maximum.[b, c]
Hot-Spot Criteria	Limit = (guideline value)(100/area)$^{0.5}$	As required	Maximum concentrations below hot-spot limit.

[a]Background values are summarized in Table 2.
[b]Gamma exposure rate and radionuclide concentrations include background.
[c]Radionuclide concentrations were determined by laboratory analysis.

Notes:
1) Th-232 is not a contaminant of concern at the DOE–GJPO facility (DOE 1994).
2) See Page 14 for abbreviation key.

Table 3 (continued). Building 18 Certification Summary

Survey Unit: Building 18 Floor and Lower Walls (unaffected habitable area, structural surface)			
Certification Criteria	**Authorized Limit**	**Number of Observations**	**Results**
Gamma Exposure Rate (habitable areas only)	< 20 µR/h above background.[a]	Over 100 measurements	Exposure rate range was 10 to 19~µR/h.[b]
Radon Decay-Product Concentration (habitable areas only)	Annual average shall not exceed 0.02 WL, to the extent practicable, and in no case shall exceed 0.03 WL.	Two	Pre-remedial action RDC was 0.0135 WL.[c] Postremedial action RDC was 0.0017 WL.[d]
Scans	Elevated activity will be investigated.	Gamma: scanned 100 percent of floor Alpha and beta-gamma: scanned 10~percent of walls and floor	Gamma: exposure rate range was 14 to 21 µR/h.[b] Maximum combined alpha and beta-gamma activity was 439 dpm/100 cm^2.[e]
Surface Activity (structural surfaces only)	Alpha or beta-gamma activity shall not exceed 5,000 dpm/100 cm^2 fixed, 1,000 dpm/100 cm^2 removable, averaged over 1 m^2.	30 direct measurements, 4 smears	Alpha (fixed): 35 dpm/100 cm^2 maximum,[e] μ_α = 23 dpm/100 cm^2.[e] Alpha (removable): 0 dpm/100 cm^2 maximum,[e] μ_α = 0.2 dpm/100 cm^2.[e] Beta-gamma (fixed): 333 dpm/100 cm^2 maximum,[e] μ_α = 38.9 dpm/100 cm^2.[e] Beta-gamma (removable): 24 dpm/100 cm^2 maximum,[e] μ_α = 30.8 dpm/100 cm^2.[e]
Radionuclide Concentrations (soil surfaces only)	Ra-226 and Th-230: Shall not exceed 5 pCi/g above background in the 15-cm surface layer, averaged over 100 m^2.	None	Not applicable (no exposed soil).
	Shall not exceed 15 pCi/g above background in any 15-cm-thick soil layer more than 15 cm below the surface, averaged over 100 m^2.	None	Not applicable (no exposed soil).
	Total uranium: Shall not exceed 106 pCi/g above background in any 15-cm–thick layer, averaged over 100 m^2.	None	Not applicable (no exposed soil).
Hot-Spot Criteria	Limit = (guideline value)(100/area)$^{0.5}$	None	Not applicable (no exposed soil).

[a]Background values are summarized in Table 2.
[b]Gamma exposure rates include background.
[c]One detector exposed from November 1989 to February 1990 (DOE 1990c).
[d]Three detectors exposed from March 1996 to May 1996.
[e]Alpha and beta-gamma activities do not include background.

Note: See Page 14 for abbreviation key.

Table 3 (continued). Building 18 Certification Summary

Survey Unit: Building 18 Upper Walls and Ceilings (unaffected area, structural surface)			
Certification Criteria	**Authorized Limit**	**Number of Observations**	**Results**
Gamma Exposure Rate (habitable areas only)	< 20 µR/h above background.	None	Not applicable (exposure rates measured for floors and lower walls survey unit).
Radon Decay-Product Concentration (habitable areas only)	Annual average shall not exceed 0.02 WL, to the extent practicable, and in no case shall exceed 0.03 WL.	None	Not applicable (RDCs measured for floors and lower walls survey unit).
Scans	Elevated activity will be investigated.	Gamma: none Alpha and beta-gamma: scanned 10-percent of walls and ceiling and in immediate vicinity of direct measurements	Not applicable (gamma exposure rate scan conducted for floor). Maximum combined alpha and beta-gamma activity was 631 dpm/100 cm^2. [a]
Surface Activity (structural surfaces only)	Net alpha or beta-gamma activity shall not exceed 5,000 dpm/100 cm^2 fixed, 1,000 dpm/100 cm^2 removable, averaged over 1 m^2.	30 direct measurements, 8-smears	Alpha (fixed): 42.5 dpm/100 cm^2 maximum,[a] μ_α = 25.8 dpm/100 cm^2.[a] Alpha (removable): 0 dpm/100 cm^2 maximum,[a] μ_α = -0.3 dpm/100 cm^2.[a] Beta-gamma (fixed): 471 dpm/100 cm^2 maximum,[a] μ_α = 105.3 dpm/100 cm^2.[a] Beta-gamma (removable): 58 dpm/100 cm^2 maximum,[a] μ_α = 35.3 dpm/100 cm^2.[a]
Radionuclide Concentrations (soil surfaces only)	Ra-226 and Th-230: Shall not exceed 5 pCi/g above background in the 15-cm surface layer, averaged over 100 m^2.	None	Not applicable (no exposed soil).
	Shall not exceed 15 pCi/g above background in any 15-cm-thick soil layer more than 15 cm below the surface, averaged over 100 m^2.	None	Not applicable (no exposed soil).
	Total uranium: Shall not exceed 106 pCi/g above background in any 15-cm–thick layer, averaged over 100 m^2.	None	Not applicable (no exposed soil).
Hot-Spot Criteria	Limit = (guideline value)$(100/area)^{0.5}$	None	Not applicable (no exposed soil).

[a]Alpha and beta-gamma activities do not include background.

Note: See Page 14 for abbreviation key.

Table 3 (continued). Building 18 Certification Summary

Survey Unit: Building 18 Exterior Walls (unaffected area, structural surface)			
Certification Criteria	**Authorized Limit**	**Number of Observations**	**Results**
Gamma Exposure Rate (habitable areas only)	< 20 µR/h above background.	None	Not applicable (not a habitable area).
Radon Decay-Product Concentration (habitable areas only)	Annual average shall not exceed 0.02 WL, to the extent practicable, and in no case shall exceed 0.03 WL.	None	Not applicable (not a habitable area).
Scans	Elevated activity will be investigated.	Gamma: none Alpha and beta-gamma: scanned 10 percent of walls and floor	Not applicable (gamma exposure rate scan conducted for floor). Maximum combined alpha and beta-gamma activity was 1,190 dpm/100 cm^2.[e]
Surface Activity (structural surfaces only)	Net alpha or beta-gamma activity shall not exceed 5,000 dpm/100 cm^2 fixed, 1,000 dpm/100 cm^2 removable, averaged over 1 m^2.	30 direct measurements 5 smears	Alpha (fixed): 358 dpm/100 cm^2 maximum,[a] μ_α = 111.5 dpm/100 cm^2.[a] Alpha (removable): 0 dpm/100 cm^2 maximum,[a] μ_α = -0.3 dpm/100 cm^2.[a] Beta-gamma (fixed): 541 dpm/100 cm^2 maximum,[a] μ_α = 195.9 dpm/100 cm^2.[a] Beta-gamma (removable): 34 dpm/100 cm^2 maximum,[a] μ_α = 37.0 dpm/100 cm^2.[a]
Radionuclide Concentrations (soil surfaces only)	Ra-226 and Th-230: Shall not exceed 5 pCi/g above background in the 15-cm surface layer, averaged over 100 m^2. Shall not exceed 15 pCi/g above background in any 15-cm-thick soil layer more than 15 cm below the surface, averaged over 100 m^2.	None None	Not applicable (no exposed soil). Not applicable (no exposed soil).
	Total uranium: Shall not exceed 106 pCi/g above background in any 15-cm–thick layer, averaged over 100 m^2.	None	Not applicable (no exposed soil).
Hot-Spot Criteria	Limit = (guideline value)(100/area)$^{0.5}$	None	Not applicable (no exposed soil).

[a]Alpha and beta-gamma activities do not include background.

Note: See Page 14 for abbreviation key.

Table 3 (continued). Building 18 Certification Summary

Key for Table 3:

cm	=	centimeter(s)
dpm/100 cm^2	=	disintegrations per minute per 100 square centimeters
m^2	=	square meter(s)
pCi/g	=	picocuries per gram
Ra-226	=	radium-226
Th-230	=	thorium-230
Th-232	=	thorium-232
μ_α	=	upper limit of true mean concentration of 100 m^2 areas or the true mean activity at the 95~percent confidence level, based on soil sample results, direct measurement, or smears
µR/h	=	microroentgens per hour
WL	=	working level

X. References

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10 CFR 835. U.S. Department of Energy, "Occupational Radiation Protection" *U.S. Code of Federal Regulations.*

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Appendix A

Applicable Program and Quality Assurance Requirements and Procedures

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GJPORAP Program Management

Operations Management Policy Manual (Manual 104)

Project Control System Manual (Manual 107)

Management Policies Manual (Manual 100), Section 1, "General Administration," and Section 12, "Organization Functions and Responsibilities"

Remedial Action Statements of Work

Grand Junction Projects Office Desk Procedures Manual

Grand Junction Projects Office Remedial Action Project (GJPORAP), Grand Junction, Colorado, Community Relations Plan Update

Grand Junction Projects Office Remedial Action Project Quality Assurance Program Plan, P–GJPO–141

Grand Junction Projects Office Remedial Action Project Records Management Plan, P–GJPO–143

GJPORAP Construction Management

Operations Management Policy Manual (Manual 104)

Operations Department Construction Procedures Manual

Engineering

Engineering Support Procedures Manual

AutoCAD Standards Manual

Assessment/Verification

Land Survey Support Procedures

AutoCAD Standards Manual

Environmental Procedures Catalog (Manual 116)

Laboratory Services

Analytical Laboratory

Analytical Chemistry Laboratory Administrative Plan and Quality Control Procedures

Analytical Chemistry Laboratory Handbook of Analytical and Sample Preparation Procedures, Volumes I, II, and III

Gamma-Ray Spectroscopy System Operations Methods Manual

Environmental Instrumentation Laboratory

Calibration Control Program for Measurement and Test Equipment and Measurement Standards

Electronics Laboratory Procedures

Quality Assurance

Quality Assurance Desk Instructions and Administrative Procedures Manual (Manual 301)

Health, Safety, and Security

Grand Junction Projects Office Remedial Action Project Health and Safety Plan, P–GJPO–144

Contracts and Procurement

Management Policies Manual (Manual 100), Section 5, "Procurement"

Procurement Manual

Stores, Property, and Transportation (SPAT) Manual (Manual 114)

Rust Guide for Preparing a Purchase Requisition

Information Services

Computer Support

Information Services Manual (Manual 105)

Publications and Records

Management Policies Manual (Manual 100), Section 2, "Documentation Systems," and Section 13, "Records Management"

Human Resources

Training and Employee Development

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Appendix B

Final Radiological Conditions

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Table B–1 summarizes the post-remediation sampling and measurement results for the site of Building 18. The samples were collected prior to backfilling and represent the 6-inch-deep soil layer at the bottom of the excavation. The samples for Areas 18-V-1 through 18-V-6 are composite samples comprising at least five aliquots. The remaining samples are individual samples. The samples were analyzed for radium-226 (Ra-226) using the Opposed Crystal System (OCS) and for Ra-226 using gamma spectrometry and thorium-230 (Th-230) and total uranium using induction-coupled plasma mass spectrometry by the U.S. Department of Energy Grand Junction Projects Office analytical laboratory, in accordance with procedures specified in the analytical reports. The radionuclide concentrations are expressed in picocuries per gram (pCi/g) and include background. Gamma exposure rates are expressed in microroentgens per hour (μR/h), and represent either scans of the area (Table B–1) or discrete measurements (Table B–3). The remediated area is shown on Figure 2. Tables B–2 through B–5 summarize the results of the surveys of the structural surfaces (unaffected areas) of Building 18. The survey data are presented in Tables B–6 through B–8, and the measurement locations are shown on Figures B–1 through B–4.

Table B–1. Post-Remediation Sample/Measurement Results for Exterior Areas

Verification Area	Gamma Exposure Rate (μR/h)	Soil Sample Ticket No.	Concentration (pCi/g)				Average Depth of Excavation (inches)
			Ra-226 (OCS)	Ra-226 (lab)	Th-230 (lab)	Total Uranium (lab)	
18–V–1	14 - 17	NCK 709	1.4	2.3	2.2	16.0	16
18–V–2	13 - 17	NCK 710	2.3	1.5	1.4	9.8	16
18–V–3	14 - 18	NCK 711	2.5	1.8	2.1	17.0	16
18–V–4	10 - 16	NCK 712	2.9	2.1	1.7	10.2	16
18–V–5	13 - 17	NCK 713	2.2	2.1	2.2	12.1	9
18–V–6	13 - 18	NCC 122	2.3	1.8	1.4	10.1	36
18–V–7	16 - 19	NCD 413	2.1	2.1	2.1	13.9	36
18–V–8	17 - 20	NCD 415	3.1	3.1	1.4	8.3	48
18–V–9	15 - 19	NCD 418	3.2	3.2	1.6	8.4	48
18–V–10	15 - 19	NCD 419	2.1	2.1	1.7	12.5	18

Table B–2. Summary of Background Measurements

Survey Unit	Meas. Type	n	df	t-95%	Activity (dpm/100 cm²)			n1
					Mean	s	μ_a	
Floor & Lower Walls	Alpha + Beta	10	9	1.833	1610.8	187.1	1719.3	1.1
Floor & Lower Walls	Alpha	10	9	1.833	38.4	33.7	57.7	N/A
Floor & Lower Walls	Beta	10	9	1.833	1572.6	200.9	1689.1	1.4
Ceiling & Upper Walls	Alpha + Beta	10	9	1.833	1528.4	140.0	1609.6	0.7
Ceiling & Upper Walls	Alpha	10	9	1.833	40.2	22.5	53.2	N/A
Ceiling & Upper Walls	Beta	10	9	1.833	1488.0	151.4	1575.8	0.9
Exterior Walls	Alpha + Beta	12	11	1.796	1363.3	97.3	1413.8	0.4
Exterior Walls	Alpha	12	11	1.796	43.7	22.0	55.1	N/A
Exterior Walls	Beta	12	11	1.796	1319.6	98.8	1370.8	0.5

Notes:

1) The activities in the mean column were used as background activities for the scan and direct measurement surveys.
2) All readings collected for 60 seconds with an NE Electra ratemeter/scaler and a DP6A probe
3) See Figures B–1 through B–4 for measurement locations

Table B–3. Gamma Exposure Rates in the Affected Area of Building 18

V-Area	n	Exposure Rate (µR/h)		
		Minimum	Maximum	Mean
18–V–1	11	14	16	15.5
18–V–2	11	15	17	16.0
18–V–3	11	16	17	16.1
18–V–4	11	15	16	15.6
18–V–5	8	15	16	15.9
18–V–6	5	15	16	15.8
18–V–7	1	—	18	18.0
18–V–8	1	—	18	18.0
18–V–9	1	—	18	18.0
18–V–10	1	—	19	19.0

Note: All measurements taken 1 meter above the sample aliquot collection location with a Mount Sopris SC-132 Scintillometer.

Key for Tables B–2 and B–3:

df	=	Degrees of Freedom (n-1)
dpm/100 cm²	=	disintegrations per minute per 100 square centimeters
Mean	=	Arithmetic average of sample measurements (dpm/100 cm²)
n	=	Number of measurements
n1	=	Total number of measurements required to determine the average background to +/- 20 percent at the 95% confidence level (from Equation 8-22 of *Manual for Conducting Radiological Surveys in Support of License Termination* NUREG/CR 5849 U. S. Nuclear Regulatory Commission, 1992).
s	=	Sample standard deviation (dpm/100 cm²)
t-95%	=	Students t distribution statistic for n-1 degrees of freedom @ 95% confidence
μ_a	=	Upper limit of population mean at 95% confidence (from Equation 8-13 of NUREG/CR 5849)
µR/h	=	microroentgens per hour

Table B–4. Summary of Direct Measurement Surveys

Survey Unit	Meas. Type	n	df	t-95%	Activity (dpm/100 cm²)		
					Mean	s	μ_α
Floor & Lower Walls	Net Alpha	30	29	1.699	12.83	32.78	23.00
Floor & Lower Walls	Net Beta	30	29	1.699	-36.40	242.80	38.92
Ceiling & Upper Walls	Net Alpha	30	29	1.699	17.84	25.59	25.78
Ceiling & Upper Walls	Net Beta	30	29	1.699	22.90	265.76	105.34
Exterior Walls	Net Alpha	30	29	1.699	85.57	83.66	111.52
Exterior Walls	Net Beta	30	29	1.699	146.10	160.41	195.86

Notes:
1) All readings collected for 60 seconds with an NE Electra ratemeter/scaler and a DP6A probe.
2) See Figures B–1 through B–4 for measurement locations and Table B–7 for the survey data.

Table B–5. Summary of Removable Contamination Surveys

Survey Unit(s)	Meas. Type	n	df	t-95%	Activity (dpm/100 cm²)		
					Mean	s	μ_α
Floor & Lower Walls	Alpha	4	3	2.353	-0.60	0.69	0.21
Floor & Lower Walls	Beta	4	3	2.353	11.95	16.06	30.84
Ceiling & Upper Walls	Alpha	8	7	1.895	-0.67	0.50	-0.34
Ceiling & Upper Walls	Beta	8	7	1.895	20.45	22.13	35.27
Exterior Walls	Alpha	5	4	2.132	-0.83	0.53	-0.33
Exterior Walls	Beta	5	4	2.132	18.31	19.56	36.96

Note: See Figures B–1 through B–4 for measurement locations and Table B–8 for the survey data.

Key for Tables B–4 and B–5:

df	=	Degrees of Freedom (n-1)
dpm/100 cm²	=	disintegrations per minute per 100 square centimeters
Mean	=	Arithmetic average of sample measurements (dpm/100 cm²)
n	=	Number of measurements
s	=	Sample standard deviation (dpm/100 cm²)
t-95%	=	Students t distribution statistic for n-1 degrees of freedom @ 95% confidence
μ_α	=	Upper limit of population mean at 95% confidence (from eq. 8-13 of NUREG/CR 5849)

Table B–6. Scan Survey Data

Survey Unit	Location	Material	Activity (dpm/100 cm²)			
			Gross Alpha + Beta		Net Alpha + Beta	
			Max	Min	Max	Min
Floor & Lower Walls	W1	carpet	2186	1620	575	9
Floor & Lower Walls	W2	carpet	2050	1423	439	-188
Floor & Lower Walls	W3	wood	1455	1003	-156	-608
Floor & Lower Walls	W4	carpet	1985	1621	374	10
Floor & Lower Walls	W5	carpet	1975	1797	364	186
Floor & Lower Walls	W6	sheetrock	1646	1275	35	-336
Floor & Lower Walls	W7	carpet	1990	1485	379	-126
Floor & Lower Walls	W8	carpet	1985	1430	374	-181
Floor & Lower Walls	W9	wood	1805	1173	194	-438
Floor & Lower Walls	W10	carpet	1922	1529	311	-82
Floor & Lower Walls	W11	sheetrock	1508	1086	-103	-525
Floor & Lower Walls	W12	sheetrock	1810	1030	199	-581
Floor & Lower Walls	W13	sheetrock	1501	1109	-110	-502
Floor & Lower Walls	W14	wood	1547	1139	-64	-472
Floor & Lower Walls	W15	carpet/tile	1746	1286	135	-325
Floor & Lower Walls	W16	carpet	1583	1423	-28	-188
Floor & Lower Walls	W17	wood	1386	1026	-225	-585
Floor & Lower Walls	W18	wood	1508	1003	-103	-608
Floor & Lower Walls	W19	carpet	1968	1569	357	-42
Floor & Lower Walls	W20	carpet	1867	1388	256	-223
Floor & Lower Walls	W21	sheetrock	1505	1155	-106	-456
Floor & Lower Walls	W22	carpet	1703	1300	92	-311
Floor & Lower Walls	W23	carpet	2020	1821	409	210
Floor & Lower Walls	W24	sheetrock	1550	1030	-61	-581
Floor & Lower Walls	W25	sheetrock	1753	1321	142	-290
Floor & Lower Walls	W26	sheetrock	1616	1386	5	-225
Floor & Lower Walls	W27	wood	1800	1348	189	-263
Floor & Lower Walls	W28	masonite	1600	1133	-11	-478
Floor & Lower Walls	W29	wood	1474	1194	-137	-417
Floor & Lower Walls	W30	carpet	1975	1332	364	-279
Ceiling & Upper Walls	W31	sheetrock	1505	1171	-23	-357
Ceiling & Upper Walls	W32	sheetrock	1512	1206	-16	-322
Ceiling & Upper Walls	W33	wood	1504	1103	-24	-425
Ceiling & Upper Walls	W34	sheetrock	1539	1327	11	-201
Ceiling & Upper Walls	W35	sheetrock	1327	1216	-201	-312
Ceiling & Upper Walls	W36	sheetrock	1233	995	-295	-533
Ceiling & Upper Walls	W37	wood	1416	1135	-112	-393
Ceiling & Upper Walls	W38	sheetrock	1459	1233	-69	-295
Ceiling & Upper Walls	W39	wood	1439	1110	-89	-418
Ceiling & Upper Walls	W40	masonite	1259	1042	-269	-486
Ceiling & Upper Walls	W41	sheetrock	1510	1241	-18	-287
Ceiling & Upper Walls	W42	sheetrock	1588	1272	60	-256
Ceiling & Upper Walls	W43	sheetrock	1371	1081	-157	-447
Ceiling & Upper Walls	W44	wood	1592	1195	64	-333
Ceiling & Upper Walls	W45	sheetrock	1810	1240	282	-288
Ceiling & Upper Walls	W46	sheetrock	2020	1410	492	-118

Table B–6 (continued). Scan Survey Data

Survey Unit	Location	Material	Activity (dpm/100 cm²)			
			Gross Alpha + Beta		Net Alpha + Beta	
			Max	Min	Max	Min
Ceiling & Upper Walls	W47	sheetrock	2095	1750	567	222
Ceiling & Upper Walls	W48	sheetrock	1810	1482	282	-46
Ceiling & Upper Walls	W49	sheetrock	1878	1392	350	-136
Ceiling & Upper Walls	W50	sheetrock	1921	1512	393	-16
Ceiling & Upper Walls	W51	sheetrock	2159	1392	631	-136
Ceiling & Upper Walls	W52	sheetrock	2022	1519	494	-9
Ceiling & Upper Walls	W53	sheetrock	1910	1454	382	-74
Ceiling & Upper Walls	W54	sheetrock	1822	1378	294	-150
Ceiling & Upper Walls	W55	sheetrock	1910	1580	382	52
Ceiling & Upper Walls	W56	sheetrock	2120	1612	592	84
Ceiling & Upper Walls	W57	sheetrock	1906	1554	378	26
Ceiling & Upper Walls	W58	sheetrock	1862	1640	334	112
Ceiling & Upper Walls	W59	sheetrock	1921	1439	393	-89
Ceiling & Upper Walls	W60	sheetrock	2000	1394	472	-134
Exterior Walls	W61	metal siding	1785	1463	422	100
Exterior Walls	W62	wood	1891	1317	528	-46
Exterior Walls	W63	metal siding	1730	1454	367	91
Exterior Walls	W64	wood	1775	1462	412	99
Exterior Walls	W65	wood	1912	1266	549	-97
Exterior Walls	W66	metal siding	1486	1187	123	-176
Exterior Walls	W67	metal siding	1946	1064	583	-299
Exterior Walls	W68	wood	1631	1225	268	-138
Exterior Walls	W69	wood	1922	1197	559	-166
Exterior Walls	W70	metal siding	1968	1471	605	108
Exterior Walls	W71	metal	1859	1333	496	-30
Exterior Walls	W72	wood	1817	1486	454	123
Exterior Walls	W73	wood	2553	1707	1190	344
Exterior Walls	W74	wood	2161	1731	798	368
Exterior Walls	W75	wood	2408	1908	1045	545
Exterior Walls	W76	wood	1607	1348	244	-15
Exterior Walls	W77	metal	1746	1209	383	-154
Exterior Walls	W78	metal	1571	1102	208	-261
Exterior Walls	W79	metal	1679	1286	316	-77
Exterior Walls	W80	wood	1816	980	453	-383
Exterior Walls	W81	metal	1667	1334	304	-29
Exterior Walls	W82	metal	1612	1324	249	-39
Exterior Walls	W83	metal	1749	1282	386	-81
Exterior Walls	W84	wood	1967	1563	604	200
Exterior Walls	W85	metal	1639	792	276	-571
Exterior Walls	W86	wood	1846	1312	483	-51
Exterior Walls	W87	metal	1616	1087	253	-276
Exterior Walls	W88	metal	1832	1317	469	-46
Exterior Walls	W89	wood	1716	1409	353	46
Exterior Walls	W90	wood	1914	1340	551	-23

Note: All measurements collected with NE Electra ratemeter/scaler and a DP6A probe

Table B–7. Direct Measurement Survey Data

Survey Unit	Location	Material	Activity (dpm/100 cm²)			
			Gross Alpha	Gross Beta	Net Alpha	Net Beta
Floor & Lower Walls	D1	carpet	10.3	1865	-27.7	292
Floor & Lower Walls	D2	carpet	10.3	1906	-27.7	333
Floor & Lower Walls	D3	wood	61.9	1273	23.9	-300
Floor & Lower Walls	D4	carpet	92.8	1767	54.8	194
Floor & Lower Walls	D5	carpet	92.8	1694	54.8	121
Floor & Lower Walls	D6	sheetrock	113	1322	75	-251
Floor & Lower Walls	D7	carpet	51.5	1767	13.5	194
Floor & Lower Walls	D8	carpet	30.9	1874	-7.1	301
Floor & Lower Walls	D9	wood	72.2	1449	34.2	-124
Floor & Lower Walls	D10	carpet	30.9	1739	-7.1	166
Floor & Lower Walls	D11	Sheetrock	92.8	1278	54.8	-295
Floor & Lower Walls	D12	Sheetrock	51.5	1425	13.5	-148
Floor & Lower Walls	D13	Sheetrock	92.8	1216	54.8	-357
Floor & Lower Walls	D14	wood	113	1220	75	-353
Floor & Lower Walls	D15	carpet	20.6	1596	-17.4	23
Floor & Lower Walls	D16	carpet	20.6	1694	-17.4	121
Floor & Lower Walls	D17	wood	82.5	1171	44.5	-402
Floor & Lower Walls	D18	wood	41.2	1351	3.2	-222
Floor & Lower Walls	D19	carpet	41.2	1882	3.2	309
Floor & Lower Walls	D20	carpet	20.6	1714	-17.4	141
Floor & Lower Walls	D21	sheetrock	41.2	1261	3.2	-312
Floor & Lower Walls	D22	carpet	20.6	1629	-17.4	56
Floor & Lower Walls	D23	carpet	10.3	1771	-27.7	198
Floor & Lower Walls	D24	sheetrock	61.9	1404	23.9	-169
Floor & Lower Walls	D25	sheetrock	0	1735	-38	162
Floor & Lower Walls	D26	sheetrock	51.5	1359	13.5	-214
Floor & Lower Walls	D27	wood	82.5	1429	44.5	-144
Floor & Lower Walls	D28	masonite	30.9	1147	-7.1	-426
Floor & Lower Walls	D29	wood	61.9	1454	23.9	-119
Floor & Lower Walls	D30	carpet	20.6	1706	-17.4	133
Ceiling & Upper Walls	D31	sheetrock	20.6	1392	-19.4	-96
Ceiling & Upper Walls	D32	sheetrock	61.9	1167	21.9	-321
Ceiling & Upper Walls	D33	wood	61.9	1245	21.9	-243
Ceiling & Upper Walls	D34	sheetrock	30.9	1306	-9.1	-182
Ceiling & Upper Walls	D35	sheetrock	41.2	1327	1.2	-161
Ceiling & Upper Walls	D36	sheetrock	82.5	1114	42.5	-374
Ceiling & Upper Walls	D37	wood	61.9	1482	21.9	-6
Ceiling & Upper Walls	D38	sheetrock	51.5	1253	11.5	-235
Ceiling & Upper Walls	D39	wood	20.6	1196	-19.4	-292
Ceiling & Upper Walls	D40	masonite	72.2	1122	32.2	-366
Ceiling & Upper Walls	D41	sheetrock	82.5	1241	42.5	-247
Ceiling & Upper Walls	D42	sheetrock	134	1229	94	-259
Ceiling & Upper Walls	D43	sheetrock	72.2	1314	32.2	-174
Ceiling & Upper Walls	D44	wood	51.5	1176	11.5	-312
Ceiling & Upper Walls	D45	sheetrock	51.5	1759	11.5	271
Ceiling & Upper Walls	D46	sheetrock	82.5	1959	42.5	471

Table B–7 (continued). Direct Measurement Survey Data

Survey Unit	Location	Material	Activity (dpm/100 cm²)			
			Gross Alpha	Gross Beta	Net Alpha	Net Beta
Ceiling & Upper Walls	D47	sheetrock	72.2	1833	32.2	345
Ceiling & Upper Walls	D48	sheetrock	51.5	1555	11.5	67
Ceiling & Upper Walls	D49	sheetrock	83	1604	43	116
Ceiling & Upper Walls	D50	sheetrock	21	1788	-19	300
Ceiling & Upper Walls	D51	sheetrock	72	1661	32	173
Ceiling & Upper Walls	D52	sheetrock	52	1776	12	288
Ceiling & Upper Walls	D53	sheetrock	31	1641	-9	153
Ceiling & Upper Walls	D54	sheetrock	31	1616	-9	128
Ceiling & Upper Walls	D55	sheetrock	62	1669	22	181
Ceiling & Upper Walls	D56	sheetrock	103	1853	63	365
Ceiling & Upper Walls	D57	sheetrock	52	1849	12	361
Ceiling & Upper Walls	D58	sheetrock	42	1771	2	283
Ceiling & Upper Walls	D59	sheetrock	52	1784	12	296
Ceiling & Upper Walls	D60	sheetrock	31	1645	-9	157
Exterior Walls	D61	metal	113	1433	69	113
Exterior Walls	D62	wood	62	1480	18	160
Exterior Walls	D63	metal	93	1384	49	64
Exterior Walls	D64	wood	62	1559	18	239
Exterior Walls	D65	wood	83	1412	39	92
Exterior Walls	D66	metal	93	1318	49	-2
Exterior Walls	D67	metal	72	1388	28	68
Exterior Walls	D68	wood	41	1331	-3	11
Exterior Walls	D69	wood	62	1616	18	296
Exterior Walls	D70	metal	144	1416	100	96
Exterior Walls	D71	metal	165	1453	121	133
Exterior Walls	D72	wood	247	1641	203	321
Exterior Walls	D73	wood	258	1841	214	521
Exterior Walls	D74	wood	402	1861	358	541
Exterior Walls	D75	wood	351	1780	307	460
Exterior Walls	D76	wood	103	1294	59	-26
Exterior Walls	D77	metal	144	1351	100	31
Exterior Walls	D78	metal	83	1286	39	-34
Exterior Walls	D79	metal	93	1306	49	-14
Exterior Walls	D80	wood	62	1567	18	247
Exterior Walls	D81	metal	93	1192	49	-128
Exterior Walls	D82	metal	113	1339	69	19
Exterior Walls	D83	metal	93	1518	49	198
Exterior Walls	D84	wood	113	1539	69	219
Exterior Walls	D85	metal	82	1375	38	55
Exterior Walls	D86	wood	165	1527	121	207
Exterior Walls	D87	metal	113	1388	69	68
Exterior Walls	D88	metal	155	1437	111	117
Exterior Walls	D89	wood	134	1473	90	153
Exterior Walls	D90	wood	93	1478	49	158

Note: All measurements collected for 60 seconds with an NE Electra ratemeter/scaler and a DP6A probe

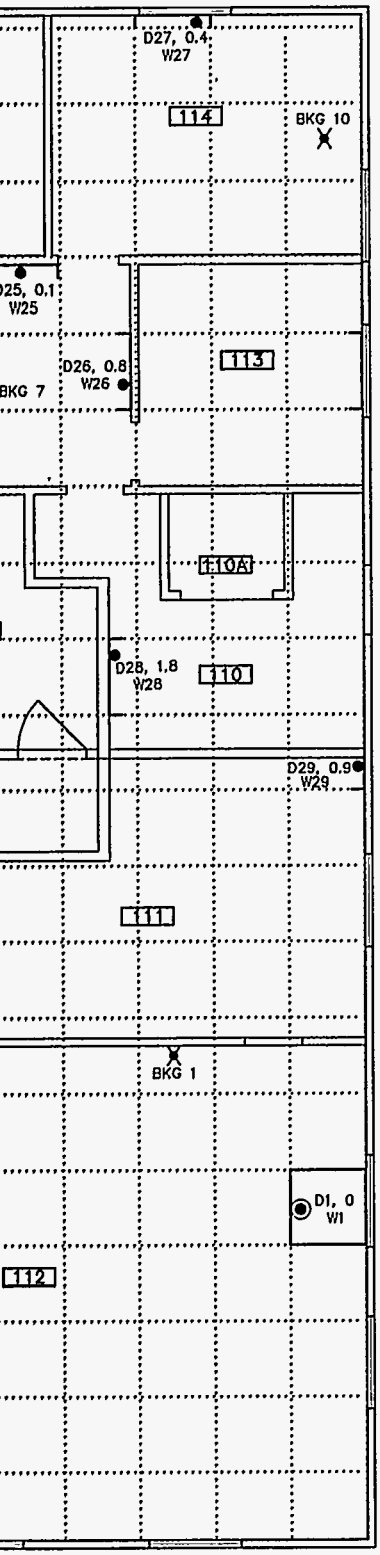
Table B–8. Removable Contamination Survey Data

Survey Unit	Sample Location	counts per 5 minutes		counts per minute		Activity (dpm/100 cm²)	
		Gross Alpha	Gross Beta	Alpha Bkgd.	Beta Bkgd.	Net Alpha	Net Beta
Floor & Lower Walls	D1	2	375	0.4	69.0	0.0	24.3
Floor & Lower Walls	D2	0	373	0.4	69.0	-1.2	22.7
Floor & Lower Walls	D8	0	332	0.4	69.0	-1.2	-10.5
Floor & Lower Walls	D19	2	359	0.4	69.0	0.0	11.3
Ceiling & Upper Walls	D46	1	348	0.4	69.0	-0.6	2.4
Ceiling & Upper Walls	D47	0	367	0.4	69.0	-1.2	17.8
Ceiling & Upper Walls	D50	1	370	0.4	69.0	-0.6	20.3
Ceiling & Upper Walls	D52	2	352	0.4	69.0	0.0	5.7
Ceiling & Upper Walls	D56	0	341	0.4	69.0	-1.2	-3.2
Ceiling & Upper Walls	D57	2	416	0.4	69.0	0.0	57.5
Ceiling & Upper Walls	D58	1	407	0.4	69.0	-0.6	50.2
Ceiling & Upper Walls	D59	0	361	0.4	69.0	-1.2	13.0
Exterior Walls	D69	1	326	0.4	69.0	-0.6	-15.4
Exterior Walls	D72	0	370	0.4	69.0	-1.2	20.3
Exterior Walls	D73	0	374	0.4	69.0	-1.2	23.5
Exterior Walls	D74	0	387	0.4	69.0	-1.2	34.0
Exterior Walls	D75	2	381	0.4	69.0	0.0	29.2

Notes: 1) Smears were counted for 5 minutes on a Ludlum 2929 scaler.
2) All smears were wiped over an area of 100 cm².
3) Alpha and beta-gamma background activities were 0.4 cpm and 69.0 cpm, respectively.
4) Gross counts per 5 minutes were converted to dpm/100 cm² using

[(gross counts / 5) - (Bkgd counts)] x CF = net activity.

Key:
bkgd = background
CF = conversion factor; 2.98 dpm/cpm for alpha, 4.05 dpm/cpm for beta-gamma
cpm = counts per minute
cp5m = counts per 5 minutes
dpm/100 cm² = disintegrations per minute per 100 square centimeters
gross counts = the number of events recorded by the measurement instrument



NORTH

SCALE IN METERS

0 5

LEGEND

•	DIRECT MEASUREMENT LOCATION
O	SMEAR LOCATION
D25, 3.0	DIRECT MEASUREMENT IDENTIFIER, FOLLOWED BY HEIGHT ABOVE FLOOR (IN METERS)
□	1 m² SCAN AREA ON CEILING
⌊	1 m² SCAN AREA ON LOWER WALL
W40	SCAN AREA IDENTIFIER
X	BACKGROUND MEASUREMENT LOCATION
BKG 1	BACKGROUND MEASUREMENT IDENTIFIER
102	ROOM NUMBER

NOTE: DIRECT MEASUREMENT LOCATION IS WITHIN CORRESPONDING SCAN AREA. SCAN AREAS ON WALLS ARE EITHER 0- TO 1-m OR 1- TO 2-m ABOVE FLOOR.

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GRAND JUNCTION PROJECTS OFFICE, COLORADO

Figure B-1 GJPORAP BUILDING 18 FLOOR AND LOWER WALLS

PREPARED:	CHECKED:	DATE PREPARED:
TT 8-96	[illegible] 8/96	AUGUST 1996

PROJECT NUMBER: TCR-031-0002-00-000

FILENAME: T0003500

Lower Wall Survey Locations

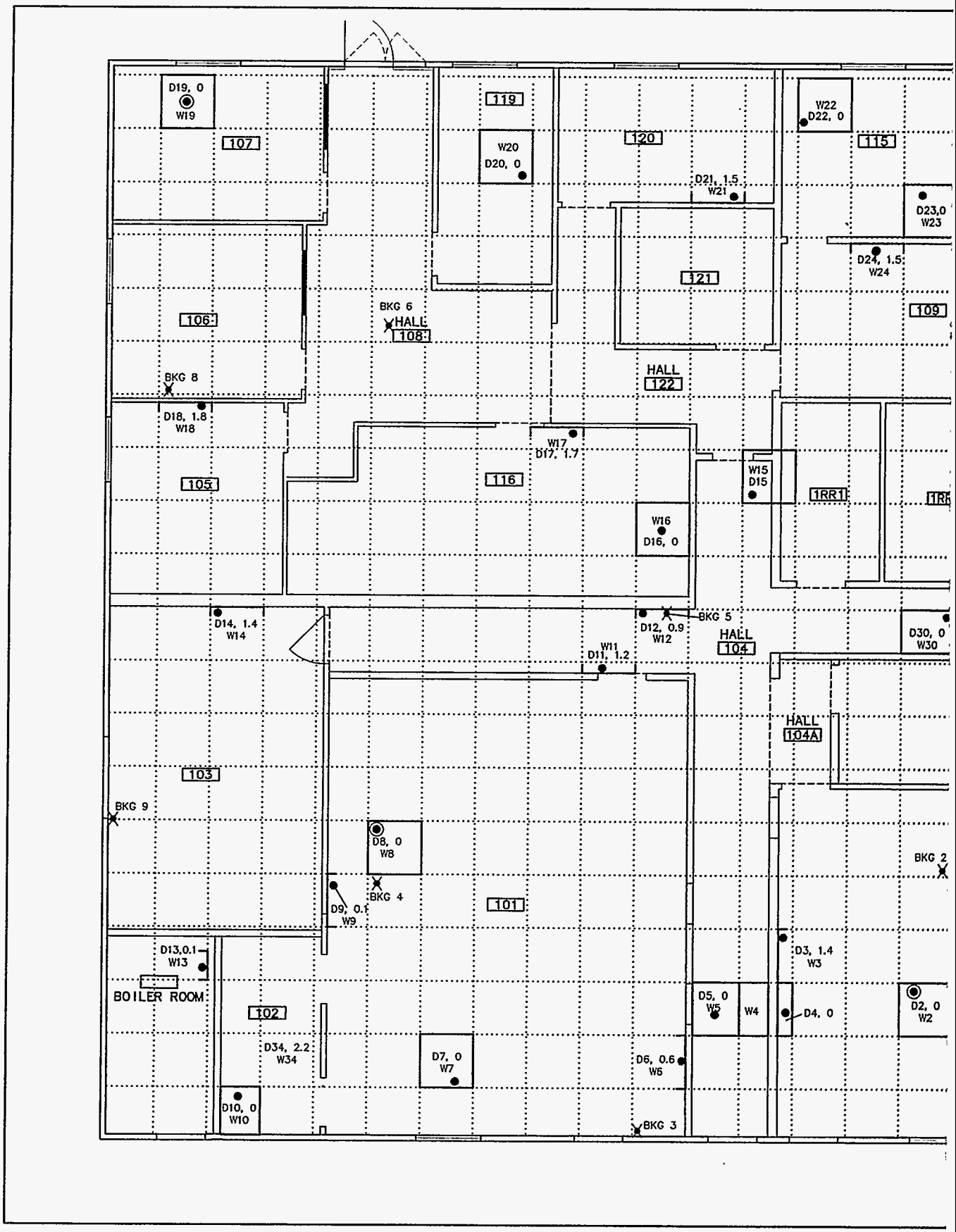
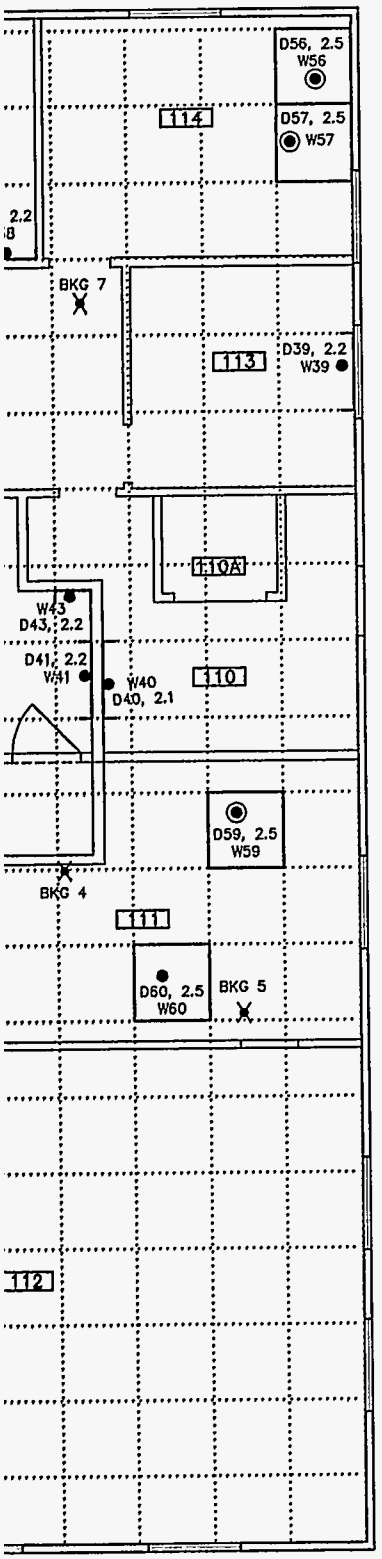


Figure B–1. Interior Floor and



NORTH

SCALE IN METERS

0 5

LEGEND

•	DIRECT MEASUREMENT LOCATION
O	SMEAR LOCATION
D25, 3.0	DIRECT MEASUREMENT IDENTIFIER, FOLLOWED BY HEIGHT ABOVE FLOOR (IN METERS)
□	1 m^2 SCAN AREA ON CEILING
⌊	SCAN AREA ON UPPER WALL
W40	SCAN AREA IDENTIFIER
X	BACKGROUND MEASUREMENT LOCATION
BKG 1	BACKGROUND MEASUREMENT IDENTIFIER
102	ROOM NUMBER

NOTE: ALL WALL SCAN AREAS LOCATED BETWEEN 2 m ABOVE FLOOR AND CEILING. CEILING HEIGHT IS 2.5 m.

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GRAND JUNCTION PROJECTS OFFICE, COLORADO

Figure B-2 GJPORAP BUILDING 18 UPPER WALLS & CEILING

PREPARED:	CHECKED:	DATE PREPARED:
TT 8-96	8/96	AUGUST 1996

PROJECT NUMBER: TCR-031-0010-00-000

FILENAME: T0003400

and Ceiling Survey Locations

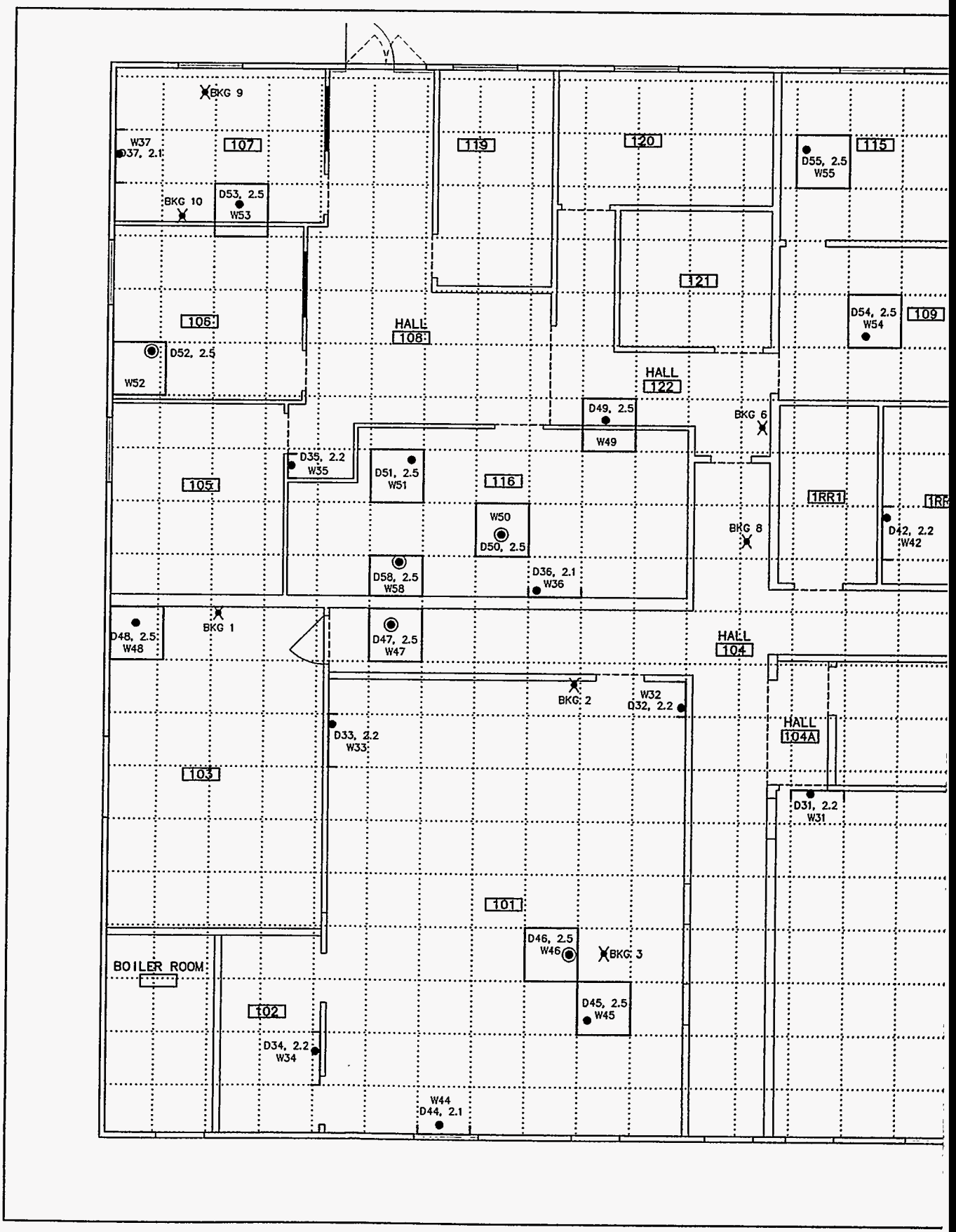
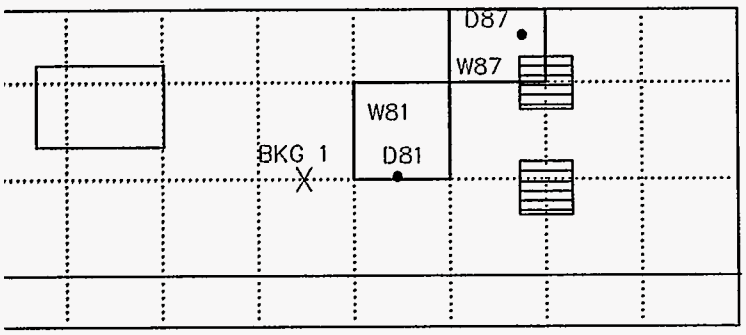


Figure B–2. Interior Upper Wa

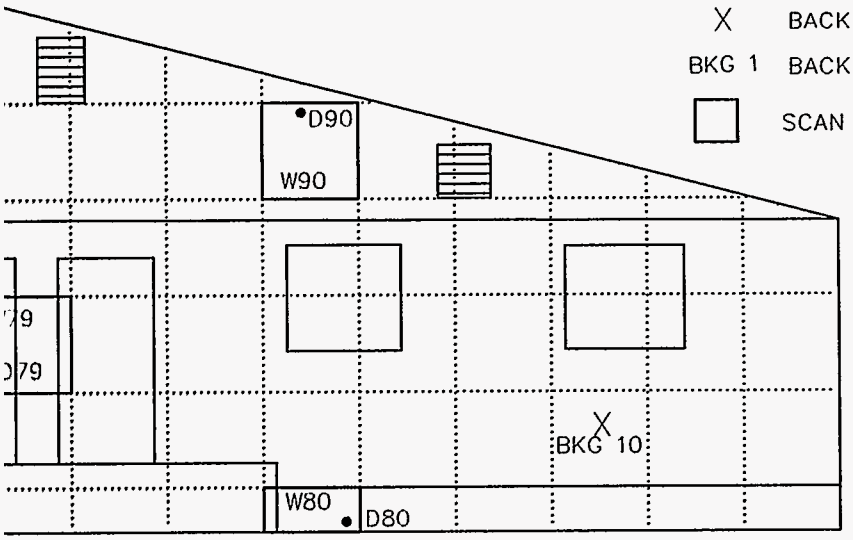


SCALE IN METERS

0 5

LEGEND

- • DIRECT MEASUREMENT LOCATION
- O SMEAR LOCATION
- D25, DIRECT MEASUREMENT IDENTIFIER
- W40 SCAN AREA IDENTIFIER
- X BACKGROUND MEASUREMENT LOCATION
- BKG 1 BACKGROUND MEASUREMENT IDENTIFIER
- ☐ SCAN AREA



N

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Figure B-3 GJPORAP BUILDING 18 EXTERIOR WALLS

PREPARED:	CHECKED:	DATE PREPARED:
TT 8.96	8/96	AUGUST 1996

PROJECT NUMBER:	FILENAME:
TCR-031-0010-00-000	T0003700

Wall Survey Locations

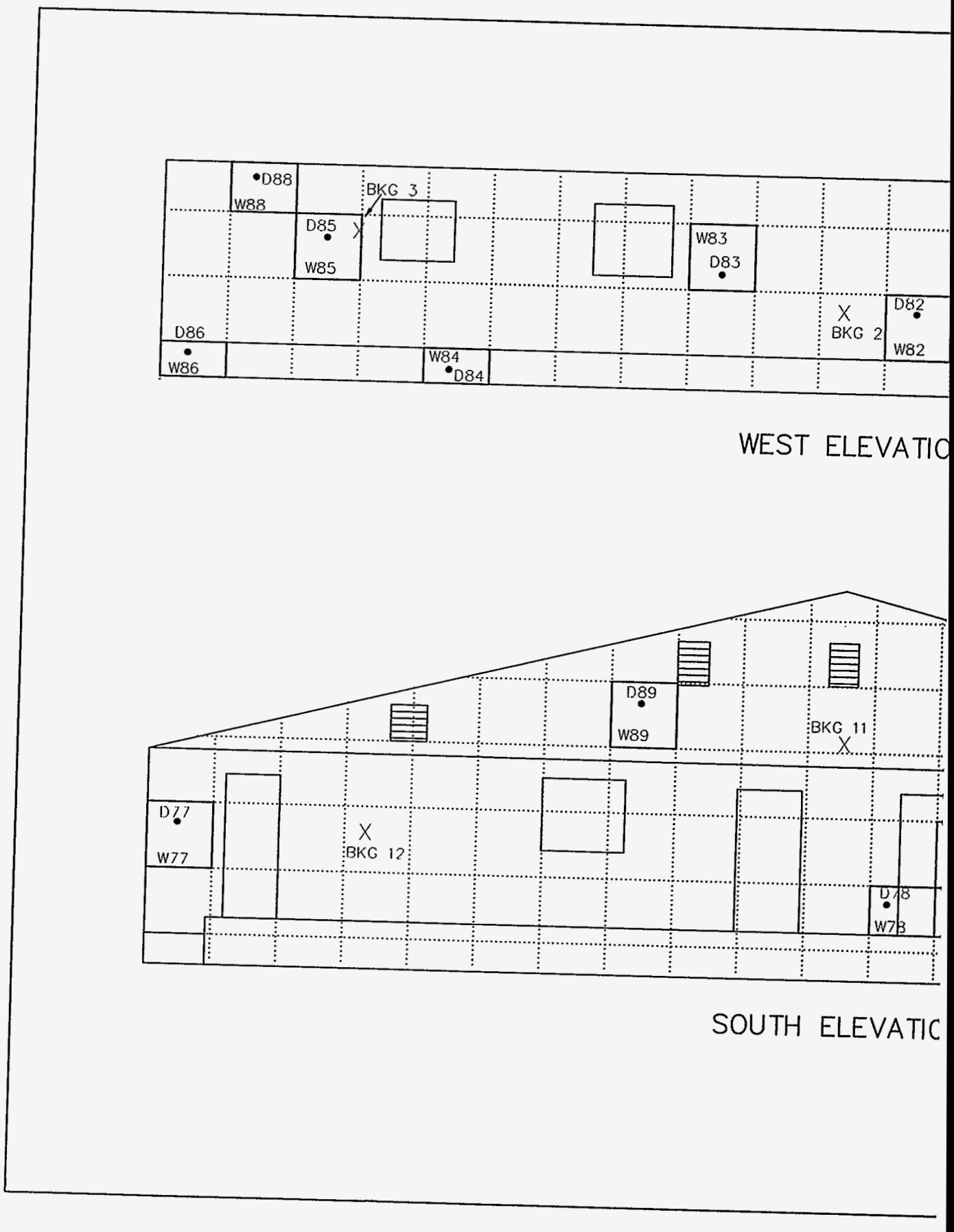
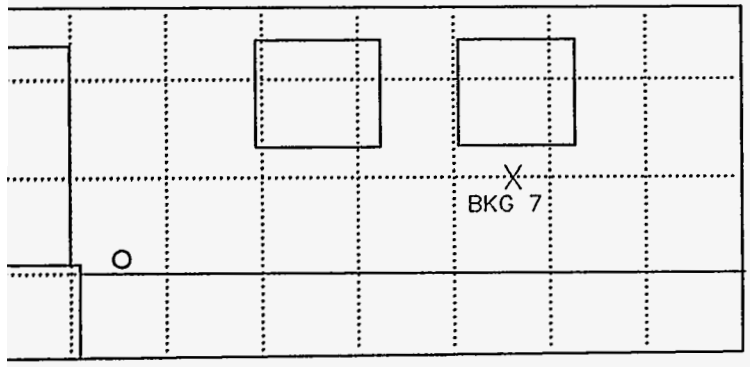


Figure B–3. Exterior V

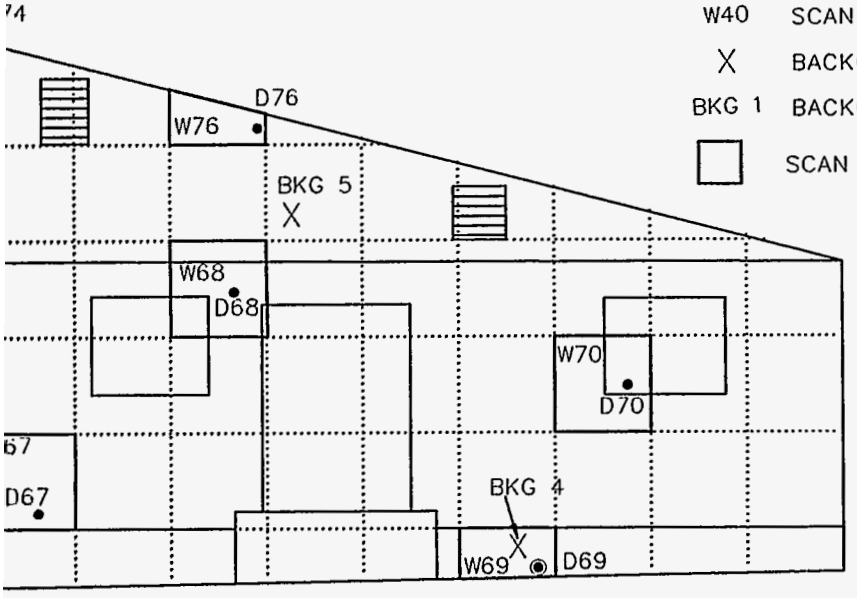


SCALE IN METERS

0 5

LEGEND

- ● DIRECT MEASUREMENT LOCATION
- O SMEAR LOCATION
- D25, DIRECT MEASUREMENT IDENTIFIER
- W40 SCAN AREA IDENTIFIER
- X BACKGROUND MEASUREMENT LOCATION
- BKG 1 BACKGROUND MEASUREMENT IDENTIFIER
- □ SCAN AREA



N

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Figure B-4	GJPORAP BUILDING 18 EXTERIOR WALLS	
PREPARED: TT 8-96	CHECKED: KW 8/96	DATE PREPARED: AUGUST 1996
PROJECT NUMBER: TCR-031-0010-00-000		FILENAME: T0003600

'all Survey Locations

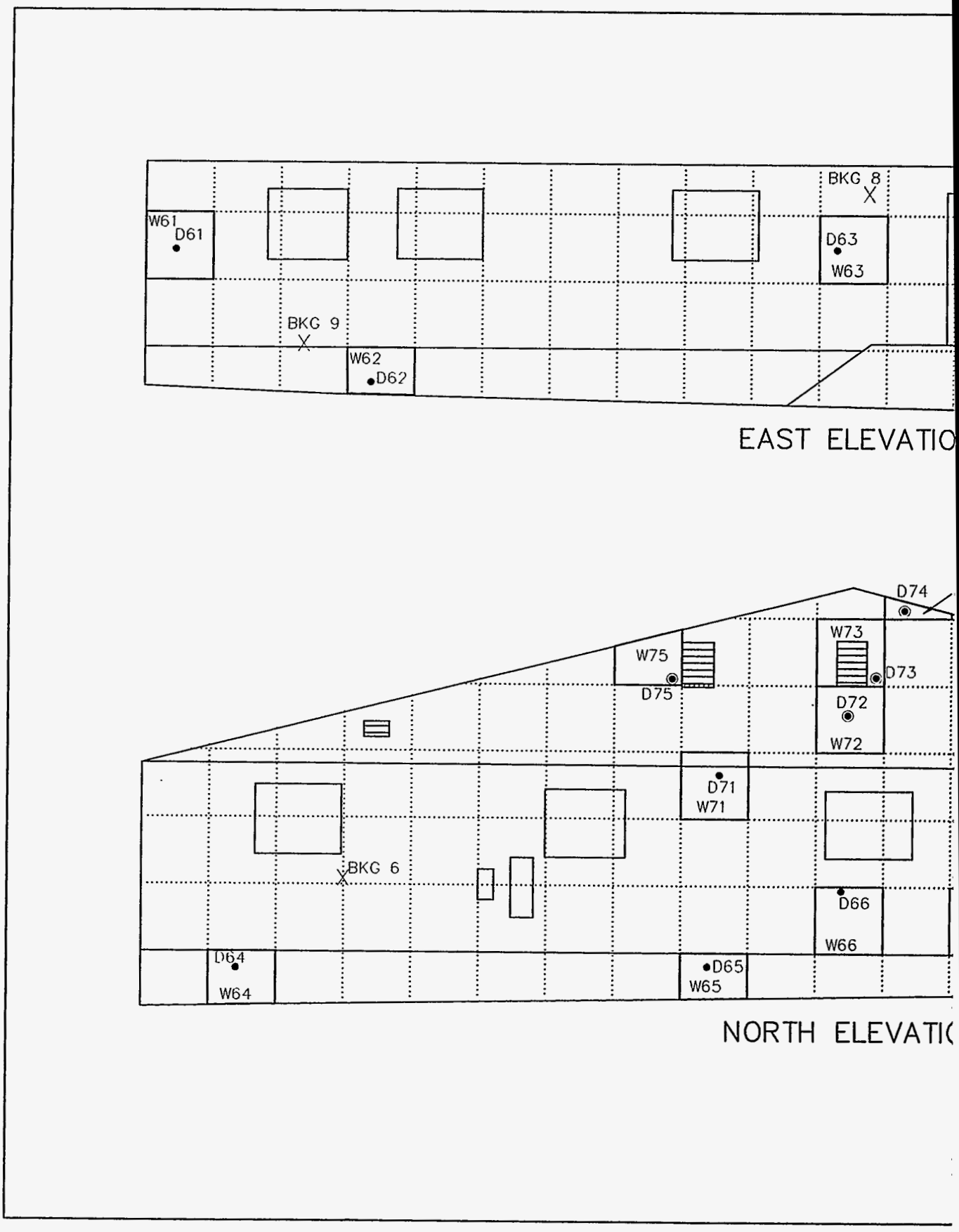

Figure B–4. Exterior V