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Research and Development Report

SURVEY OF ENVIRONMENTAL
RADIOACTIVITY FOR PERIOD
1-1-67 to 6-30-67

by

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Ames Laboratory

at

Iowa State University of Science and Technology

F. H. Spedding, Director

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SURVEY OF ENVIRONMENTAL RADIOACTIVITY
FOR PERIOD 1-1-67 TO 6-30-67

Milo Voss

ABSTRACT

This is the environmental monitoring program of the Ames Laboratory of the USAEC for the Ames Laboratory Research Reactor (ALRR).

The environmental program consists of air samples, soil, vegetation, river water, bottom sediment, precipitation, pond water, ALRR outfall, and well water samples. This report will cover the period from January 1, 1967 to June 30, 1967. As soil and vegetation samples are collected later in the year (usually August) that data will be reported in the annual report.

The ALRR reached full power as of 7/12/65. As of 12/31/66 the ALRR had generated 11, 927 megawatts of heat. A total of 27, 606 megawatts of heat has been generated as of 6/30/67.

The data indicates that the ALRR has not contributed a significant amount of radioactivity to the environment in the Ames area. The conclusion is reached that radioactivity levels recorded for environmental samples represent background conditions from atmospheric fallout and naturally occurring radioactivity.

The following levels of radioactivity were recorded for the period.

| <u>Sample Media</u> | <u>Individual Samples</u> | <u>Beta Activity</u> | <u>Alpha Activity</u> |
|---------------------|---------------------------|----------------------|-----------------------|
| Air | 142 | 0.18 | 0.0026 |
| River Water | 131 | 13.52 | 0.83 |
| ALRR Outfall | 126 | 11.56 | 0.47 |
| Bottom Sediment | 25 | 12.61 | 0.73 |
| Precipitation | 29 | 122.11 | 4.87 |
| Well Water | 18 | 6.48 | 1.18 |
| Pond Water | 13 | 16.14 | 1.13 |

The units are pCi/M³ for air, pCi/l for River Water, Precipitation, Well Water, Pond Water, and ALRR Outfall, and pCi/g for bottom sediment.

II. Sample Information

A. Air Samples

Daily air samples are taken on top of the Ames Laboratory Research Building. Samples are collected on Wattman No. 41 filters with a Gast sampler which has a flow rate of 3.75 cfm. The air samples are counted on a Sharp Low Beta Matic System for gross alpha and beta activity seven days after collection.

The beta activity range was 0.01 to 2.66 pCi/M³ with an average of 0.18 pCi/M³. The alpha activity range was 0.001 to 0.91 pCi/M³ with an average of 0.006 pCi/M³. Average levels reported for 1966 were 0.15 pCi/M³ beta and 0.0025 pCi/M³ alpha.

B. River Water Samples

One liter samples are collected weekly from each of the sample sites unless the site is dry or frozen solid. These samples are filtered and the soluble and insoluble fractions are counted for gross alpha and beta content.

The beta activity range was 2.40 to 27.7 pCi/l with an average of 13.52 pCi/l. The alpha range was 0.18 to 2.70 pCi/l with an average of 0.83 pCi/l.

Average levels reported for 1966 were 16.03 pCi/l beta and 1.02 pCi/l alpha.

C. ALRR Outfall Samples

One liter samples are collected daily from this site and analyzed for gross beta and alpha content. The samples are filtered and counted as soluble and insoluble fractions.

The beta range was 3.30 pCi/l to 50.3 pCi/l with an average of 11.56 pCi/l. The alpha activity range was 0.18 pCi/l to 2.60 pCi/l with an average level of 0.47 pCi/l.

Average levels reported for 1966 were 12.25 pCi/l beta and 0.61 pCi/l alpha.

D. Bottom Sediment Samples

One quart bottom sediment samples are obtained at or near the river water sites on a quarterly basis. Samples are analyzed for gross alpha and beta activity.

The beta activity range was 7.50 pCi/g to 18.80 pCi/g

with an average of 12.61 pCi/g. The alpha activity range was 0.11 pCi/g to 2.40 pCi/g with an average of 0.73 pCi/g.

The average levels reported for 1966 were 13.52 pCi/g beta and 0.79 pCi/g alpha.

E. Precipitation Samples

Precipitation samples are collected on an "as it happens" basis from a site near ALRR. The samples are filtered and counted as soluble and insoluble fractions for gross beta and alpha.

The beta activity range was 5.80 pCi/l to 600.15 pCi/l with an average of 122.11 pCi/l. The alpha activity range was 0.28 pCi/l to 20.55 pCi/l with an average of 4.87 pCi/l.

The average levels reported for 1966 were 217.15 pCi/l beta and 9.21 pCi/l alpha.

F. Well Water Samples

Well water samples are obtained from three sites on a monthly basis and analyzed for gross alpha and beta content. Samples are filtered and counted as soluble and insoluble fractions.

The beta activity range was 2.88 pCi/l to 9.21 pCi/l with an average of 6.48 pCi/l. The alpha activity range was 0.36 pCi/l to 4.10 pCi/l with an average of 1.18 pCi/l.

The average levels reported for 1966 were 6.93 pCi/l beta and 1.14 pCi/l alpha.

G. Pond Water Samples

Pond water samples are collected monthly from three sites: the George Todd site three miles northeast of the ALRR; the Izaak Walton League site three miles east of the ALRR; and the Kelley site five miles south of the ALRR. A one liter sample is filtered and counted as soluble and insoluble fractions for gross alpha and beta.

The beta activity range was 5.40 pCi/l to 31.50 pCi/l with an average of 16.14 pCi/l. The alpha activity range was 0.36 pCi/l to 3.80 pCi/l with an average of 1.13 pCi/l.

The average level reported for 1966 was 15.49 pCi/l beta and 0.82 pCi/l alpha.

H. Detection Limits

Detection limits are by definition only.

I. Abbreviations Used

ND means not detectable.

Air Samples (pCi/M³)

1967

| <u>Date</u> | <u>Beta Conc.</u> | <u>Alpha Conc.</u> |
|---------------|-------------------|--------------------|
| January (23) | 0.48 | 0.013 |
| February (23) | 0.17 | 0.004 |
| March (25) | 0.18 | 0.011 |
| April (22) | 0.12 | 0.006 |
| May (25) | 0.11 | 0.003 |
| June (24) | 0.05 | 0.0027 |
| Average | 0.18 | 0.006 |
| High | 2.66 | 0.091 |
| Low | 0.01 | 0.001 |

Detection Limit 0.0066 pCi/M³ β 0.0026 pCi/M³ α

River Water Samples (pCi/l)

January 1967

Beta Activity

Alpha Activity

| <u>Location</u> | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
|-----------------|--------------------|------------------|---------------------|------------------|
| 1-DD-U | No Sample | ----- | ----- | ----- |
| 3-On-U | No Sample | ----- | ----- | ----- |
| 4-On-D | No Sample | ----- | ----- | ----- |
| 5-Sq-U | No Sample | ----- | ----- | ----- |
| 6-Sq-D | No Sample | ----- | ----- | ----- |
| 7-Sk-U | 19.30 | 0.54 | 0.18 | 0.54 |
| 9-CC | No Sample | ----- | ----- | ----- |
| 10-DM | 10.45 | 1.59 | 0.64 | 0.38 |
| 11-Sk-S | 18.06 | 1.34 | 0.43 | 0.36 |
| Average | 15.94 | 1.16 | 0.42 | 0.43 |
| High | 19.30 | 1.59 | 0.64 | 0.54 |
| Low | 10.45 | 0.54 | 0.18 | 0.36 |
| Detection Limit | 1.00 pCi/l β | | 0.39 pCi/l α | |

River Water Samples (pCi/l)

February 1967

| <u>Location</u> | <u>Beta Activity</u> | | <u>Alpha Activity</u> | |
|-----------------|----------------------|------------------|-----------------------|------------------|
| | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
| 1-DD-U | No Sample | ----- | ----- | ----- |
| 3-On-U | No Sample | ----- | ----- | ----- |
| 4-On-D | No Sample | ----- | ----- | ----- |
| 5-Sq-U | No Sample | ----- | ----- | ----- |
| 6-Sq-D | No Sample | ----- | ----- | ----- |
| 7-Sk-U | No Sample | ----- | ----- | ----- |
| 9-CC | No Sample | ----- | ----- | ----- |
| 10-DM | 9.68 | 3.84 | 0.23 | 0.55 |
| 11-Sk-S | 17.90 | 0.81 | 0.18 | 0.36 |
| Average | 13.79 | 2.33 | 0.21 | 0.46 |
| High | 17.90 | 3.84 | 0.23 | 0.55 |
| Low | 9.68 | 0.81 | 0.18 | 0.36 |
| Detection Limit | 1.00 pCi/l β | | 0.39 pCi/l α | |

River Water Samples (pCi/l)

March 1967

| <u>Location</u> | <u>Beta Activity</u> | | <u>Alpha Activity</u> | |
|-----------------|----------------------|------------------|-----------------------|------------------|
| | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
| I-DD-U | No Sample | ----- | ----- | ----- |
| 3-On-U | 21.90 | 4.70 | 0.72 | ND |
| 4-On-D | No Sample | ----- | ----- | ----- |
| 5-Sq-U | 8.83 | 1.72 | 0.60 | 0.36 |
| 6-Sq-D | 9.10 | 1.50 | 0.24 | 0.30 |
| 7-Sk-S | 7.17 | 1.52 | 0.30 | 0.24 |
| 9-CC | 9.90 | 1.08 | 0.12 | 0.12 |
| 10-DM | 12.80 | 2.83 | 0.59 | 0.32 |
| 11-Sk-S | 18.63 | 1.89 | 0.41 | 0.36 |
| Average | 12.62 | 2.18 | 0.43 | 0.24 |
| High | 21.90 | 4.70 | 0.72 | 0.36 |
| Low | 7.17 | 1.08 | 0.12 | 0.12 |
| Detection Limit | 1.00 pCi/l β | | 0.39 pCi/l α | |

River Water Samples (pCi/l)

April 1967

| <u>Location</u> | <u>Beta Activity</u> | | <u>Alpha Activity</u> | |
|-----------------|----------------------|------------------|-----------------------|------------------|
| | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
| 1-DD-U | No Sample | ----- | ----- | ----- |
| 3-On-U | 8.23 | 0.51 | 0.67 | 0.14 |
| 4-On-D | No Sample | ----- | ----- | ----- |
| 5-Sq-U | 8.30 | 0.66 | 0.50 | 0.27 |
| 6-Sq-D | 7.43 | 0.58 | 0.58 | 0.23 |
| 7-Sk-U | 10.38 | 0.88 | 0.27 | 0.23 |
| 9-CC | 11.50 | 0.41 | 0.57 | 0.32 |
| 10-DM | 11.85 | 2.10 | 0.55 | 0.57 |
| 11-Sk-S | 15.20 | 0.68 | 0.18 | 0.41 |
| Average | 10.41 | 0.83 | 0.47 | 0.31 |
| High | 15.20 | 2.10 | 0.67 | 0.57 |
| Low | 7.43 | 0.41 | 0.18 | 0.14 |
| Detection Limit | 1.00 pCi/l β | | 0.39 pCi/l α | |

River Water Samples (pCi/l)

May 1967

| <u>Location</u> | <u>Beta Activity</u> | | <u>Alpha Activity</u> | |
|-----------------|----------------------|------------------|-----------------------|------------------|
| | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
| 1-DD-U | No Sample | ----- | ----- | ----- |
| 3-On-U | 8.03 | 0.81 | 0.50 | 0.09 |
| 4-On-D | No Sample | ----- | ----- | ----- |
| 5-Sq-U | 8.18 | 0.82 | 0.43 | 0.40 |
| 6-Sq-D | 7.50 | 0.75 | 0.44 | 0.22 |
| 7-Sk-U | 8.34 | 0.76 | 0.36 | 0.58 |
| 9-CC | 7.82 | 0.30 | 0.43 | 0.22 |
| 10-DM | 9.94 | 2.26 | 0.71 | 0.40 |
| 11-Sk-S | 16.62 | 0.27 | 0.47 | 0.18 |
| Average | 9.49 | 0.85 | 0.48 | 0.30 |
| High | 16.02 | 2.26 | 0.71 | 0.58 |
| Low | 7.50 | 0.27 | 0.36 | 0.09 |
| Detection Limit | 1.00 pCi/l β | | 0.39 pCi/l α | |

River Water Samples (pCi/l)

June 1967

| <u>Location</u> | <u>Beta Activity</u> | | <u>Alpha Activity</u> | |
|-----------------|----------------------|------------------|-----------------------|------------------|
| | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
| 1-DD-U | 4.57 | 0.09 | 0.12 | 0.12 |
| 3-On-U | 12.45 | 0.71 | 0.50 | 0.49 |
| 4-On-D | No Sample | ----- | ----- | ----- |
| 5-Sq-U | 12.35 | 1.38 | 0.89 | 0.23 |
| 6-Sq-D | 11.05 | 2.12 | 0.81 | 0.50 |
| 7-Sk-U | 12.56 | 1.51 | 1.35 | 0.50 |
| 9-CC | 10.25 | 0.75 | 1.50 | 0.18 |
| 10-DM | 9.38 | 2.20 | 1.33 | 0.50 |
| 11-Sk-S | 10.00 | 0.94 | 0.60 | 0.27 |
| Average | 10.33 | 1.21 | 0.88 | 0.34 |
| High | 12.56 | 2.20 | 1.50 | 0.50 |
| Low | 4.57 | 0.09 | 0.12 | 0.12 |
| Detection Limit | 1.00 pCi/l β | | 0.39 pCi/l α | |

ALRR Outfall Samples (pCi/l)

January - June 1967

| <u>Date</u> | <u>Beta Activity</u> | | <u>Alpha Activity</u> | |
|-----------------|----------------------|------------------|-----------------------|------------------|
| | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
| January | 7.67 | 3.30 | 0.17 | 0.25 |
| February | 9.25 | 1.05 | 0.22 | 0.28 |
| March | 10.41 | 1.23 | 0.15 | 0.21 |
| April | 13.44 | 0.58 | 0.48 | 0.36 |
| May | 8.43 | 0.46 | 0.17 | 0.27 |
| June | 12.60 | 0.93 | 0.12 | 0.19 |
| Average | 10.30 | 1.26 | 0.21 | 0.26 |
| High | 13.44 | 3.30 | 0.48 | 0.36 |
| Low | 7.67 | 0.46 | 0.12 | 0.19 |
| Detection Limit | 1.00 pCi/l β | | 0.39 pCi/l α | |

Bottom Sediment Samples (pCi/g)

| <u>Location</u> | <u>Date</u> | <u>Beta Concentration</u> | <u>Alpha Concentration</u> |
|------------------------|-------------|-------------------------------|--------------------------------|
| 1-DD-U | 3-29-67 | 8.20 | 0.18 |
| | 6-29-67 | 8.90 | 0.20 |
| | Average | 8.55 | 0.19 |
| 2-DD-D ALRR Outfall | 3-29-67 | 8.00 | 0.20 |
| | 6-29-67 | 9.00 | 0.25 |
| | Average | 8.50 | 0.23 |
| 3-On-U | 3-29-67 | 7.50 | 0.20 |
| | 6-29-67 | 8.20 | 0.11 |
| | Average | 7.85 | 0.16 |
| 4-On-D | 3-29-67 | 8.10 | 0.27 |
| | 6-29-67 | 10.00 | 0.29 |
| | Average | 9.05 | 0.28 |
| 5-Sq-U | 3-29-67 | 12.00 | 0.75 |
| | 6-29-67 | 18.80 | 0.78 |
| | Average | 15.40 | 0.77 |
| 6-Sq-D | 3-29-67 | 10.00 | 0.75 |
| | 6-29-67 | 17.00 | 1.00 |
| | Average | 13.50 | 0.88 |
| 7-Sk-U | 3-29-67 | 8.10 | 0.80 |
| | 6-29-67 | 17.40 | 2.40 |
| | Average | 12.75 | 1.60 |
| 9-CC | 3-29-67 | 11.00 | 0.71 |
| | 6-29-67 | 12.00 | 0.52 |
| | Average | 11.50 | 0.62 |
| 10-DM | 3-29-67 | 13.00 | 0.61 |
| | 6-29-67 | 17.00 | 0.41 |
| | Average | 15.00 | 0.51 |
| 11-Sk-S | 3-29-67 | 11.00 | 0.51 |
| | 6-29-67 | 18.00 | 2.20 |
| | Average | 14.50 | 1.36 |

Continued

| <u>Location</u> | <u>Date</u> | <u>Beta Concentration</u> | <u>Alpha Concentration</u> |
|--|-------------|-------------------------------|--------------------------------|
| Todd Pond | 3-29-67 | No Sample | (pond dry and dredged) |
| | 6-29-67 | 15.00 | 1.80 |
| | Average | 15.00 | 1.80 |
| Izaak Walton League Pond | 3-29-67 | 10.00 | 0.30 |
| | 6-29-67 | 21.00 | 2.10 |
| | Average | 15.50 | 1.20 |
| Kelley Pond | 3-29-67 | 19.00 | 0.50 |
| | 6-29-67 | 17.00 | 0.40 |
| | Average | 18.00 | 0.45 |
| Average for 25 samples (1st half of 1967) | | 12.61 | 0.73 |
| High | | 18.80 | 2.40 |
| Low | | 7.50 | 0.11 |
| Detection Limit | | 0.25 pCi/g β | |
| | | 0.10 pCi/g α | |

Precipitation Samples (pCi/l)

| <u>Date</u> | <u>Beta Activity</u> | | <u>Alpha Activity</u> | |
|-----------------|----------------------|--------------------|-----------------------|---------------------|
| | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
| January | 64.33 | 22.00 | 1.71 | 0.94 |
| February | 130.00 | 120.00 | 1.54 | 2.60 |
| March | 100.66 | 62.00 | 1.67 | 7.96 |
| April | 37.86 | 22.62 | 2.30 | 2.30 |
| May | 41.70 | 112.94 | 1.92 | 3.49 |
| June | 14.80 | 3.77 | 2.17 | 0.56 |
| Average | 64.89 | 57.22 | 1.89 | 2.98 |
| Individual High | 173.00 | 500.00 | 8.50 | 20.50 |
| Individual Low | 5.80 | 0.14 | 0.30 | 0.28 |
| Detection Limit | | 1.00 pCi/l β | | 0.39 pCi/l α |

Well Water Samples pCi/l

| <u>Location</u> | <u>Date</u> | <u>Beta Activity</u> | | <u>Alpha Activity</u> | |
|------------------------|-------------|----------------------|------------------|-----------------------|------------------|
| | | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
| City of Ames | 1-30-67 | 5.00 | 0.41 | 0.36 | ND |
| | 2-27-67 | 3.50 | ND | 0.90 | 1.10 |
| | 3-31-67 | 7.30 | ND | 1.80 | 0.54 |
| | 4-24-67 | 5.70 | 0.81 | 0.90 | ND |
| | 5-27-67 | 2.20 | 0.68 | 0.36 | 0.36 |
| | 6-26-67 | 4.50 | 0.68 | 2.20 | ND |
| Average | | 4.70 | 0.43 | 1.09 | 0.33 |
| High | | 7.30 | 0.81 | 2.20 | 1.10 |
| Low | | 2.20 | 0.41 | 0.36 | 0.36 |
| Iowa State University | 1-30-67 | 6.60 | ND | 0.54 | 0.36 |
| | 2-27-67 | 7.00 | 1.40 | 1.10 | 0.90 |
| | 3-31-67 | 6.50 | 1.40 | 1.10 | ND |
| | 4-24-67 | 3.50 | ND | 1.10 | ND |
| | 5-27-67 | 6.60 | 0.68 | 0.36 | ND |
| | 6-26-67 | 5.00 | 0.41 | 2.30 | 1.80 |
| Average | | 5.87 | 0.65 | 1.08 | 0.51 |
| High | | 7.00 | 1.40 | 2.30 | 1.80 |
| Low | | 3.50 | 0.41 | 0.36 | 0.36 |
| Arland Martin Acreage | 1-30-67 | 5.80 | ND | 0.36 | ND |
| | 2-27-67 | 8.40 | 0.54 | 0.18 | 0.18 |
| | 3-31-67 | 7.70 | ND | 1.40 | ND |
| | 4-24-67 | 6.20 | 0.14 | ND | 0.18 |
| | 5-27-67 | 8.40 | 0.81 | 0.36 | ND |
| | 6-26-67 | 7.20 | 1.50 | 0.54 | ND |
| Average | | 7.28 | 0.50 | 0.47 | 0.06 |
| High | | 8.40 | 1.50 | 1.40 | 0.18 |
| Low | | 5.80 | 0.14 | 0.18 | 0.18 |
| Average for 18 Samples | | 5.95 | 0.53 | 0.88 | 0.30 |
| High for 18 Samples | | 8.40 | 1.50 | 2.30 | 1.80 |
| Low for 18 Samples | | 2.20 | 0.14 | 0.18 | 0.18 |
| Detection Limit | | 1.00 pCi/l β | | | |
| | | 0.39 pCi/l α | | | |

Pond Water Samples (pCi/l)

| <u>Location</u> | <u>Date</u> | <u>Beta Activity</u> | | <u>Alpha Activity</u> | |
|--------------------------|-------------|----------------------|------------------|-----------------------|------------------|
| | | <u>Soluble</u> | <u>Insoluble</u> | <u>Soluble</u> | <u>Insoluble</u> |
| Georg. Todd Pond | 1-30-67 | No Sample | ----- | ----- | ----- |
| | 2-28-67 | No Sample | ----- | ----- | ----- |
| | 3-31-67 | No Sample | ----- | ----- | ----- |
| | 4-24-67 | No Sample | ----- | ----- | ----- |
| | 5-27-67 | No Sample | ----- | ----- | ----- |
| | 6-26-67 | 4.60 | 0.80 | 0.90 | 0.36 |
| | Average | | 4.60 | 0.81 | 0.90 |
| High | | 4.60 | 0.81 | 0.90 | 0.36 |
| Low | | 4.60 | 0.81 | 0.90 | 0.36 |
| Isaac Walton League Pond | 1-30-67 | 28.40 | 2.30 | ND | ND |
| | 2-28-67 | 20.00 | 3.10 | 1.10 | 0.18 |
| | 3-31-67 | 7.30 | 1.90 | 1.60 | 2.20 |
| | 4-24-67 | 18.60 | 0.27 | 0.90 | 0.36 |
| | 5-27-67 | 23.20 | 1.60 | 0.18 | 0.72 |
| | 6-26-67 | 19.00 | 0.81 | 0.72 | 0.54 |
| | Average | | 19.42 | 1.66 | 0.75 |
| High | | 28.40 | 3.10 | 1.60 | 2.20 |
| Low | | 7.30 | 0.27 | 0.18 | 0.18 |
| Kelley Pond | 1-30-67 | 23.60 | 2.80 | 0.36 | ND |
| | 2-28-67 | 10.30 | 1.40 | 0.36 | 0.36 |
| | 3-31-67 | 10.00 | 0.81 | 1.30 | 1.10 |
| | 4-24-67 | 6.90 | 0.41 | ND | ND |
| | 5-27-67 | 11.00 | 1.90 | 0.54 | 0.54 |
| | 6-26-67 | 7.40 | 1.40 | ND | 0.36 |
| | Average | | 11.53 | 1.45 | 0.43 |
| High | | 23.60 | 2.80 | 1.30 | 1.10 |
| Low | | 6.90 | 0.41 | 0.36 | 0.36 |
| Average for 13 Samples | | 14.64 | 1.50 | 0.61 | 0.52 |
| High for 13 Samples | | 28.40 | 3.10 | 1.60 | 2.20 |
| Low for 13 Samples | | 4.60 | 0.27 | 0.18 | 0.18 |
| Detection Limit | | 1.00 pCi/l β | | | |
| | | 0.39 pCi/l α | | | |

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