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Radiological Verification  
Survey Results  
at 898 Black Oak Ridge Rd,  
Wayne, New Jersey  
(WJ004V)

R. E. Rodriguez  
C. A. Johnson

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HEALTH SCIENCES RESEARCH DIVISION  
Environmental Restoration and Waste Management Non-Defense Programs  
(Activity No. EX 20 20 01 0; ADS317AEX))

## **Radiological Verification Survey Results at 898 Black Oak Ridge Road, Wayne, New Jersey (WJ004V)**

R. E. Rodriguez and C. A. Johnson

Date issued —May 1995

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## ABSTRACT

The U. S. Department of Energy (DOE) conducted remedial action during 1993 at the Pompton Plains Railroad Spur and eight vicinity properties in the Wayne and Pequannock Townships in New Jersey as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP). These properties are in the vicinity of the DOE-owned Wayne Interim Storage Site (WISS), formerly the W. R. Grace facility. The property at 898 Black Oak Ridge Road, Wayne, New Jersey is one of these vicinity properties.

At the request of DOE, a team from Oak Ridge National Laboratory conducted an independent radiological verification survey at this property. The purpose of the survey, conducted between September and December 1993, was to confirm the success of the remedial actions performed to remove any radioactive materials in excess of the identified guidelines. The verification survey included surface gamma scans and gamma readings at one meter, beta-gamma scans, and the collection of soil and debris samples for radionuclide analysis.

Results of the survey demonstrated that all radiological measurements on the property at 898 Black Oak Ridge Road were within applicable DOE guidelines. Based on the results of the remedial action data and confirmed by the verification survey data, the portions of the site that had been remediated during this action successfully meet the DOE remedial action objectives.

# RADIOLOGICAL VERIFICATION SURVEY RESULTS AT 898 BLACK OAK RIDGE ROAD, WAYNE, NEW JERSEY (WJ004V)\*

## INTRODUCTION

As part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), the Department of Energy (DOE) conducted a remedial action project in 1993 at several residential vicinity properties in the Townships of Pequannock and Wayne, New Jersey. Figure 1 shows the general location of these vicinity properties.

From September to December 1993, a team from the Measurements Application and Development Group, Oak Ridge National Laboratory (ORNL), conducted radiological verification surveys of these properties in the Wayne and Pequannock, New Jersey areas. The property at 898 Black Oak Ridge Rd., Wayne, New Jersey was one of the properties that had previously been surveyed and designated for remedial action. After completion of the remediation, the team from ORNL conducted a radiological verification survey of this property at the request of DOE. The verification survey consisted primarily of a complete gamma scan of the grounds and the collection of soil samples for radionuclide analysis.

This report describes the radiological verification survey of the private residential property at 898 Black Oak Ridge Rd., Wayne, New Jersey, conducted by ORNL at the request of the Department of Energy's Office of Environmental Restoration.

The property at 898 Black Oak Ridge Rd., is a single family, wood frame dwelling with separate garage and shed, and gravel driveway. The property grounds extend ~200 ft east of the house, and include a culvert on the far east end (Fig. 2). The DOE-owned Wayne Interim Storage Site (WISS) is adjacent to the south side of the property.

A walkover survey of the property (a technician walks slowly over the property swinging a detection probe at ~1-2 inches from the ground surface) was conducted in September and October of 1993 by ORNL's Measurement Applications and Development Group. The purpose of the survey was to determine whether any radiological contamination might remain on the property.

Field survey drawings showing 10-m grids and indicating soil sampling locations and gamma radiation measurements are included in this report as Figs. 3 and 4.

## SCOPE OF THE SURVEY

A comprehensive description of the survey methods and instrumentation used in this survey is given in *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, ORNL/TM-8600 (April 1987), and *Measurement Applications and Development Group Guidelines*, ORNL-6782 (January 1995).

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\* The survey was performed by members of the Measurement Applications and Development Group of the Health Sciences Research Division at Oak Ridge National Laboratory under DOE contract DE-AC05-84OR21400.

The radiological survey of this property included: (1) a surface gamma scan of the entire grounds and driveway, and (2) the collection of surface and subsurface soil samples and miscellaneous rock materials for analysis.

Gamma radiation levels were determined using a portable sodium iodide (NaI) gamma scintillation detector connected to a Victoreen ratemeter. Measurements were recorded and converted to  $\mu\text{R/h}$ . Because NaI gamma scintillators are energy dependent, measurements of gamma radiation levels in counts per minute (CPM) are normalized to pressurized ionization chamber (PIC) measurements to estimate gamma exposure rates in  $\mu\text{R/h}$ .

Surface (0-15 cm, or 0 to 6 in) and subsurface (15-45 cm, or 6 to 18 in) soil samples were collected at various locations over the property. Confirmatory samples were taken from the remediated areas on the northwestern and eastern quadrants of the property. These are referred to as biased samples and are labeled as B1 to B6. Systematic samples (S1 to S31) were taken at locations irrespective of gamma exposure rates. Locations of the samples are shown in Figs. 3 and 4, and results of the analyses are shown in Table 1.

Direct measurement results presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background radiation levels have not been subtracted from radionuclide concentrations measured in environmental samples.

## VERIFICATION SURVEY AND ANALYSIS

Gamma measurements at one meter from the surface ranged from 9 to 15  $\mu\text{R/h}$  over all the property as shown on Figs. 3 and 4. Surface gamma readings varied. Gamma levels measured at the surface of the lawn and drive ranged from 18 to 33  $\mu\text{R/h}$ , and up to 50  $\mu\text{R/h}$  on contact with the south wall of the culvert. All of these measurements are comparable to background levels in the northern New Jersey area. Rocks from the culvert area measured from 40 to 132  $\mu\text{R/h}$  on contact. This high level of gamma activity is attributable to the naturally occurring radiological elements in the rocks and gravel found in the Wayne area.

Surface and subsurface soil samples were collected systematically from the front and back yards of the property, including from all of the remediated areas. Biased samples were also taken from the gravel driveway and from the culvert on the east end of the property where elevated gamma levels were measured. Samples S12 - S31 and B4 - B6 were all taken from the remediated area on the east end of the property (see Fig. 4). Grid locations are shown in Table 1. Two samples were chipped from rocks found near the culvert and labeled as miscellaneous samples M1 and M2. All samples were analyzed for radium ( $^{226}\text{Ra}$ ), thorium ( $^{232}\text{Th}$ ), and uranium ( $^{238}\text{U}$ ).

Results of the soil analyses are in picocuries per gram (pCi/g) and are shown in Table 1. Radionuclide concentrations of  $^{226}\text{Ra}$  (including surface and subsurface soil) in systematic samples ranged from 0.43 to 2.2 pCi/g and from 0.60 to 8.0 pCi/g in the biased samples. Concentrations of  $^{232}\text{Th}$  in systematic samples ranged from 0.83 to 3.5 pCi/g and from 1.2 to 4.5 pCi/g in biased samples (maximum values for  $^{226}\text{Ra}$  and  $^{232}\text{Th}$



were in the samples taken from the gravel driveway). These values are all below the DOE guideline for these radionuclides in soil which is 5 and 15 pCi/g above background averaged over 100 m<sup>2</sup> for surface and subsurface soil, respectively.\*

Concentrations of <sup>238</sup>U in soil ranged from 0.48 to 2.8 pCi/g in systematic samples, and from 0.97 to 8.0 pCi/g in the biased samples. These values are well below the site specific guidelines for uranium in soil.\*\*

Analysis of the rock samples from the culvert ditch area (M1 and M2, Table 1) showed higher than normal concentrations of all three radionuclides that occur naturally in some rocks of this area.

## CONCLUSIONS

Gamma measurements on the property at 898 Black Oak Ridge Rd., Wayne, New Jersey were comparable to the average values for the area. The previously remediated areas on the grounds of the property were thoroughly investigated for radionuclide residues. The results of soil radionuclide analysis for <sup>238</sup>U, <sup>226</sup>Ra, and <sup>232</sup>Th indicate that all soil concentration measurements are within the limits prescribed by DOE radiological guidelines. The slightly elevated gamma measurements found on the driveway are attributable to the naturally occurring radiological elements in the gravel used in the Wayne area, as can be seen by the typical concentrations of radionuclides in samples from the graveled driveway.

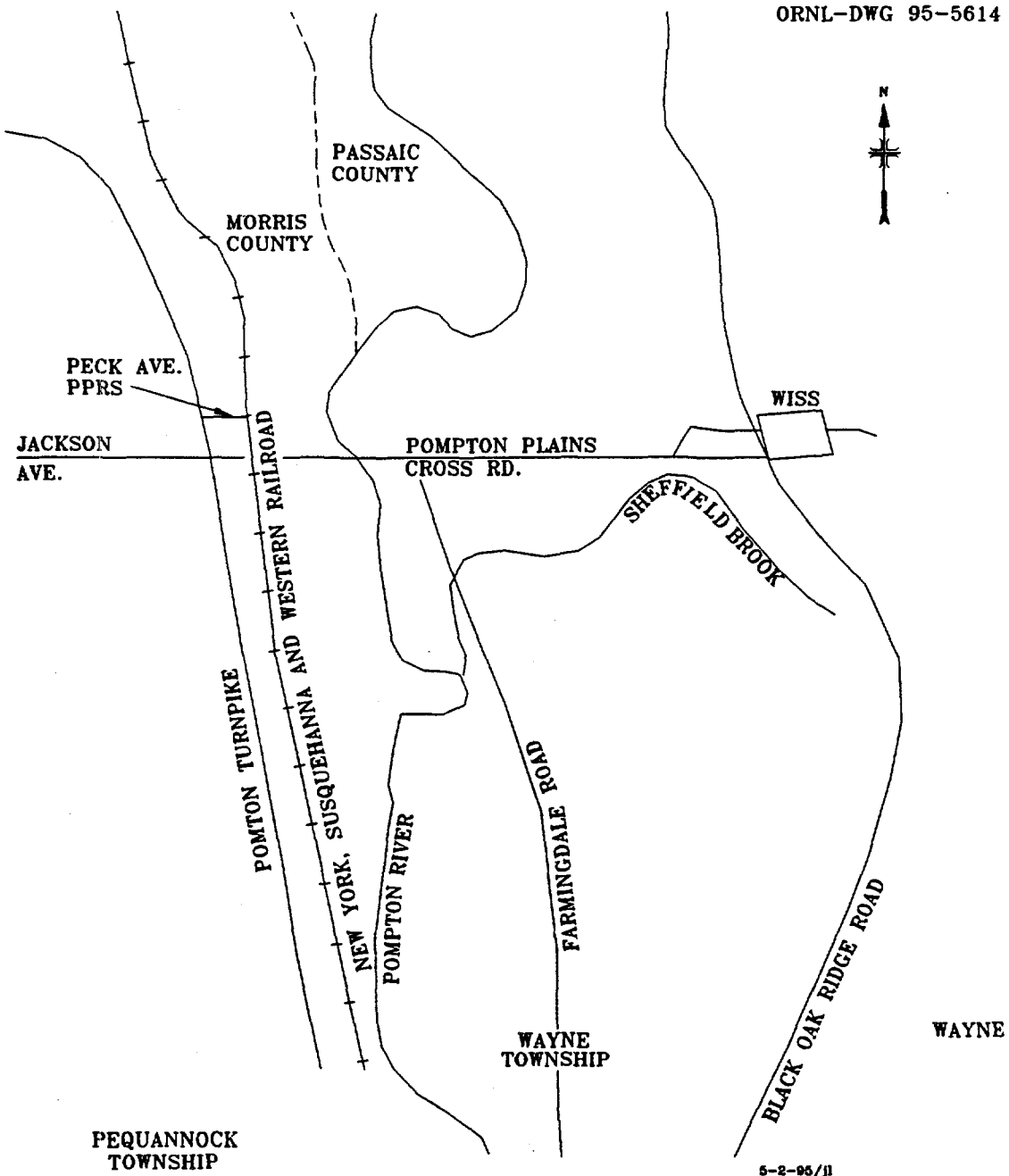
Based on the results of the remedial action data and confirmed by the verification survey data, all radiological measurements fall below the limits prescribed by DOE radiological guidelines established for this site. It is concluded that the portions of the site which had been remediated during this action successfully meet the DOE remedial action objectives.

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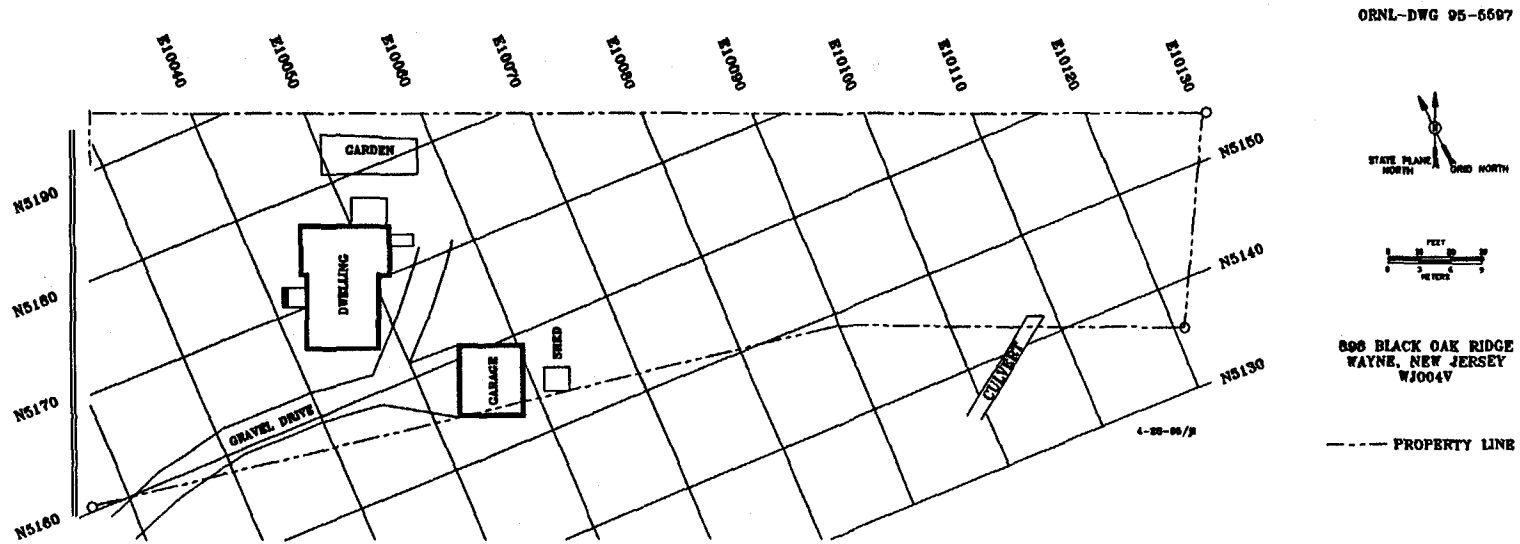
\* For residential properties in this area, the guideline for <sup>232</sup>Th is 5 pCi/g for both surface and subsurface soil.

\*\* DOE guidelines for uranium are derived on a site-specific basis. Guidelines of 100 pCi/g have been applied to this FUSRAP site. Source: Memo, J. W. Wagoner II, Director, Division of Off-Site Programs, Office of Environmental Restoration, U. S. Department of Energy, to L. K. Price, Director, Former Sites Restoration Division, Oak Ridge Field Office, U. S. DOE, April 25, 1995.

ORNL-DWG 95-5614



**Fig. 1. Diagram showing general location of the Wayne Interim Storage Site (WISS) relative to the Wayne and Pequannock, New Jersey vicinity properties.**



**Fig. 2. Diagram showing the overall view of the property at 898 Black Oak Ridge Rd., Wayne, N. J. The Wayne Interim Storage Site borders the south and east sides of the property.**

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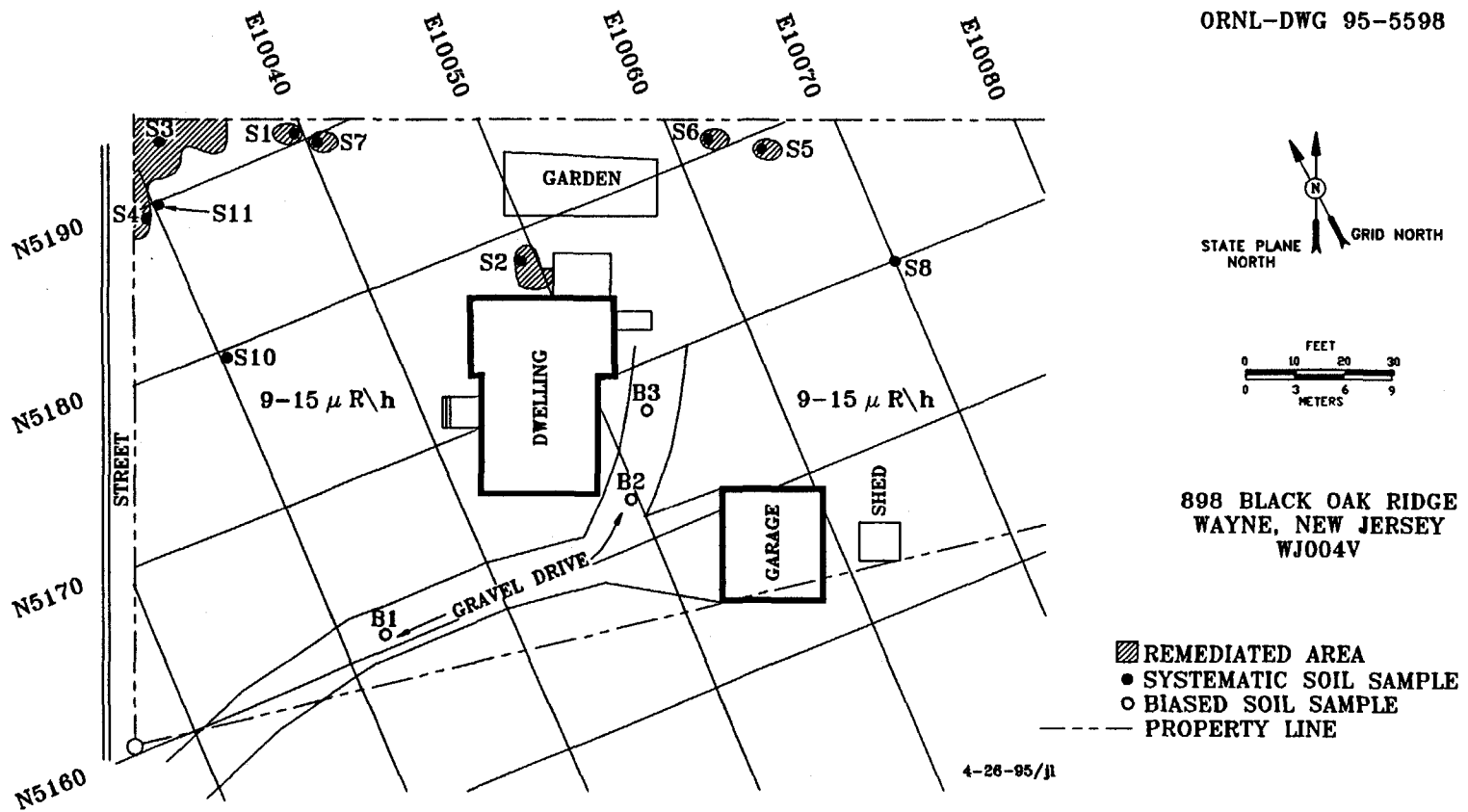


Fig. 3. Diagram of the west end of the property at 898 Black Oak Ridge Rd., showing remediated areas, gamma radiation levels, and the locations of soil samples.

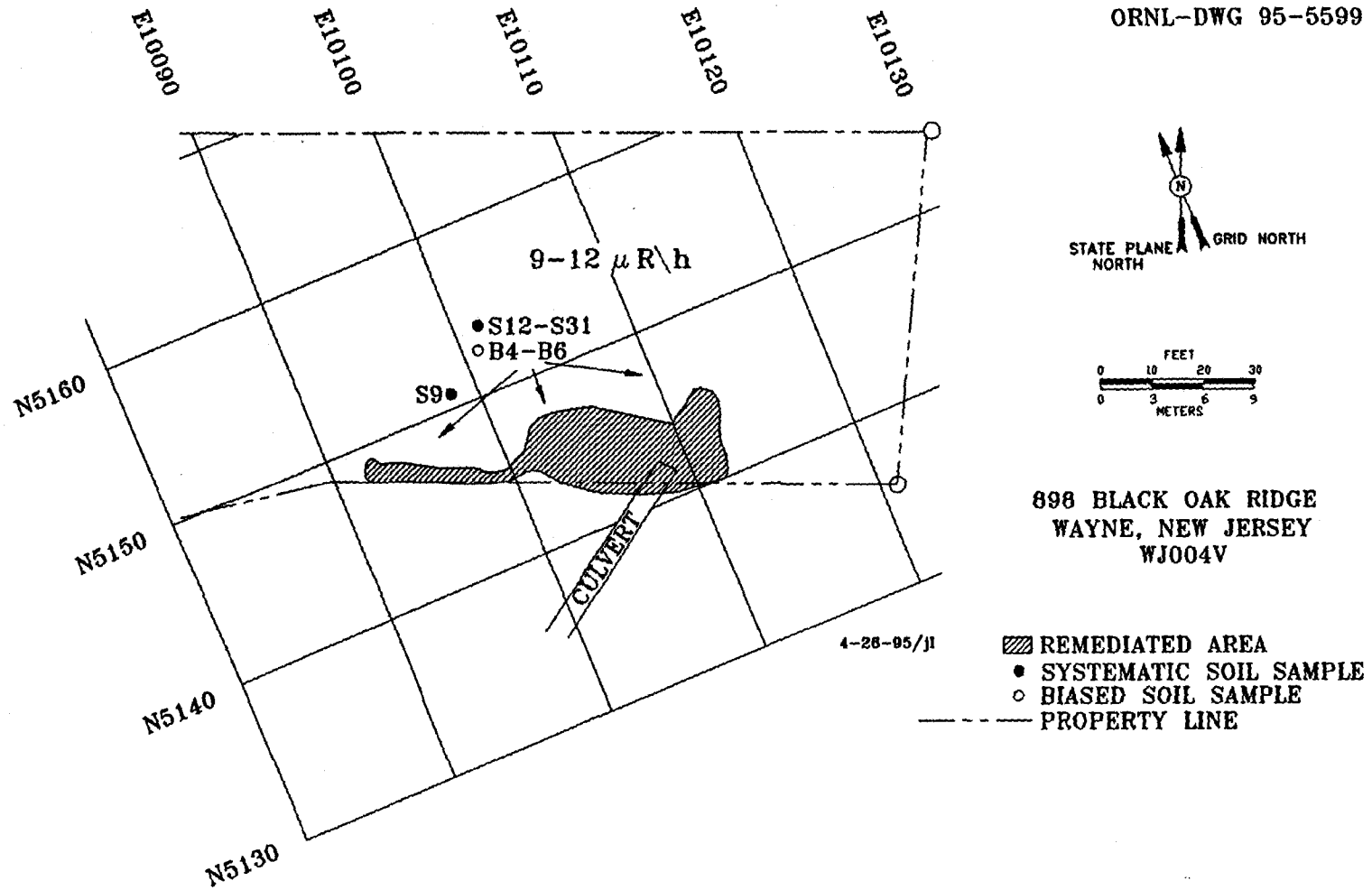


Fig. 4. Diagram of the east end of the property at 898 Black Oak Ridge Rd., showing the culvert and remediated area where soil and rock samples were taken. Grid locations for the soil samples are shown in Table 1.

**Table 1. Concentrations of radionuclides in soil and other materials at 898 Black Oak Ridge Rd., Wayne, New Jersey (WJ004V)**

Sample number <sup>a</sup>	Grid location	Depth (cm)	Radionuclide concentration (pCi/g) <sup>b</sup>		
			<sup>238</sup> U	<sup>226</sup> Ra	<sup>232</sup> Th
<i>Systematic samples<sup>c</sup></i>					
S01	5091N,10041E	15-25	1.3 ± 0.4	0.54 ± 0.07	2.3 ± 0.14
S02	5178N,10049E	15-30	2.8 ± 0.6	0.65 ± 0.06	3.5 ± 0.14
S03	5193N,10032E	0-8	2.5 ± 1	0.52 ± 0.06	1.2 ± 0.11
S04	5189N,10028E	0-8	1.2 ± 0.3	0.51 ± 0.06	1.3 ± 0.13
S05	5177N,10071E	0-8	2.3 ± 0.3	0.64 ± 0.09	1.6 ± 0.19
S06	5179N,10064E	0-8	1.3 ± 0.4	0.75 ± 0.08	3.0 ± 0.19
S07	5190N,10040E	0-8	1.5 ± 0.4	0.71 ± 0.12	2.8 ± 0.23
S08	5170N,10070E	0-15	1.5 ± 0.8	0.62 ± 0.08	1.1 ± 0.17
S09	5152N,10098E	0-15	1.4 ± 0.7	0.61 ± 0.07	1.1 ± 0.13
S10	5180N,10030E	0-15	1.1 ± 0.3	0.66 ± 0.07	0.83 ± 0.16
S11	5190N,10030E	0-15	1.1 ± 0.2	0.68 ± 0.08	1.2 ± 0.14
S12	5142N,10111E	0-8	0.48 ± 0.1	0.58 ± 0.07	0.88 ± 0.12
S13	5146N,10096E	0-10	1.2 ± 0.3	0.61 ± 0.05	0.90 ± 0.09
S14	5146N,10098E	0-15	1.2 ± 0.3	1.2 ± 0.07	1.3 ± 0.11
S15	5145.5N,10100E	0-8	2.0 ± 0.7	0.76 ± 0.05	0.95 ± 0.13
S16	5145N,10103E	0-15	1.1 ± 0.3	0.86 ± 0.08	1.1 ± 0.14
S17	5146N,10103E	0-15	0.96 ± 0.2	0.78 ± 0.06	1.1 ± 0.14
S18	5147N,10105E	0-15	1.3 ± 0.6	0.90 ± 0.08	1.2 ± 0.12
S19	5142N,10106E	0-8	1.5 ± 0.3	1.3 ± 0.03	1.3 ± 0.05
S20	5142N,10107E	0-8	1.6 ± 0.5	1.3 ± 0.04	2.1 ± 0.07
S21	5143N,10107E	0-15	1.1 ± 0.2	0.72 ± 0.09	1.3 ± 0.15
S22	5144N,10106E	0-10	1.4 ± 0.3	1.0 ± 0.08	1.1 ± 0.14
S23	5144N,10108E	0-10	1.9 ± 0.6	2.2 ± 0.04	1.8 ± 0.06
S24	5145N,10108E	0-5	1.8 ± 0.4	1.4 ± 0.06	1.5 ± 0.10

Table 1 (continued)

Sample number <sup>a</sup>	Grid location	Depth (cm)	Radionuclide concentration (pCi/g) <sup>b</sup>		
			<sup>238</sup> U	<sup>226</sup> Ra	<sup>232</sup> Th
S25	5142N,10108E	0-8	1.4 ± 0.25	0.82± 0.07	1.1 ± 0.13
S26	5142N,10107.5E	0-15	1.6 ± 0.40	0.75± 0.07	1.1 ± 0.12
S27	5141.5N,10107E	0-15	1.9 ± 0.52	1.7 ± 0.08	2.0 ± 0.13
S28	5140.5N,10108E	0-15	2.0 ± 0.36	2.1 ± 0.11	2.0 ± 0.18
S29	5145.5N,10111E	0-10	0.63± 0.24	0.68± 0.07	0.99± 0.13
S30A	5140N,10111E	0-8	0.88± 0.18	0.43± 0.07	1.1 ± 0.14
S30B		0-8	1.2 ± 0.50	0.71± 0.08	0.97± 0.14
S31	5141N,10111E	0-8	1.0 ± 0.22	0.67± 0.08	0.91± 0.13
<i>Biased samples<sup>d</sup></i>					
B1A	5161N,10034E	0-5	8.0 ± 1.1	8.0 ± 0.50	2.3± 0.12
B1B		5-15	1.4 ± 0.50	0.62± 0.04	1.7± 0.08
B2A	5163N,10049E	0-5	2.5 ± 0.62	1.6 ± 0.20	4.5± 0.49
B2B		5-15	1.9 ± 0.51	1.1 ± 0.18	2.8± 0.37
B2C		15-30	0.97± 0.30	0.80± 0.11	1.4± 0.24
B3	5167N,10052E	0-5	2.7 ± 0.53	1.4 ± 0.12	4.1± 0.30
B4	5154N,10108E	0-0	3.9 ± 0.50	4.2 ± 0.16	2.3± 0.23
B5A	5143N,10106E	0-10	2.2 ± 0.43	2.5 ± 0.11	2.0± 0.14
B5B		10-25	1.7 ± 0.42	1.5 ± 0.11	1.4± 0.14
B6	5140N,10115E	0-8	1.5 ± 0.39	0.60± 0.03	1.2± 0.10

Table 1 (continued)

Sample number	Depth (cm)	Radionuclide concentration (pCi/g) <sup>b</sup>		
		<sup>238</sup> U	<sup>226</sup> Ra	<sup>232</sup> Th
<i>Miscellaneous samples<sup>e</sup></i>				
M001	0-0	15000± 4000	19000± 1000	600± 200
M002A	0-0	80± 22	100± 10	2.4± 1.2
M002B	0-0	130± 25	150± 10	3.5± 0.60

<sup>a</sup>Locations of soil samples are shown on Figs. 3 and 4.

<sup>b</sup> Indicated counting error is at the 95% confidence level ( $\pm 2\sigma$ ).

<sup>c</sup> Systematic samples are taken at locations irrespective of gamma exposure rates.

<sup>d</sup> Biased samples are taken from areas with elevated gamma exposure rates.

<sup>e</sup> Miscellaneous samples were chippings from granite-like rocks chosen randomly in the culvert area on the east end of the property (see Fig. 4 for location of culvert area).



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