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RADIOLOGICAL CHARACTERIZATION OF OFF-SITE DITCHES AT THE FORMER ST. LOUIS AIRPORT STORAGE SITE

SURVEY PLAN

SEPTEMBER, 1981

SUBMITTED TO BECHTEL NATIONAL, INC.
AS PART OF THE FORMERLY UTILIZED SITES
REMEDIAL ACTION PROGRAM
SUBCONTRACT NO. 14501-SC-1

5L-001 001399

Bechtel National, Inc.
Engineers — Constructors

Oak Ridge Office
Jackson Plaza Tower
800 Oak Ridge Turnpike
Oak Ridge, Tennessee
Mail Address: P. O. Box 350, Oak Ridge, TN 37830

SEP 11 1981

U.S. Department of Energy
Oak Ridge Operations
Post Office Box E
Oak Ridge, Tennessee 37830

Attn: E. L. Keller, Director
Technical Services Div.

Subject: Bechtel Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-81OR20722
Survey Plan For The Radiological Characterization Of the Off-Site Ditches At The Former St. Louis Airport Storage Site (SLAPSS)
File No. 080 and 190-22A
060

Dear Mr. Keller:

Please find enclosed six copies of the subject radiological survey plan. This activity needs to be carried out in order to provide input to our final remedial engineering design for the off-site ditch decontamination plan. Upon your approval of the plan and once an agreement has been reached with the St. Louis Airport Authority for access to the site, this survey can begin within one week. We would like to initiate this survey in September if possible.

If you need additional information, please let me know.

Very truly yours,

Robert L. Rudolph

Robert L. Rudolph
Project Manager-FUSRAP

FFH:dc

Attachment: As Stated

cc: F. F. Haywood
E. M. Miholits
E. Walker

BACKGROUND AND INTRODUCTION

Beginning in the mid 1940's, the Manhattan Engineer District (MED) acquired a 21.7 acre site north of the St. Louis International Airport to be used as a storage site for residues resulting from the processing of uranium ores. This site is now referred to as the St. Louis Airport Storage Site (SLAPSS). Uranium extraction was performed by the Mallinckrodt Chemical Works, (under a contract with the MED), at its Destreban Street plant in St. Louis. For the initial years of operation, only pitchblende ores from the Belgian Congo were processed. Later, domestic ores of much lower uranium assay from western states were also processed. There were four types of residues which accounted for most of the material stored in the open at this site.[1] These were 74,000 tons of pitchblende raffinate (AM-7), 32,500 tons of Colorado raffinate (AM-10), 10,200 tons of barium sulfate cake (AJ-4), both leached and unleached, and 4,000 tons of magnesium fluoride slag (C-liner) resulting from a uranium metalizing operation. It was estimated that there was a total of 239 tons of uranium in these residues. The quantities of these residues grew steadily as Mallinckrodt's operations continued, and were stored without cover on the storage site. A fence surrounding the site prevented casual entry to the site and thus limited direct exposure to members of the public. A plan view of the site is presented in Figure 1 and indicates where the residues were stored. The procurement contract between the United States and African Metals, supplier of pitchblende ore, required that radium bearing residues be stored for eventual return to African Metals who retained ownership of the ^{226}Ra. For this reason, these residues, referred to as K-65, were stored in metal drums and were not subject to dispersal by wind and rain. However, other pitchblende residues (AM-7) which contained ^{230}Th and radioactive daughters of ^{235}U,? namely ^{231}Pa and ^{227}Ac were not to be returned and were thus stored in bulk. no ^{238}U?

Radiological surveys have been conducted at this site on several occasions since the residues were sold and removed from the site in 1966 and 1967. The first two surveys were performed in 1969[2] when the property was transferred to the St. Louis-Lambert Airport Authority, and again in 1971[3] to document the surface elevations and radiological status of the site. There is no information in these survey documents to suggest that radiation measurements were made outside the site fence, in particular in drainage paths along Brown Road. (It is believed that the contamination in these ditches occurred during the storage of bulk residues or during the transport of these residues to another site in the 1960's, or both.) In November, 1976, and August, 1978, a comprehensive radiological survey was conducted at this site by the Oak Ridge National Laboratory[1] for the purpose of determining the radiological status of the property at the time of the survey. The survey was designed to provide input to Department of Energy engineering and environmental[4] assessments which were to be used to determine what action was required to minimize exposure to members of the public. Results of this survey revealed the presence of radioactivity in the drainage ditches north and south of Brown Road.

RADIOLOGICAL SURVEY PLAN TO SUPPORT REMEDIAL ENGINEERING

The Department of Energy has determined that radioactive contamination in drainage ditches along Brown Road is to be excavated, returned to the SLAPSS, and stabilized for long term storage. A preliminary decontamination plan[5] for the offsite drainage ditches has been prepared by the Roy F. Weston Company under a subcontract with the Oak Ridge National Laboratory. In developing this plan, Weston conducted a study of the existing data from ORNL's radiological survey, and from topographical surveys done by Rowland Surveying, Co., St. Louis, Missouri. Through the application of a data management technique, Weston was able to prepare a series of graphs which displayed isopleths of the intensities of several parameters for which data existed. Four of these graphs are of interest in the full radiological characterizaion of the ditches. These are: (1) isopleths of external gamma-ray exposure rates ~~1M~~ m above the ground (Fig. 2), (2) isopleths of beta-gamma dose rates 1cm above the surface (Fig. 3), (3) isopleths of the ^{226}Ra concentration in surface soil (Fig. 4), and (4) isopleths of the ^{238}U concentration in surface soil (Fig. 5). Based upon an analysis of these data, Weston prepared a diagram of the site depicting the location of contaminated areas and the estimated maximum excavation depth as shown in Fig. 6.[5] This estimated area containing radioactivity pick up 1st line on p. 5 (line) is not accurately defined because of the relatively small number of discrete data points from previous surveys. Therefore, a thorough radiological characterization of the offsite drainage ditches is required in order to more accurately determine the boundaries of contaminated soil and thus minimize the volume of soil returned to the site for stabilization and long-term storage.

Areal Boundaries Of Radiological Characterization

Each element of the survey plan listed below will be carried out within the survey areas depicted in Fig. 7 as the heavily accented lines enclosing those portions of the ditches estimated to be contaminated. Radiological survey activities will be extended to a 25 ft. wide strip of land inside the existing fence in order to accomodate plans to decontaminate the fence line and establish a shallow drainage ditch south of the fence.

Also included in this survey will be a series of measurement activities at regular intervals along both banks of Coldwater Creek.

Measurement Grid System

In order to facilitate this survey, a previously established grid system will be used. This grid consists of mutually perpendicular lines spaced 100' apart. The survey area depicted in Fig. 7 will be established by placing 2 in. x 2 in. wood hubs in the ground at the intersection of grid lines. This work will be completed by a land surveying firm prior to initiating the radiological survey. A smaller grid system will be established in the field by the radiological survey crew in order to acquire closely spaced survey measurements for defining the boundaries of contamination. Lightweight chains with tags spaced at 10 ft. intervals will be used for this purpose.

Radiological Survey Measurements

During this survey, radiation measurements will be limited, for the most part, to gamma-ray and combined beta and gamma radiation measurements ~~dose~~ close to the ground surface. However, to the extent that the base grid system has been extended to areas beyond the limits of the ORNL surveys in 1976 and 1978, gamma-ray exposure rate measurements will be made one meter above the ground at the major intersection of grid lines at 100 ft. intervals. Using this major site grid system (100 x 100 ft.) as a base, measurements will begin at the east end of the site at grid point S0+00, -R3+00, and proceed westward. The frequency for the various types of measurements is presented in the sections below.

Beta-gamma dose rate measurements at ground surface

Measurements of the combined beta and gamma-ray dose rate will be made at the ground surface at 20 ft. intervals within the grid system as shown in the sample site grid block in Figure 8. Based in an analysis of the data from these measurements, additional measurements may be taken at 10 ft. intervals to obtain a more precise description of the surface boundary of contaminated soil. These measurements will be made using a thin window pancake type detector equipped with a background reducing shield (Eberline Instrument Corp. Model HP-210). Pulse signals from this detector will be counted using an Eberline PRS-1 ratemeter/scaler with digital display. A description of the detector and read-out unit is given in Appendix A.

Gamma radiation measurements at ground surface

Gamma radiation measurements will be made at the ground surface at 20 ft. intervals within the grid system as shown in the sample site grid block in Figure 8. As mentioned in the previous section for combined beta-gamma dose rate measurements, additional measurements may be taken at 10 ft. intervals, based on an analysis of data from measurements taken at 20 ft. intervals. The gamma-ray measurements will be made with a sodium-iodide (NaI) detector 2 in. diameter and 2 in. long. This detector (Eberine model SPA-3), is mounted in a probe assembly, is shielded around the sides with 1/2 in. of lead, and pulses from the unit are counted using the above mentioned ratemeter/scaler. The lead shield surrounding the sides of this detector is used to reduce the gamma-ray intensity through the sides thus providing a downward directional response. A description of these units is given in Appendix A.

Gamma-ray exposure rates one meter above the surface

Measurements of the gamma-ray exposure rate will be made at grid points which, for the purposes of this survey, have been added recently to the base grid system established originally in 1976. These data will be collected at 100 ft. intervals as shown in the sample site grid block in Figure 8. The gamma-ray measurements will be made 1m above the ground using the same detector and read-out units described above, except that the NaI probe assembly will be used without the 1/2 in. layer of lead. The calibration factor used to estimate the gamma-ray exposure rate in micro-roentgens per hour (μR/h) will be determined through a series of cross-measurements with a pressurized ionization chamber whose response to gamma-rays is proportional to exposure in roentgens.

Determination of Radionuclides in Soil

Upon completion of the series of radiation measurements at the ground surface, samples of surface and sub-surface soil will be collected and returned to Eberline's Albuquerque, New Mexico Facility for analysis. The samples will be dried, crushed, and placed in containers used for analysis by the high resolution gamma-ray spectrometry technique. The principal radionuclides to be determined through this analysis are ^{226}Ra, ^{228}Th, ^{223}Ra, and ^{227}Ac. An aliquot of soil will be taken from 10% of the soil samples for the purpose of determining, through radio-chemical analyses, the concentration of three radionuclides which cannot be analyzed adequately using gamma-ray spectrometry. These are ^{230}Th, ^{238}U, and ^{231}Pa. Because ? residues from the processing of high assay uranium ores were stored at this site, it is likely that elevated soil concentrations of ^{230}Th and ^{231}Pa will be found in the offsite ditch area.

Sampling of surface soils

Surface soil samples will be collected for the purpose of quantifying the radionuclide concentration in soil within the contaminated soil boundaries as determined from the ground surface radiation measurements. For the purposes of this survey, surface soil is considered that from the top 6 in. of the ground. The initial estimated number of surface soil samples is 253. The spatial resolution of the samples from east-to-west is presented in Table 1. In this table, the number of soil samples collected along a given grid line running north-south is indicated. The exact location of a given ~~each~~ sample along a grid line will be determined upon review of the surface radiation measurements and its location will be recorded.

Sampling of sub-surface soil

Soil samples below a depth of six inches will be collected from the sidewall of a series of ditches approximately 12 in. wide, 12 in deep and 36-72 in. long. The initial estimated number of ditches to be dug for this purpose is 85, and the approximate spacing from east-to-west is presented in Table 1. As in the case of surface soil samples, the exact location of the ditches along any given north-south grid line will be determined upon review of the surface radiation measurments and the location of each ditch will be recorded in relation to the site grid. Instruments used for making surface radiation measurements will be used to monitor sidewalls of the ditches. It is anticipated that these measurements will indicate the approximate depth of radioactivity. Samples will be collected from the side wall at measured depths below the surface in order to determine the concentration of radionuclides as a function of depth. Samples collected from the top 6 in. of the sidewall will represent surface soil and have been included in the surface soil budget. It is estimated that two samples below 6 in. will be collected in each ditch yielding a total of 170 samples below the surface. When removing spoil from the ditches, care will be taken to place hay bales around this material to prevent erosion in the event of rain. In addition, an effort will be made to return the spoil to the approximate same location when refilling the ditches. how do they do this?

Determination of Radionuclides in Water and Sediment

In previous radiological surveys at the SLAPSS[1], samples of water and sediment have been collected at selected locations. Since the last sampling of this area in 1979, there has been at least one heavy rainfall causing near flooding conditions along

Coldwater Creek. For this reason, samples of Creek water and sediment will be collected along both banks of the creek at regular intervals from the outfall of the Creek at Banshee Road downstream to a point east of the Berkeley Khoury League Park where the creek intersects the projection of north-south grid line R0+00, origin of the site grid system. It is anticipated that 30 water and sediment samples would be collected and returned for the analysis of ^{238}U, ^{226}Ra, ^{230}Th, and ^{210}Pb. Additional samples of water will be collected from the drainage ditches along Brown Road if standing water is present.

Implementation of Radiological Survey Plan

It is estimated that the elements of this plan can be carried out in 3-4 weeks of on-site work. Personnel for this survey will be furnished from Eberline's Albuquerque Facility, and field portable instruments will be furnished from the supply of equipment purchased in FY-1981. In order to provide logistics support for this survey, it is proposed that the FUSRAP Access Trailer No. 2, stored currently in Oak Ridge, be moved to the site. This unit would be used for a field office, housing for radiological instrumentation, instrument repair, daily standardization of instruments, and as a center for logging soil samples and preparing them for shipment to Eberline's Albuquerque facility.

References

1 Radiological Survey of the St. Louis Airport Storage Site, St.Louis Missouri, DOE/EV-0005/16, September, 1979.

2 Letter from S. R. Sapirie to David E. Leigh, with enclosures, January 14, 1970.

3 Letter from S. R. Sapirie to David E. Leigh, with enclosures, January 17, 1972.

4 Oak Ridge National Laboratory, Environmental Impact Assessment of the Former Airport Storage Site of the Atomic Energy Commission, St. Louis, Country, Missouri, Draft Report, October, 1978.

5 Formerly Utilized Site Remedial Action Program. St. Louis Airport Storage Site (SLAPSS), Technical Series, Vol. 2 Engineering, No. 2 Decontamination Plan for Off-site Drainage Ditches, Prepared by Roy F. Weston, Inc. for Oak Ridge National Laboratory under Contract No. 32C-705-18C, June, 1981.

6 Formerly Utilized Sites Remedial Action Program St. Louis Airport Storage Site (SLAPSS), Technical Series, Vol. 1 Site Characterization, No. 1 Site History, Topographical and Radiological Data Analysis, Geological/Hydrological Data Appendix A - Plates, Prepared by Roy F. Weston, Inc. for Oak Ridge National Laboratory under contract 32C-705-18C, June, 1981.

TABLE NO. 1

Approximate location and number of surface soil samples and ditches for sub-surface soil samples.

North-South grid line	No. of surface soil samples to be collected along grid line	No. of ditches to be dug for subsurface soil investigation and sample
-R3+00	3	3
-R2+50	3	0
-R2+00	3	0
-R1+50	3	0
-R1+00	3	2
-R0+50	3	0
R0+00	7	0
R0+50	7	0
R1+00	9	2
R1+50	5	0
R2+00	7	0
R2+50	5	0
R3+00	6	5
R3+50	6	0
R4+00	6	0
R4+50	6	0
R5+00	4	4
R5+50	5	0
R6+00	4	4
R6+50	5	0
R7+00	5	0
R7+50	4	0
R8+00	3	4

TABLE NO. 1 - Continued

North-South grid line	No. of surface soil samples to be collected along grid line	No. of ditches to be dug for subsurface soil investigation and sample
R8+50	3	0
R9+00	3	4
R9+50	3	0
R10+00	3	0
R10+50	3	0
R11+00	5	5
R11+50	5	3
R12+00	5	6
R12+50	5	1
R13+00	6	6
R13+50	6	0
R14+00	6	0
R14+50	5	0
R15+00	4	5
R15+50	6	0
R16+00	7	0
R16+50	5	0
R17+00	5	5
R17+50	5	0
R18+00	5	0
R18+50	6	0
R19+00	5	4
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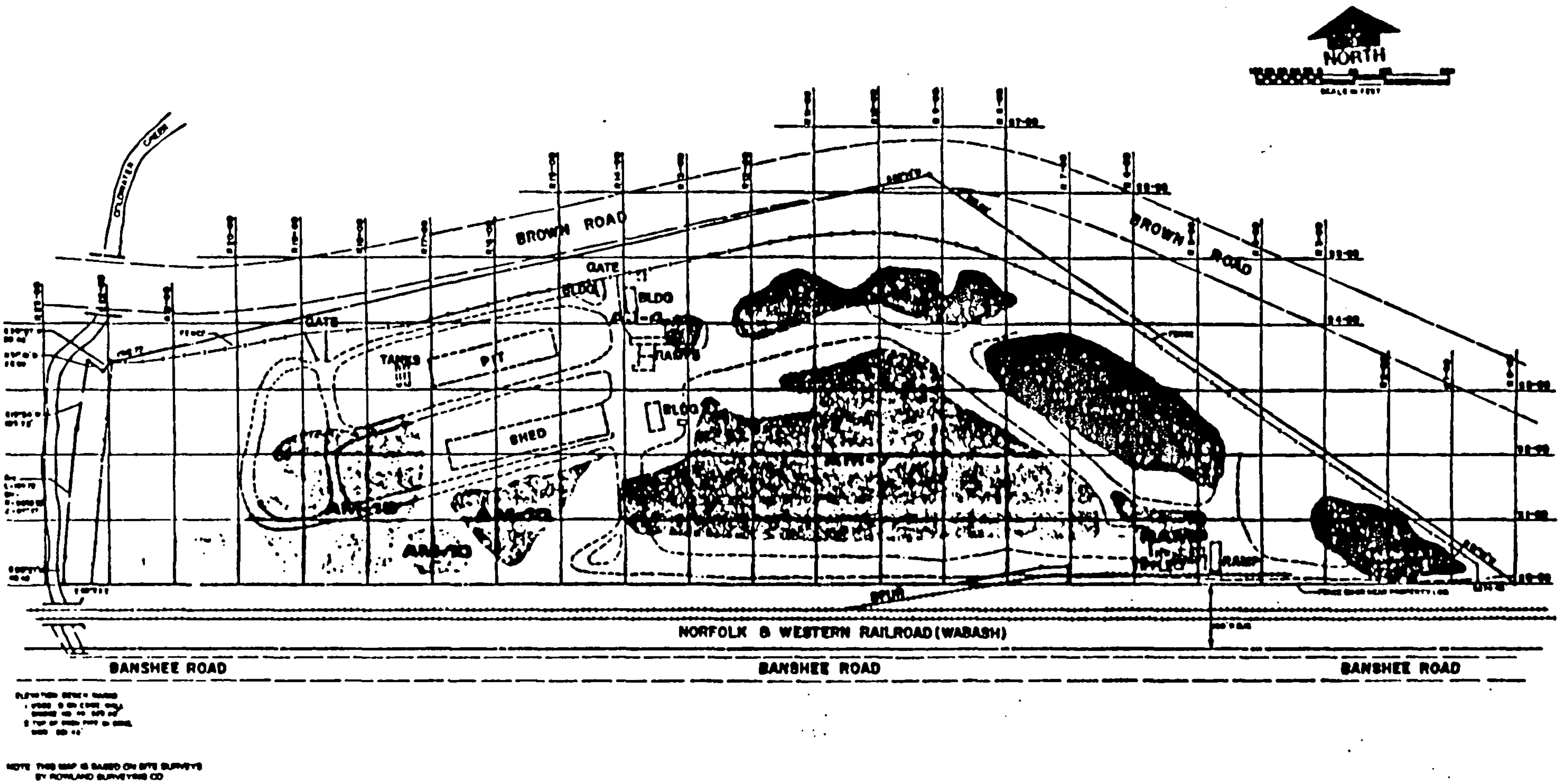
R20+00	6	4
R20+50	6	3
R21+00	6	6
R21+50	6	4
R22+00	6	2



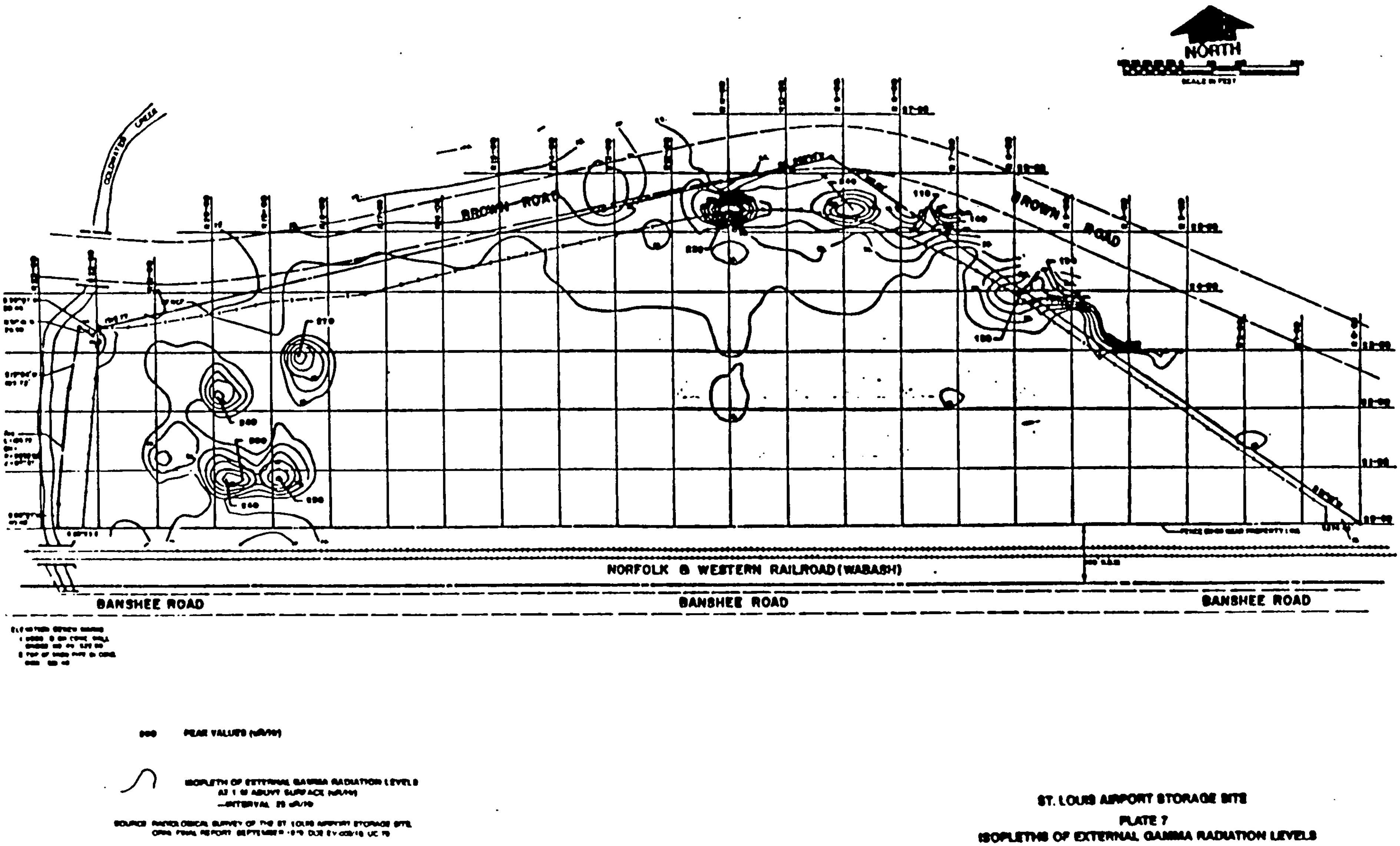
This illustration taken from Ref 6.

ST. LOUIS AIRPORT STORAGE SITE

PLATE 2

WASTE PILES (AS OF 1960), BUILDING AND ROAD LOCATIONS

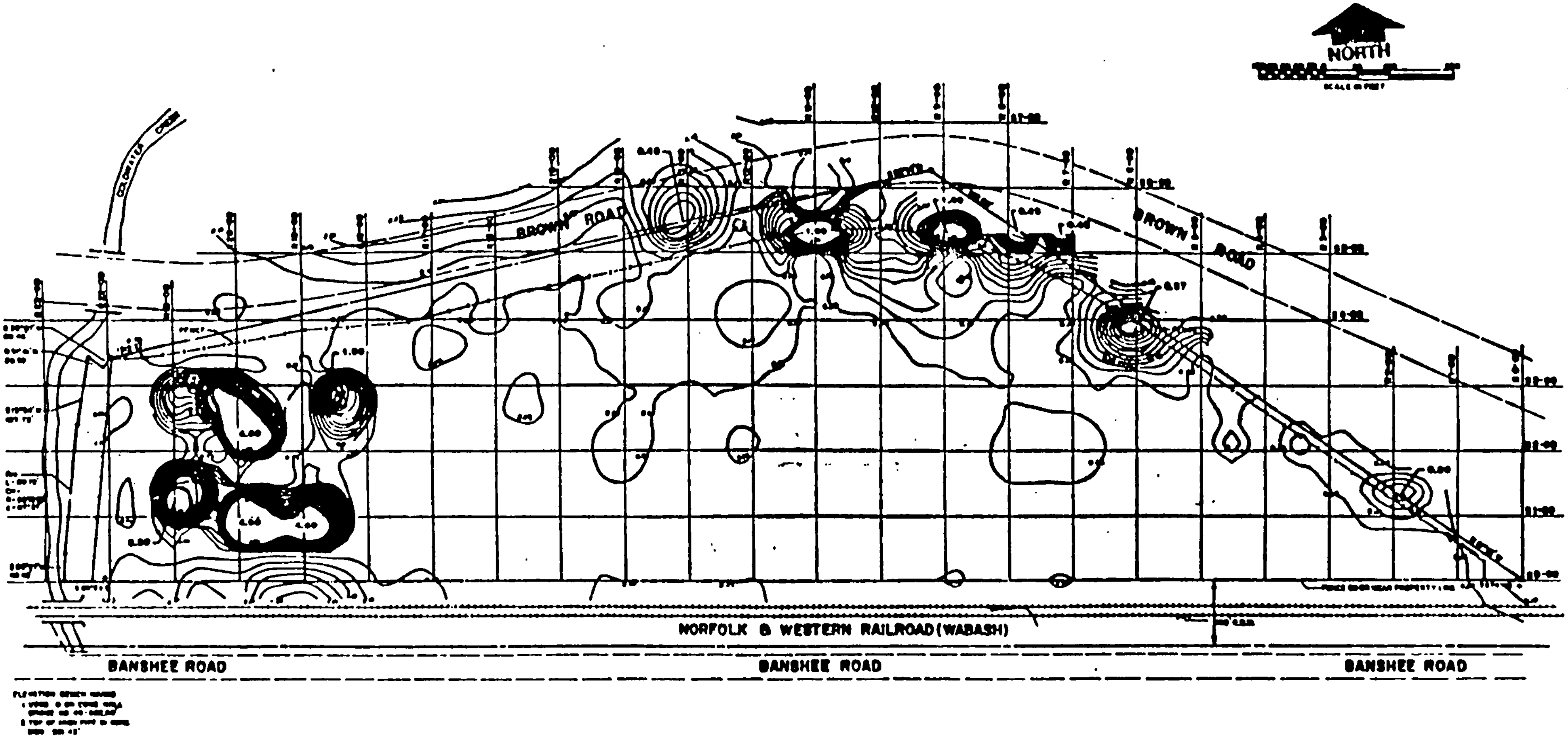
Fig 1 - Original location of residues at the SLAPSS



ST. LOUIS AIRPORT STORAGE SITE
PLATE 7
ISOPLETHS OF EXTERNAL GAMMA RADIATION LEVELS
ONE METER ABOVE THE SURFACE (1976)

This illustration taken from Ref 6

Fig 2 - Isopleths of gamma-ray exposure rates 1m above the ground based on ORNL Survey



1.00 PEAK VALUES (mRAD/hr)

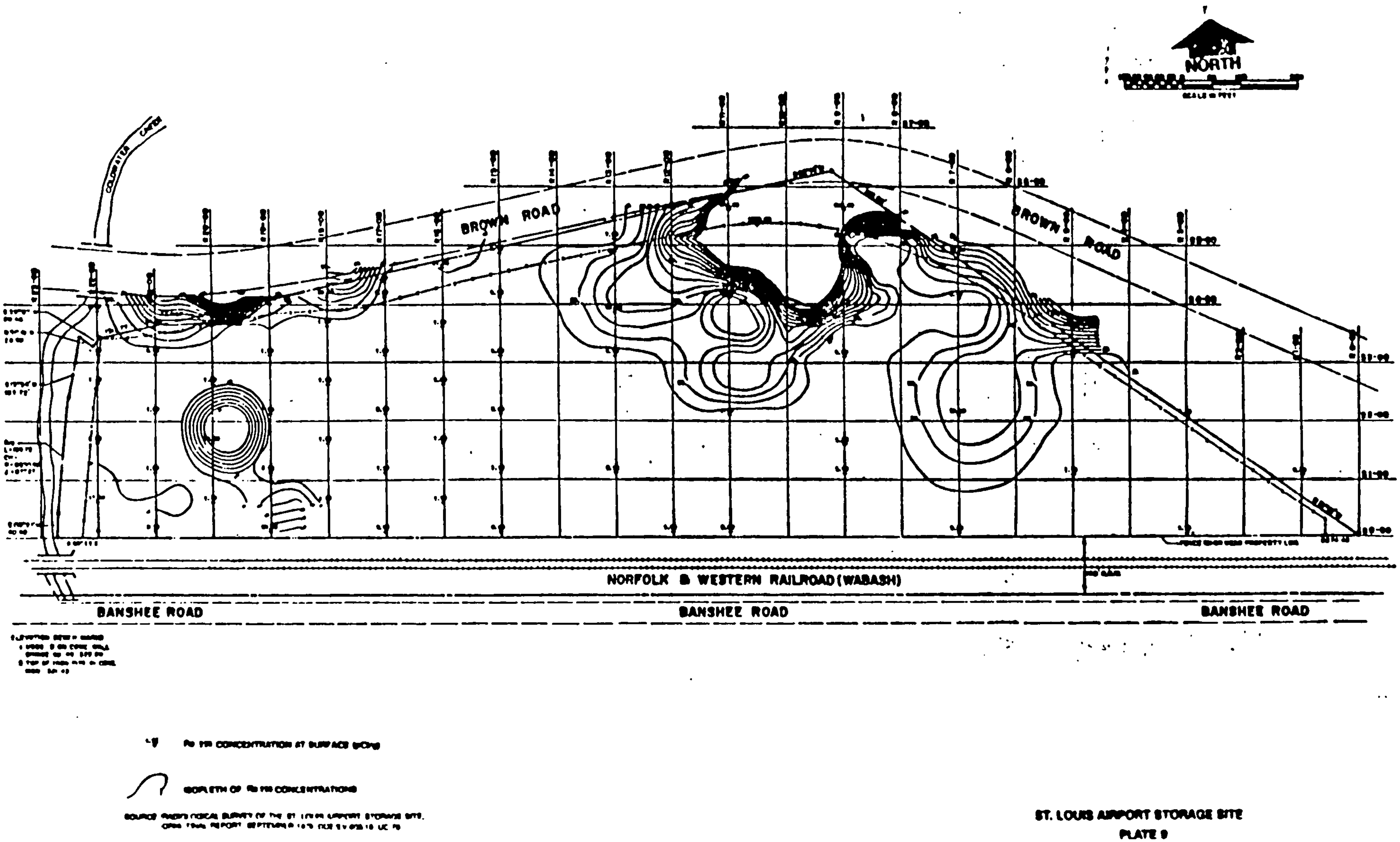
ISOPLETH OF BETA-GAMMA RADIATION LEVELS
AT 1 CM ABOVE SURFACE (mRAD/hr)
—INTERVAL [illegible] mRAD/hr

SOURCE: RADIOLOGICAL SURVEY OF THE ST. LOUIS AIRPORT STORAGE SITE
ORNL FINAL REPORT SEPTEMBER [illegible]

ST. LOUIS AIRPORT STORAGE SITE
PLATE [illegible]
ISOPLETHS OF BETA-GAMMA RADIATION LEVELS
ONE CENTIMETER ABOVE THE SURFACE (1976)

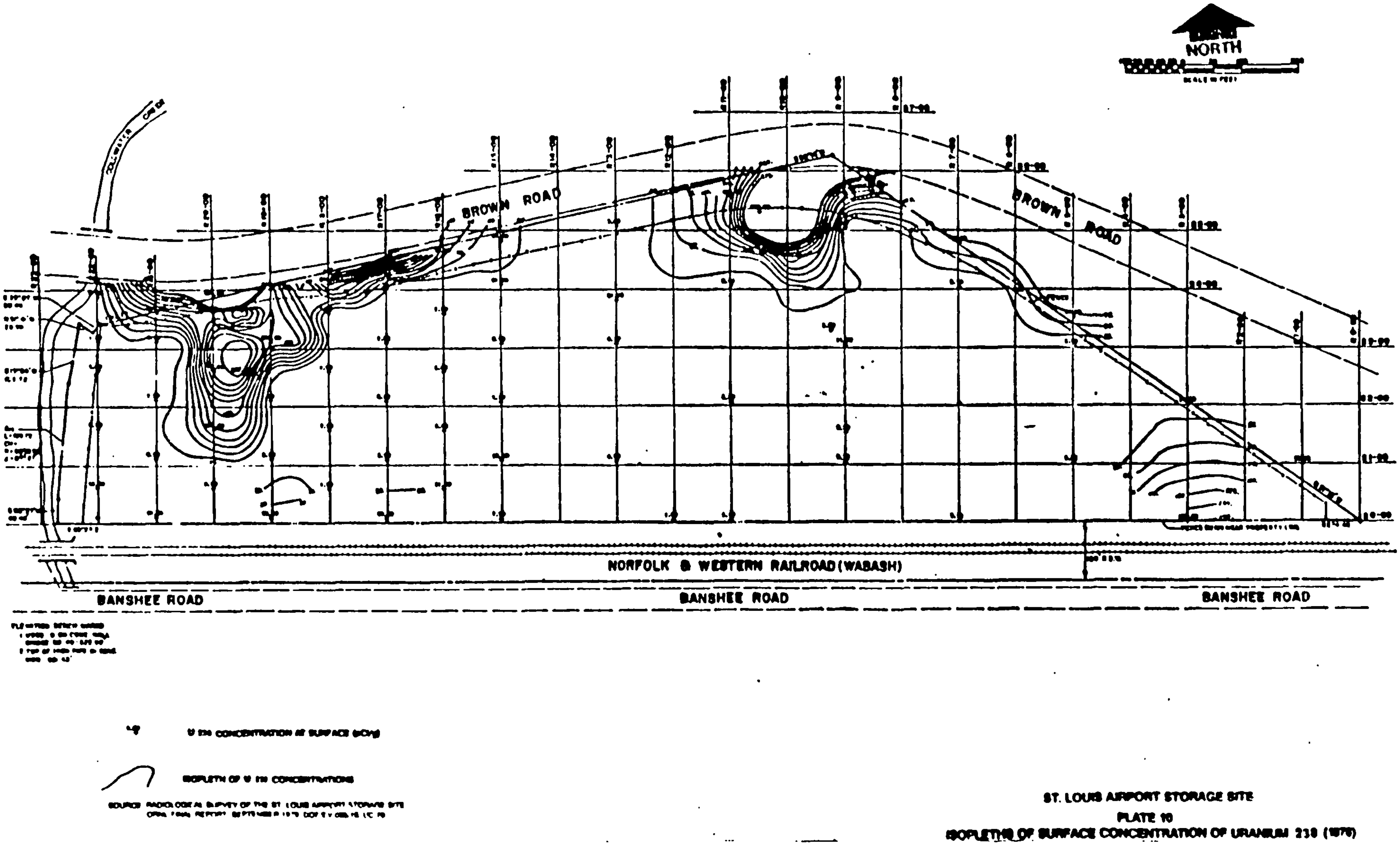
This illustration taken from Ref. 6

Fig 3 - Isopleths of beta-gamma dose rates
1 cm above the ground based on ORNL survey



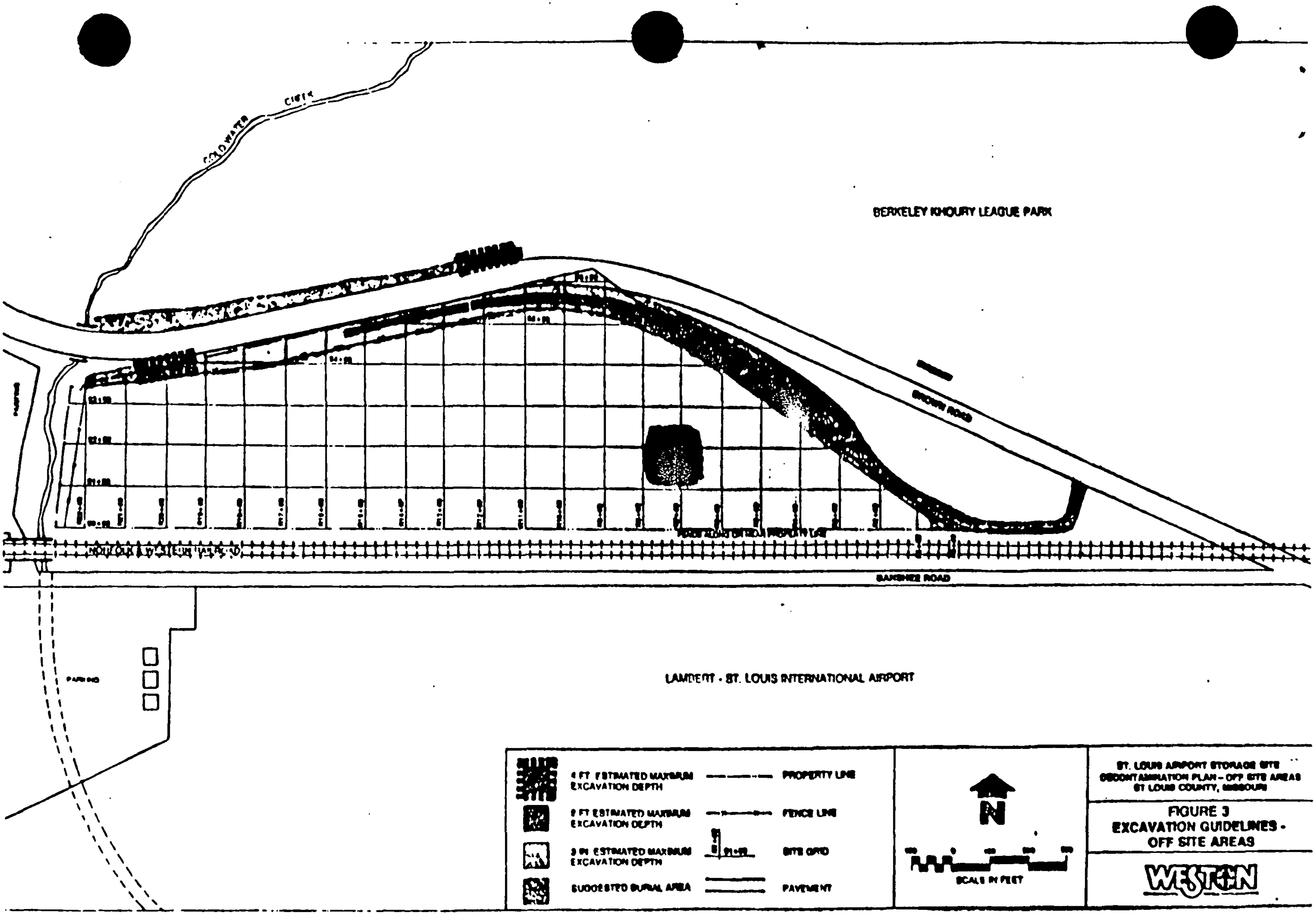
This illustration taken from Ref. 6.

Fig 4 - Isopleths of ^{226}Ra soil concentration based on ORNL survey



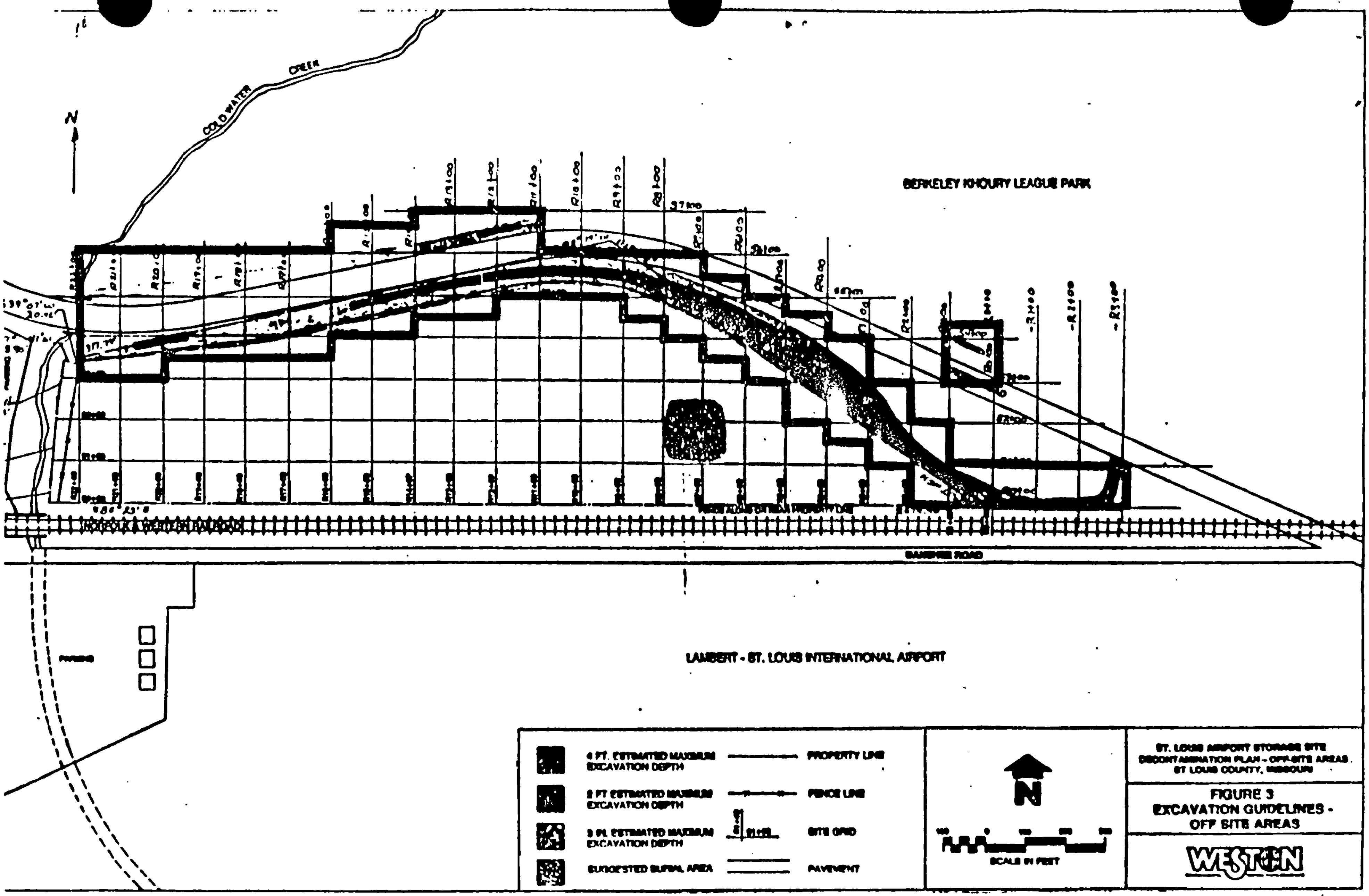
This illustration taken from Ref. 6

Fig 5 - Isopleths of ^{238}U soil concentrations based on ORNL survey



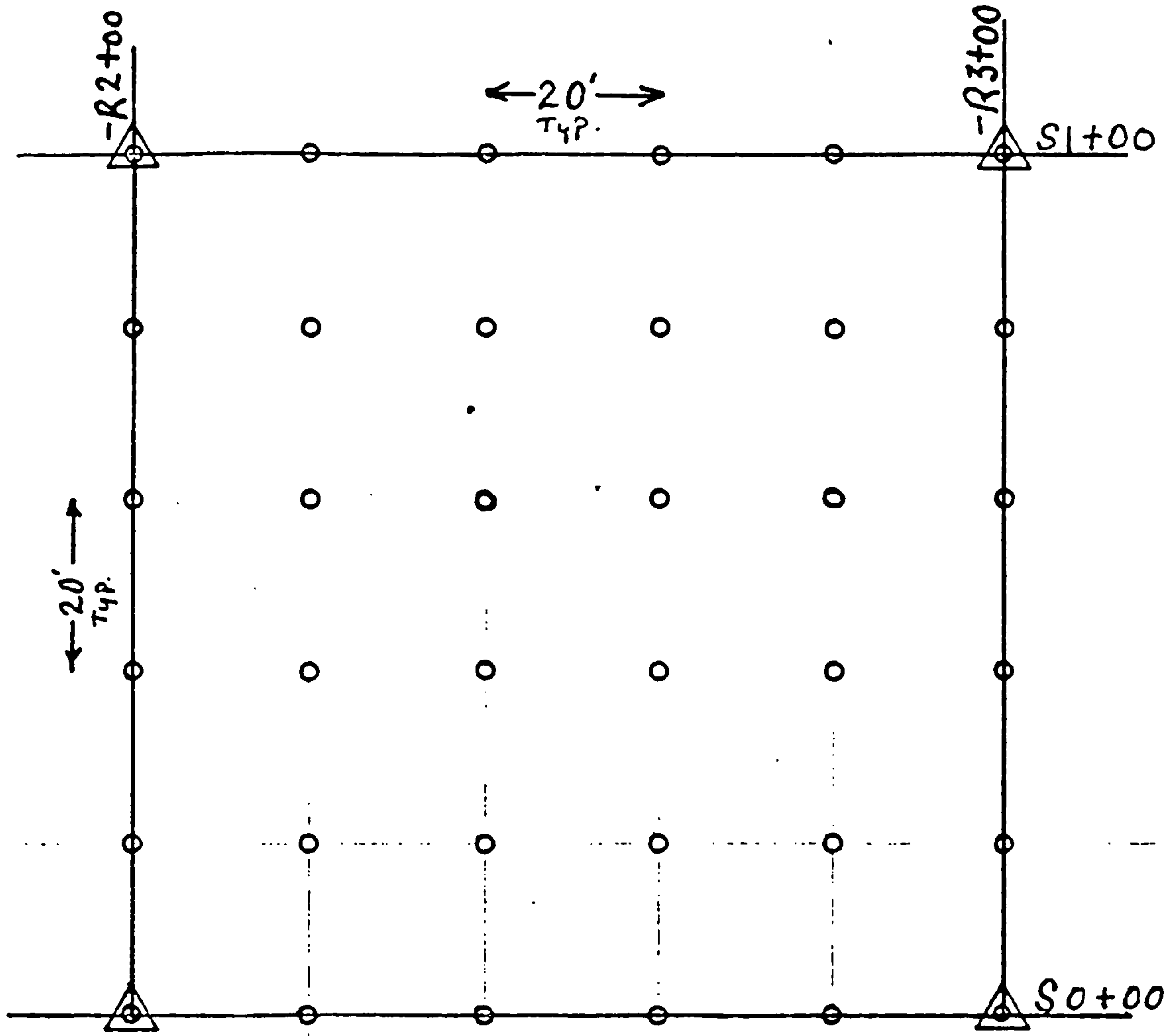
This illustration taken from Ref 5

Fig 6 - Initial estimated maximum excavation depth



This illustration taken from Ref 5

Fig 7 - Boundary of Radiological Survey Area



△ Gamma-ray Exposure Rates 1 m Above the Surface, and Beta-Gamma Dose Rate at Ground Surface.

○ Beta-Gamma Dose Rate at Ground Surface, and Gamma Radiation Measurements at at Ground Surface.

Figure 8

Sample Site Grid for Radiological Measurements

APPENDIX A

Hand Probe, Model HP-210

GENERAL DESCRIPTION

The Model HP-210 Hand Probe is a rugged, sensitive detector for monitoring beta (β) radiation. This hand probe offers a G-M tube with a thin mica window, a large open area protected by a sturdy wire screen which allows useful sensitivities for β energies down to about 40 keV. The probe is also alpha sensitive. It is ideal for contamination control when used as a personnel frisker, or to monitor tables, floors, equipment, etc. The high-density tungsten shield makes it possible to monitor for low levels of β radiation in a gamma field. When monitoring in a low level radiation field, an optional aluminum probe housing may be used in place of the tungsten shield for considerable weight reduction.

The Model HP-210 Hand Probe may be used on any Eberline +900 V portable instrument or laboratory monitor.

SPECIFICATIONS

OPERATING VOLTAGE: 900 ±50 V.

PLATEAU LENGTH: 100 V minimum.

PLATEAU SLOPE: 0.1%/V maximum.

DEAD TIME: 50 μseconds maximum.

TEMPERATURE RANGE: -30°C to +75°C.

LIFE: Unaffected by operation.

MICA WINDOW THICKNESS: 1.4 to 2.0 mg/cm^2.

MICA WINDOW SIZE: 1-3/4 inch (4.45 cm) dia., 2.4 inch^2 (15.5 cm^2) area.

SERIES RESISTOR (in probe): 3.3 MΩ.

GAMMA SENSITIVITY (^{137}Cs into window): Approximately 3600 counts per minute (cpm) per mR/h.

SHIELDING RATIO (front to back ^{60}Co): Approximately 4:1.

*BETA EFFICIENCY (1 inch dia. source):

- ^{90}Sr-^{90}Y (E_{max} 0.54 - 2.2 MeV): Approximately 45% of 2π emission rate.
- ^{99}Tc (E_{max} 0.29 MeV): Approximately 30% of 2π emission rate.
- ^{14}C (E_{max} 0.15 MeV): Approximately 10% of 2π emission rate.

ALPHA SENSITIVITY: 3 MeV or higher at mica window.

CONNECTOR: BNC series coaxial.

SIZE: 6-1/2 inches long x 3-1/2 inches wide x 3-7/8 inches high (16.5 x 8.9 x 9.8 cm).

WEIGHT: 4-1/4 pounds (1.9 kg) with shield, 1-1/2 pounds (0.7 kg) without shield.

SHIELD: High density tungsten.

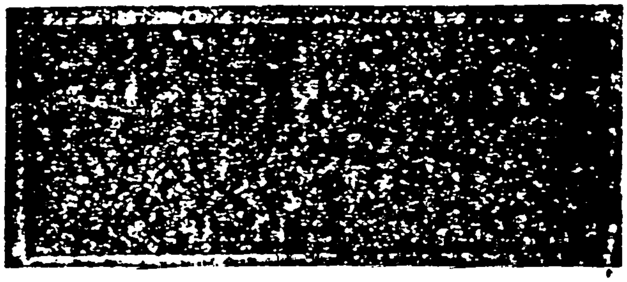
*All efficiencies with screen in place. Removal of screen will increase given efficiencies by approximately 40%.

Model SH-4A continued on the following page.

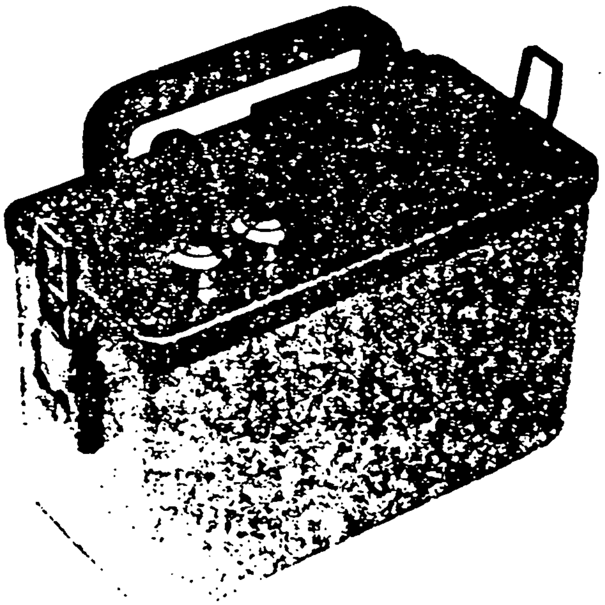
eberline P.O. Box 2108, Santa Fe, New Mexico 87501 (505) 471-3232 TWX: 910-985-0678

September 1980

"RASCAL"
Models PRS-1, PRS-2



PRS Legends, Digits and Decimal Point Placements



- OPERATOR SELECTS DESIRED PRECISION OF MEASUREMENT
- RATEMETER OR SCALER OPERATION WITH DIGITAL DISPLAY
- EASY TO CALIBRATE IN DESIRED UNITS
- SINGLE CHANNEL ANALYZER (PRS-1)
- DIGITAL HIGH VOLTAGE DISPLAY
- OPERATES WITH PROPORTIONAL, SCINTILLATION AND GEIGER DETECTORS
- BUILT-IN SPEAKER
- LIGHTED LIQUID CRYSTAL DISPLAY HAS SIX DIGITS, NINE LEGENDS AND THREE DECIMAL POINTS
- USER SELECTS CALIBRATION CONSTANT, DECIMAL POINT PLACEMENT AND READOUT UNITS

eberline

"RASCAL"
Models PRS-1, PRS-2
GENERAL DESCRIPTION

The RASCAL is a compact portable, digital display instrument with selectable ratemeter or scaler functions. The instrument is rugged and splashproof with its own internal battery power supply. Included in the PRS-1 is a variable high voltage power supply, pulse amplifier for single channel pulse height analysis, six-decade liquid crystal display, crystal-controlled time base. calibration functions, built-in speaker and a self-contained rechargeable battery pack. All circuits are solid-state with extensive use of CMOS integrated circuits for low power consumption and to enhance reliability.

The Model PRS-2 is similar to the PRS-1, except it does not have the pulse height analysis capability.

The PRS-1 and PRS-2 are designed to be used with all Eberline scintillation and G-M detectors. The PRS-1P and PRS-2P are designed for use with all Eberline scintillation and proportional detectors and with all 900V G-M detectors. The P version provides a high voltage suitable for proportional counting. All versions have a digital readout of the internal high voltage provided to the detector.

EMERGENCY KIT

The RASCAL is ideal for emergency kits because it can be used with so many different detectors and can be calibrated in advance for each detector. Digital display of the high voltage allows the user to interchange probes quickly, readjust the high voltage to the setting for the specific probe, make a change in the conversion factor and continue operating. These data can be predetermined for the individual detectors and attached to the instrument for ready access. The emergency kit contents should be tailored to the needs of each customer. Specify individual items needed when ordering.

SUGGESTED CONTENTS OF

EMERGENCY KIT

PRS-1	Portable Rate Meter Scaler
HP-210	Pancake G-M Tube Detector
SH-4A	Sample Holder
SPA 3	High Energy Gamma Detector
LEG-1	Low Energy Gamma Detector
AC-3-7	Alpha Scintillation Probe
HP-270	Beta-Gamma Probe Energy Compensated
CA-5-36	Cable
CA-14-36	Cable
CS-7A	Gamma Check Source
CS-13	Beta Check Source
CC-113X	Carrying Case
CS-11	Alpha Check Source
HP-290	Gamma Probe

Continued on following page

eberline P.O. Box 2108, Santa Fe, New Mexico 87501 (505) 471-3232 TWX: 910-985-0678

September 1980

"RASCAL," MODELS PRS-1, PRS-2 (continued)

SPECIFICATIONS

HIGH VOLTAGE: Regulated, adjustable by a front panel control and can supply a 100 MΩ load. A voltmeter position on the range switch provides a digital indication of the voltage. The supply is a plug-in module for ease of maintenance. The PRS-1 and PRS-2 use an Eberline P-201A plug-in module that provides 500 to 1500 V. The PRS-1P and PRS-2P use an Eberline P-201AS plug-in module that provides 800 to 2400 V.

COUNT RATE: True digital computing circuitry is used to provide six decades of count rate information without any range changing necessary. A front panel switch selects a preset number of counts: 10, 100, 1k or 10k for computation. The least number of counts selected provides the fastest answer and the greatest number of counts selected provides the most accurate answer. The compute time is fixed at 3 seconds.

SCALER: Six decades of digital information with fixed timed positions of 0.5, 1, 2 and 5 minutes plus manual and stop. The display may indicate each increment of count or the display may be updated at the end of the count period as selected by an internal switch. A front panel control is provided for a variable reset rate of approximately 1 to 10 seconds or the control may be switched off.

CALIBRATION FUNCTION: The calibration function provides a means of converting the count rate information, in counts per minute, to useful units such as mR/hr, or to correct for probe efficiency. A rate multiplier board with selectable multiplication from 9.99 to 0.01 is provided as a standard item with the instrument. A rate divider board with selectable division from 00.1 to 99.9 is available as an option. All controls for the calibration function are internal. The placement of the decimal point and the measurement units displayed are preselected at the time of calibration.

DISPLAY: A liquid crystal display is used for low power consumption and continuous display of data. The display has six digits, nine legends and three decimal points. Five legends, "CPM," "CPS," "mR/hr," "mREM/hr" and "R/hr" plus the three decimal points are selected for display by internal switches. Other measurement units, e.g. dpm/100 cm^2, may be used with the units display left blank. The remaining legends, "Count," "Compute" and "Batt OK" are controlled by the circuit logic of the instrument. A light, controlled by a panel-mounted push button switch, is provided for instrument use in low ambient light.

AMPLIFIER: Charge sensitive type approximately 2×10^{-14} to 2×10^{-13} coulombs (approximately 1 – 10 mV equivalent on voltage sensitive input). The amplifier board (P-8B) is a plug-in module for ease of maintenance.

THRESHOLD: PRS-1 and PRS-1P: Adjustable by a 10-turn front panel control from 0 to 1.0 volt. PRS-2 and PRS-2P: Adjustable by a single-turn, screwdriver adjust, front panel control from 0 to 1.0 volt.

WINDOW (PRS-1 and PRS-1P): Adjustable by a 10-turn front panel control from 0 to 1.0 volt, always constant above threshold. A "PHA-GROSS" switch provides gross counting by disabling the window.

TIME BASE: Quartz crystal controlled for an accuracy of greater than 0.01% over wide temperature range and battery conditions. The time base provides all timing signals for the count rate and scaler functions of the instrument.

SPEAKER: The speaker and the speaker control switch are mounted on the front panel.

RESET: Resets both count rate and scaler functions.

Continued on the reverse page

"RASCAL" MODELS PRS-1, PRS-2 (continued)

DETECTOR CONNECTOR: Eberline type CJ-1, waterproof connector mates with CP-1.

POWER: Rechargeable Gel-Cell® battery provides approximately 75 hours of continuous operation between charging. (An optional battery pack is available for five Ni-Cd rechargeable D-cell batteries, or five D-cell non-rechargeable batteries, for approximately 200 hours of continuous operation.)

BATTERY CHARGER CONNECTOR: Miniature phone jack.

BATTERY CHARGER: Recharges batteries in 14 hours.

MECHANICAL:

Size: 7-3/4 inches high x 9-1/2 inches long x 4 inches wide (19.7 x 24.1 x 10.2 cm).

Weight: Approximately 5 pounds (2.3 kg).

TEMPERATURE: Operational from 0°F to 140°F (-18°C to 60°C).

ACCESSORIES: Carrying strap.
Gas can assembly for use with gas flow proportional detector and either PRS-1P or PRS-2P.

eberline P.O. Box 2108, Santa Fe, New Mexico 87501 (505) 471-3232 TWX: 910-985-0678

September 1980

Scintillation Probe Assembly Model SPA-3

HIGH GAMMA SENSITIVITY
OPERATES FROM MOST PORTABLE INSTRUMENTS
RUGGED PACKAGE
2 X 2 INCH NaI(Tl) CRYSTAL
MAGNETIC SHIELD

eberline

Scintillation Probe Assembly, Model SPA-3

GENERAL DESCRIPTION

The Model SPA-3 Scintillation Probe Assembly is a rugged, waterproof gamma detector for use when high sensitivity to radiation is desired, or for pulse height analysis applications. The probe contains a 2 inch dia. x 2 inch long NaI(Tl) crystal, a 2 inch dia. 10 stage photomultiplier tube, a tube socket with a dynode resistor string and a magnetic shield.

The SPA-3 will function properly with most Eberline instruments, but maximum versatility is obtained with Models PRM-4, PRM-5, PRM-6 Pulse Rate Meters; the PS-2, PRS-1, PRS-2, PRS-2P, or the Mini Scaler series of laboratory instruments.

SPECIFICATIONS

Crystal: 2 inch dia. x 2 inches long (5.1 x 5.1 cm) NaI(Tl).

Photomultiplier Tube: Nominal 2 inch dia., 10-dynode, end window with S-11 photocathode.

Operating Voltage: Highly variable depending on application. Depends on photomultiplier gain, cable length and input characteristics of counter used.

Maximum Voltage: +1600 V.

Current Drain: Approximately 120 MΩ resistance string yields 10 μA at 1200 V applied.

Wall: 1/8 inch thick (0.32 cm), except at crystal 1/16 inch thick (0.16 cm) aluminum.

Connector: Waterproof. Mating connector is Eberline Model CP-1.

Size: 2-5/8 inch dia. x 11-1/8 inches long (6.7 x 28.3 cm).

Weight: 3-1/4 pounds (1.5 kg).

Finish: Enamel body with chrome-plated connector.

Sensitivity: Approximately 1200k counts per minute per mR/hr with ^{137}Cs.

NOTE: Add cable if required.

ACCESSORY

A machined aluminum probe holder which allows easy attachment and removal of the SPA-3 to the instrument is available as an accessory item.

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March 1978