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PRELIMINARY SITE SURVEY REPORT FOR THE UNIROYAL CHEMICAL COMPANY, FORMERLY THE DIAMOND MAGNESIUM COMPANY, 720 FAIRPORT–NURSERY ROAD, PAINESVILLE, OHIO (DMP001)

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ABSTRACT

At the request of the U.S. Department of Energy (DOE), a group from Oak Ridge National Laboratory conducted a preliminary radiological survey at the Uniroyal Chemical Company, formerly the Diamond Magnesium Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001), in 1988. The purpose of the survey was to determine whether the property was contaminated with radioactive residues from the former Manhattan Engineer District (MED) project. The scope of this preliminary survey primarily covered the area west of the buildings around the railroad car spill containment basin. The survey included direct measurement of gamma radiation levels at the surface and soil sampling for radionuclide analyses.

Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria for both ^{238}U and ^{226}Ra in soil. Based on the results of this radiological assessment, it is recommended that a follow-up, detailed radiological survey of both surface and subsurface environs be performed to more precisely define the extent of the contamination.

PRELIMINARY SITE SURVEY REPORT FOR THE UNIROYAL CHEMICAL COMPANY, FORMERLY THE DIAMOND MAGNESIUM COMPANY, 720 FAIRPORT–NURSERY ROAD, PAINESVILLE, OHIO (DMP001)*

INTRODUCTION

In the early 1940s, the Defense Plant Corporation constructed a magnesium reduction facility in Painesville, Ohio, on property owned by the Diamond Magnesium Company (DMC). In support of the war effort and later government operations, DMC operated this facility from the early 1940s to the early 1960s, for the General Services Administration (GSA). In early 1953, DMC received approximately 800 tons of "slightly" contaminated ferrous metal scrap released through GSA . The plant was excessed and sold by GSA in two parts around 1963. At that time, the Uniroyal Chemical Company purchased approximately 143 acres as commercial property, located at 720 Fairport–Nursery Road, Painesville, Ohio.[1]

Some of the original plant facilities are still used by Uniroyal today. Figures 1 and 2 depict the previous layout of DMC and the present layout of Uniroyal. The Uniroyal facility consists of several large buildings, covering about one–third of the property on the north side of Fairport–Nursery Road, as well as a waste lake west of the buildings (Fig. 2). Uniroyal did not purchase or utilize several lagoons south of this road, formerly used by DMC for sludge and equalization. West of the buildings, Uniroyal installed a butadiene storage tank and constructed an earthen dike around it (Figs. 3 and 4). The bottom of this dike was lined with stone. An overhead pipe rack system leads eastward from the butadiene storage tank, first to the railroad tank cars and then to a variety of other storage tanks closer to the buildings (Figs. 5 and 6). Southward along the railroad tracks and midway from the butadiene tank to the sewer ditch, Uniroyal installed a spill containment area with a spill retention basin and lined it with asphalt (Figs. 7 and 8). This area was designated to contain possible spills during the unloading of railroad tank cars. In the grassy area between the dike and the spill containment area and around the circumference of the butadiene tank (Figs. 3 and 4), Uniroyal buried fire water lines approximately three feet deep.

The ferrous metal scrap was generated from discarded iron drums and other items previously used to store uranium compounds involved with pitchblende operations. The scrap was then shipped to DMC from the Atomic Energy Commission (AEC) Storage Area at Lake Ontario. DMC utilized the scrap for its ferrous content; its radioactive

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

contamination was incidental to this use. The scrap metal was delivered via railroad cars on the western side of the property (Fig. 1). Conversations with former employees indicated an additional delivery route via the railroad on the eastern side of the buildings. From the eastern side, the scrap metal was either immediately added to the digester tanks of hydrochloric acid or stored on the ground on the north side of the building (Fig. 1). The ferrous metal was used to scrub chlorine gas generated during the magnesium production process. Hydrochloric acid oxidized the scrap metal to ferrous chloride. Chlorine gas released during magnesium reduction was bubbled through the ferrous chloride, further oxidizing it to ferric chloride which was then discarded.

Because the contamination of the scrap metal was related to AEC activities, a radiological survey of the facility was necessary to verify whether the site meets current radiological guidelines. The Formerly Utilized Sites Remedial Action Program (FUSRAP) was established for the U.S. Department of Energy (DOE) to verify radiological conditions of sites previously used by the Manhattan Engineer District (MED) project and AEC; then, if necessary and appropriate, to correct these conditions. The former DMC locale is one of these sites, identified as a result of DOE record reviews. DOE decided a preliminary radiological survey was required to verify the conditions of this property and determined whether further DOE actions would be warranted.

The principal radionuclide of concern is ^{238}U and its naturally occurring decay products. On October 10 and 11, 1988, the preliminary radiological survey at 720 Fairport–Nursery Road was conducted by members of the Measurement Applications and Development Group of the Oak Ridge National Laboratory. Soil samples were taken for further analyses during this time. The areas surveyed are shown in Figs. 3 through 8 and generally covered the section of the property west of the buildings from the west parking area to the fence south of the F. P. and E. Railroad tracks. During the survey, information was obtained concerning the other portions of the property which will be addressed on future efforts.

SURVEY METHODS

The radiological survey of the property included: (1) a gamma scan of selected portions of the property outdoors and (2) collection of surface and subsurface soil samples. No indoor survey measurements were performed. The survey methods followed the basic plan outlined in a correspondence from W. D. Cottrell to A. J. Whitman.[2] A comprehensive description of the survey methods and instrumentation has been presented in another report.[3]

Using a portable gamma scintillation meter, ranges of measurements were recorded for areas of the property surface (in μR/h). When an area exceeded the capacity of the gamma scintillation meter, an instrument with a Geiger–Müller (GM) type probe was used to measure surface radiation in this elevated area. The GM probe detects both beta and gamma radiation; therefore, measurements with this instrument were reported in mrad/h. Systematic soil samples were then obtained at randomly selected locations irrespective of gamma exposure rates. In addition, biased soil samples were collected in areas of elevated gamma levels. (Not all elevated areas were sampled, however.) The biased locations were sampled to depths of approximately 45 cm for an initial examination of possible subsurface soil contamination. Measurements were usually made and soil samples taken at 15–cm intervals. The samples were analyzed for ^{226}Ra, ^{232}Th, and ^{238}U content.

SURVEY RESULTS

Applicable DOE guidelines are summarized in Table 1.[4] The normal background radiation levels for the Ohio area are presented in Table 2.[5] These data are provided for comparison with survey results presented in this section. All direct measurement results presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations measured in soil samples.

Surface Gamma Radiation Levels

Gamma radiation levels measured during a gamma scan of selected portions of the property surface west of the buildings are given in Fig. 9. Gamma exposure rates over the major portion of the property ranged from 4 to 8 μR/h. However, the section involving the spill containment area and a number of smaller spots had elevated gamma levels, ranging up to 5 mrad/h at the ground surface. The larger areas of elevated measurements are shaded in Fig. 9. The two highest levels were within this shaded area. One spot, measuring 5 mrad/h on the surface, was found south of the pipe rack and yielded a "stone" with an exposure rate of 50 mrad/h at 1 cm. Soil sample B1 was taken from this location. The other spot, east of the flare stack, had gamma levels of 3 mrad/h on the surface and yielded a "stone", measuring 20 mrad/h at 1 cm. Soil sample B4 was taken from this area. Although the "stones" appeared to contain a majority of the activity, additional contamination was associated with each area. Elevated gamma levels were evident apparently under the asphalt in several places in the spill containment area; however, no samples were taken from beneath the asphalt. The fire water lines had been installed through the most heavily contaminated regions which ranged from 8 to 150 μR/h. Soil samples B3, B6, B7, and B8 were taken in this grassy area. The soil making up part of the dike was elevated, and high spots were found both inside and outside the dike wall and at the level of the surrounding soil. Soil sample B5 was taken near the flare stack in an area with exposure rates ranging from 16 to 28 μR/h. Other scattered spots ranged from 16 to 24 μR/h. A cluster of spots were found around the sanitation filter, south of the sewer ditch, measuring between 10 and 30 μR/h.

Systematic and Biased Soil Samples

Systematic and biased soil samples were taken from various locations on the property for radionuclide analyses. Locations of the systematic (S) and biased (B) samples are shown in Fig. 10, with results of laboratory analyses provided in Table 3. Concentrations of radium, thorium, and uranium in the systematic samples were all near background levels for the Ohio area (Table 2), ranging from 1.30 to 1.39 pCi/g, 1.14 to 1.33 pCi/g, and <1.51 to 1.91 pCi/g, respectively. Concentrations of radium, thorium, and uranium in the biased samples ranged from 1.92 to 1200 pCi/g, 0.54 to <2.81 pCi/g, and 2.04 to 130 pCi/g, respectively. DOE guidelines for uranium are derived on a site-specific basis. While none have been derived for this site, guidelines for ^{238}U typically range between 35 and 150 pCi/g.

Many of the biased soil samples were above DOE guideline values for radium and uranium (Table 1). Biased sample B6B contained the highest concentrations of these two radionuclides, with values of 1200 pCi/g for ^{226}Ra and 130 pCi/g for ^{238}U.

SIGNIFICANCE OF FINDINGS

Measurements and results of soil sample analyses taken at 720 Fairport–Nursery Road indicate that the property contained radioactive contamination, from both ^{238}U and ^{226}Ra. The concentration and extent of uranium and radium in several soil samples taken on this property were in excess of applicable DOE criteria (Table 1). These materials were found at all biased sample locations shown in Fig. 10. Based on the results of this radiological assessment, it is recommended that a follow-up, detailed radiological survey of both surface and subsurface environs be performed to more precisely define the extent of the contamination.

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3. T. E. Myrick, B. A. Berven, W. D. Cottrell, W. A. Goldsmith, and F. F. Haywood, *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, Oak Ridge National Laboratory, ORNL/TM-8600 (April 1987).

4. U.S. Department of Energy, *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites* (Rev. 2, March 1987).

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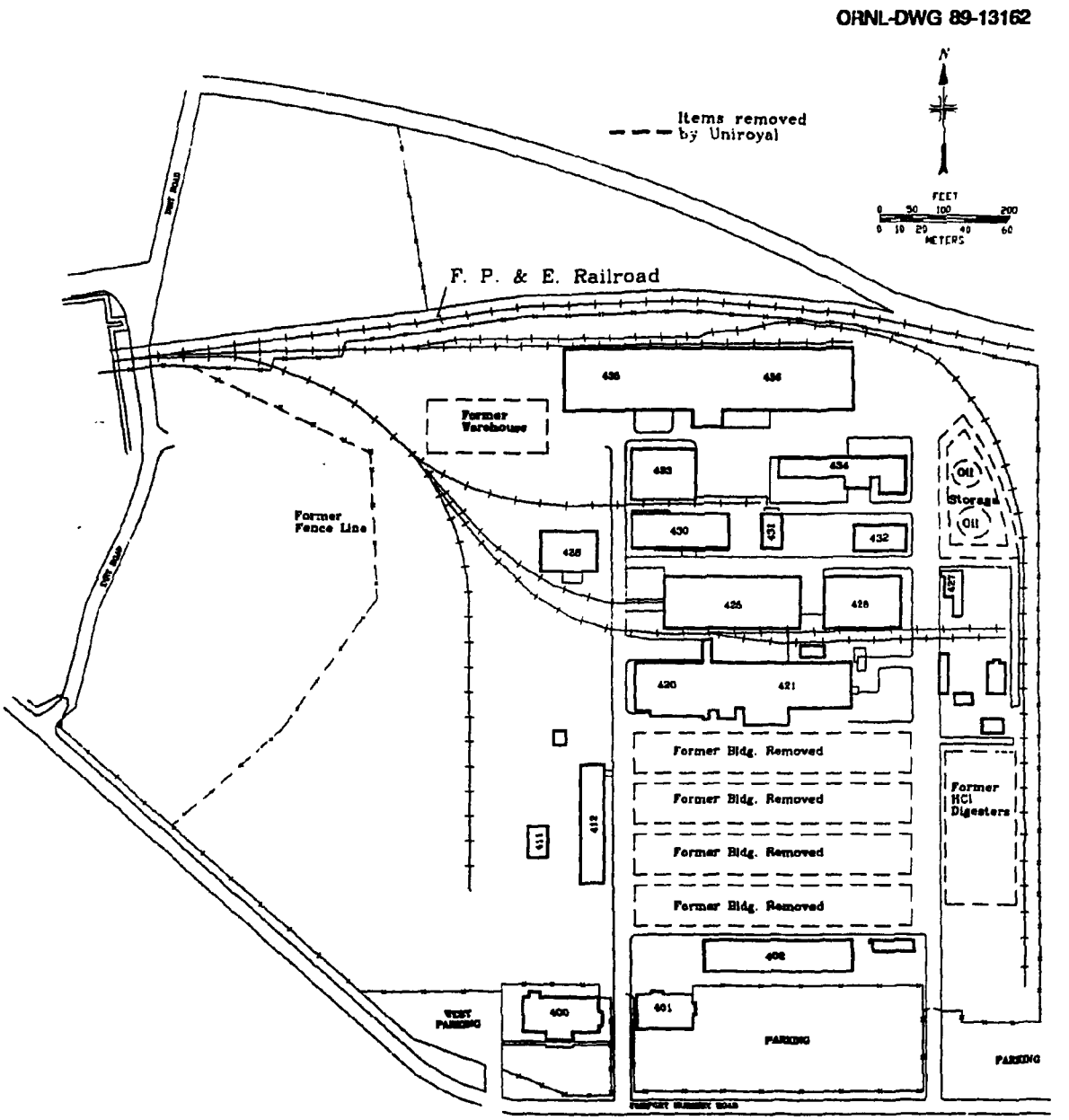

Fig. 1. Plot plan of the former Diamond Magnesium Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

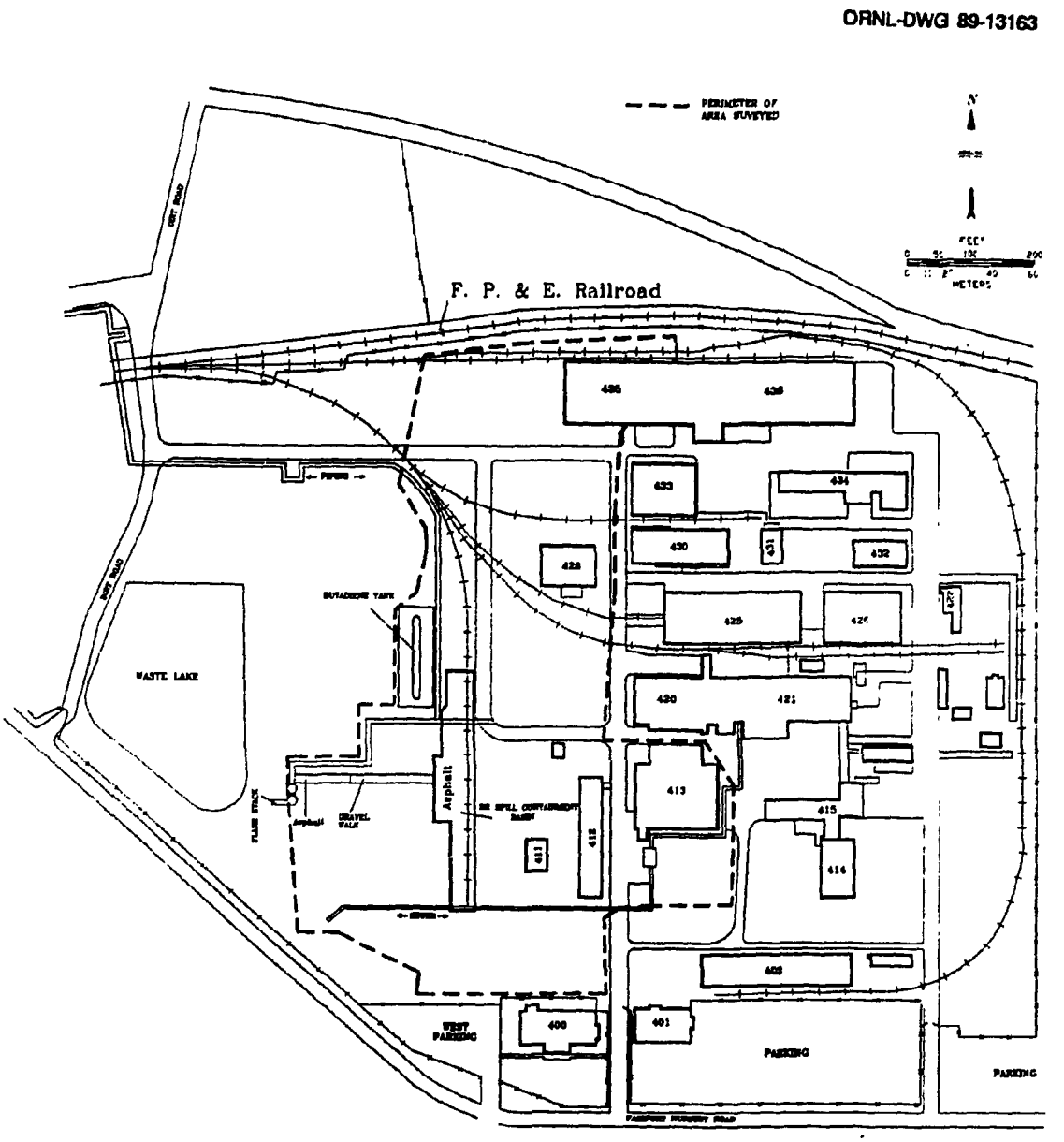

Fig. 2. Plot plan of the present Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

ORNL-PHOTO 3208-89

Fig. 3. View of the butadiene storage tank west of the buildings at Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

Fig. 4. Northwestern view of the butadiene storage tank and earthen dike at Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

ORNL-PHOTO 3210-89

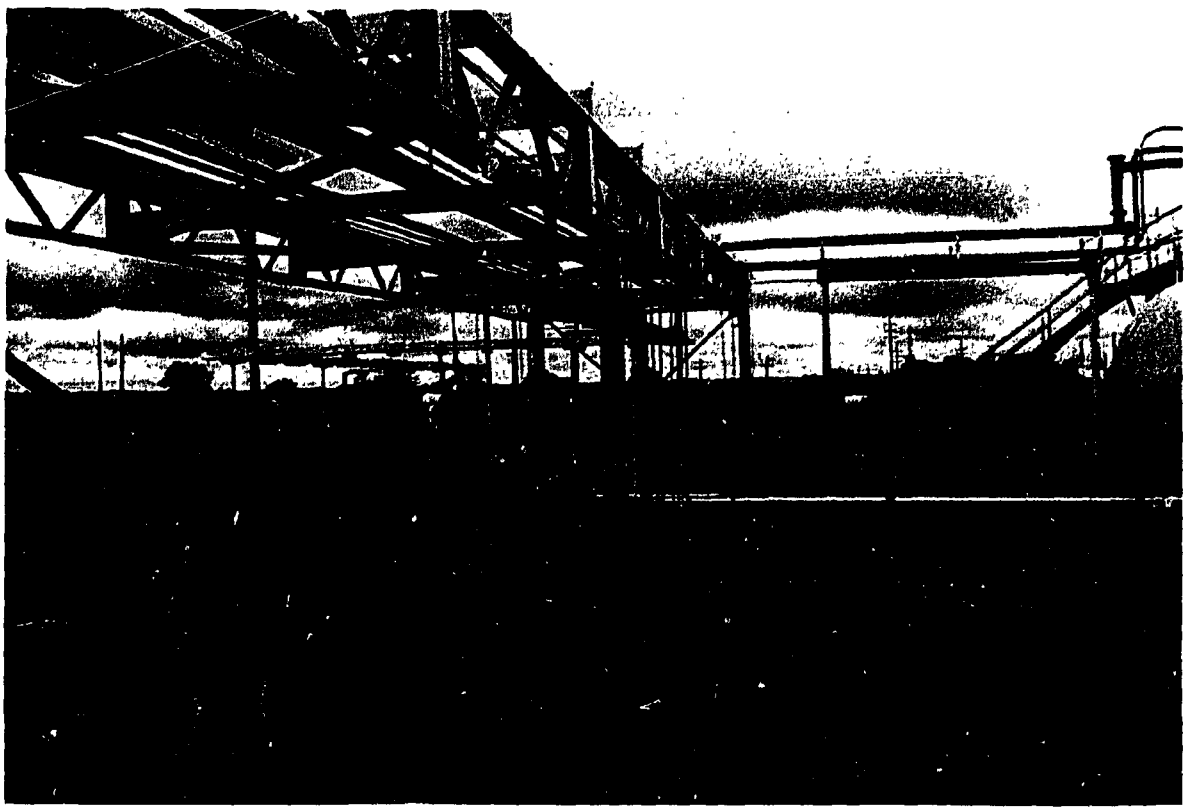

Fig. 5. Western view of the property, showing the overhead pipe rack system from the southern end of the butadiene storage tank at Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

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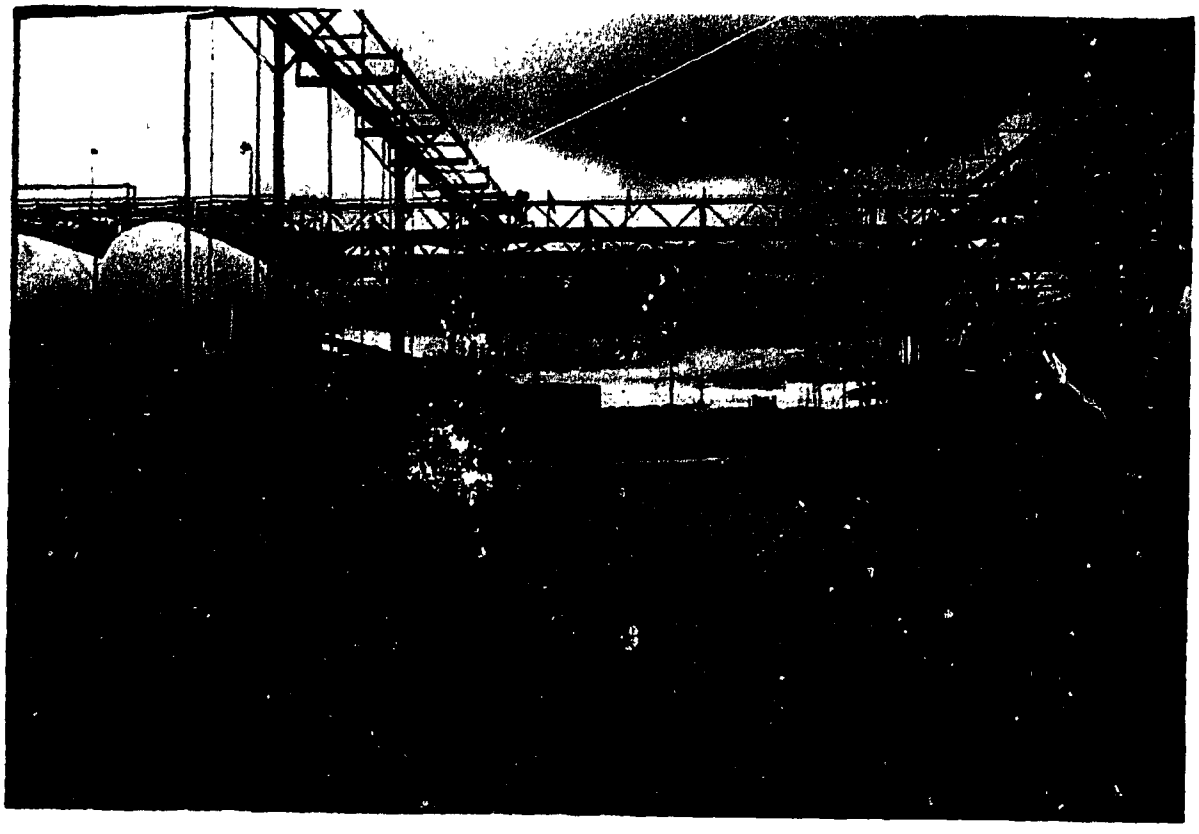

Fig. 6. Southern view of the overhead pipe rack system between the buildings on the left and the spill containment area on the right at Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

ORNL-PHOTO 3212-89

Fig. 7. Southern view of the spill containment area for railroad tank cars, showing the spill retention basin west of the buildings at Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

ORNL-PHOTO 3213-89

Fig. 8. Northern view of the property from the spill containment area west of the buildings at Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

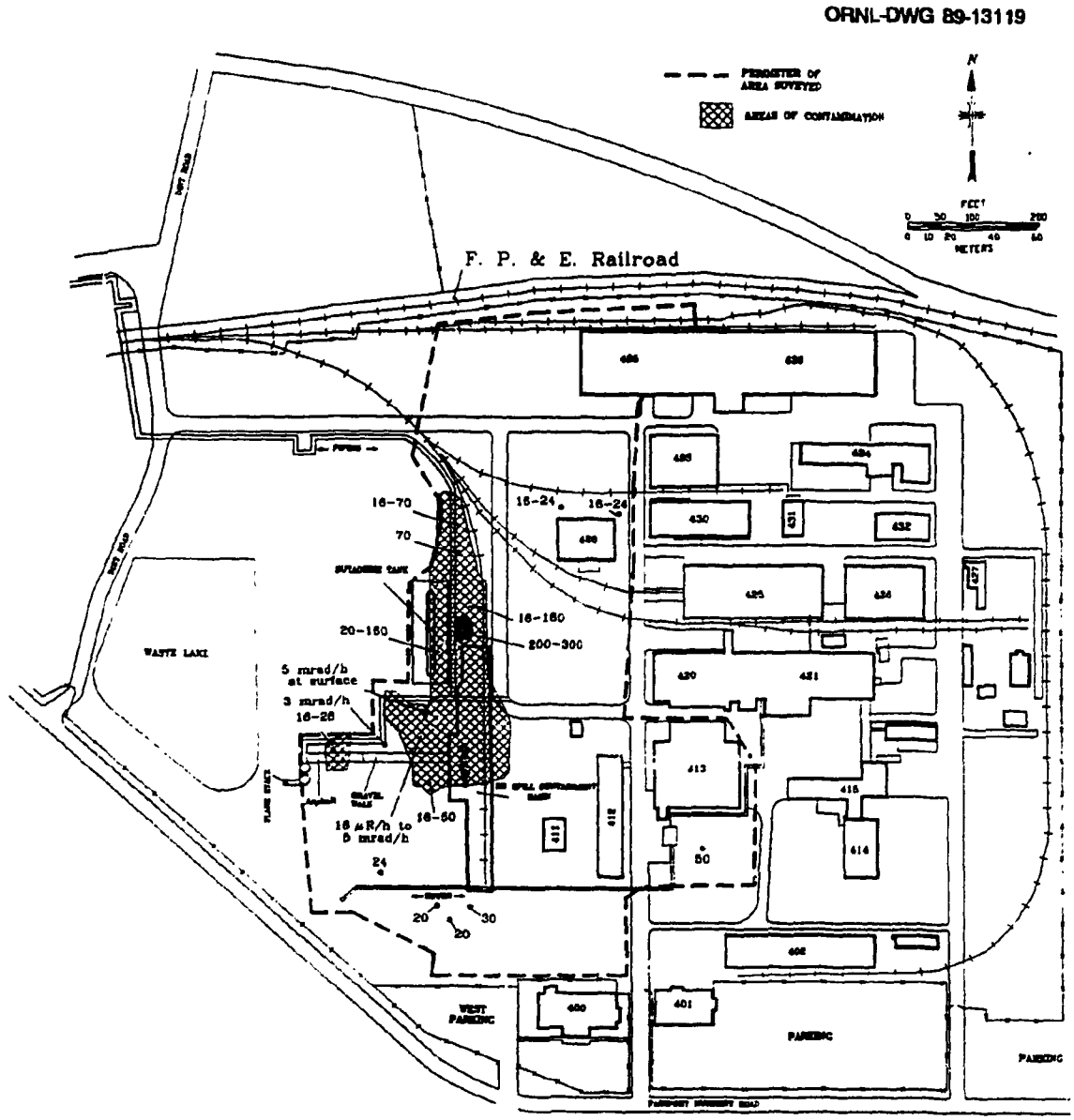

Fig. 9. Gamma radiation levels (μR/h) measured on selected portions of the property surface at Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

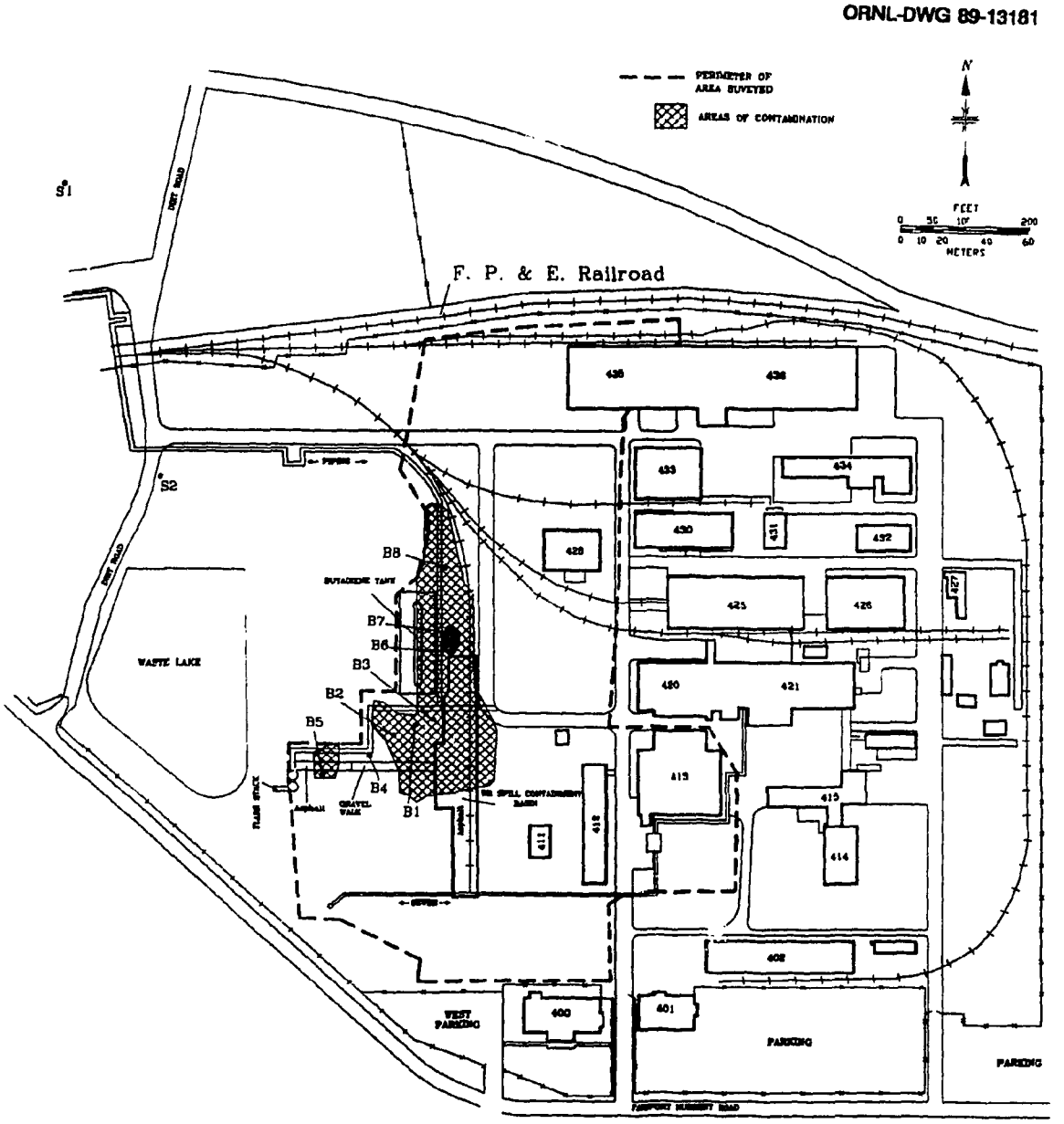

Fig. 10. Diagram showing locations of soil samples taken at Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001).

Table 1. Applicable guidelines for protection against radiation[a]

Mode of exposure	Exposure conditions	Guideline value
Radionuclide concentrations in soil	Maximum permissible concentration of the following radionuclides in soil above background levels averaged over 100 m^2 area	5 pCi/g averaged over the first 15-cm of soil below the surface; 15 pCi/g when averaged over 15-cm thick soil layers more than 15 cm below the surface
	^{232}Th	
	^{230}Th	
	^{228}Ra	
	^{226}Ra	
	^{238}U	Derived (site specific)[b]

[a]Reference 4.

[b]DOE guidelines for uranium are derived on a site-specific basis. While none have been derived for this site, guidelines for ^{238}U typically range between 35 and 150 pCi/g.

Table 2. Background radiation levels in soil from the Ohio area

Radionuclide	Concentration (pCi/g)[a]
^{226}Ra	0.9[b]
^{232}Th	0.9[b]
^{238}U	0.9[b]

[a]These values represent an average of normal radionuclide concentrations in this part of the state. Actual values may fluctuate.

[b]Reference 5.

Table 3. Concentrations of radionuclides in soil at Uniroyal Chemical Company, 720 Fairport–Nursery Road, Painesville, Ohio (DMP001)

Sample[b]	Depth (cm)	Radionuclide concentration (pCi/g)[a]		
		^{226}Ra	^{232}Th	^{238}U
		Systematic samples[c]		
S1A	0–15	1.30±0.02	1.33±0.04	1.88± 0.90
S1B	15–30	1.33±0.02	1.23±0.10	1.91± 0.36
S2	0–15	1.39±0.02	1.14±0.04	<1.51
		Biased samples[d]		
B1A	0–15	78.61±0.46	0.54±0.18	26.82± 8.06
B1B	15–30	12.87±0.18	0.82±0.16	19.65± 3.76
B2A	0–15	920 ±4.04	<2.06	<64.37
B2B	15–30	8.24±0.08	0.95±0.08	<5.01
B3A	0–15	150 ±0.54	0.93±0.30	64.39±13
B3B	15–30	17.68±0.06	1.13±0.04	15.05± 1.74
B3C	30–45	6.66±0.06	0.97±0.08	6.39± 1.68
B4A	0–15	100 ±0.50	0.96±0.28	<15.71
B4B	15–30	6.49±0.08	1.14±0.10	<4.79
B5A	0–15	18.72±0.12	0.94±0.08	5.84± 1.50
B5B	15–30	5.37±0.04	1.22±0.04	3.19± 0.42
B5C	30–45	1.92±0.04	1.23±0.08	2.04±1.26
B6A	0–15	240 ±0.58	1.18±0.32	51.23± 7.32
B6B	15–30	1200 ±2.68	<2.81	130 ±48
B7A	0–15	290 ±0.76	<0.80	53.37±10
B7B	15–30	360 ±1.14	<0.97	88.02±20
B7C	30–45	67.08±0.44	1.20±0.28	71.21±14
B8A	0–15	28.57±0.26	0.99±0.16	22.14± 4.5
B8B	15–30	130 ±0.56	1.04±0.30	65.10±13
B8C	30–45	83.68±0.30	0.93±0.20	74.19± 7.6

[a]Indicated counting error is at the 95% confidence level (±2σ).

[b]Locations of soil samples are shown on Fig. 10.

[c]Systematic samples are taken at locations irrespective of gamma exposure rates.

[d]Biased samples are taken from areas with elevated gamma exposure rates.