IS-1320

Health and Safety (UC-41) TID 4500,
(47th Ed.), November 1, 1965

UNITED STATES ATOMIC ENERGY COMMISSION

Research and Development Report

SURVEY OF ENVIRONMENTAL RADIOACTIVITY

by

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December, 1965

Ames Laboratory
at
Iowa State University of Science and Technology
F. H. Spedding, Director
Contract W-7405 eng-82

This report is distributed according to the category Health and Safety (US-41) as listed in TID 4500, (47th Ed.) November 1, 1965.

Printed in USA. Price $. Available from the Clearinghouse for Federal Scientific and Technical Information, National Bureau of Standards, U. S. Department of Commerce, Springfield, Virginia

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SURVEY OF ENVIRONMENTAL RADIOACTIVITY

Milo D. Voss †

I. SUMMARY

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

The pre-operational environmental program consists of gross alpha and beta determinations of air, soil, vegetation, river water, bottom sediment, precipitation, and well water samples. This report includes data for the period January 1, 1965 to December 31, 1965.

The ALRR reached full power as of 7-12-65. In the ensuing time period covered by this report full power runs have become routine, but are relatively short term. Service irradiations have been made for the Laboratory.

The data indicate that the ALRR has not been a contributor to environmental radioactivity in the Ames area. The conclusion is reached that radioactivity levels recorded represent background conditions from atmospheric fallout and naturally occurring radioactivity.

The following average levels of radioactivity were recorded for 1965:

Sample Media	Individual Samples	Beta Activity	Alpha Activity
Air	327	0.30 $\mu\mu c/M^3$	0.0068 $\mu\mu c/M^3$
Soil	25	14.45 $\mu\mu c/g$	0.86 $\mu\mu c/g$
Vegetation	13	32.49 $\mu\mu c/g$	0.38 $\mu\mu c/g$
River Water	305	18.12 $\mu\mu c/l$	0.83 $\mu\mu c/l$
Bottom Sediment	30	14.64 $\mu\mu c/g$	0.89 $\mu\mu c/g$
Precipitation	57	714.94 $\mu\mu c/l$	3.95 $\mu\mu c/l$
Well Water	30	6.80 $\mu\mu c/l$	1.08 $\mu\mu c/l$

II. SAMPLE INFORMATION

A. Air Samples

Daily air samples are taken at a location on top of the Ames Laboratory Research Building. Samples are collected on Whatman #41 filter paper with a Gast pump at the flow rate of 3.75 cfm. The filter samples are held for seven days to allow short activities to decay. The samples are then placed directly in a Sharp Low Beta-Matic three-inch system and counted for gross alpha and beta activity.

Beta Activity Range ($\mu\mu c/M^3$)

	1962	1963	1964	1965
Average	3.40	3.86	1.26	0.30
High	22.40	13.50	5.95	1.50
Low	0.50	0.21	0.05	0.01

Alpha Activity Range ($\mu\mu c/M^3$)

	1962	1963	1964	1965
Average	0.05	0.11	0.0139	0.0068
High	0.40	0.73	0.1135	0.0760
Low	0.01	0.10	0.0004	0.00012

B. Soil Samples

Soil samples are collected once each year. Circles surrounding the

ALRR site were divided into quadrants on the basis of wind frequencies. The annuli were chosen on the basis of simplicity for defining sampling area. One sample was taken in each sector of each annulus (see maps #1 and #2). Reference samples were collected at Fort Dodge, Iowa. The number-letter designations on the data sheets are our Codes for sample locations. One-quart samples are collected from the 0-2 inches of top soil. The samples are dryed thoroughly in a 100° C drying oven, mixed thoroughly, with large stones and roots being removed. A 3-4 gram counting sample is made from the dried soil, placed in a 3-inch aluminum planchet, and counted directly in the Sharp System for gross alpha and beta activity.

Beta Activity Range ($\mu\mu$c/g)

	1962	1963	1964	1965
Average	7.57	9.45	19.97	14.45
High	9.40	14.00	32.00	20.50
Low	5.20	7.80	13.00	3.26

Alpha Activity Range ($\mu\mu$c/g)

	1962	1963	1964	1965
Average	0.26	0.56	0.94	0.86
High	0.60	1.08	1.31	1.20
Low	0.11	0.19	0.53	0.56

C. Vegetation

Vegetation samples are collected once each year. Samples are obtained from the same location as soil samples. Date of collection is correlated to maximum growth period which is July to August for this area. Samples are not collected directly after precipitation of any kind to minimize surface contamination. The type of vegetation is confined to grasses and none of the root system is included in the sample.

Samples are dried, ground to a fine powder, and made into 3-4 gram counting samples on 3-inch aluminum planchets. Samples are counted for gross alpha and beta activity in the Sharp System.

Beta Activity Range ($\mu\mu$c/g)

	1962	1963	1964	1965
Average	117.30	87.50	73.26	32.49
High	181.00	186.00	125.00	43.00
Low	10.80	10.50	51.00	26.00

Alpha Activity Range ($\mu\mu$c/g)

	1962	1963	1964	1965
Average	1.62	0.96	1.27	0.38
High	4.00	4.10	3.24	1.06
Low	0.11	0.15	0.35	0.07

D. River Water Samples

River water samples are collected weekly and analyzed for gross alpha and beta activity. One liter samples are filtered and counted separately as soluble and insoluble fractions. Samples are obtained from each river or creek in the flow route of the ALRR drainage system. In addition, two samples are obtained from streams outside the ALRR flow route. These constitute control samples and are numbers nine and ten in the data. Samples are obtained at each site until the creeks go dry in late summer and until the rivers are frozen solid in winter. If water is flowing under ice, a sample is obtained by chopping through the ice. The insoluble portion of the sample is prepared by igniting the filter paper directly on a planchet. The soluble portion is evaporated to near dryness and transferred to a planchet. The planchets are placed directly in the Sharp System for counting.

Beta Activity Range ($\mu\mu$c/l)

	1962	1963	1964	1965
Average	18.09	55.94	18.26	18.12
High	118.00	2270.00	273.00	51.97
Low	4.50	0.80	0.39	4.68

Alpha Activity Range ($\mu\mu$c/l)

	1962	1963	1964	1965
Average	1.01	2.09	0.893	0.83
High	9.60	108.00	3.80	1.93
Low	0.25	0.06	0.046	0.33

E. Bottom Sediment

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. A one-quart sample is obtained from the top 2-3 inches of bottom sediment in a semiquiescent area. The sample is mixed thoroughly and a 3-4 gram counting sample is prepared. The counting samples are dried thoroughly in an oven and then counted directly in the Sharp System.

Beta Activity Range ($\mu\mu$c/l)

	1962	1963	1964	1965
Average	9.88	10.65	11.13	14.64
High	22.70	51.00	54.00	34.00
Low	0.60	3.90	4.50	7.00

Alpha Activity Range ($\mu\mu$c/l)

	1962	1963	1964	1965
Average	0.25	0.61	0.47	0.89
High	0.94	8.00	3.10	6.70
Low	0.09	0.01	0.096	0.08

F. Precipitation Samples

Precipitation samples are collected on an "as it happens basis" and

analyzed for gross alpha and beta activity. The sampling site is the weather observation tower near the ALRR. The samples are filtered and prepared in the same manner as the river water samples.

Beta Activity Range ($\mu\mu$c/l)

	1962	1963	1964	1965
Average	2018.17	1360.00	366.23	714.94
High	4288.00	7000.00	2520.00	19500.00
Low	922.00	20.00	20.00	8.70

Alpha Activity Range ($\mu\mu$c/l)

	1962	1963	1964	1965
Average	65.90	39.20	12.67	3.95
High	97.00	234.00	53.00	32.80
Low	13.50	0.28	3.50	0.17

G. Well Water Samples

Well water samples are obtained monthly from City of Ames wells, Iowa State University (ISU) campus wells, and from a personal farm well at a location two miles north of the ALRR. The sample size is one liter and is filtered and prepared for counting in the same manner as the river water samples.

Beta Activity Range ($\mu\mu$c/l)

	1962	1963	1964	1965
Average	4.01	4.78	6.83	6.80
High	6.78	16.40	12.90	22.80
Low	2.75	1.18	2.60	2.04

Alpha Activity Range ($\mu\mu$c/l)

	1962	1963	1964	1965
Average	0.31	1.04	1.42	1.08
High	0.90	5.69	20.90	5.20
Low	0.17	0.10	0.046	0.12

H. Detection Limits

Detection limits are by definition only.

III

ENVIRONMENTAL RADIOACTIVITY DATA

Air Samples ($\mu\mu c/M^3$)

	Beta Conc.	Alpha Conc.
January (31)	0.26	0.0088
February (28)	0.28	0.0104
March (31)	0.33	0.0126
April (29)	0.30	0.0072
May (31)	0.58	0.0085
June (30)	0.92	0.0133
July (31)	0.41	0.0059
August (31)	0.20	0.0037
September (23)	0.09	0.0029
October (23)	0.10	0.0023
November (19)	0.08	0.0033
December (20)	0.08	0.0025
Average	0.30	0.0068
Individual High	1.50	0.076
Individual Low	0.01	0.00012

Detection Limit - 0.0066 $\mu\mu c/M^3$ β

0.0026 $\mu\mu c/M^3$ α

SOIL SAMPLES ($\mu\mu$c/g)

Location	Date	Beta Conc.	Alpha Conc.
1S-SE1	8-20-65	15.30	0.84
2S-SW1	"	12.10	0.84
3S-NW1	"	17.10	0.78
4S-NE1	"	14.40	0.88
5S-SE2	"	15.90	0.77
6S-SW2	"	13.20	0.72
7S-NW2	"	12.80	0.66
8S-NE2	"	16.00	0.92
9SV-SE3	"	13.10	0.88
10SV-SW3	"	13.50	0.99
11SV-NW3	"	12.40	0.82
12SV-NE3	"	13.50	0.64
13SV-SE4	"	15.70	1.15
14SV-SW4	"	13.60	0.94
15SV-NW4	"	13.30	0.69
16S-NE4	"	17.10	0.71
17SV-SE5	"	15.70	1.15
18S-SW5	"	13.90	0.61
19SV-NW5	"	15.90	1.20
20SV-NE5	"	3.26	1.17
21SV-SE6	"	14.00	0.56
22SV-SW6	"	15.90	0.80
23S-NW6	"	20.50	1.14
24SV-NE6	"	16.40	0.77
25SV-Ft. Dodge	"	16.60	0.93
Average		14.45	0.86
High		20.50	1.20
Low		3.26	0.56

Detection Limit 0.25$\mu\mu$c/g β

0.10$\mu\mu$c/g α

VEGETATION SAMPLES ($\mu\mu$c/g)

Location	Date	Beta Conc.	Alpha Conc.
3SV-NW1	8-26-65	35.40	0.61
9SV-SE3	"	43.00	0.64
10SV-SW3	"	30.90	0.46
11SV-NW3	"	29.40	0.29
12SV-NE3	"	41.50	0.42
13SV-SE4	"	43.00	0.35
15SV-NW4	"	29.60	0.20
17SV-SE5	"	31.20	0.16
19SV-NW5	"	26.20	0.26
21SV-SE6	"	29.60	1.06
22SV-SW6	"	26.00	0.07
24SV-NE6	"	27.60	0.25
Ft. Dodge	"	29.00	0.20
Average		32.49	0.38
High		43.00	1.06
Low		26.00	0.07

Detection Limit 2.07 $\mu\mu$c/g - β

0.78 $\mu\mu$c/g - α

River Water Samples ($\mu\mu$c/l)

January 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	No Samples			
2-DD-D	2.55	1.11	0.29	0.14
3-On-U	No Samples			
4-On-D	No Samples			
5-Sq-U	8.60	N.D.	0.23	0.23
6-Sq-D	24.70	0.08	0.02	0.14
7-Sk-U	12.00	N.D.	N.D.	N.D.
8-Sk-D	This site dropped from environmental survey program.			
9-CC	42.60	0.38	0.23	0.23
10-DM	10.90	N.D.	0.31	0.14
11-Sk-S	10.00	0.43	0.71	0.07
Average	15.91	0.29	0.26	0.14
High	42.60	1.11	0.71	0.23
Low	2.55	0.08	0.02	0.07

N.D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/l β 0.39 $\mu\mu$c/l α

River Water Samples ($\mu\mu$c/l)

February 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	No Samples			
2-DD-D	5.33	0.23	0.58	0.06
3-On-U	54.00	N.D.	1.28	0.06
4-On-D	No Samples			
5-Sq-U	45.00	N.D.	0.34	N.D.
6-Sq-D	43.55	0.43	0.69	0.06
7-Sk-U	56.67	N.D.	N.D.	N.D.
9-CC	42.60	0.38	0.23	0.23
10-DM	10.93	N.D.	0.31	0.14
11-Sk-S	10.00	0.43	0.71	0.08
Average	33.51	0.18	0.52	0.08
High	56.67	0.43	1.28	0.23
Low	5.33	0.23	0.23	0.06

N.D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/l β 0.39 $\mu\mu$c/l α

River Water Samples ($\mu\mu$c/l)

March 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	46.50	130.00	1.50	0.65
2-DD-D	4.92	0.29	0.69	0.17
3-On-U	42.33	10.72	0.62	0.67
4-On-D	No Samples			
5-Sq-U	45.00	9.65	0.96	0.19
6-Sq-D	39.32	2.20	0.94	0.38
7-Sk-U	37.20	4.16	0.98	0.46
9-CC	40.67	1.45	1.30	0.16
10-DM	24.00	0.15	0.81	0.43
11-Sk-S	28.67	0.53	0.48	0.27
Average	34.29	17.68	0.92	0.38
High	46.50	130.00	1.50	0.67
Low	4.92	0.15	0.48	0.16
Detection Limit -	1.00 $\mu\mu$c/l β		0.39 $\mu\mu$c/l α	

River Water Samples ($\mu\mu$c/l)

April 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	9.20	1.05	4.28	0.04
2-DD-D	5.57	1.00	0.54	0.10
3-On-U	18.73	2.97	1.21	0.47
4-On-D	No Samples	----------	----------	----------
5-Sq-U	14.73	0.84	0.67	0.15
6-Sq-D	18.88	1.79	1.48	0.38
7-Sk-U	17.23	1.48	0.89	0.50
9-CC	13.65	3.86	0.70	0.44
10-DM	23.25	2.60	0.97	0.55
11-Sk-S	16.17	0.18	0.56	0.86
Average	15.27	1.75	1.26	0.39
High	23.25	3.86	4.28	0.86
Low	5.57	0.18	0.54	0.04

Detection Limit - 1.00 $\mu\mu$c/l β 0.39 $\mu\mu$c/l α

River Water Samples ($\mu\mu$c/l)

May 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	11.26	0.06	0.54	0.07
2-DD-D	8.44	0.12	0.45	0.14
3-On-U	12.18	0.61	0.44	0.13
4-On-D	5.45	0.10	0.05	0.03
5-Sq-U	12.14	0.69	0.31	0.11
6-Sq-D	11.20	0.90	0.39	0.23
7-Sk-U	16.24	1.31	1.86	0.10
9-CC	18.24	0.14	0.34	0.16
10-DM	19.10	13.22	0.35	0.40
11-Sk-S	15.72	0.94	0.59	0.31
Average	13.00	1.81	0.53	0.17
High	19.10	13.22	1.86	0.40
Low	5.45	0.06	0.05	0.03
Detection Limit -	1.00 $\mu\mu$c/l β		0.39 $\mu\mu$c/l α	

River Water Samples ($\mu\mu$c/l)

June 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	6.48	0.44	0.32	0.14
2-DD-D	5.28	0.15	0.01	0.06
3-On-U	10.85	1.35	0.37	0.06
4-On-D	No Samples			
5-Sq-U	8.93	2.45	0.42	0.04
6-Sq-D	16.00	1.29	0.92	0.19
7-Sk-U	122.35	1.88	1.73	0.14
9-CC	12.33	1.48	0.45	0.08
10-DM	14.15	6.31	0.55	0.27
11-Sk-S	16.38	2.90	0.89	0.32
Average	23.64	2.03	0.63	0.14
High	122.35	6.31	1.73	0.32
Low	5.28	0.15	0.01	0.04
Detection Limit -	1.00 $\mu\mu$c/l β		0.39 $\mu\mu$c/l α	

River Water Samples ($\mu\mu$c/l)

July, 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	7.50	N. D.	0.45	0.16
2-DD-D	4.14	1.11	0.44	0.28
3-On-U	8.77	1.40	0.48	0.21
4-On-D	10.30	1.60	0.44	0.24
5-Sq-U	9.63	1.87	0.66	0.83
6-Sq-D	9.23	1.26	0.29	0.41
7-Sk-U	9.23	1.80	0.28	N. D.
9-CC	9.10	0.86	1.01	0.20
10-DM	11.77	0.77	1.06	0.33
11-Sk-S	8.63	1.52	0.37	0.10
Average	8.83	1.22	0.55	0.28
High	11.77	1.87	1.06	0.83
Low	4.14	0.77	0.28	0.10

N. D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/l β 0.39 $\mu\mu$c/l α

River Water Samples ($\mu\mu$c/l)

August, 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	No Sample			
2-DD-D	9.18	3.01	0.54	1.33
3-On-U	12.30	N.D.	0.82	0.06
4-On-D	No Sample			
5-Sq-U	9.63	0.81	0.50	0.08
6-Sq-D	13.93	1.42	0.66	0.39
7-Sk-U	9.74	1.46	0.65	0.52
9-CC	11.85	0.45	0.37	0.48
10-DM	11.08	2.90	0.57	0.91
11-Sk-S	9.60	1.41	0.46	0.41
Average	10.91	1.43	0.57	0.52
High	12.30	3.01	0.82	1.33
Low	9.18	0.45	0.37	0.06

N. D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/1 β 0.39 $\mu\mu$c/1 α

River Water Samples ($\mu\mu$c/l)

September, 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	19.00	1.50	0.41	0.36
2-DD-D	9.67	0.45	0.17	0.14
3-On-U	12.13	0.45	0.64	0.20
4-On-D	No Sample			
5-Sq-U	12.57	1.17	0.39	0.23
6-Sq-D	11.57	0.75	0.70	0.17
7-Sk-U	11.30	1.05	0.79	0.26
9-CC	9.23	0.90	0.50	0.14
10-DM	8.97	1.22	0.39	0.09
11-Sk-S	9.83	0.63	0.53	0.32
Average	11.59	0.90	0.50	0.21
High	19.00	1.50	0.79	0.36
Low	8.97	0.45	0.17	0.09

Detection Limit - 1.00 $\mu\mu$c/l β 0.39 $\mu\mu$c/l α

River Water Samples ($\mu\mu$c/l)

October, 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	3.60	N.D.	0.38	0.38
2-DD-D	5.77	0.05	0.09	0.06
3-On-U	5.07	0.10	0.34	0.10
4-On-D	4.90	N.D.	0.08	0.26
5-Sq-U	4.13	N.D.	0.23	0.33
6-Sq-D	4.40	0.10	0.20	0.08
7-Sk-U	4.00	N.D.	0.14	0.10
9-CC	4.13	0.15	0.14	0.24
10-DM	5.07	0.35	0.28	0.02
11-Sk-S	4.93	0.05	0.65	0.91
Average	4.60	0.08	0.25	0.25
High	5.77	0.35	0.65	0.91
Low	3.60	0.05	0.08	0.02

N.D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/l β 0.39 $\mu\mu$c/l α

River Water Samples ($\mu\mu$c/l)

November, 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	3.30	N.D.	0.23	0.23
2-DD-D	7.76	1.04	0.22	0.49
3-On-U	4.15	1.15	0.15	0.15
4-On-D	5.40	1.50	0.52	N.D.
5-Sq-U	4.60	0.85	0.30	0.08
6-Sq-D	3.85	0.90	0.26	0.84
7-Sk-U	4.30	0.95	0.19	0.08
9-CC	4.80	1.00	0.31	0.08
10-DM	4.70	1.35	0.23	0.12
11-Sk-S	8.83	0.90	0.22	0.27
Average	5.17	0.96	0.26	0.23
High	8.83	1.50	0.52	0.84
Low	3.30	0.85	0.15	0.08

N.D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/l β 0.39 $\mu\mu$c/l α

River Water Samples ($\mu\mu$c/l

December, 1965

	Beta Activity		Alpha Activity	
Location	Soluble	Insoluble	Soluble	Insoluble
1-DD-U	No Sample			
2-DD-D	9.35	0.50	0.31	0.33
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	No Sample			
11-Sk-S	14.45	1.19	0.23	1.00
Average	11.90	0.85	0.27	0.67
High	14.45	1.19	0.31	1.00
Low	9.35	0.50	0.23	0.33

N.D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/l - β 0.39 $\mu\mu$c/l - α

River Water Samples ($\mu\mu$c/l)

1965 Yearly Averages of Months

	Beta Activity		Alpha Activity	
	Soluble	Insoluble	Soluble	Insoluble
Average	15.72	2.40	0.54	0.29
High	34.29	17.68	1.26	0.67
Low	4.60	0.08	0.25	0.08

Detection Limit - 1.00 $\mu\mu$c/l - β 0.39 $\mu\mu$c/l - α

Bottom Sediment Samples ($\mu\mu$c/g)

Location	Date	Beta Conc.	Alpha Conc.
1	4-30-65	10.00	0.48
	7-02-65	8.70	0.08
	11-05-65	8.80	0.75
Average		9.17	0.44
2	4-30-65	10.60	0.22
	7-02-65	14.00	0.64
	11-05-65	10.00	0.78
Average		11.53	0.55
3	4-30-65	7.00	0.17
	7-02-65	13.00	0.86
	11-05-65	7.90	0.32
Average		9.30	0.45
4	4-30-65	17.00	0.96
	7-02-65	8.80	0.16
	11-05-65	7.10	0.44
Average		10.97	0.52
5	4-30-65	17.00	0.88
	7-02-65	17.00	0.44
	11-05-65	9.10	0.61
Average		14.37	0.64
6	4-30-65	10.80	0.28
	7-02-65	10.80	0.08
	11-05-65	18.30	0.34
Average		13.30	0.23
7	4-30-65	20.00	0.73
	7-02-65	20.40	1.53
	11-05-65	34.00	0.80
Average		24.80	1.02
8	This sampling site dropped from the environmental survey program.		
9	4-30-65	9.00	0.32
	7-02-65	8.50	0.28
	11-05-65	7.50	0.24
Average		8.33	0.28
10	4-30-65	20.40	1.14
	7-02-65	31.00	1.70
	11-05-65	14.50	2.20
Average		21.97	1.68
Detection Limit - 0.25 $\mu\mu$c/g - β		0.10 $\mu\mu$c/g - α	

Bottom Sediment Samples ($\mu\mu$c/g)

(Continued)

Location	Date	Beta Conc.	Alpha Conc.
11	4-30-65	17.00	0.97
	7-02-65	32.50	1.70
	11-05-65	18.50	6.70
Average		22.67	3.12
Average for 30 samples (1965)		14.64	0.89
High		34.00	6.70
Low		7.00	0.08
Detection Limit - 0.25 $\mu\mu$c/g - β		0.10 $\mu\mu$c/g - α	

Precipitation Samples ($\mu\mu$c/l)

Date	Beta Activity		Alpha Activity	
	Soluble	Insoluble	Soluble	Insoluble
January	66.00	106.30	1.12	0.68
February	70.50	36.95	1.77	0.68
March	49.29	70.71	1.28	2.19
April	47.33	24.41	1.32	0.51
May	1216.67	6343.33	12.13	6.10
June	179.40	79.24	4.14	2.03
July	76.75	38.70	2.07	1.73
August	50.17	20.13	3.35	2.00
September	21.23	5.85	1.00	0.38
October	20.05	15.05	0.18	0.94
November	12.65	6.90	0.42	0.08
December	11.90	9.70	0.37	0.23
Average	151.83	563.11	2.49	1.46
Individual High	1400.00	18,100.00	19.70	13.10
Individual Low	7.10	1.60	0.07	0.10

Detection Limit - 1.00 $\mu\mu$c/l - β
0.39 $\mu\mu$c/l - α

Well Water Samples ($\mu\mu$c/l)

Location	Date	Beta Activity		Alpha Activity	
		Soluble	Insoluble	Soluble	Insoluble
Iowa State Univ.	1-4-65	9.20	N. D.	N. D.	0.23
	2-1-65	5.50	0.60	0.79	N. D.
	3-1-65	8.20	N. D.	1.10	0.86
	4-5-65	7.70	13.00	2.00	3.20
	5-3-65	8.00	0.14	0.54	0.23
	6-7-65	9.70	0.59	1.30	0.23
	7-6-65	6.40	0.45	1.80	0.61
	8-2-65	5.70	0.90	1.30	0.14
	9-7-65	5.90	N. D.	0.05	N. D.
	10-4-65	1.90	N. D.	0.45	0.38
	11-1-65	2.80	N. D.	N. D.	N. D.
	12-6-65	4.40	N. D.	0.29	0.07
Average		6.28	1.31	0.80	0.50
High		9.70	13.00	2.00	3.20
Low		1.90	0.14	0.05	0.07

N. D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/l - β
0.39 $\mu\mu$c/l - α

Well Water Samples ($\mu\mu$c/l)

Location	Date	Beta Activity		Alpha Activity	
		Soluble	Insoluble	Soluble	Insoluble
City of Ames	1-4-65	5.10	N.D.	0.90	N.D.
	2-1-65	2.70	0.75	1.20	N.D.
	3-1-65	5.30	0.90	2.00	N.D.
	4-5-65	No Sample			
	5-3-65	5.90	0.60	0.59	0.18
	6-7-65	9.80	0.77	1.08	0.23
	7-6-65	6.40	0.45	1.58	0.23
	8-2-65	6.80	0.14	0.90	0.07
	9-7-65	5.90	N.D.	0.27	N.D.
	10-4-65	4.20	1.00	0.54	0.54
	11-1-65	5.40	N.D.	0.36	0.36
	12-6-65	3.90	N.D.	0.52	0.45
Average		5.58	0.42	0.90	0.19
High		9.80	1.00	2.00	0.54
Low		2.70	0.14	0.27	0.07

N.D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/l - β
0.39 $\mu\mu$c/l - α

Well Water Samples ($\mu\mu$c/l)

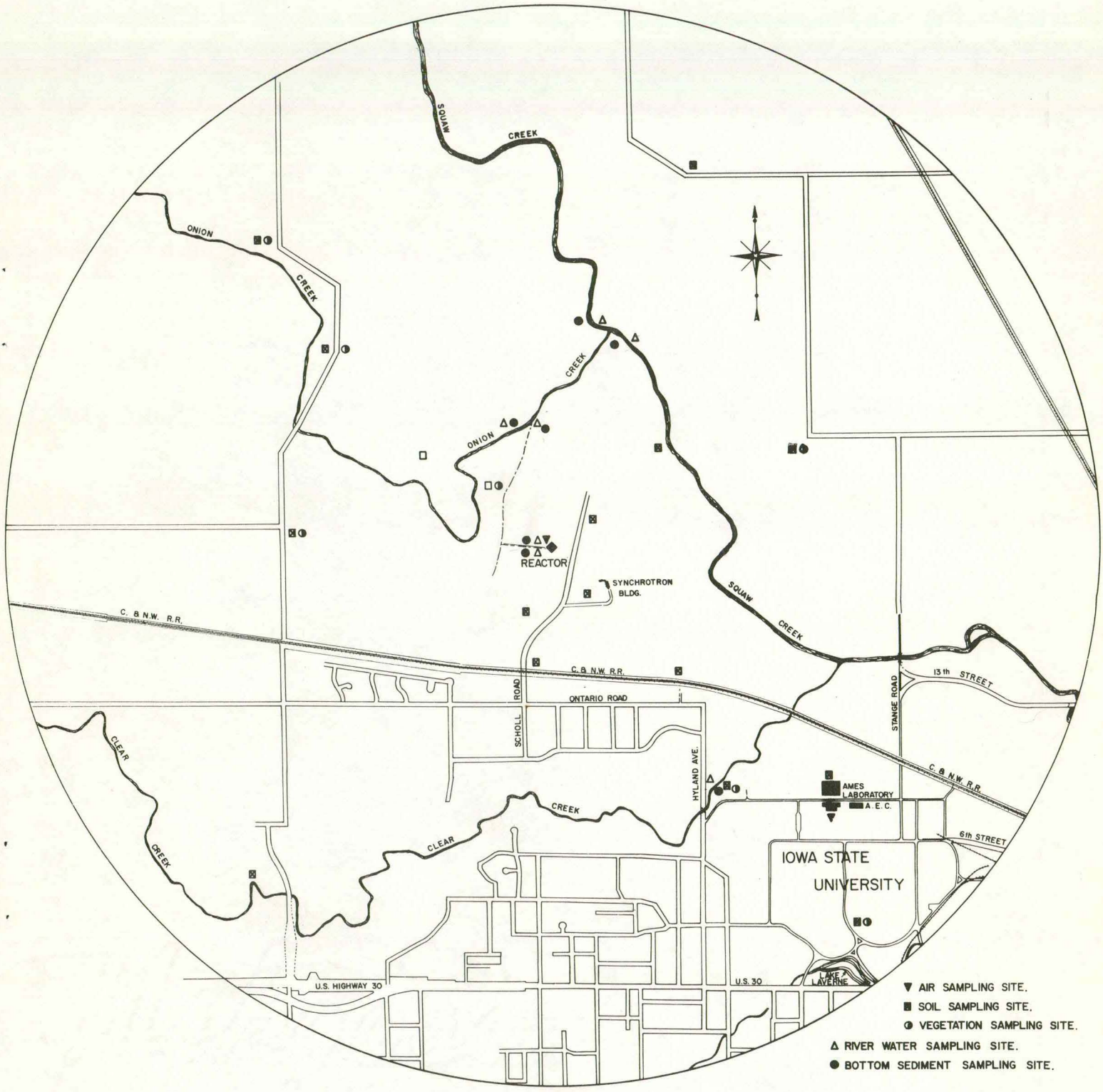
Location	Date	Beta Activity		Alpha Activity	
		Soluble	Insoluble	Soluble	Insoluble
Arlen Martin Acreage	1-4-65	7.10	N.D.	N.D.	0.23
	2-1-65	7.80	0.14	1.69	0.34
	3-1-65	No Sample			
	4-5-65	No Sample			
	5-3-65	9.30	N.D.	0.38	N.D.
	6-7-65	No Sample			
	7-6-65	No Sample			
	8-2-65	No Sample			
	9-7-65	6.30	N.D.	0.36	N.D.
	10-4-65	7.10	0.45	N.D.	1.20
	11-1-65	3.00	N.D.	N.D.	N.D.
	12-6-65	5.50	N.D.	0.52	0.16
Average		6.59	0.08	0.42	0.28
High		9.30	0.45	1.69	1.20
Low		3.00	0.14	0.36	0.16
Average for 30 samples		6.10	0.70	0.75	0.33
High for 30 samples		9.80	13.00	2.00	3.20
Low for 30 samples		1.90	0.14	0.05	0.07

N.D. = Not Detectable

Detection Limit - 1.00 $\mu\mu$c/l - β
0.39 $\mu\mu$c/l - α

IV

MAPS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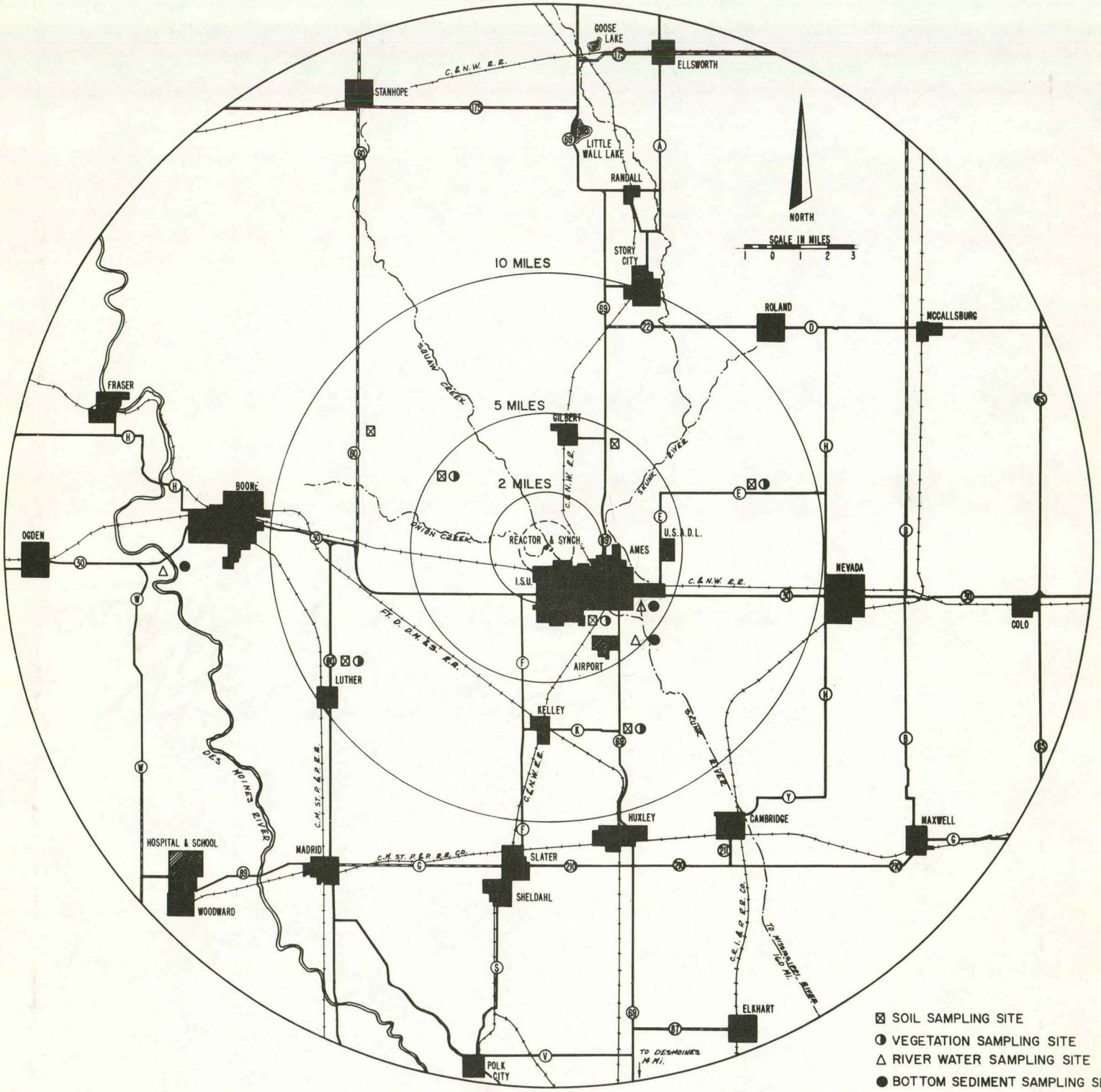
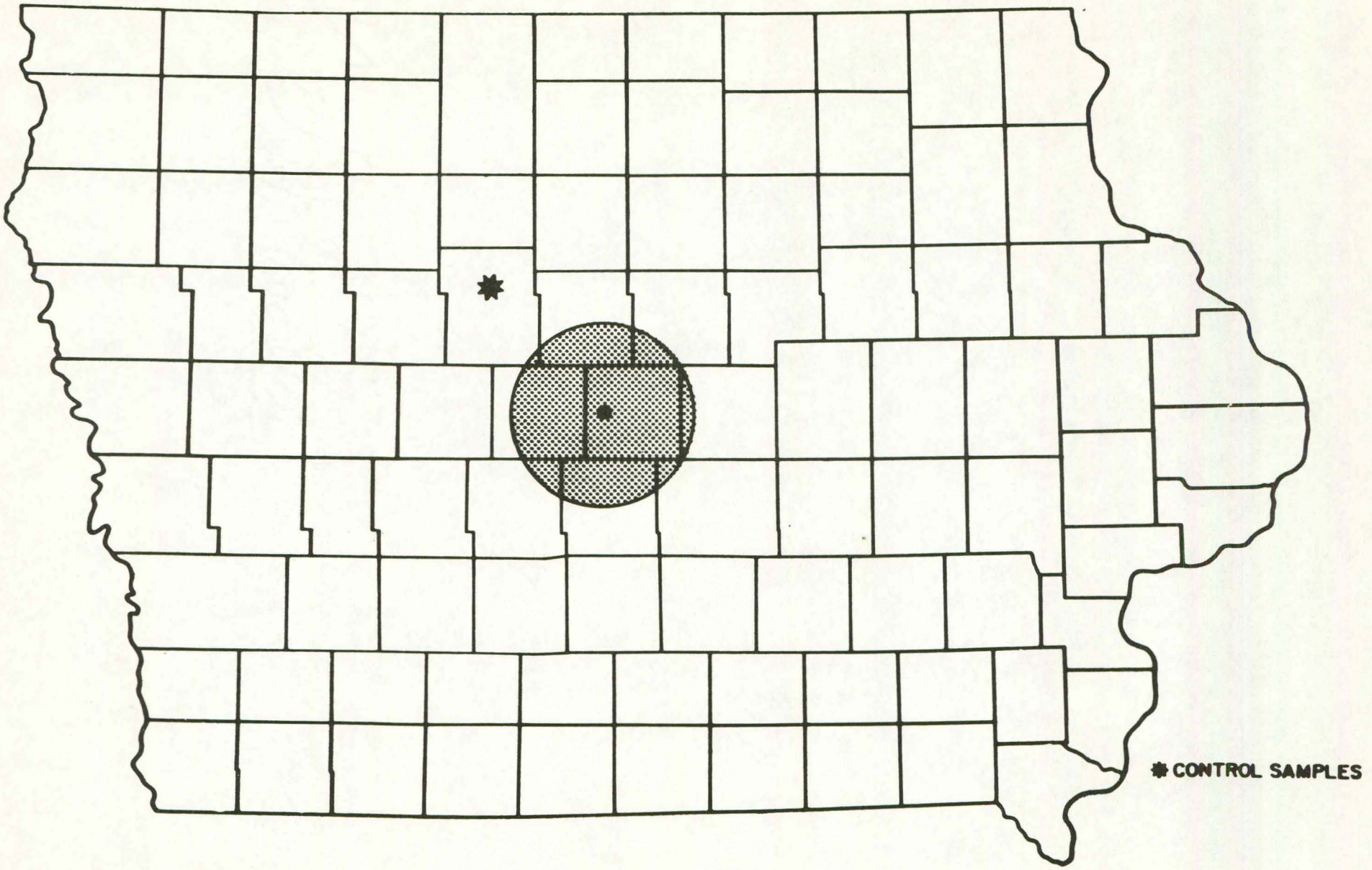
ONION CREEK
ONION CREEK
REACTOR
SYNCHROTRON BLDG.
SQUAW CREEK
C. & N.W. R.R.
C. & N.W. R.R.
C. & N.W. R.R.
ONTARIO ROAD
SCHOLL ROAD
HYLAND AVE.
STANGE ROAD
13th STREET
6th STREET
AMES LABORATORY
A.E.C.
IOWA STATE UNIVERSITY
CLEAR CREEK
CLEAR CREEK
U.S. HIGHWAY 30
U.S. 30
LAKE LAVERNE
▼ AIR SAMPLING SITE.
■ SOIL SAMPLING SITE.
◑ VEGETATION SAMPLING SITE.
△ RIVER WATER SAMPLING SITE.
● BOTTOM SEDIMENT SAMPLING SITE.

MAP 1


GOOSE LAKE
ELLSWORTH
C. & N.W. R.R.
STANHOPE
LITTLE WALL LAKE
RANDALL
NORTH
SCALE IN MILES
1 0 1 2 3
10 MILES
STORY CITY
ROLAND
MCCALLSBURG
SQUAW CREEK
FRASER
5 MILES
GILBERT
2 MILES
C.&N.W. R.R.
SKUNK RIVER
BOONE
OGDEN
UNION CREEK
REACTOR & SYNCH.
U.S.A.D.L.
AMES
I.S.U.
NEVADA
COLO
C.&N.W. R.R.
FT. D. DM. & S. R.R.
AIRPORT
LUTHER
KELLEY
DES MOINES RIVER
C.M.ST.P.&P.R.R.
C.&N.W.R.R.
SKUNK RIVER
HUXLEY
CAMBRIDGE
MAXWELL
HOSPITAL & SCHOOL
MADRID
C.M.ST.P.&P.R.R. CO.
SLATER
WOODWARD
SHELDAHL
C.R.I.&P.R.R. CO.
12 MISSISSIPPI RIVER 1601 MI.
ELKHART
TO DESMOINES 14 MI.
POLK CITY
SOIL SAMPLING SITE
VEGETATION SAMPLING SITE
RIVER WATER SAMPLING SITE
BOTTOM SEDIMENT SAMPLING SITE

MAP 2



MAP 3

†ACKNOWLEDGMENTS

We wish to express our thanks to the following individuals and organizations for their cooperation and assistance.

City of Ames - Water Department - Sewage Treatment Department

City of Fort Dodge - Water Department

Iowa State University - Physical Plant

Individuals who permitted and helped us to obtain samples

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