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QUARRY RESIDUALS SAMPLING PLAN ADDENDUM 1: QUARRY PROPER SAMPLING

Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

DECEMBER 1995 **REV. 1**

U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

Prepared by MK-Ferguson Company and Jacobs Engineering Group

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Weldon Spring Site Remedial Action Project

Quarry Residuals Sampling Plan Addendum 1: Quarry Proper Sampling

Revision 1

December 1995

Prepared by

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for the

U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

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1 INTRODUCTION

The excavation, transportation, and interim storage of bulk waste from the Weldon Spring Quarry is governed by the *Record of Decision (ROD) for the Management of the Bulk Wastes at the Weldon Spring Quarry* (Ref. 1), which was signed by the U.S. Environmental Protection Agency in September 1990. The ROD directs that bulk waste be removed by conventional mechanical means.

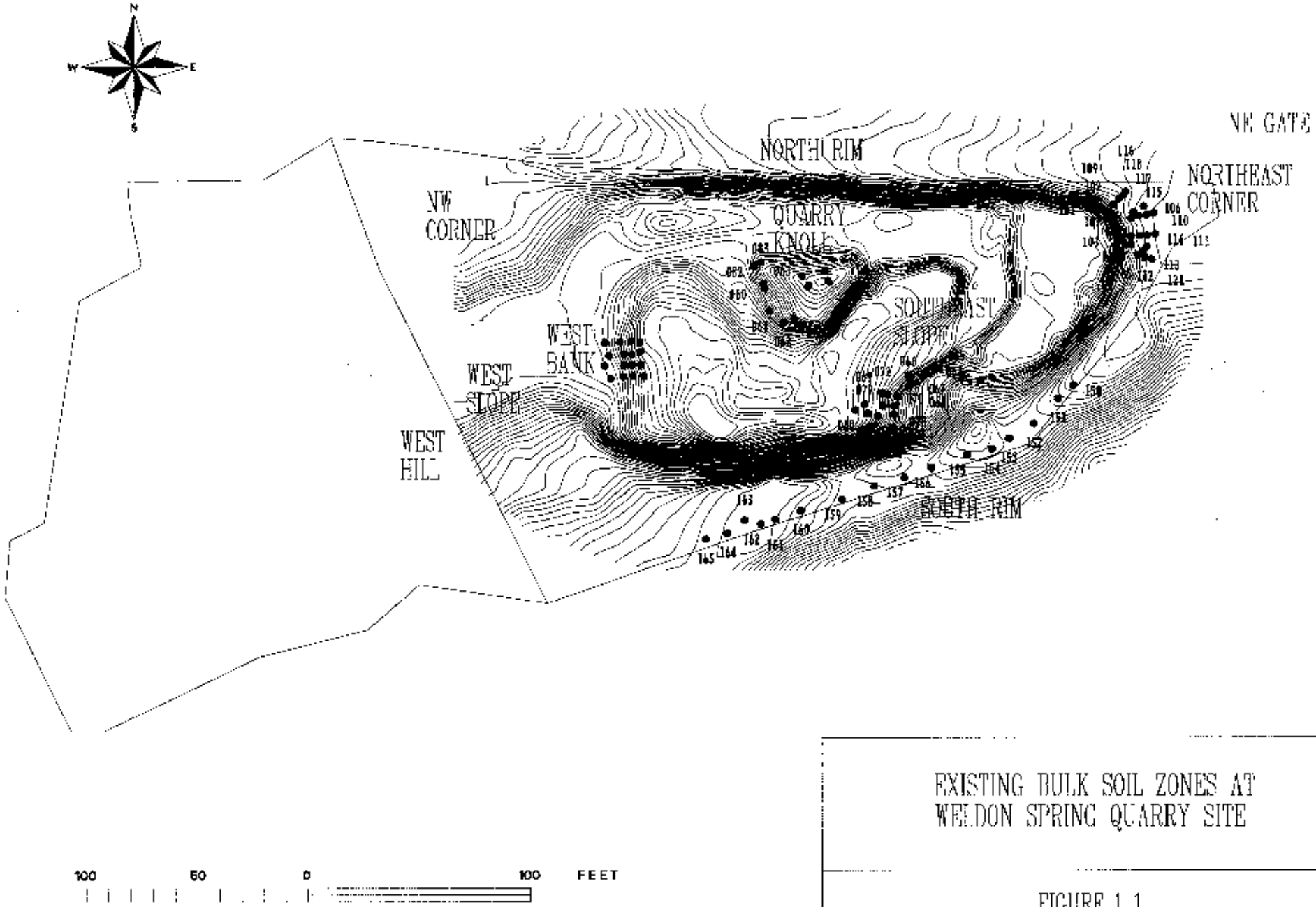
The Quarry Residuals Operable Unit (QROU) has been designated to address all contamination remaining in various media in the quarry area following removal of bulk waste. The sampling described here is designed to obtain necessary data from the quarry proper to support the remedial investigation/baseline risk assessment (RI/BRA) for this operable unit.

Sampling will be preceded by field scans to identify any remaining areas of radiological contamination. These scans will be followed by collection of spill samples, that will be submitted to the on-site laboratory for a rapid-turnaround analysis of radiological and nitroaromatic parameters using gamma spectrometer and immunoassay kits. Because some areas will not be as easily accessible in the future (once bulk waste removal is completed), areas identified as contaminated will be evaluated for further excavation to remove contaminants. Samples will be collected again from any remediated areas. It is expected that the resulting data would serve as the dataset for the quarry residuals OU remedial investigation effort.

1.1 Purpose and Scope

This addendum to the *Quarry Residuals Sampling Plan* (Ref. 2) addresses supplemental characterization activities inside the quarry fence line (Figure 1-1). Background sampling, quality assurance/quality control, health and safety issues, and other topics common to all phases of the sampling are addressed in the *Quarry Residual Sampling Plan* (Ref. 2).

A second addendum will be prepared to address additional sampling outside the quarry, water sampling inside the quarry, and any other sampling that may be required to fill data gaps for the Quarry Residuals Operable Unit.



EXISTING BULK SOIL ZONES AT WELDON SPRING QUARRY SITE

FIGURE 1 1

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2 DATA QUALITY OBJECTIVES

2.1 State the Problem

Sampling and chemical analysis are required to determine levels of radioactive and chemical contamination in residual materials remaining in the quarry after bulk waste removal. This information is needed to characterize the extent of contamination and to determine risks relative to the QROU.

In some areas, this sampling is being performed to provide data where bulk waste excavation activities have not yet been demobilized. Based on these data, removal of additional material from these areas may be perfromed while excavating equipment is still present in the quarry.

2.2 Identify the Decision

The data generated from this plan will be used to perform the baseline risk assessment (BRA) for the QROU and to identify areas of contamination exceeding target risk levels (see Table 2-1) after bulk waste has been removed.

2.3 Identify Inputs to the Decision

Inputs to the decision include:

- Concentrations of radiological and chemical parameters in residual materials (primarily soil) in the quarry proper.
- External gamma exposure rates from surfaces such as floor, walls, and soil areas.
- Radon measurements at predesignated monitoring stations.

2.4 Define Boundaries of the Study

This study is confined to the quarry proper. The quarry proper has been divided into two types of exposure units, fractured zones and bulk soil zones, that are based on discrete features in the quarry and accessibility. The bulk soil exposure units defined in the plan are illustrated in Figure 1-1. Fractured zones include those areas throughout the quarry where bulk waste has been removed and the underlying rock washed down. Sampling will focus on soils remaining in fractures. These units may be reevaluted (i.e., other units added or specified units combined) as excavation proceeds and data become available.

Exposure Units:

- Soil slope above the northeastern rim of quarry.
- Soil slope (apparent slump area) adjacent to southeastern wall.
- Soil on southern margin of the quarry rim.*
- Soil on north rim of quarry.*
- Soil on limestone knoll.
- The west bank.
- Quarry floor fractures.
- Quarry wall fractures.
- Soil in NW corner (large area near water tank).*
- Soil behind west bank (west slope area).

* Soil not in direct contact with bulk waste.

2.5 Develop a Decision Rule

Based on a recreational risk scenario, the concentration levels corresponding to a 10^{-5} risk or 0.5 hazard quotient have been chosen as guidelines for decisions regarding any additional remediation and are shown in Table 2-1. For Th-232 and the radium isotopes, the decision level was based on the 10^{-4} risk level, because the 10^{-5} risk level corresponds to near-background concentrations. It is not practical to set a field decision level at near-background concentrations due to limitations in field instrumentation and the large number of samples needed to statistically

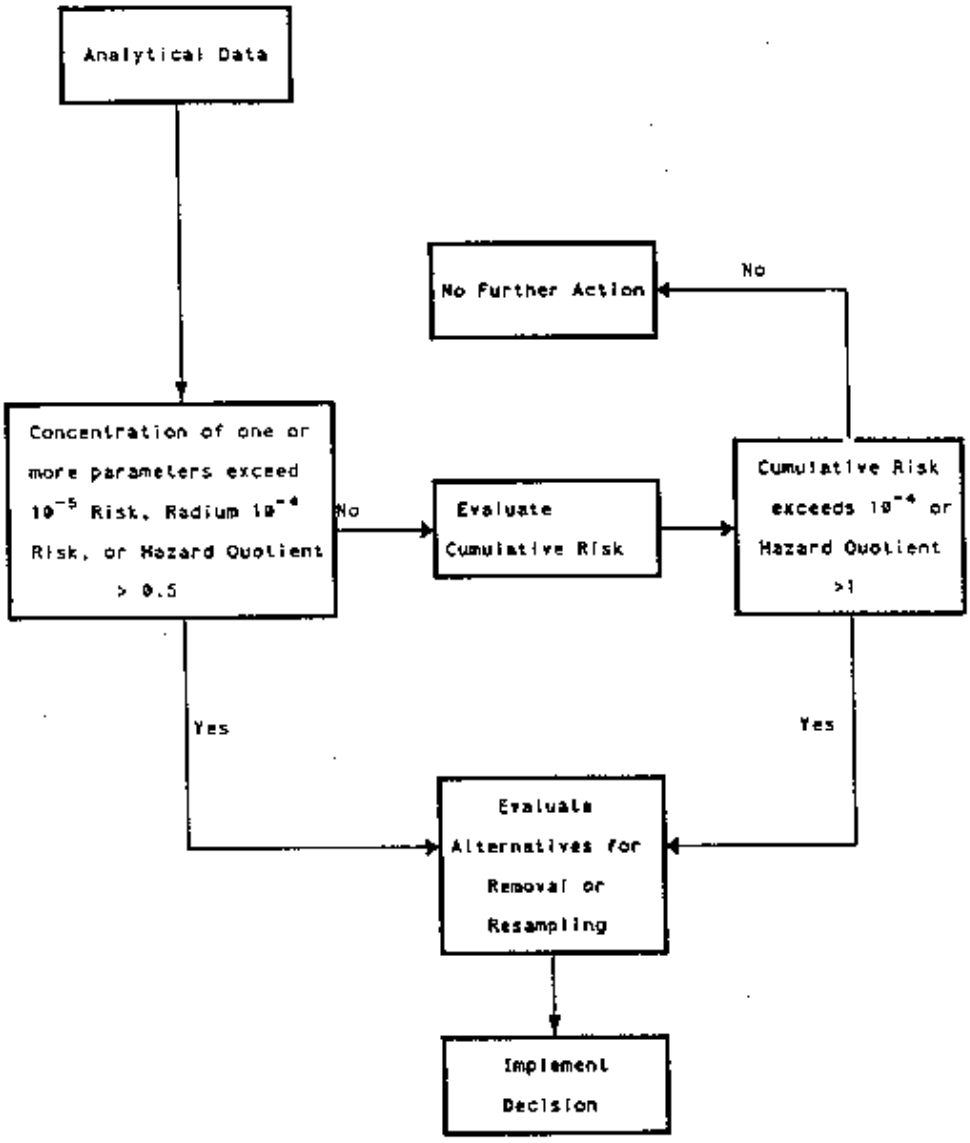
determine that the level has been achieved. The decision level for TNT/TNB is 1000 ppm. This level slightly exceeds the 830 ppm TNT concentration for the 1×10^{-6} risk level.

The decision rule to guide field activities is as follows and as shown in Figure 2-1:

- If the mean concentration for one or more contaminants in an exposure unit is greater than the decision level (Table 2-1), then remedial alternatives (including collection of additional samples) will be evaluated and appropriate action taken.

- If the mean concentration for all contaminants in an exposure unit is less than the decision level (Table 2-1), but the cumulative risk is greater than 10^{-4} and/or the hazard quotient is greater than 1, then remedial alternatives (including collection of additional samples) will be evaluated and appropriate action taken.

- If the mean concentrations for all contaminants in an exposure unit correspond to a cumulative risk of less than 10^{-4} and a hazard index less than 1, then no action will be taken.



DECISION RULE

FIGURE 2-1

REPORT NO.: DOE/OR/21548-382 AD1	EXHIBIT NO.: A/PI/063/0595	
ORIGINATOR: WRG	DRAWN BY: SRS	DATE: 5/26/95

TABLE 2-1 Contaminant Decision Levels***

CONTAMINANT	SOIL CONCENTRATION	CARCENOGENIC RISK	CHEMICAL	SOIL CONCENTRATION	HAZARD QUOTIENT
Ra-226	14** pCi/g	$1x10^{-4}$	Antimony	2,100 mg/kg	0.5
Ra-228	28 pCi/g	$1x10^{-4}$	Barium	370,000 mg/kg	0.5
Th-230	420 pCi/g	$1x10^{-5}$	Cadmium	5,300 mg/kg	0.5
Th-232	28** pCi/g	$1x10^{-4}$	Chromium (III)	200,000 mg/kg	0.5
U-238	240 pCi/g	$1x10^{-5}$	Chromium (VI)	24,000 mg/kg	0.5
Arsenic	140 mg/kg	$1x10^{-5}$	Copper	210,000 mg/kg	0.5
Beryllium	58 mg/kg	$1x10^{-5}$	Lithium	110,000 mg/kg	0.5
			Mercury	1,600 mg/kg	0.5
TNT/TNB	1,000 mg/kg	$>10^{-6}$	Molybdenum	27,000 mg/kg	0.5
PAHs*	34 mg/kg	$1x10^{-5}$	Nickel	110,000 mg/kg	0.5
PCBs*	32 mg/kg	$1x10^{-5}$	Selenium	27,000 mg/kg	0.5
			Silver	27,000 mg/kg	0.5
			Thallium	370 mg/kg	0.5
			Vanadium	37,000 mg/kg	0.5

* PAHs = sum of Carcinogenic PAHs
PCBs = sum of Arclor 1248, 1254, and 1260

** The decision level for Th-232 is equal to the level for Ra-228, based on ingrowth.

*** With exception of PAHs and PCBs values listed in this table are taken from Ref. 3, Tables A-3 and A-4.

2.6 Developing Uncertainty Constraints

Sampling in the quarry proper is designed to minimize the probability of false negatives (i.e., the probability of determining that an area is clean when it is actually contaminated). Sampling will be performed for each exposure unit, as tentatively defined in Section 2.4. Evaluation of data will include determining the performance criteria achieved. The baseline risk assessment (BRA) will incorporate this information.

The number of samples to be collected is detailed in Section 3.1 and is based on the tentative list of exposure units identified in Section 2.4. Identification of specific or actual exposure units will be performed as part of the evaluation included in the BRA.

2.7 Optimize the Design

Details of the sampling to be conducted are provided in Section 3.1. To facilitate rapid identification of areas requiring additional sampling or potential remediation, this sampling effort uses field techniques (e.g., immunoassay tests and a thorough walkover survey with an NaI detector to identify areas with elevated radioactivity) and use of the on-site laboratory for radionuclide analyses when available. If the on-site laboratory cannot perform the radionuclide analyses, samples will be sent to an off-site laboratory.

3 SAMPLING

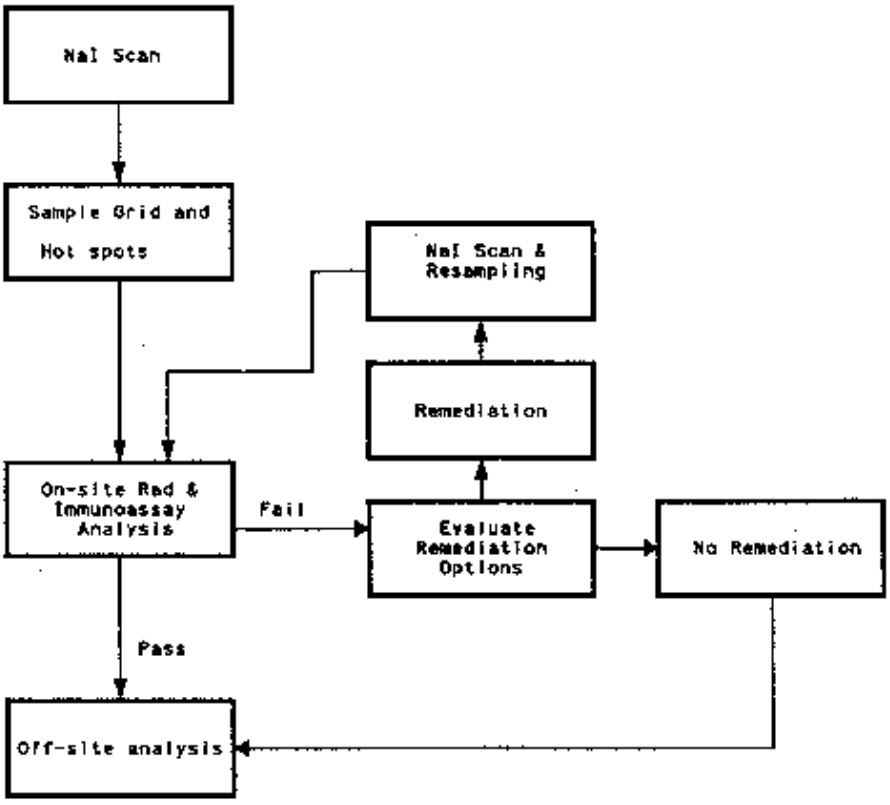
3.1 Quarry Bulk Soil Sampling and Geophysical Surveys

3.1.1 Soil Sampling

Seven discrete areas of soil have been identified inside the quarry: the knoll, the northeast corner (beneath the environmental air monitoring station), the southeast corner soil slope, the west bank and area behind west bank, the northwest area, the north rim and the south rim (Figure 1-1). Sixteen samples will initially be collected (Figure 3-1) from each area (fewer samples will be collected from small areas or from areas that have been previously characterized for radiological parameters and found to be clean). Based on the target levels listed in Table 2-1 and the equations presented in *Soil Sampling Quality Assurance User's Guide* (Ref. 4), it was determined that collection of 16 samples from each tentative exposure unit should limit the probability of making a Type II (false negative) error to less than 5% and that of making a Type I (false positive) error to less than 20%. Evaluation of early data indicates that using 16 samples provides significantly lower error rates.

A walkover scan with an NaI detector will be performed with gamma exposure rates recorded at each sampling point, each point will be sampled in the 0 cm - 15 cm (0 in. - 6 in.) depth interval, and each location showing an NaI measurement indicating elevated contamination (hot spot), as judged in the field, will also be sampled. Sample locations will be flagged and surveyed. At 10% of the locations, which will be randomly selected, and at selected hot spots, samples will be taken in the 15 cm - 30 cm (6 in. - 1 ft), 30 cm - 60 cm (1 ft - 2 ft), and 60 cm - 90 cm (2 ft - 3 ft) depth intervals, unless bedrock is encountered.

Samples will be homogenized and split into aliquots. Two aliquots will be sent to the Weldon Spring Site Remedial Action Project for on-site radiological (when available) and immunological analysis. Radiological analyses will include Ra-226, Ra-228, Th-230, Th-232, and U-238, and samples will be tested for trinitrotoluene (TNT) using immunoassay. Each soil area will be divided into quadrants, composited, and analyzed for polycyclic (or polynuclear) aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) using immunoassay.



QUARRY SOILS SAMPLING DECISION PATH

FIGURE 3-1

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ORIGINATOR: WRG	DRAWN BY: GLN	DATE: 5/26/95	

Where disturbed soils are thicker than 5 ft, soil borings to bedrock may be collected in addition to or in place of surface samples. Soil cores from these borings will be collected at 5 ft intervals. Each interval will be scanned with a gamma detector. At depths greater than 5 ft, the soil cores will be composited for analysis unless the gamma scan indicates a 0.5 ft or greater section of the core exceeds 2 times background. These sections will be removed from the core and analyzed for radiological parameters. In the top 5 ft interval, samples will be collected for analysis at the following depths: 0 ft - 0.5 ft, 0.5 ft - 2 ft, 2 ft - 5 ft. Each sample will be handled in the manner described in the previous paragraph. Sample collection techniques will follow those described in the *Sampling Plan* (Ref. 2).

Four soil areas that have been identified as exposure units were not in direct contact with the bulk waste. Previous analysis of radiological parameters in surface soil samples and soil borings from these areas indicated these soils were at background levels (Ref. 5). Three or four additional borings will be collected from each of these areas and will be analyzed for the suite of parameters described in the third paragraph of this section.

Due to safety concerns and accessibility problems, soil sampling strategies may be revised. This is particularly true of the limestone knoll where steep areas and heavy vegetation may limit access.

At remediated locations, an additional walkover scan will be performed, and resampling for parameters that were about action levels will be conducted after remediation is complete. To the degree feasible, this step will be repeated until soil concentrations of these parameters are at acceptable levels. When radiological and immunoassay tests show acceptable levels, the remaining aliquots will be sent for off-site analysis. Twenty-five percent of immunoassay samples will be sent to an off-site laboratory for analysis. If evaluation of the off-site data indicates that the probability of making Type II and Type I errors exceeds 5% and 20%, respectively, additional samples will be sent off site. Twenty percent of the samples sent off site for Th-230 analysis (i.e., 5% of the total number of samples) will also be analyzed for U-238, Ra-226, and Ra-228, as part of the on-site laboratory quality assurance/quality control program. A composite from each of the quadrants will also be sent for off-site analyses for metals (antimony, arsenic, barium, beryllium, cadmium, Chromium (III), Chromium (VI), copper, lithium, mercury, molybdenum, selenium, silver, thallium, vanadium, and nickel), PCBs, PAHs, and nitroaromatics.

3.1.2 Geophysical Surveys

During bulk waste activities, buried metal debris was recovered from clean soils in the northwest area of the quarry. In this area, radiological contamination was found only in association with this debris. Previous soil borings in this area (Ref. 5) showed these soils to be at background levels for radiological parameters. Because it is reasonable to suspect that buried debris may still be present beneath this large area of disturbed soil, a geophysical survey will be performed to look for hidden metallic debris. If buried metal is detected, removal will be evaluated.

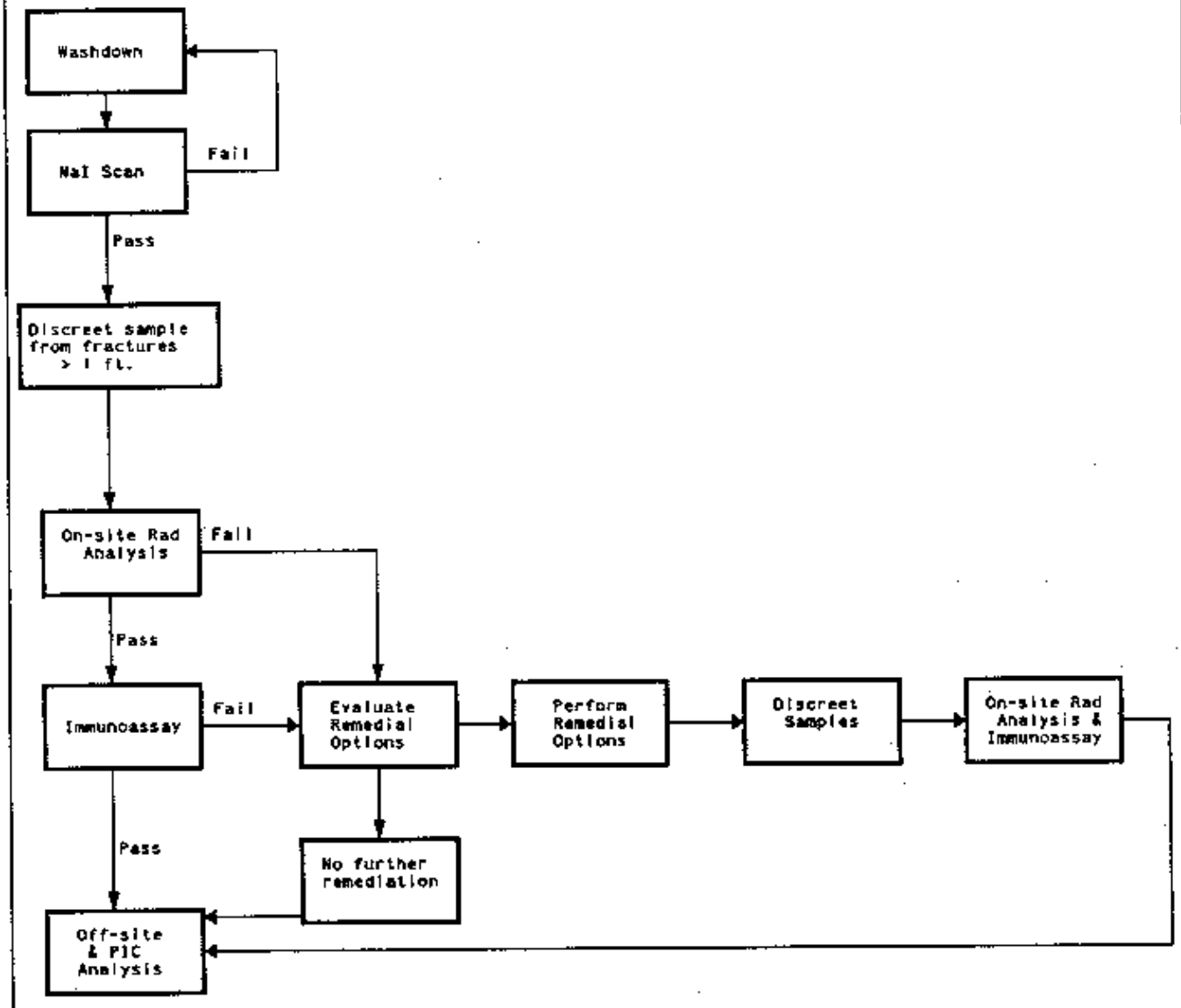
3.2 Fractured Rock Sampling

3.2.1 Quarry Walls

Sampling rock faces will focus on soil in fractures. Following the initial washdown, a scan with an NaI meter will be performed on accessible areas of rock and fracture (Figure 3-2). Based on field judgement, further washdown will be performed on areas of high contamination. When washdown is complete, a composite soil sample from the 0 cm - 15 cm (0 in. - 6 in.) depth interval will be taken from accessible fractures with an aperture reaching 1 ft or greater. Due to the effectiveness of the washdown, there may not be enough soil remaining in fractures to sample. If NaI readings indicate elevated contamination levels, samples in the 15 cm - 30 cm (6 in.-1 ft), 30 cm - 60 cm (1 ft-2 ft), and 60 cm - 90 cm (2 ft-3 ft) depth intervals perpendicular to the face will also be taken, as possible.

3.2.2 Quarry Floor

The quarry floor comprises a series of relatively flat areas (benches) at different elevations. After washdown, each bench area will be divided into half-acre sections and then subdivided into quadrants. A radiological survey with an NaI detector will be performed in each quadrant, and additional remediation will be conducted if necessary. This process is illustrated



QUARRY FRACTURED ROCK SAMPLING DECISION PATH

FIGURE 3-2

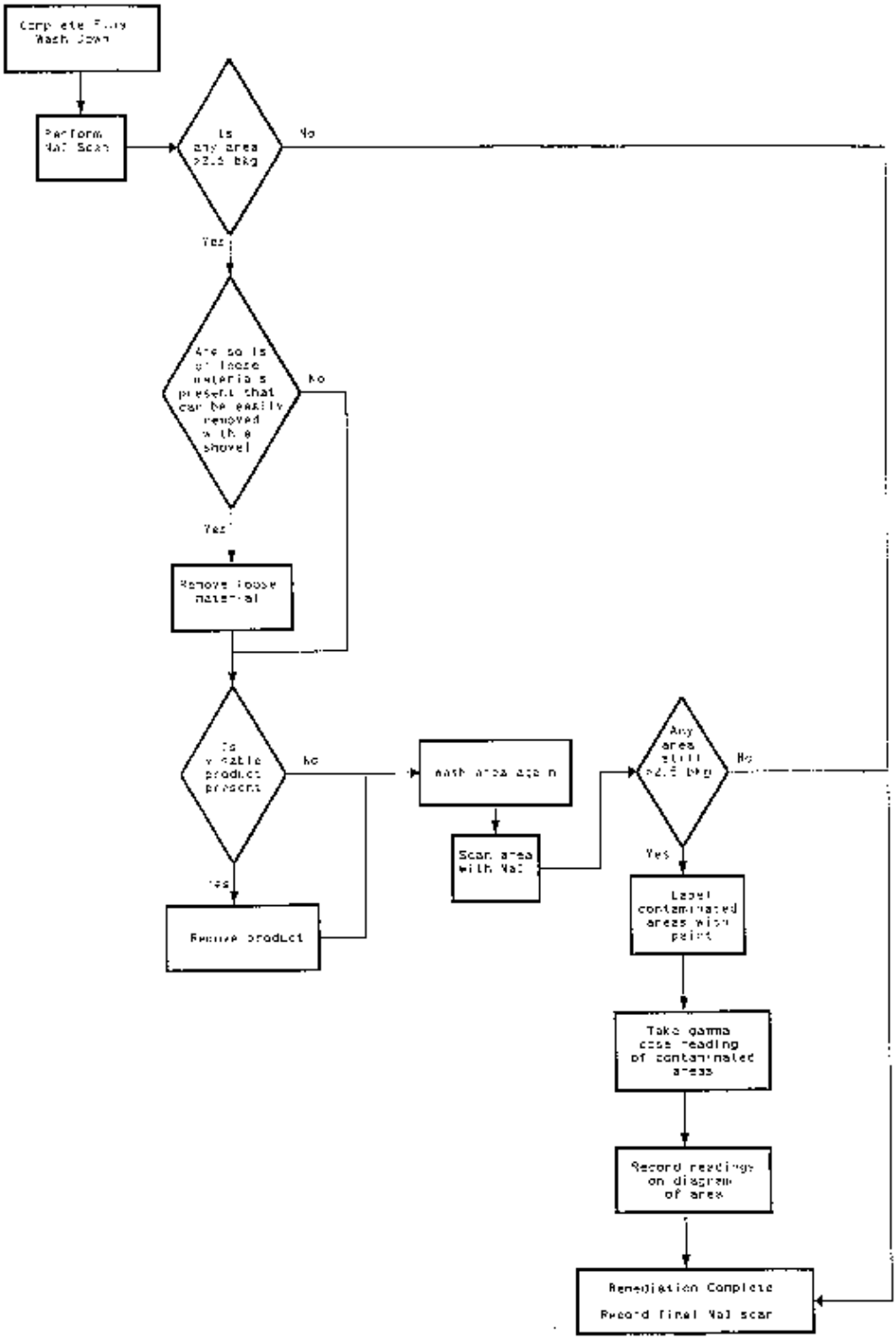
REPORT NO.: DOE/OR/21548-382		EXHIBIT NO.: A/PI/056/0495	
ORIGINATOR: WRG	DRAWN BY: GLN	DATE: 5/3/95	

in Figure 3-3. When the quarry floor decision process is complete, a composite soil sample representing the half-acre section will be collected in the following manner:

- Each composite will comprise no more than 10 subsamples.
- No more than four subsamples will be collected from any one quadrant of the section.
- All subsample locations will be marked and identified on a map.
- Each subsample will contain approximately 1 kg of soil and will be collected from areas containing more than 10 kg of soil.
- Each subsample will be split in the laboratory. Half of the sample will be archived and half will be composited with the other subsamples from the section. Individual archived samples may be analyzed if the composite exceeds the target criteria.
- Each composite will be split into two aliquots. One aliquot will be analyzed for radionuclides and TNT (immunoassay) in the on-site laboratory. The remaining aliquot will be composited with aliquots from the three adjacent half-acre sections and analyzed off site for metals, PCBs, and PAHs.

3.3 Adjacent Soil Areas Outside the Quarry Fence

Although the scope of this plan is limited to the quarry proper, areas that are outside but adjacent to the quarry fence and were potentially impacted by previous quarry operations will also be assessed under this plan. The two major areas that fit these criteria are the hill west of the west slope and the area outside the gate near the northeast slope area. Radiological scans will be performed in each of these areas, and soil sampling and/or borings may be collected from these areas if the scans or other information indicates that contamination may be present.



FLOOR/FRACTURE REMEDIATION

FIGURE 3-3

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Following final bulk waste excavation, pressurized ionization chamber meters will be placed at three locations in each distinct area of the quarry (i.e., each bench) to determine external γ (gamma) exposure.

4 REFERENCES

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MK-Ferguson Company
Weldon Spring Site Remedial Action Project

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Purpose of Transmittal: Request for Department of Energy acceptance of contract deliverable.

The Project Management Contractor has reviewed and approved the attached document and hereby delivers it to the U.S. Department of Energy, Weldon Spring Site Office.

The document will be considered accepted unless we receive written notification to the contrary within 30 days of the date of this transmittal.

James R. Powers
Project Director

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