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**RESULTS OF RADIOLOGICAL  
MEASUREMENTS TAKEN IN THE  
NIAGARA FALLS, NEW YORK,  
AREA (NF002)**

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OPERATED BY  
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RESULTS OF RADIOLOGICAL MEASUREMENTS TAKEN IN THE  
NIAGARA FALLS, NEW YORK, AREA (NF002)

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## ABSTRACT

The results of a radiological survey of 100 elevated gamma radiation anomalies in the Niagara Falls, New York, area are presented in this report. These radiation anomalies were identified by a mobile gamma scanning survey during the period October 3-16, 1984, and were recommended for an onsite survey to determine if the elevated levels of radiation may be related to the transportation of radioactive waste material to the Lake Ontario Ordnance Works for storage. In this survey, radiological measurements included outdoor gamma exposure rates at 1 m above the surface; outdoor gamma exposure rates at the surface, range of gamma exposure rates during scan; and uranium, radium, and thorium concentrations in biased surface soil samples.

The results show 38 anomalies (35 located along Pletcher Road and 3 associated with other unrelated locations) were found to exceed Formerly Utilized Sites Remedial Action Program (FUSRAP) remedial action guidelines and were recommended for formal characterization surveys. (Since the time of this survey, remedial actions have been conducted on the 38 anomalies identified as exceeding FUSRAP guidelines, and the radioactive material above guidelines has been removed.) The remaining 62 anomalies are associated with asphalt driveways and parking lots, which used a phosphate slag material (previously identified as cyclowollastonite, synthetic  $\text{CaSiO}_3$ ). This rocky-slag waste material was used for bedding under asphalt surfaces and in general gravel applications. Most of the contaminated soil and rock samples collected at the latter anomalies had approximately equal concentrations of  $^{226}\text{Ra}$  and  $^{238}\text{U}$  and, therefore, are not related to materials connected with the Niagara Falls Storage Site (NFSS), including material that was transported to the NFSS.

## INTRODUCTION

A mobile gamma scanning survey was conducted of some streets in Niagara Falls, New York, and the surrounding area by the Radiological Survey Activities (RSA) group of Oak Ridge National Laboratory (ORNL) during the period October 3-16, 1984.<sup>1</sup> The area covered during the survey is shown in Fig. 1. The purpose of this mobile scanning survey was to identify all detectable gamma radiation anomalies that may be related to the transportation of radioactive waste material to the Lake Ontario Ordnance Works for storage. As a result of this activity, 100 anomalies in the Niagara Falls, New York, area were identified as having elevated levels of radiation and were recommended for onsite surveys. Three anomalies (#47, #51, and #87), located at the junction of Highways 18 and 104 (ORNL/RASA-85/40),<sup>2</sup> Highway 31 and Military Road (ORNL/RASA-85/42),<sup>3</sup> and Buffalo Avenue and Hyde Park Boulevard (ORNL/RASA-85/41),<sup>4</sup> respectively, have been previously reported to exceed U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP) remedial action guidelines.<sup>5</sup> The ORNL survey of both sides of Pletcher Road was only a confirmatory survey, as the area had been previously surveyed by Oak Ridge Associated Universities (ORAU).<sup>6</sup> Anomalies 1 through 23 (south side of Pletcher Road), 24 through 33 (north side of Pletcher Road), and 34 through 35 (south side of Old Pletcher Road) have been remediated.

Radiological surveys were performed at the 100 anomalies by members of the RSA group at ORNL during the period July 15-17, 1985. Anomaly locations are shown in Figs. 2, 3, and 4. The purpose of the radiological surveys at these anomalies is to determine if contaminated materials are present, and, if so, to determine if they are in excess of remedial action guidelines established for the Niagara Falls Storage Site (NFSS) in FUSRAP. This report provides the radiological survey results of the 100 anomalies identified by the mobile gamma scanning van.

## SURVEY METHODS

Radiological surveys of these anomalies included: (1) gamma exposure rates, (2) a gamma scan of the entire ground surface outdoors, and (3) samples of outdoor soil. A comprehensive description of the survey methods and instrumentation has been presented in another report.<sup>7</sup>

## SURVEY RESULTS

Typical background radiation levels for the Niagara Falls area are presented in Table 1. The data are provided for purposes of comparison with the survey results presented in this section.

All measurements presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations in soil samples.



## GAMMA MEASUREMENTS

### South Side of Pletcher Road

Results of gamma exposure rate measurements taken at 23 anomalies on the south side of Pletcher Road are presented in Table 2. Generally, the gamma exposure rates scanned 23 to 86  $\mu\text{R}/\text{h}$  (microroentgens\* per hour) in a 3-ft (0.9-m) wide band along the edge of the pavement, and 11 to 17  $\mu\text{R}/\text{h}$  along a 3-ft (0.9-m) wide band from the pavement to the ditch. Gamma exposure rates at 1 m above the ground surface ranged from 11 to 23  $\mu\text{R}/\text{h}$  and averaged 16  $\mu\text{R}/\text{h}$ . Gamma exposure rates at the ground surface ranged from 29 to 230  $\mu\text{R}/\text{h}$  and averaged 59  $\mu\text{R}/\text{h}$ . The maximum gamma exposure rate (230  $\mu\text{R}/\text{h}$ ) was measured at 8960 feet (2688 m), scanning east from Creek Road (anomaly #23).

### North Side of Pletcher Road and South Side of Old Pletcher Road

Results of gamma exposure rate measurements taken at 12 anomalies on the north side of Pletcher Road and south side of Old Pletcher Road are presented in Table 3. Generally, the gamma exposure rates on the north side of Pletcher Road scanned 20 to 57  $\mu\text{R}/\text{h}$  in a 2-ft (0.6-m) wide band along the edge of the pavement, and 9 to 17  $\mu\text{R}/\text{h}$  along a 2-ft (0.6-m) wide band from the pavement to the ditch. Gamma exposure rates at 1 m above the ground surface ranged from 17 to 23  $\mu\text{R}/\text{h}$  and averaged 19  $\mu\text{R}/\text{h}$ . Gamma exposure rates at the ground surface ranged from 29 to 77  $\mu\text{R}/\text{h}$  and averaged 41  $\mu\text{R}/\text{h}$ . The maximum gamma exposure rate measured (77  $\mu\text{R}/\text{h}$ ) was found on the south side of Old Pletcher Road 570 feet (171 m) east of the KOA entrance (anomaly #35).

### Lewiston, New York, Area

Gamma measurements were taken at 12 anomalies located in the Lewiston, New York, area as noted in Table 4. Gamma exposure rates at 1 m above the ground surface ranged from 11 to 200  $\mu\text{R}/\text{h}$  and averaged 35  $\mu\text{R}/\text{h}$ . Gamma exposure rates at the ground surface ranged from 29 to 710  $\mu\text{R}/\text{h}$  and averaged 106  $\mu\text{R}/\text{h}$ . The maximum gamma exposure rate measured (710  $\mu\text{R}/\text{h}$ ) was found in a small area approximately 10 ft wide (3 m) by 59 ft (18 m) in length along a ditch and gravel driveway at 738 Upper Mountain Road (anomaly #43).

### Northeast of Niagara Falls Area

Results of gamma exposure rate measurements taken at 12 anomalies northeast of Niagara Falls are presented in Table 5. Gamma exposure rates at 1 m above the ground surface ranged from 16 to 49  $\mu\text{R}/\text{h}$  and averaged 28  $\mu\text{R}/\text{h}$ . Gamma exposure rates at the ground surface ranged from 26 to 140  $\mu\text{R}/\text{h}$  and averaged 57  $\mu\text{R}/\text{h}$ . The maximum gamma exposure rate, 140  $\mu\text{R}/\text{h}$ , was found in the southwest corner of a residential asphalt driveway, averaging 10 ft wide (3 m) by 13 ft (4 m) in length, at 2924 Military Road (anomaly #52).

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\*The roentgen (R) is a unit which was defined for radiation protection purposes for people exposed to penetrating x rays or gamma radiation. A microroentgen ( $\mu\text{R}$ ) is one millionth of a roentgen. A milliroentgen (mR) is one thousandth of a roentgen or one thousand microroentgens.

### Grand Island-Tonawanda Area

Results of gamma exposure rate measurements taken at six anomalies in the Grand Island-Tonawanda area are presented in Table 6. Gamma exposure rates at 1 m above the ground surface ranged from 9 to 34  $\mu\text{R/h}$  and averaged 23  $\mu\text{R/h}$ . Gamma exposure rates at the ground surface ranged from 17 to 140  $\mu\text{R/h}$  and averaged 57  $\mu\text{R/h}$ . The maximum gamma exposure rate (160  $\mu\text{R/h}$ ) was measured in a culvert northeast of 3060 Grand Island Boulevard (anomaly #63).

### Niagara Falls, New York, Area

Gamma measurements were taken at 35 identified anomalies located in the Niagara Falls, New York, area as noted in Table 7. Gamma exposure rates at 1 m above the ground surface ranged from 9 to 86  $\mu\text{R/h}$  and averaged 26  $\mu\text{R/h}$ . Gamma exposure rates at the ground surface ranged from 17 to 160  $\mu\text{R/h}$  and averaged 60  $\mu\text{R/h}$ . The maximum gamma exposure rate (160  $\mu\text{R/h}$ ) was measured at the surface of a gravel driveway at 6901 Buffalo Avenue, region #4 (anomaly #81).

### SOIL SAMPLING

Sixty soil samples were taken at 53 anomalies. These biased samples were selected from positions having elevated gamma exposure rates. The locations of the samples are shown in Figs. 5, 6, and 7, and the results of analysis are presented in Tables 8 through 14. Single soil samples were taken from the surface (0-15 cm) at areas of elevated gamma radiation. In many instances, a sample could not be taken because the ground was too dry and rocky or the anomaly was associated with asphalt pavement.

### South Side of Pletcher Road

The concentration of  $^{226}\text{Ra}$  in 13 soil samples taken on the south side of Pletcher Road ranged from 12 to 430 pCi/g (picocuries\* per gram) and averaged 79 pCi/g. The maximum concentration of  $^{226}\text{Ra}$  in soil (430 pCi/g) was sampled at anomaly #23, approximately 8960 ft (2688 m) east from Creek Road (NF002B1). Uranium concentrations in the soil ranged from 1.1 to 5.0 pCi/g and averaged 2.3 pCi/g. The maximum concentration of  $^{238}\text{U}$  (5.0 pCi/g) was also found at anomaly #23 (NF002B1). Concentrations as high as 4.1 pCi of  $^{232}\text{Th}$  per gram of soil were sampled at anomaly #23 (NF002B1).

### North Side of Pletcher Road and South Side of Old Pletcher Road

The concentration of  $^{226}\text{Ra}$  in seven soil samples taken on the north side of Pletcher Road and south side of Old Pletcher Road ranged from 23 to 120 pCi/g and averaged 47 pCi/g. The maximum concentration of  $^{226}\text{Ra}$  in soil (120 pCi/g) was sampled at anomaly #35, south of Old Pletcher Road, approximately 570 ft (171 m) east of the KOA entrance

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\*The curie is a unit used to define the radioactivity in a substance and equals that quantity of any radioactive isotope undergoing  $2.2 \times 10^{12}$  disintegrations per minute. The picocurie is one million-millionth of a curie, or that amount yielding 2.2 disintegrations per minute.

(NF002B5). Uranium concentrations in the soil ranged from 1.3 to 3.0 pCi/g and averaged 1.8 pCi/g. The maximum concentration of  $^{238}\text{U}$  (3.0 pCi/g) was also found at anomaly #35 (NF002B5). Concentrations as high as 1.2 pCi of  $^{232}\text{Th}$  per gram of soil were sampled at anomaly #26, north of Pletcher Road, approximately 1298 ft (389 m) west from Harold Road (NF002B4).

#### **Lewiston, New York, Area**

The concentration of  $^{226}\text{Ra}$  in nine soil samples taken in the Lewiston, New York, area ranged from 6.0 to 180 pCi/g and averaged 42 pCi/g. The maximum concentration of  $^{226}\text{Ra}$  in soil (180 pCi/g) was sampled at anomaly #47, at the junction of Highways 18 and 104 (ORNL/RASA-85/40)<sup>2</sup> (NF002B53). Uranium concentrations in the soil ranged from 1.0 to 70 pCi/g and averaged 18 pCi/g. The maximum concentration of  $^{238}\text{U}$  (70 pCi/g) was found at anomaly #43, 738 Upper Mountain Road (NF002B55). Concentrations as high as 560 pCi of  $^{232}\text{Th}$  per gram of soil were also sampled at anomaly #43 (NF002B55).

#### **Northeast of Niagara Falls Area**

The concentration of  $^{226}\text{Ra}$  in 12 soil samples taken northeast of Niagara Falls ranged from 1.2 to 40 pCi/g and averaged 14 pCi/g. The maximum concentration of  $^{226}\text{Ra}$  in soil (40 pCi/g) was sampled at anomaly #51, Military Road approximately 400 ft (120 m) north of Highway 31 (ORNL/RASA-85/42)<sup>3</sup> (NF002B33). Uranium concentrations in the soil ranged from 1.1 to 33 pCi/g and averaged 10 pCi/g. The maximum concentration of  $^{238}\text{U}$  (33 pCi/g) was sampled at anomaly #54, Walter S. Kozdranski Co., Inc., 1865 3rd Avenue (NF002B48). Concentrations as high as 45 pCi of  $^{232}\text{Th}$  per gram of soil were found at anomaly #52, 2924 Military Road (NF002B30).

#### **Grand Island-Tonawanda Area**

The concentration of  $^{226}\text{Ra}$  in seven soil samples taken in the Grand Island-Tonawanda area ranged from 1.4 to 25 pCi/g and averaged 6.3 pCi/g. Uranium concentrations in the soil ranged from 1.2 to 26 pCi/g and averaged 6.3 pCi/g. The maximum concentrations of  $^{226}\text{Ra}$  (25 pCi/g),  $^{232}\text{Th}$  (39 pCi/g), and  $^{238}\text{U}$  (26 pCi/g) in soil were sampled at anomaly #63, 3060 Grand Island Boulevard (NF002B43).

#### **Niagara Falls, New York, Area**

The concentration of  $^{226}\text{Ra}$  in 12 soil samples taken in the Niagara Falls, New York, area ranged from 4.1 to 150 pCi/g and averaged 37 pCi/g. The maximum concentration of  $^{226}\text{Ra}$  in soil (150 pCi/g) was sampled at anomaly #87, near the junction of Buffalo Avenue and Hyde Park Boulevard (ORNL/RASA-85/41)<sup>4</sup> (NF002B24). Uranium concentrations in the soil ranged from 3.7 to 52 pCi/g and averaged 22 pCi/g. The maximum concentration of  $^{238}\text{U}$  (52 pCi/g) was sampled at anomaly #81, 6901 Buffalo Avenue (Region #1, NF002B25A). Concentrations as high as 20 pCi of  $^{232}\text{Th}$  per gram of soil were found at anomaly #91, 2434 Willow Avenue (NF002B46).

## SIGNIFICANCE OF FINDINGS

As a result of the ORNL onsite survey of 100 anomalies in the Niagara Falls, New York, area, three anomalies (#47, #51, and #87), located at the junctions of Highways 18 and 104 (ORNL/RASA-85/40),<sup>2</sup> Highway 31 and Military Road (ORNL/RASA-85/42),<sup>3</sup> and Buffalo Avenue and Hyde Park Boulevard (ORNL/RASA-85/41),<sup>4</sup> were found to exceed FUSRAP remedial action guidelines and were recommended for formal radiological characterization surveys.<sup>5</sup> These anomalies, in addition to the 35 anomalies located along Pletcher Road, have been remediated.

The remaining 62 anomalies do not result from materials connected with NFSS. Contaminated rocks at several anomalies appeared to be a porous, slag material (previously identified as cyclowollastonite,  $\text{CaSiO}_3$ ).<sup>8</sup> This rocky-slag waste material was once involved in the electrochemical production of elemental phosphorous using uranium-bearing raw materials and reportedly originated from the former Oldbury Furnace in Niagara Falls, New York. Previous radiological surveys in the greater Niagara Falls, New York, area have revealed that this material was used for bedding under asphalt surfaces and for general gravel applications.<sup>9</sup>

Essentially all the contaminated soil and rock samples collected had approximately equal concentrations of  $^{226}\text{Ra}$  and  $^{238}\text{U}$ . This indicates that  $^{226}\text{Ra}$  and  $^{238}\text{U}$  are nearly in secular equilibrium and, furthermore, suggests that the rocks probably originated from a singular source. Thorium-232 in this latter slag or rock is believed (from previous analysis) to be tied up in monazite inclusions in the material.<sup>10</sup> The origin of this thorium-bearing material is unknown, but possibly was from some type of mineral extraction in the Niagara Falls area.<sup>10</sup> Five anomalies are attributable to slag material with elevated amounts of thorium: anomaly #42 (789 Upper Mt. Road), anomaly #43 (738 Upper Mt. Road), anomaly #52 (2924 Military Road), anomaly #63 (3060 Grand Island Blvd.), and anomaly #91 (2434 Willow Avenue).

### SOUTH SIDE OF PLETCHER ROAD

Measurements of the gamma exposure levels outdoors at 23 anomalies determined that the exposure rate at 1 m above the ground surface ranged from 11 to 23  $\mu\text{R}/\text{h}$  and averaged 16  $\mu\text{R}/\text{h}$ . For comparison, the typical background for the Niagara Falls, New York, area is 9  $\mu\text{R}/\text{h}$ , and the background for the state of New York<sup>11,12</sup> averages 9.5  $\mu\text{R}/\text{h}$  and ranges from 6.8 to 13  $\mu\text{R}/\text{h}$  (one standard deviation) based on 51 measurements. Thirteen soil samples taken from anomalies in this area had concentrations of  $^{226}\text{Ra}$  in excess of 93 times average background levels, while the  $^{238}\text{U}$  concentration was 2.4 times average background levels.

The ratio of  $^{226}\text{Ra}$  to  $^{238}\text{U}$  activity is consistent with contaminated material originating from the NFSS. The concentration of these nuclides at the identified anomalies was found to be in excess of relevant FUSRAP remedial action guidelines<sup>5</sup> (i.e., the weighted average in excess of 5 pCi/g of  $^{226}\text{Ra}$  over 100  $\text{m}^2$  in the upper 15 cm of soil).

## NORTH SIDE OF PLETCHER ROAD AND SOUTH SIDE OF OLD PLETCHER ROAD

Measurements of the gamma exposure levels outdoors at 12 anomalies determined that the exposure rate at 1 m above the ground surface ranged from 17 to 23  $\mu\text{R/h}$  and averaged 19  $\mu\text{R/h}$ . For comparison, the typical background for the Niagara Falls, New York, area is 9  $\mu\text{R/h}$ , and the background for the state of New York<sup>11,12</sup> averages 9.5  $\mu\text{R/h}$  and ranges from 6.8 to 13  $\mu\text{R/h}$  (one standard deviation) based on 51 measurements. Seven soil samples taken from anomalies in this area had concentrations of  $^{226}\text{Ra}$  in excess of 55 times average background levels, while the  $^{238}\text{U}$  concentration was 1.9 times average background levels.

The ratio of  $^{226}\text{Ra}$  to  $^{238}\text{U}$  activity is consistent with contaminated material originating from the NFSS. The concentration of these nuclides at the identified anomalies were found to be in excess of relevant FUSRAP remedial action guidelines<sup>5</sup> (i.e., the weighted average in excess of 5 pCi/g of  $^{226}\text{Ra}$  over 100 m<sup>2</sup> in the upper 15 cm of soil).

## LEWISTON, NEW YORK, AREA

Measurements of the gamma exposure levels outdoors at 12 anomalies determined that the exposure rate at 1 m above the ground surface ranged from 11 to 200  $\mu\text{R/h}$  and averaged 35  $\mu\text{R/h}$ . For comparison, the typical background for the Niagara Falls, New York, area is 9  $\mu\text{R/h}$ , and the background for the state of New York<sup>11,12</sup> averages 9.5  $\mu\text{R/h}$  and ranges from 6.8 to 13  $\mu\text{R/h}$  (one standard deviation) based on 51 measurements. Nine soil samples taken from anomalies in this area had concentrations of  $^{226}\text{Ra}$  in excess of 49 times average background levels, while the  $^{238}\text{U}$  concentration was 19 times average background levels.

With the exception of anomaly #47 (junction of Highways 18 and 104, ORNL/RASA-85/40),<sup>2</sup> which has been previously reported to exceed FUSRAP remedial action guidelines,<sup>5</sup> soil analyses indicate that  $^{226}\text{Ra}$  and  $^{238}\text{U}$  concentrations were approximately equal. The anomalies from this region are associated with phosphate slag material used as bedding for asphalt driveways and fill applications and are not related to materials connected with the NFSS, including material that was transported to the NFSS.

## NORTHEAST OF NIAGARA FALLS AREA

Measurements of the gamma exposure levels outdoors at 12 anomalies determined that the exposure rate at 1 m above the ground surface ranged from 16 to 49  $\mu\text{R/h}$  and averaged 28  $\mu\text{R/h}$ . For comparison, the typical background for the Niagara Falls, New York, area is 9  $\mu\text{R/h}$ , and the background for the state of New York<sup>11,12</sup> averages 9.5  $\mu\text{R/h}$  and ranges from 6.8 to 13  $\mu\text{R/h}$  (one standard deviation) based on 51 measurements. Twelve soil samples taken from anomalies in this area had concentrations of  $^{226}\text{Ra}$  in excess of 16 times average background levels, while the  $^{238}\text{U}$  concentration was 10 times average background levels.

With the exception of anomaly #51 (near junction of Highway 31 and Military Road, ORNL/RASA-85/42),<sup>3</sup> which has been previously reported to exceed FUSRAP remedial action guidelines,<sup>5</sup> soil analyses indicate that  $^{226}\text{Ra}$  and  $^{238}\text{U}$  concentrations were approximately equal. Anomalies from this area are associated with phosphate slag material used as bedding for asphalt driveways and fill applications and are not related to materials connected with the NFSS, including material that was transported to the NFSS.

#### GRAND ISLAND-TONAWANDA AREA

Measurements of the gamma exposure levels outdoors at six anomalies determined that the exposure rate at 1 m above the ground surface ranged from 9 to 34  $\mu\text{R}/\text{h}$  and averaged 23  $\mu\text{R}/\text{h}$ . For comparison, the typical background for the Niagara Falls, New York, area is 9  $\mu\text{R}/\text{h}$ , and the background for the state of New York<sup>11,12</sup> averages 9.5  $\mu\text{R}/\text{h}$  and ranges from 6.8 to 13  $\mu\text{R}/\text{h}$  (one standard deviation) based on 51 measurements. Seven soil samples taken from anomalies in this area had concentrations of  $^{226}\text{Ra}$  in excess of 7.4 times average background levels, while the  $^{238}\text{U}$  concentration was 6.6 times average background levels.

Soil analyses indicate that  $^{226}\text{Ra}$  and  $^{238}\text{U}$  concentrations were approximately equal. Anomalies from this region are associated with phosphate slag material used as bedding for asphalt driveways and fill applications and are not related to materials connected with the NFSS, including material that was transported to the NFSS.

#### NIAGARA FALLS, NEW YORK, AREA

Measurements of the gamma exposure levels outdoors at 32 anomalies determined that the exposure rate at 1 m above the ground surface ranged from 9 to 86  $\mu\text{R}/\text{h}$  and averaged 26  $\mu\text{R}/\text{h}$ . For comparison, the typical background for the Niagara Falls, New York, area is 9  $\mu\text{R}/\text{h}$ , and the background for the state of New York<sup>11,12</sup> averages 9.5  $\mu\text{R}/\text{h}$  and ranges from 6.8 to 13  $\mu\text{R}/\text{h}$  (one standard deviation) based on 51 measurements. Twelve soil samples taken from anomalies in this area had concentrations of  $^{226}\text{Ra}$  in excess of 44 times average background levels, while the  $^{238}\text{U}$  concentration was 23 times average background levels.

With the exception of anomaly #87 (near junction of Buffalo Avenue and Hyde Park Boulevard, ORNL/RASA-85/41),<sup>4</sup> which has been previously reported to exceed FUSRAP remedial action guidelines,<sup>5</sup> soil analyses indicate that  $^{226}\text{Ra}$  and  $^{238}\text{U}$  concentrations were approximately equal. The anomalies from this region are similarly associated with phosphate slag material used as bedding for asphalt driveways and fill applications and are not related to materials connected with the NFSS, including material that was transported to the NFSS.

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NOTE: Since the time of this survey, remedial actions have been conducted on the 38 anomalies identified as exceeding FUSRAP guidelines, and the radioactive material above guidelines has been removed.



## REFERENCES

1. W. H. Shinpaugh, B. A. Berven, and W. D. Cottrell, *Results of the Mobile Gamma Scanning Activities in Niagara Falls, New York Area*, Oak Ridge National Laboratory, ORNL/RASA-85/1 (August 1985).
2. B. A. Berven, *Results of Radiological Measurements Taken at Junction of Highways 18 and 104 in Niagara Falls, New York*, Oak Ridge National Laboratory, ORNL/RASA-85/40 (December 1985).
3. B. A. Berven, *Results of Radiological Measurements Taken near Junction of Highway 31 and Military Road in Niagara Falls, New York*, Oak Ridge National Laboratory, ORNL/RASA-85/42 (December 1985).
4. B. A. Berven, *Results of Radiological Measurements Taken near Junction of Buffalo Avenue and Hyde Park Blvd. in Niagara Falls, New York*, Oak Ridge National Laboratory, ORNL/RASA-85/41 (December 1985).
5. U.S. Department of Energy, *U.S. Department of Energy Guidelines for Residual Radioactivity at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites*, (Rev. 1, July 1985).
6. Personal communication, J. D. Berger, Oak Ridge Associated Universities, P. O. Box 117, Oak Ridge, TN 37831.
7. T. E. Myrick, B. A. Berven, W. D. Cottrell, W. A. Goldsmith, and F. F. Haywood, *Procedures Manual for the Remedial Action Survey and Certification Activities (RASCA) Program*, Oak Ridge National Laboratory, ORNL/TM-8600 (September 1982).
8. W. D. Cottrell, D. J. Christian, and F. F. Haywood, *Ground-Level Investigation of Anomalous Radiation Levels in Niagara Falls, New York*, Oak Ridge National Laboratory, unpublished report (June 1979).
9. W. D. Cottrell, T. E. Myrick, W. H. Shinpaugh, and F. F. Haywood, *Ground-Level Investigation of Anomalous Gamma Radiation Levels in the Tonawanda, New York, Area*, Oak Ridge National Laboratory, unpublished report (January 1980).
10. U.S. Department of Energy, *Exploratory Aerial and Ground Level Radiological Survey of the Niagara Falls Area, Niagara Falls, New York*, Formerly Utilized MED/AEC Sites Remedial Action Program, July 1979.
11. S. G. Levin, R. K. Stoms, E. Kuerze, and W. Huskisson, "Summary of Natural Environmental Gamma Radiation Using a Calibrated Portable Scintillation Counter," *Radiological Health Data Report* 9:679-695 (1968).
12. C. L. Lindekin, K. R. Peterson, D. E. Jones, and R. E. McMillen, "Geographic Variations in Environmental Radiation Background in the United States," *Proceedings of the Second International Symposium on the Natural Radiation Environment*, CONF-720805-P-1, pp. 317-331 (1972).
13. T. E. Myrick, B. A. Berven, and F. F. Haywood, *State Background Radiation Levels: Results of Measurements Taken During 1975-1959*, ORNL/TM-7343 (November 1981).





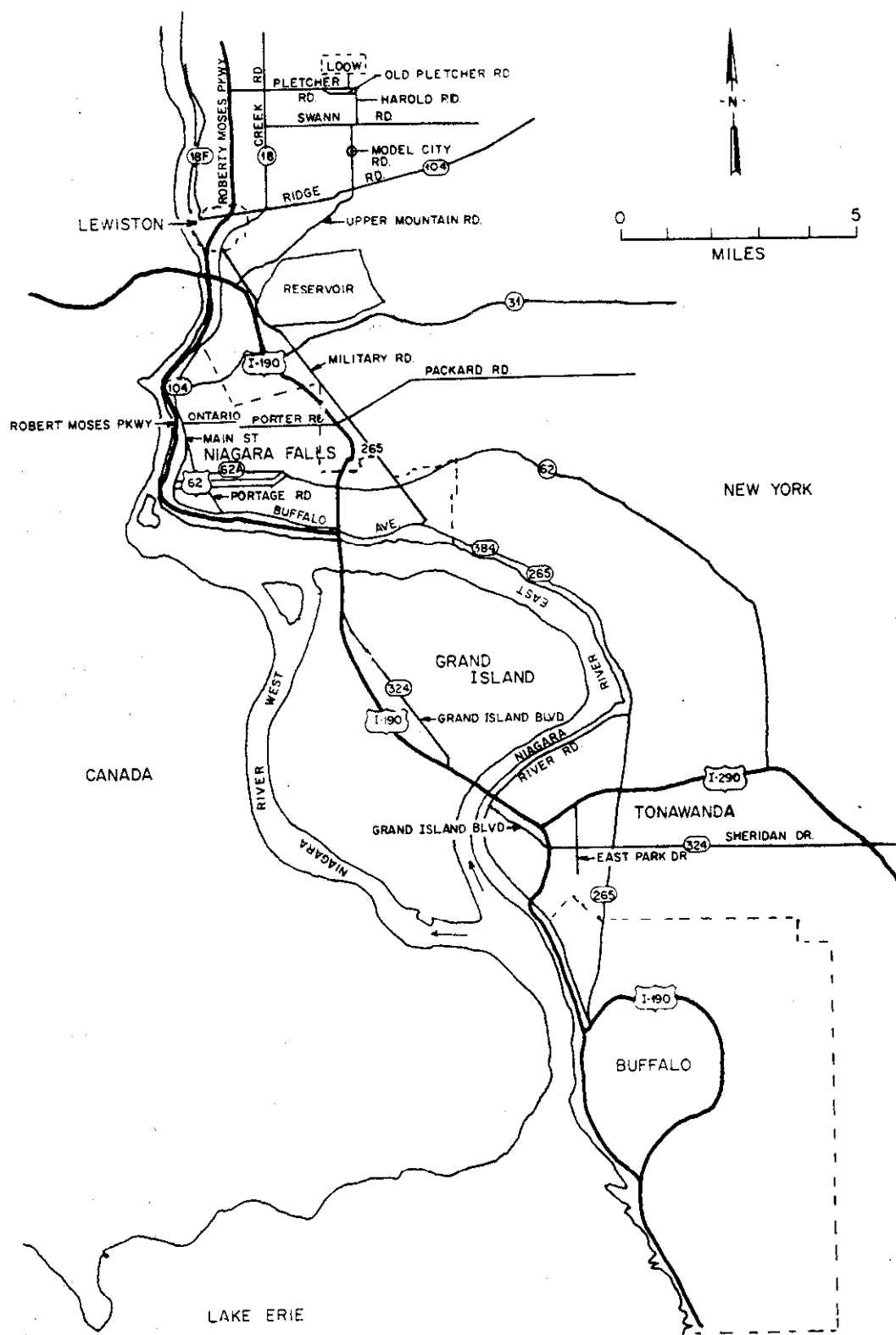


Fig. 1. Area surveyed during the mobile gamma scan of Niagara Falls, New York.

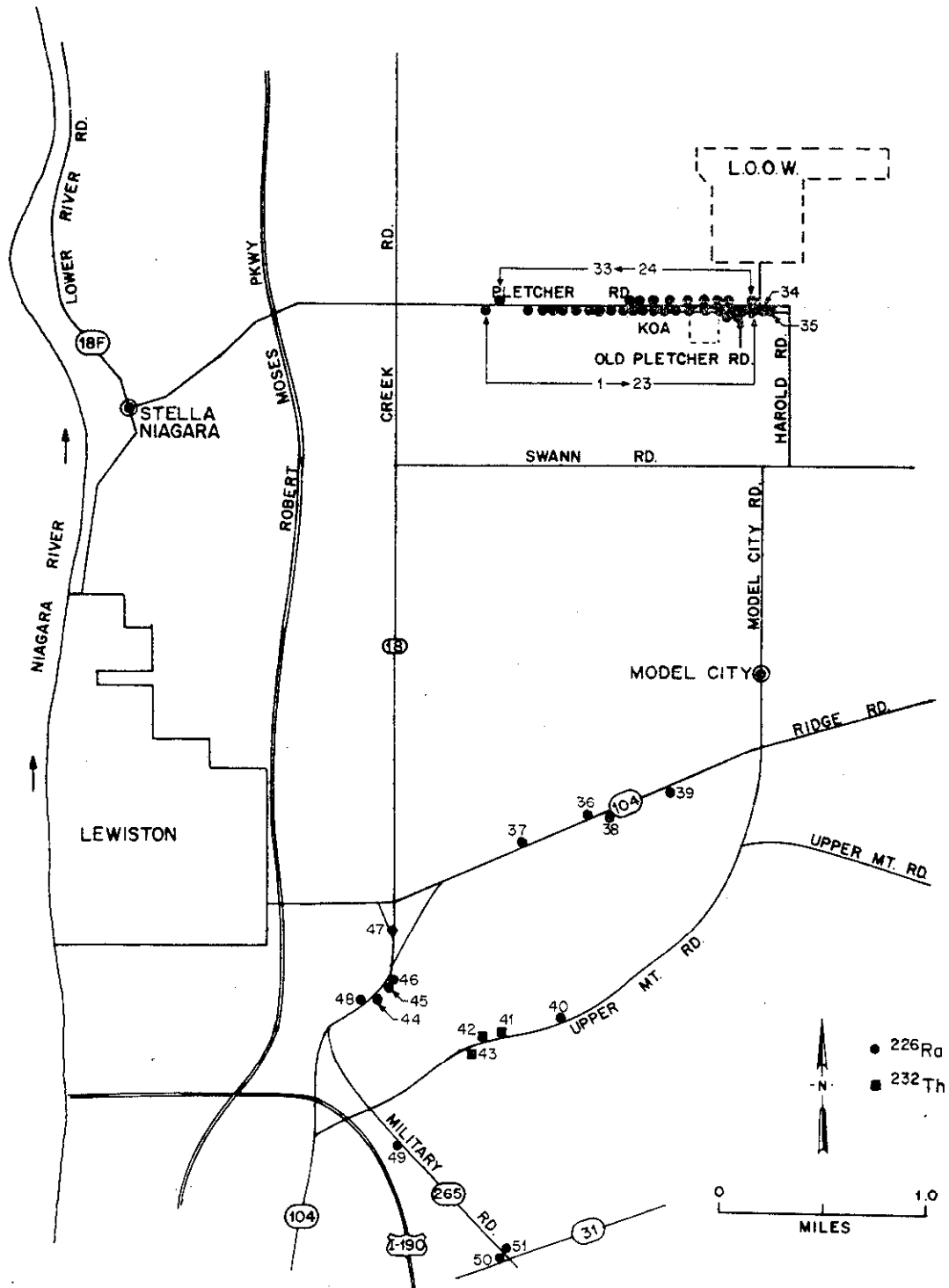


Fig. 2. Anomaly locations in the Lewiston-Lake Ontario Ordnance Works area.

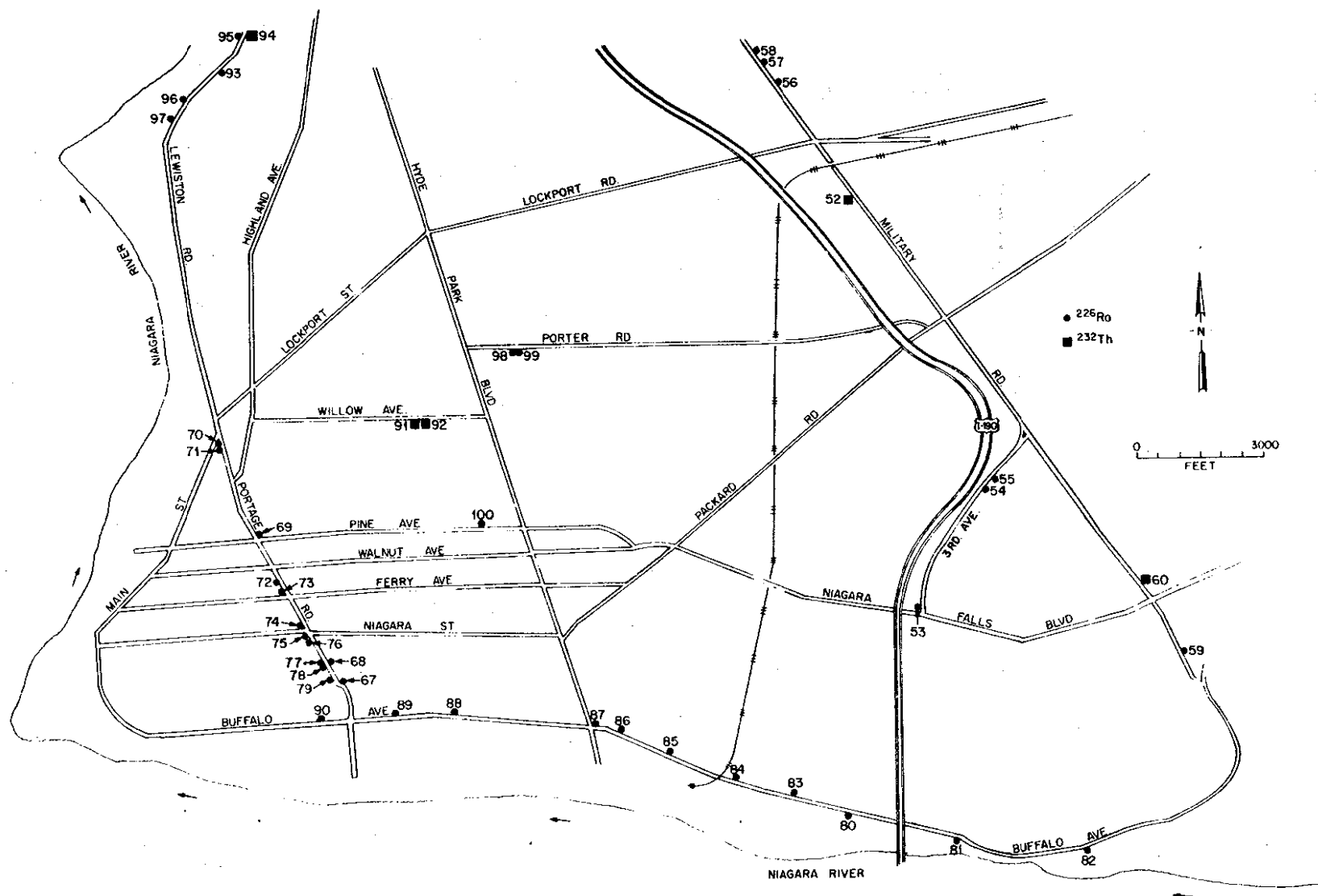
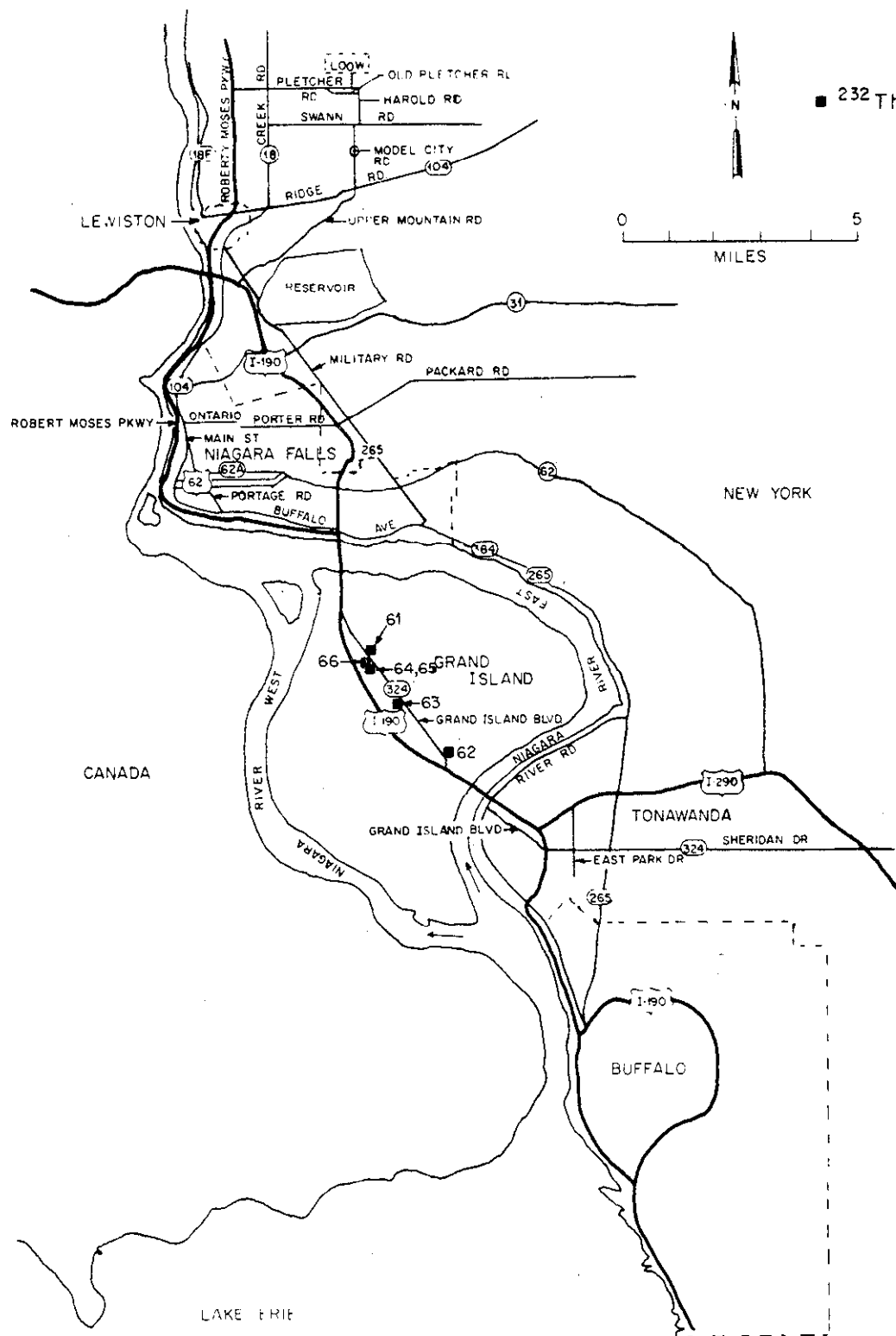


Fig. 3. Anomaly locations in the Niagara Falls area.



**Fig. 4. Anomaly locations in the Grand Island-Tonawanda area.**

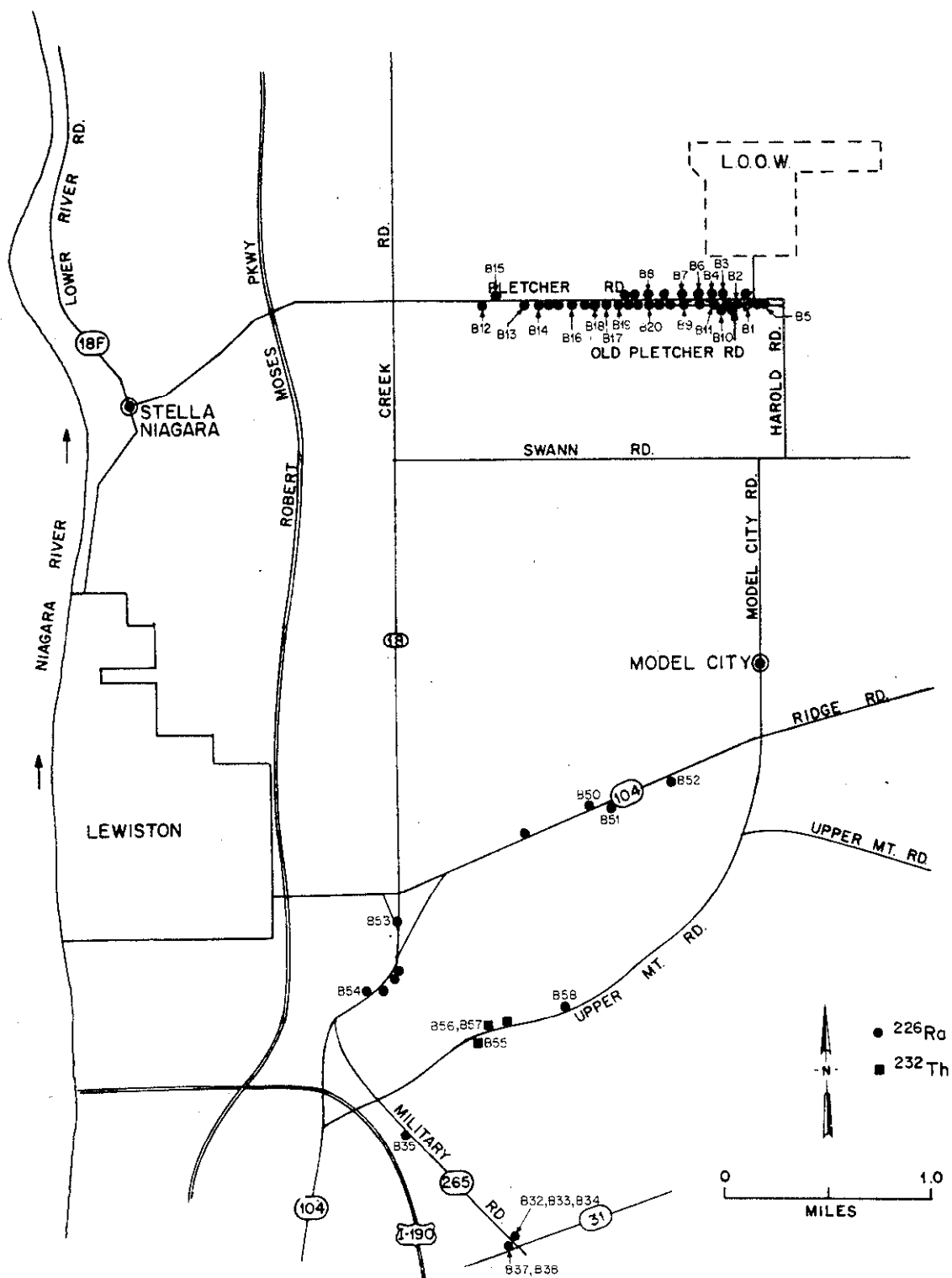


Fig. 5. Locations of soil samples in the Lewiston-Lake Ontario Ordnance Works area.

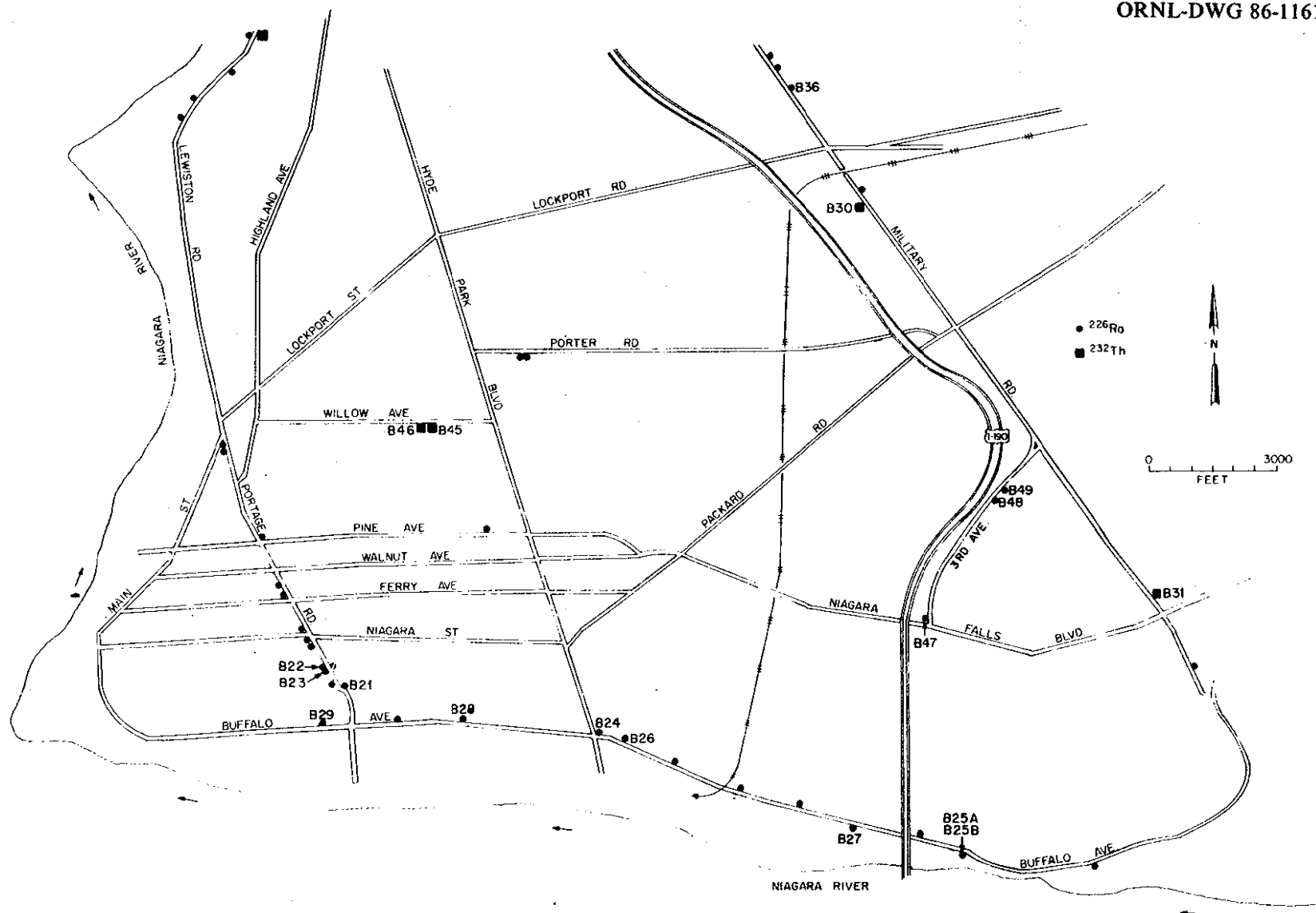


Fig. 6. Locations of soil samples in the Niagara Falls area.

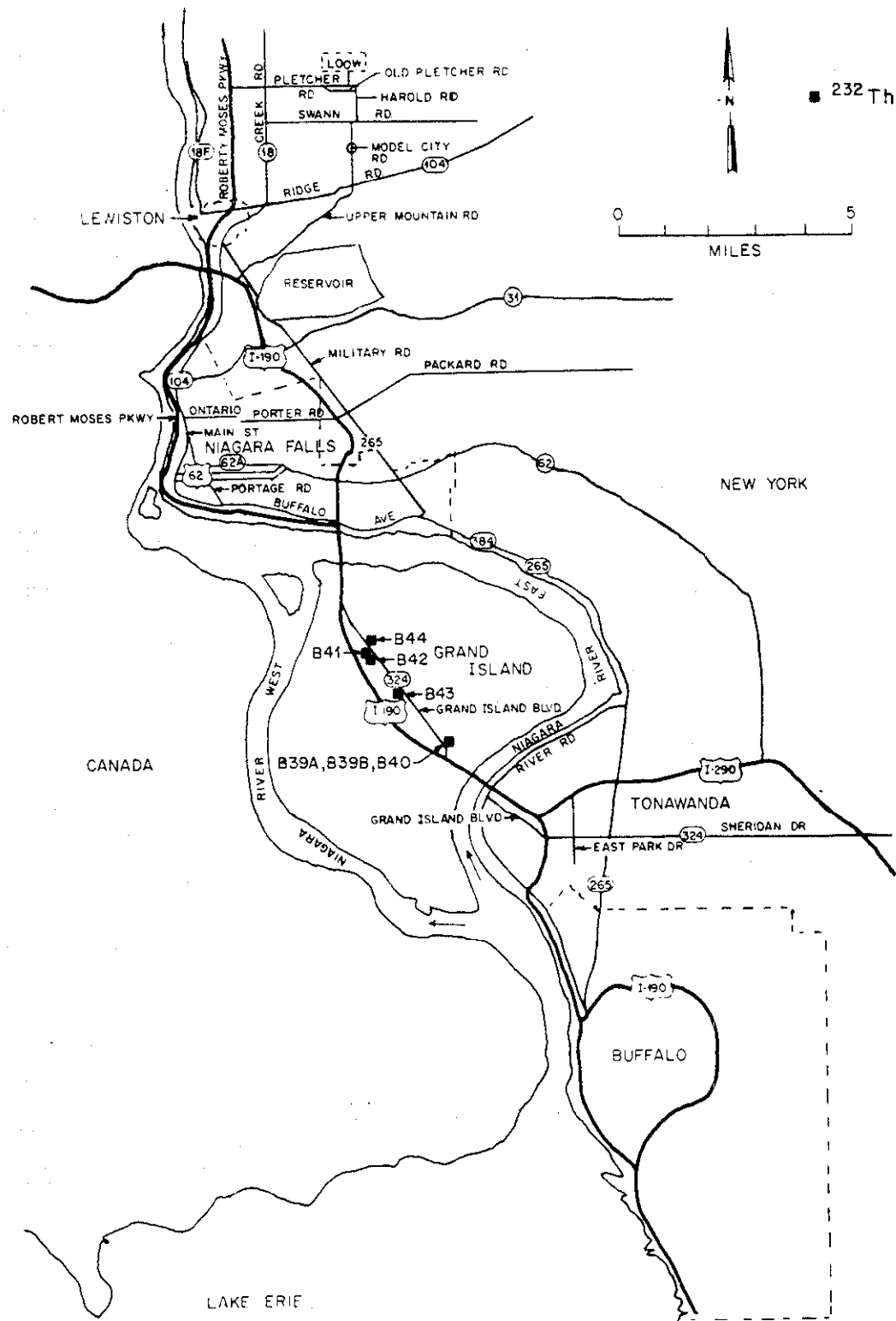


Fig. 7. Locations of soil samples in the Grand Island-Tonawanda area.





**Table 1. Background radiation levels in the Niagara Falls area**

| Type of radiation<br>measurement or sample                                                   | Radiation level or<br>radionuclide concentration |         |
|----------------------------------------------------------------------------------------------|--------------------------------------------------|---------|
|                                                                                              | Range                                            | Average |
| Gamma exposure rate at 1 m<br>above floor or ground surface ( $\mu\text{R/h}$ ) <sup>a</sup> | 8-10                                             | 9       |
| Concentration of radionuclides in soil<br>(pCi/g) <sup>b</sup>                               |                                                  |         |
| <sup>238</sup> U                                                                             | 0.76-1.2                                         | 0.96    |
| <sup>226</sup> Ra                                                                            | 0.48-1.2                                         | 0.85    |

<sup>a</sup>Values obtained from four locations in the New York area.

<sup>b</sup>Soil samples obtained from six locations around the Niagara Falls area.<sup>13</sup>

**Table 2. Results of the gamma exposure rate measurements  
outdoors on the south side of Pletcher Road**  
(Distance measurements in feet scanning east from Creek Road)

| Anomaly<br>number | Distance<br>(ft) | Gamma exposure rates<br>( $\mu\text{R/h}$ ) |                                          | Range of gamma<br>exposure rate<br>during scan<br>( $\mu\text{R/h}$ ) |
|-------------------|------------------|---------------------------------------------|------------------------------------------|-----------------------------------------------------------------------|
|                   |                  | Gamma<br>exposure<br>rate at 1 m            | Gamma<br>exposure rate<br>at the surface |                                                                       |
| 1                 | 2200             | 14                                          | 37                                       | 11-86                                                                 |
| 2                 | 2950             | 23                                          | 86                                       | 11-86                                                                 |
| 3                 | 3950             | 16                                          | 57                                       | 11-86                                                                 |
| 4                 | 4080             | a                                           | 49                                       | 11-86                                                                 |
| 5                 | 4300             | a                                           | 49                                       | 11-86                                                                 |
| 6                 | 4880             | 17                                          | 63                                       | 11-86                                                                 |
| 7                 | 5775             | a                                           | 49                                       | 11-86                                                                 |
| 8                 | 6460             | 16                                          | 43                                       | 11-86                                                                 |
| 9                 | 6875             | 15                                          | 34                                       | 11-86                                                                 |
| 10                | 7025             | 13                                          | 43                                       | 11-86                                                                 |
| 11                | 7138             | a                                           | 49                                       | 11-86                                                                 |
| 12                | 7192             | a                                           | 49                                       | 11-86                                                                 |
| 13                | 7312             | 19                                          | 51                                       | 11-86                                                                 |
| 14                | 7340             | a                                           | 49                                       | 11-86                                                                 |
| 15                | 7407             | a                                           | 49                                       | 11-86                                                                 |
| 16                | 7452             | 17                                          | 29                                       | 11-86                                                                 |
| 17                | 7525             | a                                           | 49                                       | 11-86                                                                 |
| 18                | 7600             | 20                                          | 57                                       | 11-86                                                                 |
| 19                | 7915             | 11                                          | 71                                       | 11-86                                                                 |
| 20                | 7927             | a                                           | 49                                       | 11-86                                                                 |
| 21                | 8343             | a                                           | 49                                       | 11-86                                                                 |
| 22                | 8628             | a                                           | 57                                       | 11-86                                                                 |
| 23                | 8960             | a                                           | 230                                      | 11-230                                                                |

<sup>a</sup>Reading not taken.

**Table 3. Results of the gamma exposure rate measurements outdoors on the north side of Pletcher Road and south side of Old Pletcher Road**  
(Distance measurements in feet scanning west from Harold Road)

| Anomaly number | Distance (ft)                                         | Gamma exposure rates ( $\mu\text{R/h}$ ) |                                    | Range of gamma exposure rate during scan ( $\mu\text{R/h}$ ) |
|----------------|-------------------------------------------------------|------------------------------------------|------------------------------------|--------------------------------------------------------------|
|                |                                                       | Gamma exposure rate at 1 m               | Gamma exposure rate at the surface |                                                              |
| 24             | 746                                                   | a                                        | 33                                 | 9-57                                                         |
| 25             | 1169                                                  | a                                        | 29                                 | 9-57                                                         |
| 26             | 1298                                                  | 20                                       | 31                                 | 9-57                                                         |
| 27             | 1488                                                  | 17                                       | 46                                 | 9-57                                                         |
| 28             | 2333                                                  | 20                                       | 57                                 | 9-57                                                         |
| 29             | 2363                                                  | a                                        | 33                                 | 9-57                                                         |
| 30             | 2530 (large area)                                     | 19                                       | 34                                 | 9-57                                                         |
| 31             | 2768                                                  | a                                        | 33                                 | 9-57                                                         |
| 32             | 2844                                                  | a                                        | 33                                 | 9-57                                                         |
| 33             | 6170                                                  | 17                                       | 57                                 | 9-57                                                         |
| 34             | Old Pletcher Road<br>490 feet east<br>of KOA entrance | a                                        | 33                                 | 9-57                                                         |
| 35             | 570 feet east of<br>KOA entrance                      | 23                                       | 77                                 | 9-57                                                         |

<sup>a</sup>Reading not taken.

**Table 4. Results of the gamma exposure rate measurements outdoors in the Lewiston, New York, area**

| Anomaly number | Location                                                             | Gamma exposure rates ( $\mu\text{R/h}$ ) |                                    | Range of gamma exposure rate during scan ( $\mu\text{R/h}$ ) |
|----------------|----------------------------------------------------------------------|------------------------------------------|------------------------------------|--------------------------------------------------------------|
|                |                                                                      | Gamma exposure rate at 1 m               | Gamma exposure rate at the surface |                                                              |
| 36             | 961 Ridge Road                                                       | 17                                       | 34                                 | 14-34                                                        |
| 37             | House between 889 and 913 Ridge Road                                 | 22                                       | 34                                 | 14-34                                                        |
| 38             | 1084 Ridge Road                                                      | 29                                       | 49                                 | 14-49                                                        |
| 39             | Circle gravel drive south side Ridge Road at TP45                    | 20                                       | 40                                 | 17-43                                                        |
| 40             | 1011 Upper Mt. Road                                                  | 20                                       | 57                                 | 17-57                                                        |
| 41             | 783 Upper Mt. Road                                                   | 17                                       | 43                                 | 17-43                                                        |
| 42             | 789 Upper Mt. Road                                                   | 43                                       | 130                                | 29-130                                                       |
| 43             | 738 Upper Mt. Road                                                   | 200                                      | 710                                | 17-710                                                       |
| 44             | 4977 Creek Road                                                      | a                                        | a                                  | a                                                            |
| 45             | 4979 Creek Road                                                      | 11                                       | 29                                 | 17-29                                                        |
| 46             | 4945 Creek Road                                                      | 14                                       | 29                                 | 14-29                                                        |
| 47             | Junction of Highways 18 and 104 (NE side of 104 and 18) <sup>b</sup> | 16                                       | 77                                 | 14-77                                                        |
| 48             | 4986 Creek Road and adjoining lot                                    | 16                                       | 40                                 | 17-40                                                        |

<sup>a</sup>Anomaly not found.

<sup>b</sup>B. A. Berven, *Results of Radiological Measurements Taken at Junction of Highways 18 and 104 in Niagara Falls, New York*, Oak Ridge National Laboratory, ORNL/RASA-85/40 (December 1985).

**Table 5. Results of the gamma exposure rate measurements outdoors northeast of Niagara Falls area**

| Anomaly number | Location                                                                     | Gamma exposure rates ( $\mu\text{R/h}$ ) |                                    | Range of gamma exposure rate during scan ( $\mu\text{R/h}$ ) |
|----------------|------------------------------------------------------------------------------|------------------------------------------|------------------------------------|--------------------------------------------------------------|
|                |                                                                              | Gamma exposure rate at 1 m               | Gamma exposure rate at the surface |                                                              |
| 49             | Across street from 5439 and 5447 Military Road                               | 16                                       | 29                                 | 13-29                                                        |
| 50             | Reservoir State Park (NW corner of Military Road and Highway 31)             | 24                                       | 46                                 | 14-60                                                        |
| 51             | Military Road ~400 ft north of Highway 31 (both sides of creek) <sup>a</sup> | 20                                       | 29                                 | 14-29                                                        |
| 52             | 2924 Military Road                                                           | 34                                       | 140                                | 34-140                                                       |
| 53             | 6560 Niagara Falls Blvd.                                                     | 26                                       | 71                                 | 17-86                                                        |
| 54             | Walter S. Kozdranski Co., Inc., 1865 3rd Avenue                              | 49                                       | 86                                 | 17-86                                                        |
| 55             | Nuts and Bolts Products, Inc., 2115 3rd Avenue                               | 29                                       | 43                                 | 17-63                                                        |
| 56             | Save-Rite Discount Store, 4301 Military Road                                 | 23                                       | 43                                 | 13-51                                                        |
| 57             | Louie's Place, 4509 Military Road                                            | b                                        | 26                                 | 17-57                                                        |
| 58             | 4611 and 4613 Military Road                                                  | b                                        | 43                                 | 17-43                                                        |
| 59             | Prince of Peace Church, Military Road (Rectory, 908 N. Military Road)        | 43                                       | 77                                 | 29-77                                                        |
| 60             | Metropolitan Life and National Fuel, 1329 N. Military Road                   | 20                                       | 49                                 | 13-49                                                        |

<sup>a</sup>B. A. Berven, *Results of Radiological Measurements Taken near Junction of Highway 31 and Military Road in Niagara Falls, New York*, Oak Ridge National Laboratory, ORNL/RASA-85/42 (December 1985).

<sup>b</sup>Reading not taken.

**Table 6. Results of the gamma exposure rate measurements outdoors in Grand Island-Tonawanda area**

| Anomaly number | Location                                         | Gamma exposure rates ( $\mu\text{R/h}$ ) |                                    | Range of gamma exposure rate during scan ( $\mu\text{R/h}$ ) |
|----------------|--------------------------------------------------|------------------------------------------|------------------------------------|--------------------------------------------------------------|
|                |                                                  | Gamma exposure rate at 1 m               | Gamma exposure rate at the surface |                                                              |
| 61             | Kelly's Country Store<br>3121 Grand Island Blvd. | 21                                       | 49                                 | a                                                            |
| 62             | Mobil Service Station<br>1685 Grand Island Blvd. | 9                                        | 29                                 | 11-29                                                        |
| 63             | 3060 Grand Island Blvd.                          | 29                                       | 140                                | 29-160                                                       |
| 64             | 3050 Grand Island Blvd.                          | 34                                       | 57                                 | 11-57                                                        |
| 65             | 3044 Grand Island Blvd.                          | 31                                       | 51                                 | 13-51                                                        |
| 66             | KOA Campground<br>2570 Grand Island Blvd.        | 13                                       | 17                                 | 12-17                                                        |

<sup>a</sup>Reading not taken.

**Table 7. Results of the gamma exposure rate measurements outdoors  
Niagara Falls, New York**

| Anomaly<br>number | Location                                                                  | Gamma exposure rates<br>( $\mu\text{R/h}$ ) |                                          | Range of gamma<br>exposure rate<br>during scan<br>( $\mu\text{R/h}$ ) |
|-------------------|---------------------------------------------------------------------------|---------------------------------------------|------------------------------------------|-----------------------------------------------------------------------|
|                   |                                                                           | Gamma<br>exposure<br>rate at 1 m            | Gamma<br>exposure rate<br>at the surface |                                                                       |
| 67                | SE corner of Cudaback<br>and Portage Road                                 | 17                                          | 43                                       | 17-43                                                                 |
| 68                | Between 245 and 257 Portage Road                                          | a                                           | a                                        | 57                                                                    |
| 69                | Niagara Falls High School,<br>Pine Street and Portage Road                | 9 <sup>b</sup>                              | 23 <sup>b</sup>                          | 9-23 <sup>b</sup>                                                     |
| 70                | 1318-1324 Portage Road                                                    | 9 <sup>c</sup>                              | 17 <sup>c</sup>                          | 9-17 <sup>c</sup>                                                     |
| 71                | Harris and Lever Florists,<br>Portage Road                                | 29                                          | 57                                       | 29-57                                                                 |
| 72                | 574 Portage Road                                                          | 17 <sup>d</sup>                             | 34 <sup>d</sup>                          | 17-34 <sup>d</sup>                                                    |
| 73                | NW corner Ferry Avenue and<br>Portage Road (probably<br>504 Portage Road) | a                                           | a                                        | 37                                                                    |
| 74                | Property between 434 Portage<br>Road and 1338 Niagara Street              | 29                                          | 49                                       | 29-49                                                                 |
| 75                | 368 Portage Road                                                          | 29                                          | 51                                       | 29-51                                                                 |
| 76                | 356 Portage Road                                                          | 16                                          | 37                                       | 16-37                                                                 |
| 77                | 256 Portage Road                                                          | 23                                          | 51                                       | 23-57                                                                 |
| 78                | Between 242 Portage Road and<br>Payne's Floor Covering                    | 29                                          | 91                                       | 13-91                                                                 |
| 79                | 200 Portage Road                                                          | e                                           | e                                        | e                                                                     |
| 80                | Opposite 5704 Buffalo Avenue                                              | 29                                          | 91                                       | 29-91                                                                 |
| 81                | 6901 Buffalo Avenue                                                       |                                             |                                          |                                                                       |
|                   | Region #1                                                                 | 17                                          | 71                                       | 17-71                                                                 |
|                   | Region #2                                                                 | 16                                          | 57                                       | 11-57                                                                 |
|                   | Region #3                                                                 | 16                                          | 57                                       | 11-57                                                                 |
|                   | Region #4                                                                 | 86                                          | 160                                      | 18-160                                                                |
| 82                | 7723 Buffalo Avenue                                                       | 57                                          | 86                                       | 29-86                                                                 |
| 83                | 5512 Buffalo Avenue                                                       | a                                           | a                                        | 57                                                                    |



Table 7 (continued)

| Anomaly number | Location                                                          | Gamma exposure rates<br>( $\mu\text{R/h}$ ) |                                    | Range of gamma exposure rate during scan<br>( $\mu\text{R/h}$ ) |
|----------------|-------------------------------------------------------------------|---------------------------------------------|------------------------------------|-----------------------------------------------------------------|
|                |                                                                   | Gamma exposure rate at 1 m                  | Gamma exposure rate at the surface |                                                                 |
| 84             | Buffalo Avenue (230 ft west of 53rd Street)                       | 19                                          | 43                                 | 19-43                                                           |
| 85             | Occidental Chemical Corp., Buffalo Avenue                         | 19                                          | 43                                 | 17-43                                                           |
| 86             | Opposite ALOX Corp., Buffalo Avenue                               | 29                                          | 86                                 | 17-86                                                           |
| 87             | Buffalo Avenue (east side of Hyde Park intersection) <sup>f</sup> | 17                                          | 71                                 | 14-71                                                           |
| 88             | Buffalo Avenue opposite SOHIO                                     | 10                                          | 29                                 | 10-29                                                           |
| 89             | 1920 Buffalo Avenue                                               | a                                           | 110                                | 110                                                             |
| 90             | Buffalo Avenue opposite Carborundum Corp.                         | 86                                          | 110                                | 29-110                                                          |
| 91             | 2434 Willow Avenue                                                | 31                                          | 57                                 | 14-57                                                           |
| 92             | 2430 Willow Avenue                                                | 11                                          | 29                                 | 14-29                                                           |
| 93             | 3017 Lewiston Road and property on south side                     | a                                           | 57                                 | 57                                                              |
| 94             | 4831 Lewiston Road                                                | a                                           | 86                                 | 86                                                              |
| 95             | 4842 Lewiston Road                                                | a                                           | 43                                 | 43                                                              |
| 96             | Intersection Rankine Road and Lewiston Road (west side)           | 14                                          | 43                                 | 14-43                                                           |
| 97             | Intersection McKinley and Lewiston Road (west side)               | 14                                          | 43                                 | 14-43                                                           |
| 98             | 2919 Porter Road                                                  | a                                           | 34                                 | 34                                                              |
| 99             | 2923 Porter Road                                                  | a                                           | a                                  | a                                                               |
| 100            | Corner of Pine Street and 29th Street (Wilson Farms Store)        | 29                                          | 51                                 | 11-51                                                           |

<sup>a</sup>Inaccessible — private property.

<sup>b</sup>Gamma exposure rates due to brick on side of school.

<sup>c</sup>Gamma exposure rates due to brick building on side of street.

<sup>d</sup>Reading taken on contact with granite steps in front of building.

<sup>e</sup>Anomaly not found.

<sup>f</sup>B. A. Berven, *Results of Radiological Measurements Taken near Junction of Buffalo Avenue and Hyde Park Blvd. in Niagara Falls, New York*, Oak Ridge National Laboratory, ORNL/RASA-85/41 (December 1985).

**Table 8. Results of biased soil sample analysis on the south side of Pletcher Road (NF002)<sup>a</sup>**

| Anomaly number | Location <sup>b,c</sup><br>(ft) | Sample   | Depth<br>(cm) | Radionuclide concentration<br>(pCi/g) |                                |                               |
|----------------|---------------------------------|----------|---------------|---------------------------------------|--------------------------------|-------------------------------|
|                |                                 |          |               | <sup>226</sup> Ra <sup>d</sup>        | <sup>232</sup> Th <sup>d</sup> | <sup>238</sup> U <sup>e</sup> |
| 1              | 2200                            | NF002B12 | 0-15          | 28 ± 1                                | 0.91 ± 0.7                     | 4.0                           |
| 2              | 2950                            | NF002B13 | 0-15          | 71 ± 2                                | 0.60 ± 0.5                     | 1.9                           |
| 3              | 3950                            | NF002B14 | 0-15          | 64 ± 2                                | 0.71 ± 0.4                     | 1.5                           |
| 4              | 4080                            | f        | f             | f                                     | f                              | f                             |
| 5              | 4300                            | f        | f             | f                                     | f                              | f                             |
| 6              | 4880                            | NF002B16 | 0-15          | 77 ± 2                                | 0.79 ± 0.9                     | 2.0                           |
| 7              | 5775                            | f        | f             | f                                     | f                              | f                             |
| 8              | 6460                            | NF002B18 | 0-15          | 37 ± 1                                | 0.79 ± 0.3                     | 1.1                           |
| 9              | 6875                            | NF002B17 | 0-15          | 37 ± 1                                | 0.96 ± 0.6                     | 1.4                           |
| 10             | 7025                            | NF002B19 | 0-15          | 35 ± 1                                | 0.63 ± 0.3                     | 1.6                           |
| 11             | 7138                            | f        | f             | f                                     | f                              | f                             |
| 12             | 7192                            | f        | f             | f                                     | f                              | f                             |
| 13             | 7312                            | NF002B23 | 0-15          | 42 ± 1                                | 1.4 ± 0.1                      | 3.7                           |
| 14             | 7340                            | f        | f             | f                                     | f                              | f                             |
| 15             | 7407                            | f        | f             | f                                     | f                              | f                             |
| 16             | 7452                            | NF002B9  | 0-15          | 12 ± 0.3                              | 0.55 ± 0.1                     | 1.1                           |
| 17             | 7525                            | f        | f             | f                                     | f                              | f                             |
| 18             | 7600                            | NF002B11 | 0-15          | 29 ± 0.6                              | 0.95 ± 0.5                     | 2.1                           |
| 19             | 7915                            | NF002B10 | 0-15          | 88 ± 2                                | 1.0 ± 0.6                      | 2.4                           |
| 20             | 7927                            | f        | f             | f                                     | f                              | f                             |
| 21             | 8343                            | f        | f             | f                                     | f                              | f                             |
| 22             | 8628                            | NF002B2  | 0-15          | 72 ± 1                                | 0.99 ± 1                       | 2.1                           |
| 23             | 8960                            | NF002B1  | 0-15          | 430 ± 10                              | <4.1                           | 5.0                           |

<sup>a</sup>Biased samples are taken from areas shown to have elevated gamma exposure rates.

<sup>b</sup>Locations of soil samples are shown on Fig. 2.

<sup>c</sup>Scanning east from Creek Road.

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

<sup>e</sup>Analytical error of measurement results is  $< \pm 5\%$  (95% confidence level).

<sup>f</sup>Not sampled.

**Table 9. Results of biased soil sample analysis on the north side of Pletcher Road and south side of Old Pletcher Road (NF002)<sup>a</sup>**

| Anomaly number | Location <sup>b,c</sup><br>(ft)                       | Sample   | Depth<br>(cm) | Radionuclide concentration<br>(pCi/g) |                                |                               |
|----------------|-------------------------------------------------------|----------|---------------|---------------------------------------|--------------------------------|-------------------------------|
|                |                                                       |          |               | <sup>226</sup> Ra <sup>d</sup>        | <sup>232</sup> Th <sup>d</sup> | <sup>238</sup> U <sup>e</sup> |
| 24             | 746                                                   | f        | f             | f                                     | f                              | f                             |
| 25             | 1169                                                  | NF002B3  | 0-15          | 23 ± 2                                | 0.90 ± 0.4                     | 1.3                           |
| 26             | 1298                                                  | NF002B4  | 0-15          | 33 ± 1                                | 1.2 ± 0.4                      | 1.4                           |
| 27             | 1488                                                  | NF002B6  | 0-15          | 39 ± 0.5                              | 0.83 ± 0.6                     | 1.8                           |
| 28             | 2333                                                  | NF002B7  | 0-15          | 53 ± 2                                | 0.58 ± 0.4                     | 1.5                           |
| 29             | 2363                                                  | f        | f             | f                                     | f                              | f                             |
| 30             | 2530                                                  | NF002B8  | 0-15          | 33 ± 0.5                              | 1.1 ± 0.5                      | 2.4                           |
| 31             | 2768                                                  | f        | f             | f                                     | f                              | f                             |
| 32             | 2844                                                  | f        | f             | f                                     | f                              | f                             |
| 33             | 6170                                                  | NF002B15 | 0-15          | 25 ± 0.6                              | 0.75 ± 0.3                     | 1.3                           |
| 34             | Old Pletcher Road<br>490 feet east of<br>KOA entrance | f        | f             | f                                     | f                              | f                             |
| 35             | Old Pletcher Road<br>570 ft east of<br>KOA entrance   | NF002B5  | 0-15          | 120 ± 4                               | <0.99                          | 3.0                           |

<sup>a</sup>Biased samples are taken from areas shown to have elevated gamma exposure rates.

<sup>b</sup>Locations of soil samples are shown on Fig. 2.

<sup>c</sup>Scanning west from Harold Road.

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

<sup>e</sup>Analytical error of measurement results is  $< \pm 5\%$  (95% confidence level).

<sup>f</sup>Not sampled.

**Table 10. Results of biased soil sample analysis in the  
Lewiston, New York, area (NF002)<sup>a</sup>**

| Anomaly<br>number | Location <sup>b</sup>                                                      | Sample   | Depth<br>(cm) | Radionuclide concentration<br>(pCi/g) |                                |                               |
|-------------------|----------------------------------------------------------------------------|----------|---------------|---------------------------------------|--------------------------------|-------------------------------|
|                   |                                                                            |          |               | <sup>226</sup> Ra <sup>c</sup>        | <sup>232</sup> Th <sup>c</sup> | <sup>238</sup> U <sup>d</sup> |
| 36                | 961 Ridge Road                                                             | NF002B50 | 0-10          | 6.0 ± 0.2                             | 0.61 ± 0.1                     | 4.3                           |
| 37                | House between 889<br>and 913 Ridge Road                                    | e        | e             | e                                     | e                              | e                             |
| 38                | 1084 Ridge Road                                                            | NF002B51 | 0-10          | 7.6 ± 0.2                             | 0.32 ± 0.1                     | 7.0                           |
| 39                | Circle gravel drive<br>south side Ridge<br>Road at TP45                    | NF002B52 | 0-10          | 16 ± 0.6                              | 0.71 ± 0.3                     | 13                            |
| 40                | 1011 Upper Mt. Road                                                        | NF002B58 | 0-15          | 24 ± 0.4                              | 0.29 ± 0.1                     | 24                            |
| 41                | 783 Upper Mt. Road                                                         | e        | e             | e                                     | e                              | e                             |
| 42                | 789 Upper Mt. Road                                                         | NF002B56 | 0-15          | 11 ± 0.5                              | 45 ± 10                        | 9.3                           |
| -                 | 789 Upper Mt. Road                                                         | NF002B57 | 0-5           | 14 ± 0.4                              | 16 ± 3.0                       | 13                            |
| 43                | 738 Upper Mt. Road                                                         | NF002B55 | 0-15          | 92 ± 5                                | 560 ± 180                      | 70                            |
| 44                | 4977 Creek Road                                                            | e        | e             | e                                     | e                              | e                             |
| 45                | 4979 Creek Road                                                            | e        | e             | e                                     | e                              | e                             |
| 46                | 4945 Creek Road                                                            | e        | e             | e                                     | e                              | e                             |
| 47                | Junction of Highways 18<br>and 104 (NE side of<br>104 and 18) <sup>f</sup> | NF002B53 | 0-15          | 180 ± 3                               | 0.60 ± 0.4                     | 0.97                          |
| 48                | 4986 Creek Road and<br>adjoining lot                                       | NF002B54 | 0-10          | 26 ± 0.6                              | 0.74 ± 0.2                     | 22                            |

<sup>a</sup>Biased samples are taken from areas shown to have elevated gamma exposure rates.

<sup>b</sup>Locations of soil samples are shown on Fig. 2.

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

<sup>d</sup>Analytical error of measurement results is  $< \pm 5\%$  (95% confidence level).

<sup>e</sup>Not sampled.

<sup>f</sup>B. A. Berven, *Results of Radiological Measurements Taken at Junction of Highways 18 and 104 in Niagara Falls, New York*, Oak Ridge National Laboratory, ORNL/RASA-85/40 (December 1985).

Table 11. Results of biased soil sample analysis northeast of  
Niagara Falls area (NF002)<sup>a</sup>

| Anomaly<br>number | Location <sup>b</sup>                                                              | Sample   | Depth<br>(cm) | Radionuclide concentration<br>(pCi/g) |                                |                               |
|-------------------|------------------------------------------------------------------------------------|----------|---------------|---------------------------------------|--------------------------------|-------------------------------|
|                   |                                                                                    |          |               | <sup>226</sup> Ra <sup>c</sup>        | <sup>232</sup> Th <sup>c</sup> | <sup>238</sup> U <sup>d</sup> |
| 49                | Across street from 5439<br>and 5447 Military Road                                  | NF002B35 | 0-15          | 3.7 ± 0.1                             | 0.92 ± 0.4                     | 3.7                           |
| 50                | Reservoir State Park<br>(NW corner of Military<br>Road and Highway 31)             | NF002B37 | 0-10          | 2.8 ± 0.09                            | 0.90 ± 0.2                     | 2.4                           |
| -                 | Reservoir State Park<br>(NW corner of Military<br>Road and Highway 31)             | NF002B38 | 0-15          | 19 ± 0.5                              | 0.83 ± 0.1                     | 18                            |
| 51                | Military Road ~400 ft<br>north of Highway 31<br>(both sides of creek) <sup>e</sup> | NF002B33 | 0-10          | 40 ± 1                                | 0.62 ± 0.3                     | 4.7                           |
| -                 | Military Road ~400 ft<br>north of Highway 31<br>(both sides of creek)              | NF002B32 | 0-10          | 7.2 ± 0.1                             | 0.97 ± 0.3                     | 6.0                           |
| -                 | Military Road ~400 ft<br>north of Highway 31<br>(both sides of creek)              | NF002B34 | 0-10          | 18 ± 0.9                              | 0.68 ± 0.7                     | 19                            |
| 52                | 2924 Military Road                                                                 | NF002B30 | 0-10          | 12 ± 0.4                              | 45 ± 10                        | 10                            |
| 53                | 6560 Niagara Falls Blvd.                                                           | NF002B47 | 0-10          | 3.7 ± 0.1                             | 0.69 ± 0.4                     | 2.8                           |
| 54                | Walter S. Kozdranski<br>Co., Inc., 1865<br>3rd Avenue                              | NF002B48 | 0-10          | 36 ± 0.6                              | 0.85 ± 0.6                     | 33                            |
| 55                | Nuts and Bolts<br>Products, Inc.,<br>2115 3rd Avenue                               | NF002B49 | 0-10          | 1.2 ± 0.04                            | 0.53 ± 0.2                     | 1.1                           |
| 56                | Save-Rite Discount Store,<br>4301 Military Road                                    | NF002B36 | 5-15          | 9.2 ± 0.3                             | 0.45 ± 0.2                     | 8.7                           |
| 57                | Louie's Place,<br>4509 Military Road                                               | f        | f             | f                                     | f                              | f                             |
| 58                | 4611 and 4613 Military<br>Road                                                     | f        | f             | f                                     | f                              | f                             |
| 59                | Prince of Peace Church,<br>Military Road (Rectory,<br>908 N. Military Road)        | f        | f             | f                                     | f                              | f                             |
| 60                | Metropolitan Life<br>and National Fuel,<br>1329 N. Military Road                   | NF002B31 | 0-10          | 13 ± 0.4                              | 0.81 ± 0.2                     | 11                            |

<sup>a</sup>Biased samples are taken from areas shown to have elevated gamma exposure rates.

<sup>b</sup>Locations of soil samples are shown on Fig. 3.

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

<sup>d</sup>Analytical error of measurement results is  $< \pm 5\%$  (95% confidence level).

<sup>e</sup>B. A. Berven, *Results of Radiological Measurements Taken near Junction of Highway 31 and Military Road in Niagara Falls, New York*, Oak Ridge National Laboratory, ORNL/RASA-85/42 (December 1985).

<sup>f</sup>Not sampled.

**Table 12. Results of biased soil sample analysis in  
Grand Island-Tonawanda area (NF002)<sup>a</sup>**

| Anomaly<br>number | Location <sup>b</sup>                             | Sample              | Depth<br>(cm) | Radionuclide concentration<br>(pCi/g) |                                |                               |
|-------------------|---------------------------------------------------|---------------------|---------------|---------------------------------------|--------------------------------|-------------------------------|
|                   |                                                   |                     |               | <sup>226</sup> Ra <sup>c</sup>        | <sup>232</sup> Th <sup>c</sup> | <sup>238</sup> U <sup>d</sup> |
| 61                | Kelly's Country Store,<br>3121 Grand Island Blvd. | NF002B44            | 0-10          | 3.3 ± 0.08                            | 5.9 ± 1                        | 2.9                           |
| 62                | Mobil Service Station,<br>1685 Grand Island Blvd. | NF002B39A<br>(dirt) | 0-10          | 1.4 ± 0.06                            | 1.3 ± 0.3                      | 1.2                           |
| -                 | Mobil Service Station,<br>1685 Grand Island Blvd. | NF002B39B<br>(rock) | 0-10          | 6.1 ± 0.2                             | 9.6 ± 2.0                      | 6.0                           |
| -                 | Mobil Service Station,<br>1685 Grand Island Blvd. | NF002B40            | 0-15          | 2.8 ± 0.08                            | 3.2 ± 0.8                      | 2.8                           |
| 63                | 3060 Grand Island Blvd.                           | NF002B43            | 0-15          | 25 ± 0.5                              | 39 ± 9                         | 26                            |
| 64                | 3050 Grand Island Blvd.                           | NF002B42            | 0-10          | 3.2 ± 0.06                            | 5.9 ± 1                        | 3.7                           |
| 65                | 3044 Grand Island Blvd.                           | e                   | e             | e                                     | e                              | e                             |
| 66                | KOA Campground,<br>2570 Grand Island Blvd.        | NF002B41            | 0-15          | 2.0 ± 0.2                             | 1.9 ± 0.4                      | 1.7                           |

<sup>a</sup>Biased samples are taken from areas shown to have elevated gamma exposure rates.

<sup>b</sup>Locations of soil samples are shown on Fig. 4.

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

<sup>d</sup>Analytical error of measurement results is  $< \pm 5\%$  (95% confidence level).

<sup>e</sup>Not sampled.

Table 13. Results of biased soil sample analysis in  
Niagara Falls, New York (NF002)<sup>a</sup>

| Anomaly<br>number | Location <sup>b</sup>                                                     | Sample    | Depth<br>(cm) | Radionuclide concentration<br>(pCi/g) |                                |                               |
|-------------------|---------------------------------------------------------------------------|-----------|---------------|---------------------------------------|--------------------------------|-------------------------------|
|                   |                                                                           |           |               | <sup>226</sup> Ra <sup>c</sup>        | <sup>232</sup> Th <sup>c</sup> | <sup>238</sup> U <sup>d</sup> |
| 67                | SE corner of Cudaback<br>and Portage Road                                 | NF002B21  | 0-15          | 6.5 ± 0.2                             | 0.47 ± 0.3                     | 5.3                           |
| 68                | Between 245 and<br>257 Portage Road                                       | e         | e             | e                                     | e                              | e                             |
| 69                | Niagara Falls High School,<br>Pine Street and<br>Portage Road             | e         | e             | e                                     | e                              | e                             |
| 70                | 1318-1324 Portage Road                                                    | e         | e             | e                                     | e                              | e                             |
| 71                | Harris and Lever Florists,<br>Portage Road                                | e         | e             | e                                     | e                              | e                             |
| 72                | 574 Portage Road                                                          | e         | e             | e                                     | e                              | e                             |
| 73                | NW corner Ferry Avenue and<br>Portage Road (probably<br>504 Portage Road) | e         | e             | e                                     | e                              | e                             |
| 74                | Property between 434<br>Portage Road and 1338<br>Niagara Street           | e         | e             | e                                     | e                              | e                             |
| 75                | 368 Portage Road                                                          | e         | e             | e                                     | e                              | e                             |
| 76                | 356 Portage Road                                                          | e         | e             | e                                     | e                              | e                             |
| 77                | 256 Portage Road                                                          | NF002B22  | 0-15          | 36 ± 1                                | 0.68 ± 0.4                     | 32                            |
| 78                | Between 242 Portage Road<br>and Payne's Floor<br>Covering                 | NF002B23  | 0-15          | 51 ± 2                                | 0.45 ± 0.3                     | 45                            |
| 79                | 200 Portage Road                                                          | e         | e             | e                                     | e                              | e                             |
| 80                | Opposite 5704 Buffalo<br>Avenue                                           | NF002B27  | 0-15          | 12 ± 0.3                              | 0.44 ± 0.2                     | 11                            |
| 81                | 6901 Buffalo Avenue<br>Region #1                                          | NF002B25A | 0-15          | 57 ± 1                                | 0.68 ± 0.4                     | 52                            |
| -                 | 6901 Buffalo Avenue<br>Region #1                                          | NF002B25B | 0-15          | 19 ± 0.7                              | 0.77 ± 0.1                     | 18                            |
| -                 | 6901 Buffalo Avenue<br>Regions #2, #3,<br>and #4                          | e         | e             | e                                     | e                              | e                             |
| 82                | 7723 Buffalo Avenue                                                       | e         | e             | e                                     | e                              | e                             |
| 83                | 5512 Buffalo Avenue                                                       | e         | e             | e                                     | e                              | e                             |
| 84                | Buffalo Avenue (230 ft<br>west of 53rd Street)                            | e         | e             | e                                     | e                              | e                             |
| 85                | Occidental Chemical Corp.,<br>Buffalo Avenue                              | e         | e             | e                                     | e                              | e                             |
| 86                | Opposite ALOX Corp.,<br>Buffalo Avenue                                    | NF002B26  | 0-15          | 29 ± 0.5                              | 0.51 ± 0.3                     | 26                            |

Table 13 (continued)

| Anomaly number | Location <sup>b</sup>                                             | Sample   | Depth (cm) | Radionuclide concentration (pCi/g) |                                |                               |
|----------------|-------------------------------------------------------------------|----------|------------|------------------------------------|--------------------------------|-------------------------------|
|                |                                                                   |          |            | <sup>226</sup> Ra <sup>c</sup>     | <sup>232</sup> Th <sup>c</sup> | <sup>238</sup> U <sup>d</sup> |
| 87             | Buffalo Avenue (east side of Hyde Park intersection) <sup>f</sup> | NF002B24 | 0-15       | 150 ± 4                            | 0.92 ± 0.5                     | 2.3                           |
| 88             | Buffalo Avenue opposite SOHIO                                     | NF002B28 | 0-15       | 18 ± 0.2                           | 0.74 ± 0.2                     | 16                            |
| 89             | 1920 Buffalo Avenue                                               | e        | e          | e                                  | e                              | e                             |
| 90             | Buffalo Avenue opposite Carborundum Corp.                         | NF002B29 | 0-15       | 55 ± 1                             | 0.40 ± 0.3                     | 48                            |
| 91             | 2434 Willow Avenue                                                | NF002B46 | 0-15       | 7.7 ± 0.3                          | 20 ± 5                         | 7.0                           |
| 92             | 2430 Willow Avenue                                                | NF002B45 | 0-15       | 4.1 ± 0.2                          | 9.8 ± 2                        | 3.7                           |
| 93             | 3017 Lewiston Road and property on south side                     | e        | e          | e                                  | e                              | e                             |
| 94             | 4831 Lewiston Road                                                | e        | e          | e                                  | e                              | e                             |
| 95             | 4842 Lewiston Road                                                | e        | e          | e                                  | e                              | e                             |
| 96             | Intersection Rankine Road and Lewiston Road (west side)           | e        | e          | e                                  | e                              | e                             |
| 97             | Intersection McKinley and Lewiston Road (west side)               | e        | e          | e                                  | e                              | e                             |
| 98             | 2919 Porter Road                                                  | e        | e          | e                                  | e                              | e                             |
| 99             | 2923 Porter Road                                                  | e        | e          | e                                  | e                              | e                             |
| 100            | Corner of Pine Street and 29th Street (Wilson Farms Store)        | e        | e          | e                                  | e                              | e                             |

<sup>a</sup>Biased samples are taken from areas shown to have elevated gamma exposure rates.

<sup>b</sup>Locations of soil samples are shown on Fig. 3.

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

<sup>d</sup>Analytical error of measurement results is  $< \pm 5\%$  (95% confidence level).

<sup>e</sup>Not sampled.

<sup>f</sup>B. A. Berven, *Results of Radiological Measurements Taken near Junction of Buffalo Avenue and Hyde Park Blvd. in Niagara Falls, New York*, Oak Ridge National Laboratory, ORNL/RASA-85/41 (December 1985).



**Table 14. Summary of anomalies in the Niagara Falls, New York, area**

| Anomaly number                           | Location             | Type anomaly | NFSS related anomaly | Property description | Figure number | Tables              |               |
|------------------------------------------|----------------------|--------------|----------------------|----------------------|---------------|---------------------|---------------|
|                                          |                      |              |                      |                      |               | Gamma exposure rate | Soil analysis |
| South Side of Pletcher Road <sup>a</sup> |                      |              |                      |                      |               |                     |               |
| 1                                        | 2200 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 2                                        | 2950 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 3                                        | 3950 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 4                                        | 4080 ft <sup>b</sup> | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 5                                        | 4300 ft <sup>b</sup> | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 6                                        | 4880 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 7                                        | 5775 ft <sup>b</sup> | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 8                                        | 6460 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 9                                        | 6875 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 10                                       | 7025 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 11                                       | 7138 ft <sup>b</sup> | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 12                                       | 7192 ft <sup>b</sup> | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 13                                       | 7312 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 14                                       | 7340 ft <sup>b</sup> | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 15                                       | 7407 ft <sup>b</sup> | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 16                                       | 7452 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 17                                       | 7525 ft <sup>b</sup> | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 18                                       | 7600 ft <sup>b</sup> | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |

**Table 14 (continued)**

| Anomaly number                                                                     | Location                                              | Type anomaly | NFSS related anomaly | Property description | Figure number | Tables              |               |
|------------------------------------------------------------------------------------|-------------------------------------------------------|--------------|----------------------|----------------------|---------------|---------------------|---------------|
|                                                                                    |                                                       |              |                      |                      |               | Gamma exposure rate | Soil analysis |
| 19                                                                                 | 7915 ft <sup>b</sup>                                  | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 20                                                                                 | 7927 ft <sup>b</sup>                                  | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 21                                                                                 | 8343 ft <sup>b</sup>                                  | Ra-226       | Yes                  | Open field           | 2             | 2                   | 8             |
| 22                                                                                 | 8628 ft <sup>b</sup>                                  | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| 23                                                                                 | 8960 ft <sup>b</sup>                                  | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 2                   | 8             |
| <b>North Side of Pletcher Road and South Side of Old Pletcher Road<sup>a</sup></b> |                                                       |              |                      |                      |               |                     |               |
| 24                                                                                 | 746 ft <sup>d</sup>                                   | Ra-226       | Yes                  | Open field           | 2             | 3                   | 9             |
| 25                                                                                 | 1169 ft <sup>d</sup>                                  | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 3                   | 9             |
| 26                                                                                 | 1298 ft <sup>d</sup>                                  | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 3                   | 9             |
| 27                                                                                 | 1488 ft <sup>d</sup>                                  | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 3                   | 9             |
| 28                                                                                 | 2333 ft <sup>d</sup>                                  | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 3                   | 9             |
| 29                                                                                 | 2363 ft <sup>d</sup>                                  | Ra-226       | Yes                  | Open field           | 2             | 3                   | 9             |
| 30                                                                                 | 2530 ft <sup>d</sup>                                  | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 3                   | 9             |
| 31                                                                                 | 2768 ft <sup>d</sup>                                  | Ra-226       | Yes                  | Open field           | 2             | 3                   | 9             |
| 32                                                                                 | 2844 ft <sup>d</sup>                                  | Ra-226       | Yes                  | Open field           | 2             | 3                   | 9             |
| 33                                                                                 | 6170 ft <sup>d</sup>                                  | Ra-226       | Yes <sup>c</sup>     | Open field           | 2             | 3                   | 9             |
| 34                                                                                 | Old Pletcher Road<br>490 feet east of<br>KOA entrance | Ra-226       | Yes                  | Open field           | 2             | 3                   | 9             |

Table 14 (continued)

| Anomaly number           | Location                                          | Type anomaly | NFSS related anomaly                        | Property description | Figure number | Tables              |               |
|--------------------------|---------------------------------------------------|--------------|---------------------------------------------|----------------------|---------------|---------------------|---------------|
|                          |                                                   |              |                                             |                      |               | Gamma exposure rate | Soil analysis |
| 35                       | 570 feet east of KOA entrance                     | Ra-226       | Yes <sup>c</sup>                            | Open field           | 2             | 3                   | 9             |
| Lewiston, New York, Area |                                                   |              |                                             |                      |               |                     |               |
| 36                       | 961 Ridge Road                                    | Ra-226       | No-asphalt <sup>c</sup>                     | Driveway             | 2             | 4                   | 10            |
| 37                       | House between 889 and 913 Ridge Road              | Ra-226       | No-asphalt <sup>c</sup>                     | Driveway             | 2             | 4                   | 10            |
| 38                       | 1084 Ridge Road                                   | Ra-226       | No-asphalt <sup>c</sup>                     | Driveway             | 2             | 4                   | 10            |
| 39                       | Circle gravel drive south side Ridge Road at TP45 | Ra-226       | No-gravel, culvert <sup>c</sup>             | Open field           | 2             | 4                   | 10            |
| 40                       | 1011 Upper Mt. Road                               | Ra-226       | No-gravel, culvert <sup>c</sup>             | Driveway             | 2             | 4                   | 10            |
| 41                       | 783 Upper Mt. Road                                | Th-232       | No-slag, fill material <sup>c</sup>         | Yard and Driveway    | 2             | 4                   | 10            |
| 42                       | 789 Upper Mt. Road                                | Th-232       | No-slag, fill material <sup>c</sup>         | Yard and Driveway    | 2             | 4                   | 10            |
| 43                       | 738 Upper Mt. Road                                | Th-232       | No-gravel, slag, fill material <sup>c</sup> | Yard and Driveway    | 2             | 4                   | 10            |
| 44                       | 4977 Creek Road                                   | Ra-226       | Not found                                   | Yard and Driveway    | 2             | 4                   | 10            |
| 45                       | 4979 Creek Road                                   | Ra-226       | No-asphalt pad <sup>c</sup>                 | Yard and Driveway    | 2             | 4                   | 10            |
| 46                       | 4945 Creek Road                                   | Ra-226       | No-asphalt <sup>c</sup>                     | Yard and Driveway    | 2             | 4                   | 10            |

Table 14 (continued)

| Anomaly number                  | Location                                                                     | Type anomaly | NFSS related anomaly    | Property description | Figure number | Tables              |               |
|---------------------------------|------------------------------------------------------------------------------|--------------|-------------------------|----------------------|---------------|---------------------|---------------|
|                                 |                                                                              |              |                         |                      |               | Gamma exposure rate | Soil analysis |
| 47                              | Junction of Highways 18 and 104 (NE side of 104 and 18) <sup>f</sup>         | Ra-226       | Yes <sup>c</sup>        | Highway median       | 2             | 4                   | 10            |
| 48                              | 4986 Creek Road and adjoining lot                                            | Ra-226       | No-asphalt <sup>e</sup> | Yard and Driveway    | 2             | 4                   | 10            |
| Northeast of Niagara Falls Area |                                                                              |              |                         |                      |               |                     |               |
| 49                              | Across street from 5439 and 5447 Military Road                               | Ra-226       | No-asphalt <sup>e</sup> | Open field, pavement | 3             | 5                   | 11            |
| 50                              | Reservoir State Park (NW corner of Military Road and Highway 31)             | Ra-226       | No-asphalt <sup>e</sup> | Park                 | 3             | 5                   | 11            |
| 51                              | Military Road ~400 ft north of Highway 31 (both sides of creek) <sup>g</sup> | Ra-226       | Yes <sup>c</sup>        | Vacant lots          | 3             | 5                   | 11            |
| 52                              | 2924 Military Road                                                           | Th-232       | No-asphalt <sup>e</sup> | Residence            | 3             | 5                   | 11            |
| 53                              | 6560 Niagara Falls Blvd.                                                     | Ra-226       | No-asphalt <sup>e</sup> | Business             | 3             | 5                   | 11            |
| 54                              | Walter S. Kozdranski Co., Inc., 1865 3rd Avenue                              | Ra-226       | No-asphalt <sup>e</sup> | Business             | 3             | 5                   | 11            |

Table 14 (continued)

| Anomaly number                     | Location                                                                    | Type anomaly | NFSS related anomaly                         | Property description | Figure number | Tables              |               |
|------------------------------------|-----------------------------------------------------------------------------|--------------|----------------------------------------------|----------------------|---------------|---------------------|---------------|
|                                    |                                                                             |              |                                              |                      |               | Gamma exposure rate | Soil analysis |
| 55                                 | Nuts and Bolts Products, Inc.,<br>2115 3rd Avenue                           | Ra-226       | No-asphalt <sup>c</sup>                      | Business             | 3             | 5                   | 11            |
| 56                                 | Save-Rite Discount Store, 4301 Military Road                                | Ra-226       | No-asphalt <sup>c</sup>                      | Business             | 3             | 5                   | 11            |
| 57                                 | Louie's Place,<br>4509 Military Road                                        | Ra-226       | No-asphalt <sup>c</sup>                      | Business             | 3             | 5                   | 11            |
| 58                                 | 4611 and 4613 Military Road                                                 | Ra-226       | No-asphalt <sup>c</sup>                      | Parking lot          | 3             | 5                   | 11            |
| 59                                 | Prince of Peace Church,<br>Military Road<br>(Rectory, 908 N. Military Road) | Ra-226       | No-asphalt <sup>c</sup>                      | Church parking lot   | 3             | 5                   | 11            |
| 60                                 | Metropolitan Life and National Fuel,<br>1329 N. Military Road               | Th-232       | No-asphalt, slag, fill material <sup>c</sup> | Business             | 3             | 5                   | 11            |
| <b>Grand Island-Tonawanda Area</b> |                                                                             |              |                                              |                      |               |                     |               |
| 61                                 | Kelly's Country Store,<br>3121 Grand Island Blvd.                           | Th-232       | No-asphalt, gravel <sup>c</sup>              | Business             | 4             | 6                   | 12            |
| 62                                 | Mobil Service Station,<br>1685 Grand Island Blvd.                           | Th-232       | No-asphalt, fill material <sup>c</sup>       | Business             | 4             | 6                   | 12            |

**Table 14 (continued)**

| Anomaly number                 | Location                                                | Type anomaly | NFSS related anomaly                   | Property description   | Figure number | Tables              |               |
|--------------------------------|---------------------------------------------------------|--------------|----------------------------------------|------------------------|---------------|---------------------|---------------|
|                                |                                                         |              |                                        |                        |               | Gamma exposure rate | Soil analysis |
| 63                             | 3060 Grand Island Blvd.                                 | Th-232       | No-asphalt, fill material <sup>c</sup> | Residence              | 4             | 6                   | 12            |
| 64                             | 3050 Grand Island Blvd.                                 | Th-232       | No-asphalt, fill material <sup>c</sup> | Residence              | 4             | 6                   | 12            |
| 65                             | 3044 Grand Island Blvd.                                 | Th-232       | No-asphalt, fill material <sup>c</sup> | Residence/<br>business | 4             | 6                   | 12            |
| 66                             | KOA Campground, 2570 Grand Island Blvd.                 | Th-232       | No-asphalt <sup>c</sup>                | Business               | 4             | 6                   | 12            |
| <b>Niagara Falls, New York</b> |                                                         |              |                                        |                        |               |                     |               |
| 67                             | SE corner of Cudaback and Portage Road                  | Ra-226       | No-gravel <sup>c</sup>                 | Commercial building    | 3             | 7                   | 13            |
| 68                             | Between 245 and 257 Portage Road                        | Ra-226       | No-asphalt <sup>c</sup>                | Parking lot            | 3             | 7                   | 13            |
| 69                             | Niagara Falls High School, Pine Street and Portage Road | Th-232       | No-brick building <sup>c</sup>         | School                 | 3             | 7                   | 13            |
| 70                             | 1318-1324 Portage Road                                  | Ra-226       | No-brick building <sup>c</sup>         | Business               | 3             | 7                   | 13            |
| 71                             | Harris and Lever Florists, Portage Road                 | Ra-226       | No-asphalt <sup>c</sup>                | Business               | 3             | 7                   | 13            |
| 72                             | 574 Portage Road                                        | Ra-226       | No-granite <sup>c</sup>                | Business               | 3             | 7                   | 13            |

Table 14 (continued)

| Anomaly number | Location                                                            | Type anomaly | NFSS related anomaly              | Property description    | Figure number | Tables              |               |
|----------------|---------------------------------------------------------------------|--------------|-----------------------------------|-------------------------|---------------|---------------------|---------------|
|                |                                                                     |              |                                   |                         |               | Gamma exposure rate | Soil analysis |
| 73             | NW corner Ferry Avenue and Portage Road (probably 504 Portage Road) | Ra-226       | No-concrete <sup>c</sup>          | Vacant lot, driveway    | 3             | 7                   | 13            |
| 74             | Property between 434 Portage Road and 1338 Niagara Street           | Ra-226       | No-asphalt <sup>c</sup>           | Residence               | 3             | 7                   | 13            |
| 75             | 368 Portage Road                                                    | Ra-226       | No-asphalt, concrete <sup>c</sup> | Residence               | 3             | 7                   | 13            |
| 76             | 356 Portage Road                                                    | Ra-226       | No-asphalt <sup>c</sup>           | Residence               | 3             | 7                   | 13            |
| 77             | 256 Portage Road                                                    | Ra-226       | No-gravel <sup>c</sup>            | Residence               | 3             | 7                   | 13            |
| 78             | Between 242 Portage Road and Payne's Floor Covering                 | Ra-226       | No-rocks <sup>c</sup>             | Vacant lot              | 3             | 7                   | 13            |
| 79             | 200 Portage Road                                                    | Ra-226       | Not found                         | Business                | 3             | 7                   | 13            |
| 80             | Opposite 5704 Buffalo Avenue                                        | Ra-226       | No-gravel <sup>c</sup>            | Vacant lot              | 3             | 7                   | 13            |
| 81             | 6901 Buffalo Avenue                                                 | Ra-226       | No-asphalt, concrete <sup>c</sup> | Vacant lot              | 3             | 7                   | 13            |
| 82             | 7723 Buffalo Avenue                                                 | Ra-226       | No-asphalt <sup>c</sup>           | Business                | 3             | 7                   | 13            |
| 83             | 5512 Buffalo Avenue                                                 | Ra-226       | No-asphalt <sup>c</sup>           | Business                | 3             | 7                   | 13            |
| 84             | Buffalo Avenue (230 ft west of 53rd Street)                         | Ra-226       | No-concrete <sup>c</sup>          | Grass area and sidewalk | 3             | 7                   | 13            |

Table 14 (continued)

| Anomaly number | Location                                                          | Type anomaly | NFSS related anomaly                         | Property description | Figure number | Tables              |               |
|----------------|-------------------------------------------------------------------|--------------|----------------------------------------------|----------------------|---------------|---------------------|---------------|
|                |                                                                   |              |                                              |                      |               | Gamma exposure rate | Soil analysis |
| 85             | Occidental Chemical Corp., Buffalo Avenue                         | Ra-226       | No-concrete <sup>e</sup>                     | Business             | 3             | 7                   | 13            |
| 86             | Opposite ALOX Corp. Buffalo Avenue                                | Ra-226       | No-asphalt <sup>e</sup>                      | Parking lot          | 3             | 7                   | 13            |
| 87             | Buffalo Avenue (east side of Hyde Park intersection) <sup>h</sup> | Ra-226       | Yes <sup>c</sup>                             | Vacant lot           | 3             | 7                   | 13            |
| 88             | Buffalo Avenue opposite SOHIO                                     | Ra-226       | No-asphalt <sup>e</sup>                      | Parking lot          | 3             | 7                   | 13            |
| 89             | 1920 Buffalo Avenue                                               | Ra-226       | No-asphalt <sup>e</sup>                      | Business             | 3             | 7                   | 13            |
| 90             | Buffalo Avenue opposite Carborundum Corp.                         | Ra-226       | No-gravel, asphalt <sup>e</sup>              | Vacant lot           | 3             | 7                   | 13            |
| 91             | 2434 Willow Avenue                                                | Th-232       | No-granite, slag, fill material <sup>e</sup> | Residence            | 3             | 7                   | 13            |
| 92             | 2430 Willow Avenue                                                | Th-232       | No-granite, slag, fill material <sup>e</sup> | Residence            | 3             | 7                   | 13            |
| 93             | 3017 Lewiston Road and property on south side                     | Ra-226       | No-asphalt <sup>e</sup>                      | Residence            | 3             | 7                   | 13            |
| 94             | 4831 Lewiston Road                                                | Th-232       | No-rocks <sup>e</sup>                        | Residence            | 3             | 7                   | 13            |
| 95             | 4842 Lewiston Road                                                | Ra-226       | No-asphalt <sup>e</sup>                      | Residence            | 3             | 7                   | 13            |



Table 14 (continued)

| Anomaly number | Location                                                          | Type anomaly | NFSS related anomaly                         | Property description | Figure number | Tables              |               |
|----------------|-------------------------------------------------------------------|--------------|----------------------------------------------|----------------------|---------------|---------------------|---------------|
|                |                                                                   |              |                                              |                      |               | Gamma exposure rate | Soil analysis |
| 85             | Occidental Chemical Corp., Buffalo Avenue                         | Ra-226       | No-concrete <sup>e</sup>                     | Business             | 3             | 7                   | 13            |
| 86             | Opposite ALOX Corp. Buffalo Avenue                                | Ra-226       | No-asphalt <sup>e</sup>                      | Parking lot          | 3             | 7                   | 13            |
| 87             | Buffalo Avenue (east side of Hyde Park intersection) <sup>h</sup> | Ra-226       | Yes <sup>c</sup>                             | Vacant lot           | 3             | 7                   | 13            |
| 88             | Buffalo Avenue opposite SOHIO                                     | Ra-226       | No-asphalt <sup>e</sup>                      | Parking lot          | 3             | 7                   | 13            |
| 89             | 1920 Buffalo Avenue                                               | Ra-226       | No-asphalt <sup>e</sup>                      | Business             | 3             | 7                   | 13            |
| 90             | Buffalo Avenue opposite Carborundum Corp.                         | Ra-226       | No-gravel, asphalt <sup>e</sup>              | Vacant lot           | 3             | 7                   | 13            |
| 91             | 2434 Willow Avenue                                                | Th-232       | No-granite, slag, fill material <sup>e</sup> | Residence            | 3             | 7                   | 13            |
| 92             | 2430 Willow Avenue                                                | Th-232       | No-granite, slag, fill material <sup>e</sup> | Residence            | 3             | 7                   | 13            |
| 93             | 3017 Lewiston Road and property on south side                     | Ra-226       | No-asphalt <sup>e</sup>                      | Residence            | 3             | 7                   | 13            |
| 94             | 4831 Lewiston Road                                                | Th-232       | No-rocks <sup>e</sup>                        | Residence            | 3             | 7                   | 13            |
| 95             | 4842 Lewiston Road                                                | Ra-226       | No-asphalt <sup>e</sup>                      | Residence            | 3             | 7                   | 13            |



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