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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS

FOR THE PERIOD
APRIL, MAY, JUNE
1951

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD APRIL, MAY, JUNE, 1951

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD APRIL, MAY, JUNE, 1951

ABSTRACT

The following abstract summarizes the most significant results obtained from the program designed to determine the extent and magnitude of radioactive contamination in the environs of the Hanford Works for the period April, May, and June, 1951. Detailed discussion of these results is presented in the text.

SECTION I - RADIOACTIVE CONTAMINATION IN EFFLUENT GASES:

Significant increases in the amount of I-131 admitted to the atmosphere from the 200 West Area stack were observed during the latter part of April and early May when the daily emission over three weekly periods increased from 19 curies to 49 and 105 curies. During May and June, the average daily emission was 117 and 182 curies, respectively. Maximum emission during the three month period was 407 curies/day. A material change in the efficiency of the silver reactors was associated with the increased emission as the amount of I-131 passing through the sand filter was comparable to that noted from the results of spot checks during the previous quarter. Graphs showing the trend of this data and a material balance for the I-131 involved in the process during the quarter are included in this section.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION:

The activity density from I-131 increased at all monitoring locations in the environs with many of the individual measurements representing maximum deposition during the years 1950 and 1951. The region of maximum deposition was an area about 2 miles long and 1 mile wide in the vicinity of the 200 West Area gatehouse, where the average activity density exceeded 2.5×10^{-3} µc/gram with maximum measurements of 6.2×10^{-2} µc/gram. Values in excess of 1.0×10^{-4} µc/gram which are normally confined to the immediate vicinity of the 200 Areas, were detected as far as 25 miles from the stacks during June. The latter region included the community of Eltopia. Increases on the order of a factor of 2 to 5 were noted in the residential areas and around the project perimeter as compared to the normal activity density ranges of 2.0 to 9.0×10^{-6} µc/gram. Maximum measurements in this region were on the order of 2×10^{-3} µc/gram. The activity density averaged 2.0×10^{-5} µc/gram in the region bounded by Prosser, Patterson, McNary Dam, and Kennewick. Comparable increases by a factor of 3 over previous values were also noted in the Ringold, Mesa Area. Off area vegetation sampling in the eastern and southeastern part of the State of Washington indicated negligible activity on vegetation during the early part of May; the results of surveys in the same region during the month of June showed an increase by factors ranging from 4 to 7 with maximum measurements noted in the region between Connell and Cheney, Washington. Results obtained from the analysis of vegetation for the activity density from non-volatile emitters were not significantly different from those noted during the previous quarter except in isolated sampling locations near the 200 West Area. Spot vegetation samples analyzed for the activity density from alpha emitters by the ether extraction method showed negligible activity in all cases.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE:

Air borne radiation levels showed increases at all intermediate monitoring stations where "M" and "S" type chambers were employed. Readings at many locations averaged between 2 and 3 mrep/day during May and June and in one extreme case, at

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the military encampment near 200 East Area, the average was 5.4 mrep/24 hours. Increases were also noted in the activity density from filterable beta emitters in the atmosphere. Maximum measurements at the 200 West Area gatehouse showed a three month average of 9.7×10^{-11} µc/cc including a one week average of 1.3×10^{-9} µc/cc. Significant increases in the activity density from I-131 were noted at all air monitoring locations; the magnitude of increase was on the order of a factor of 50 near the 200 Areas and ranged from a factor of 4 to 30 at locations around the project perimeter. Again, maximum measurements prevailed near the 200 West Area where the quarterly average was 4.8×10^{-10} µc of I-131/cc including a one week average of 3.3×10^{-9} µc/cc. Maximum measurements in residential areas for a weekly period were 1.0×10^{-11} µc/cc. Spot scrubber samples obtained during periods of maximum concentration near ground level showed an average of 3.0×10^{-8} µc/cc; 60 out of 71 samples showed values in excess of 3×10^{-9} µc/cc. All increases mentioned above were associated with the failure of the silver reactors in the 200 West Area.

The average number of radioactive particles in the atmosphere remained high and did not reflect the decrease expected from the high results noted during January, February, and March as a result of the Nevada tests. The higher concentrations appeared at random locations and indicated the source of emission as other than the Hanford Works. Average particle concentrations at Boise, Klamath Falls, and Lewiston were not significantly different than those noted at various elevations on the Meteorology Tower. Detailed tables in the text summarize the results of each of the above programs.

SECTION IV - RADIOACTIVE CONTAMINATION IN HANFORD WASTES:

The average activity density from gross beta emitters in the effluent water discharged into the Columbia River from the 5 pile areas ranged from 6.6 to 9.5×10^{-4} µc/cc. Maximum measurements on the order of 1.0 to 3.0×10^{-3} µc/cc at all areas represented some of the highest values for the past year. The activity density from alpha emitters averaged less than 8 dis/min/liter with only 3 samples indicating trace activity. Analysis for uranium and plutonium indicated negligible activity from this source. The amount of I-131 discharged into the river from the Biology Farm ranged from 0.7 to 5.0 mc/day; the average activity density in this effluent was 1.5×10^{-5} µc/cc. Sampling at open waste areas in the 200 and 300 Areas showed levels of contamination comparable to past data. Detailed surveys completed at the 300 Area waste pond are descrubed and illustrated in the text.

SECTION V - RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER:

An increase in the average river flow from 800,000 gallons/second during the previous quarter to 1,800,000 gallons/second during this period resulted in an over all decrease in activity density from gross beta emitters at all monitoring locations along the river. Maximum measurements were obtained along the Benton County shore in the vicinity of the Hanford Ferry where the average activity density of 2.8×10^{-6} µc/cc included a maximum measurement of 8.7×10^{-6} µc/cc. Samples from remote locations such as Bonneville Dam indicated negligible activity from alpha and beta emitters. Special studies designed to determine the random distribution and dispersion patterns of the radioisotopes emitted from the 107-B basin and concentrations and turbidity of ferro-floc admitted to the river via the same effluent line showed favorable correlations between the 3 variables. Graphs showing this relationship along with estimated iso-activity patterns and iso-velocity contours are included in the text. Radiochemical analyses of the activity density from alpha and beta emitters in mud samples collected from the shores of the Columbia, Yakima, and Snake Rivers showed negligible activity from these sources. Raw water monitoring reflected decreases in the mean activity density from beta emitters in the 100 Areas.

SECTION VI - RADIOACTIVE CONTAMINATION IN RAIN:

Analysis of 99 rain samples collected from twenty-seven locations indicated maximum contamination about 8000' southeast of the 200 West Area stack; the average activity density from beta emitters at this location was 8.9×10^{-5} µc/cc including a maximum measurement of 1.6×10^{-4} µc/cc. The activity density increased at nearly all monitoring locations as a result of the failure of the silver reactors at 200 West Area. Activity was detected at all perimeter locations and in all residential and construction areas.

SECTION VII - RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS:

The levels of radioactive contamination in drinking water supplies were comparable to those noted from previous measurements. Trace quantities of uranium were detected at Richland and Benton City; maximum measurements indicated 19 µg U/liter and 11 µg U/liter at Benton City and Richland Well #15, respectively. Wells which were located adjacent to the Columbia River or used the Columbia River as their source of supply showed measurable beta activity on the order of 1.0 to 4.0×10^{-7} µc/cc. Samples of various media obtained from the Pasco Filter Plant showed values comparable to those expected; maximum measurements indicated 5×10^{-7} µc/cc and 2.2×10^{-3} µc/gram in the liquid and solid portions of backwash material from the sand filter.

A two fold increase was observed in the activity density from the alpha emitter of uranium in the 300 North Area well where the average over the three month period was 1.9×10^{3} µg U/liter. Tables which summarize all positive measurements during the three month period are presented in the text.

SECTION I

RADIOACTIVE CONTAMINATION IN EFFLUENT GASES

200 AREAS:

Estimations of the amount fo I-131 admitted to the atmosphere from the dissolving process in the 200 West Area were made by continuously drawing a small aliquot (0.3 cfm) of the off gases through a CWS #6 filter and a caustic scrubber by means of a motoair pump. The filter and scrubber samples were then analyzed for I-131 according to standard procedures and techniques used by the Control Laboratory (HW-20136.) Additional information as to the source of emitted I-131 was obtained by sampling off gases from the sand filter using the technique outlined above. This latter measurement determines the amount of I-131 emitted from all processes except dissolving, while the former is a measure of the total amount emitted. Subtraction then yields the amount coming from the dissolvers alone.

During the early part of April an average of 16 curies of I-131 were admitted to the atmosphere daily. Maximum emission was on the order of 39 curies per day. These values represented a significant increase over measurements obtained during the previous quarter when the average emission was 3.8 curies per day including maximum measurements of 15.8 curies a day. This increase was associated with the continued dissolving of irradiated uranium that had been cooled for a shorter period than that which was dissolved during the period January through March. Minimum cooling periods during the early part of April averaged 48 days as compared with average cooling periods of 60 days during the early part of March. The efficiency of the silver reactors in the dissolver off-gas line was comparable to that during March. On a percentage basis, 2 to 5 percent of the I-131 involved in the dissolvers was admitted to the atmosphere via the stack during the first week in April. Similar values for the previous quarter indicated that from 1.2 to 4.6 percent of the dissolved I-131 was passing out of the stack at that time.

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Indications of a meterial change in the efficiency of the silver reactors in the 200 West Area were observed from the results of the samples collected during the middle and latter part of April (Figure 1.) During the weekly period ending April 21, 28, and May 5, the average percent of the dissolved I-131 emitted daily increased to 4.9 percent, 8.1 percent, and 25 percent, respectively. The average daily emission during this three week period was 19, 49, and 105 curies; in one extreme case during the first week of May, 154 curies of I-131 were emitted during a 24 hour period; this value represented 34 percent of the I-131 involved in the dissolving operation. This increase in the amount of I-131 leaving the stack appeared highly significant because the increase occurred during a period in which the cooling time of the dissolved metal was comparable to the cooling period at the time that the daily emission was on the order of 2 to 5 percent. Average cooling periods during the weekly periods ending April 21, 28, and May 5 were 53, 49, and 55 days, respectively. The minimum cooling period during the three weeks was 44 days as compared with a minimum cooling period of 42 days during the month of March and early part of April.

Samples collected from the down stream side of the sand filter indicated that the amount of I-131 originating from this source was negligible during the period in which the stack emission increased. An average of only 1.9 curies passed through the sand filter daily during April; maximum emission from this source was 4.4 curies per day. These lower values were comparable in magnitude to those found in spot checks during previous months and tended to confirm the fact that the silver reactors in the 200 West Area had failed. Further indications that an increased amount of I-131 was passing through the reactors from the dissolving process were observed when reviewing data recorded from constant air monitors; significant increases in the counting rates of air filters were noted during the first 2 hours of each dissolving and in all cases, increases above normal counting rates were directly associated with periods when the dissolving operation was in progress.

Stack monitoring results obtained during the remainder of May and throughout June indicated a continued increase in the amount of I-131 admitted to the atmosphere. During May and June, the average daily emission was 117 and 182 curies, respectively. Maximum emission during the quarter was 407 curies/day. A summary of the results obtained from monitoring the 200 West Area stack during the period April, May, and June, 1951, is presented in Table I.

TABLE I
SUMMARY OF RESULTS FROM STACK MONITORING
200 WEST AREA STACK
APRIL, MAY, JUNE
1 9 5 1

Month	Curies I-131 Dissolved*		Curies I-131 Emitted Daily		Curies Emitted Through Sand Filter Daily	
	Maximum	Average	Maximum	Average	Maximum	Average
April	1383	624	39.8	13.2	4.4	1.9
May	2223	985	407.	117.	19.9	11.6
June	2405	1323	370.	182	24.8	9.3

* These values represent theoretical calculations for those batches of metal which were dissolved during the time that the stack was monitored; average figures for all dissolving during April, May, and June were 631, 1144, and 1189 curies, respectively.

The monitoring results obtained from the 50' level of the stack and from the down stream side of the sand filter were reviewed in respect to the calculated amount of I-131 involved in the separations process to obtain a material balance for I-131. The results of the study are portrayed graphically in Figure 2, which also shows the daily material balance for 2 of the 24 hour periods during which maximum emission occurred. The over-all trend of the amount of I-131 involved, the cooling period and daily emission via the stack is portrayed graphically in Figure 1; similar data which represents measurements during previous months is included for comparison. A more detailed summary of the trend outlined above may be referred to in an associated document (HW-21891.)

100 AREAS:

During the latter part of June, the program designed for the purpose of determining the activity density of tritium oxide admitted to the atmosphere at the

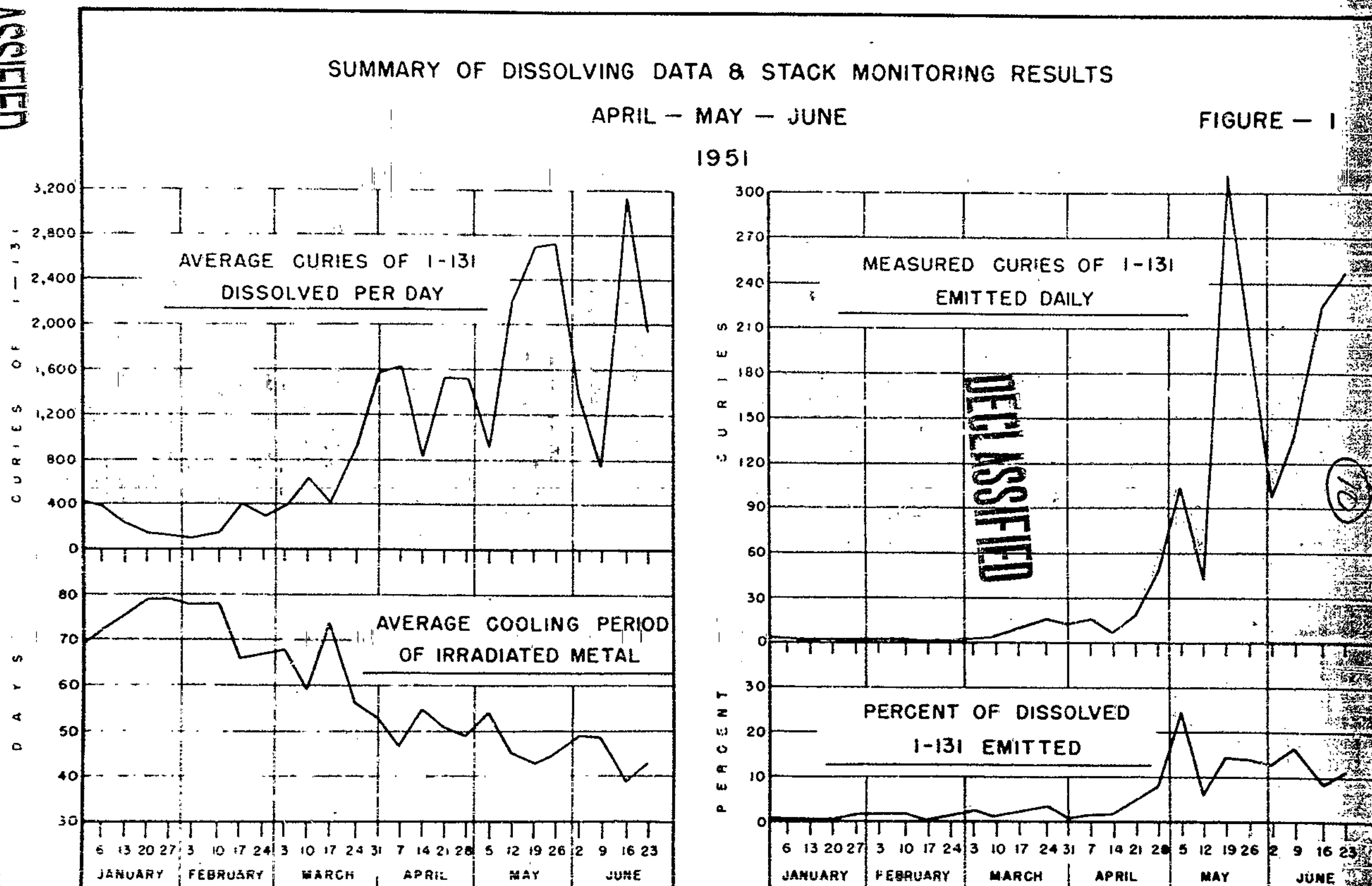
[redacted]

105-F and 105-D stacks was incorporated into the Regional Survey Program. Monitoring of these two stacks was part of an over-all program incorporated into the group for the purpose of determining the magnitude and extent of the aerosol quantities of tritium oxide in the environs of the Hanford Works. The air samples consisted of a cylinder containing dehydrated silica jell through which an air flow of 0.5 cfm was passed for an interval of 3 to 5 hours. A quarter HP motoair pump was used to propel the air stream. Standard procedures and techniques were used for the radiochemical analyses (HW 20136.) Only 3 out of 28 samples collected during June indicated results above the sensitivity limit of the analyses. One sample obtained on June 23 from the 105-F stack showed the activity density to be 2.2×10^{-8} µc/cc; samples collected on June 18 and June 19 from the 105-D stack showed values of 2.4 and 2.1×10^{-8} µc/cc.

Spot samples were obtained from the 105-F and 105-D stacks and were analyzed for the activity density from C-14 and S-35. The results obtained from these preliminary measurements indicated negligible activity from this source. A program is currently planned for the coming quarter in which daily samples will be obtained from several of the 100 Areas stacks for the specific purpose of determining whether measurable quantities of C-14 and S-35 are being admitted to the atmosphere from this source.

SECTION I

(Please refer to Figures 1 and 2.)


SUMMARY OF DISSOLVING DATA & STACK MONITORING RESULTS
APRIL — MAY — JUNE
1951
FIGURE — I
AVERAGE CURIES OF I-131 DISSOLVED PER DAY
AVERAGE COOLING PERIOD OF IRRADIATED METAL
MEASURED CURIES OF I-131 EMITTED DAILY
PERCENT OF DISSOLVED I-131 EMITTED
CURIES OF I-131
DAYS
CURIES
PERCENT
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
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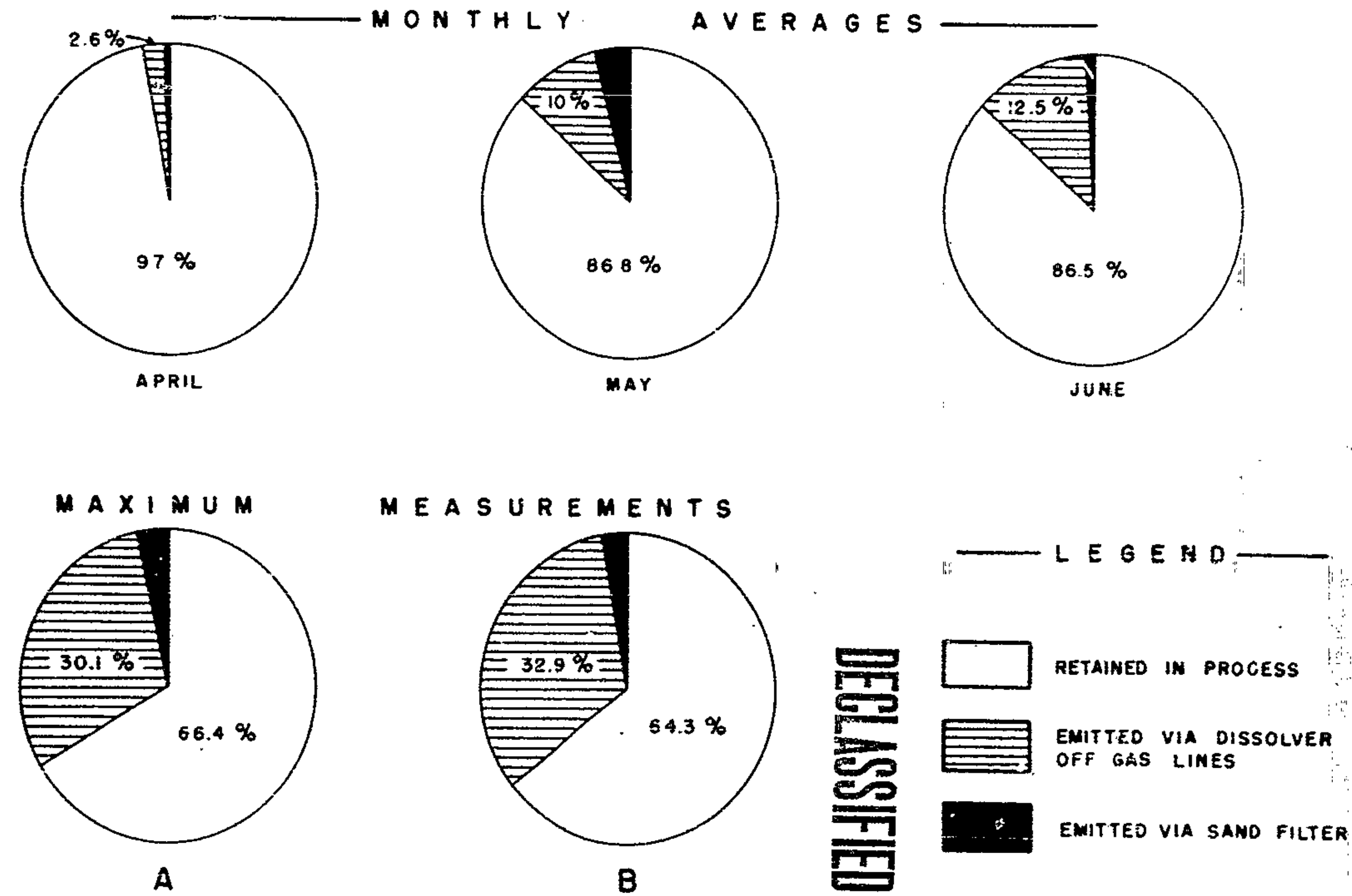
MATERIAL BALANCE
I-131 INVOLVED IN SEPARATIONS PROCESS
200 WEST AREA

FIGURE — 2



SECTION II

RADIOACTIVE CONTAMINATION ON VEGETATION

Over two thousand vegetation samples were collected from locations on and adjacent to the Hanford Works for the purpose of evaluating the magnitude and deposition pattern of the radioactive effluent emitted from the separations area stacks. The majority of these samples were obtained from locations within the Hanford Works perimeter and in the adjoining communities of Pasco, Kennewick, and Benton City; 550 samples were obtained from locations beyond a 50 mile radius of the separation area stacks. A map showing the locations at which samples were obtained routinely in the immediate environs may be found in a previous document of this series (HW-21214.)

The radiochemical analysis included specific measurements for the activity density of 8-day I-131 and for the activity density of non-volatile beta emitters from the longer half-lived fission products. The latter analysis includes the evaluation of the activity density from the natural occurring isotopes such as potassium and uranium. The detection limits for these measurements are 3×10^{-6} μc/gram for I-131 and 1×10^{-5} μc/gram for the non-volatile emitters.

A summary of the results of these analyses for the period April, May, and June 1951 is presented in Table I; the averages which represented the results of similar measurements during the previous quarterly period are included for comparison.

A review of the data summarized in Table I shows that an over-all increase occurred in the activity density of I-131 throughout the environs. It should be noted that the average activity density from I-131 on vegetation represents maximum measurements during the years 1950 and 1951. Many of the present values are comparable to the activity density found after the dissolving of 20 day metal during December, 1949, (HW-17381) with several of the individual maximum values exceeding those obtained immediately after the experimental dissolving of 20 day metal.

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TABLE I
RADIOACTIVE CONTAMINATION ON VEGETATION
APRIL, MAY, JUNE
1951

Location	No. Samples	I-131 Activity Density x 10^6 µc/gm Maximum	I-131 Average	I-131 Previous Average	Non-Volatile Activity Density x 10^6 µc/gm Maximum	Non-Volatile Average	Non-Volatile Previous Average
North of 200 Areas	204	430	36	17	350	20	25
Near the 200 Areas	217	2500	200	55	230	25	24
Route 3	14	32000	4400	730	150	100	45
200 West Gate	134	42000	6900	1500	3200	350	42
200 E Tower #16	133	30000	550	140	730	48	35
Batch Plant	132	22000	1400	110	540	64	28
Meteorology Tower	13	4000	1000	180	71	30	15
South of 200 Areas	269	2300	86	26	242	23	79
Richland	184	2400	60	18	170	17	22
Pasco	84	220	44	10	110	20	21
Kennewick	176	120	32	15	74	14	20
Benton City	36	71	28	19	95	19	22
Richland "Y"	14	69	18	21	19	10	14
Hanford	26	300	54	9	50	16	14
200 East Area	48	980	250	60	58	25	45
200 West Area	54	62000	5000	314	1300	134	19
Redox Construction Area	91	5600	1200	318	1100	79	27
Wahluke Slope	52	180	56	9	77	24	17
Goose Egg Hill	30	2600	300	70	90	31	24
Rattlesnake Mountain	63	22000	400	50	68	26	51
Off Area Sampling:							
Plymouth-McNary-Prosser-Patterson-Kennewick	224	380	20	7	97	15	10
Pasco-Ringold-Mesa Area	120	200	19	6	39	11	17
PCN 300-310-320	6	260	84	---	39	29	--

Increases on the order of a factor of 2 to 5 were noted in the mean activity density on vegetation collected around the project perimeter and in the residential communities of Richland, Pasco, Kennewick, and Benton City. In general, the activity density averages between 2.0 and 9.0×10^{-6} µc/gram in the populated area; maximum measurements on the order of 2.0×10^{-3} µc/gram were noted in Richland during June.

Weekly samples obtained from representative locations between Prosser, Patterson, McNary Dam and Kennewick indicated that the mean activity throughout the quarter was 2.0×10^{-5} µc/gram; maximum measurements were 3.8×10^{-4} µc/gram in the region between Plymouth and Kennewick. These values represented a three-fold increase

[redacted]

over measurements obtained during the previous quarter. A comparable increase was also noted in the Ringold-Mesa Area where the current average of 1.9×10^{-5} µc/gram indicated a three-fold increase over the previous average of 6×10^{-6} µc/gram. Maximum measurements in the Ringold-Mesa Area were on the order of 2.0×10^{-4} µc/gram.

Fifty-two samples were obtained from various locations on the Wahluke Slope during June; the mean activity density from I-131 at this time was 5.6×10^{-5} µc/gram. Maximum measurements were on the order of 1.8×10^{-4} µc/gram. The average activity density from I-131 on the Wahluke Slope increased by a factor of 8 when comparing these data to measurements obtained during the previous quarter. A four-fold increase was noted in the magnitude of deposition in the Rattlesnake Mountain region where the average of 63 samples was 4.0×10^{-4} µc/gram. Maximum measurements in this region were 2.2×10^{-2} µc/gram.

Based on the tendency of the general deposition pattern of I-131 on vegetation to elongate to the southeast and east, and on the determination of probable trajectories for airborne waste emitted at Hanford (HW-20502), off area vegetation sampling was confined to the southeast and eastern part of the State of Washington. Surveys were conducted in this region during May and June. The sampling was generally confined to the vicinity of the residential areas in this region; four or five samples were obtained from the perimeter of the various communities. Table II summarizes the results obtained from these two surveys.

A comparison of these data indicates an increase by factors of 3 to 5 occurring during the interval between the two surveys with the most significant increases noted in the region between Connell and Cheney, Washington.

The average increase in the deposition of I-131 was a result of an upward trend throughout the period; the measurements obtained during the early part of April were comparable to similar measurements obtained during January, Febriary, and March of 1951. The first significant increase in the deposition of I-131 on vegetation was observed towards the latter part of April; this trend continued until the middle of June when the increase leveled off. A month to month breakdown

[redacted]

TABLE II
ACTIVITY DENSITY FROM I-131 ON VEGETATION
OFF AREA LOCATIONS
MAY, JUNE, 1951

units of 10^{-6} μc/cc

Location	May, 1951 Maximum	May, 1951 Average	June, 1951 Maximum	June, 1951 Average
Waitsburg, Wn.	4	3	38	29
Dayton, Wn.	11	7	40	31
Dodge, Wn.	<3	<3	39	30
Pomeroy, Wn.	8	3	33	29
Lewiston, Idaho	<3	<3	22	18
Uniontown, Wn.	7	6	46	39
Pullman, Wn.	10	6	46	32
Colfax, Wn.	14	6	50	43
Steptoe, Wn.	7	4	30	22
Wallula, Wn.	16	8	95	59
Touchet, Wn.	6	5	23	22
Lowden, Wn.	6	4	30	29
Walla Walla, Wn.	24	9	39	28
Dixie, Wn.	5	<3	33	32
Rosalia, Wn.	8	6	28	19
Spangle, Wn.	<3	<3	31	27
Spokane, Wn.	5	4	35	27
Cheney, Wn.	4	<3	45	32
Sprague, Wn.	4	<3	44	35
Ritzville, Wn.	4	3	67	53
Lind, Wn.	13	6	67	53
Connell, Wn.	7	4	83	62

showing the maximum and average activity density from I-131 detected at representative locations in the environs is presented in Table III.

The over-all increase in the deposition of I-131 in the environs was primarily due to a failure of the silver reactors (See Section I) and may in part be due to the use of metal with short cooling times (Figure 1.)

TABLE III
ACTIVITY DENSITY FROM I-131 ON VEGETATION
APRIL, MAY, JUNE
1 9 5 1

units of 10^{-6} μc/gram

Location	April Maximum	April Average	May Maximum	May Average	June Maximum	June Average
North of 200 Areas	58	12	430	55	210	38
Near the 200 Areas	520	55	1400	150	3600	380
Route 3	5500	1400	4200	1800	32000	9500
200 West Gate	4000	1500	34000	4600	42000	15000
200 East Tower #16	440	130	12000	760	30000	850
Batch Plant	1200	430	22000	1500	18000	270
Meteorology Tower	150	93	3000	1200	4000	1600
South of 200 Areas	73	36	270	44	2300	160
Richland	52	21	340	45	2400	99
Pasco Environs	38	15	220	50	200	62
Kennewick Environs	66	20	220	34	120	40
Benton City	30	16	61	30	71	38
Richland "Y"	10	6	69	24	31	20
Hanford	18	11	180	53	300	90
200 East Area	270	81	780	270	980	400
200 West Area	1900	350	62000	12000	1200	350
Redox Construction Area	1500	380	5200	800	5600	1900
Wahluke Slope	----	----	-----	----	180	56
Goose Egg Hill	430	93	500	100	2600	800
Rattlesnake Mountain	110	45	61	27	22000	800

Analysis of the measurements summarized in Tables I and II indicate that the maximum deposition was observed in nearly the identical points that maximum measurements have prevailed in the past. The average activity density from I-131 exceeded 2.5×10^{-3} μc/gram over an area about 2 miles long and 1 mile wide in which the 200 West gatehouse was approximately the center point. The maximum activity density noted in this region was 6.2×10^{-2} μc/gram in a sample obtained immediately inside the 200 West Area gate; the average activity density based on 64 samples collected from this location was 5.0×10^{-3} μc/gram. Daily samples obtained from a location approximately 1000 feet due east southeast of the 200 West gatehouse averaged 6.9×10^{-3} μc/gram including a maximum measurement of 4.2×10^{-2} μc/gram. The location and extent of this maximum deposition area may be appraised by reviewing Figures 3 through 6 which portray the estimated distribution pattern of the activity density from I-131 on vegetation for the months of April, May, and June, and for the over-all quarterly period. As indicated on Figures 3 and 5, the size of the area in which the activity density exceeded 2.5×10^{-3} μc/gram increased nearly two-fold between April and June. Significant increases were also noted when comparing the size of the area in which the activity density exceeded 1.0×10^{-4} μc/gram. During April, the region in which the activity exceeded 1.0×10^{-4} μc/gram was essentially confined to the two separation areas; the elongated region which this magnitude of activity existed was extended 9 miles to the southeast during May and 25 miles to the east during June. The latter extention included the community of Eltopia.

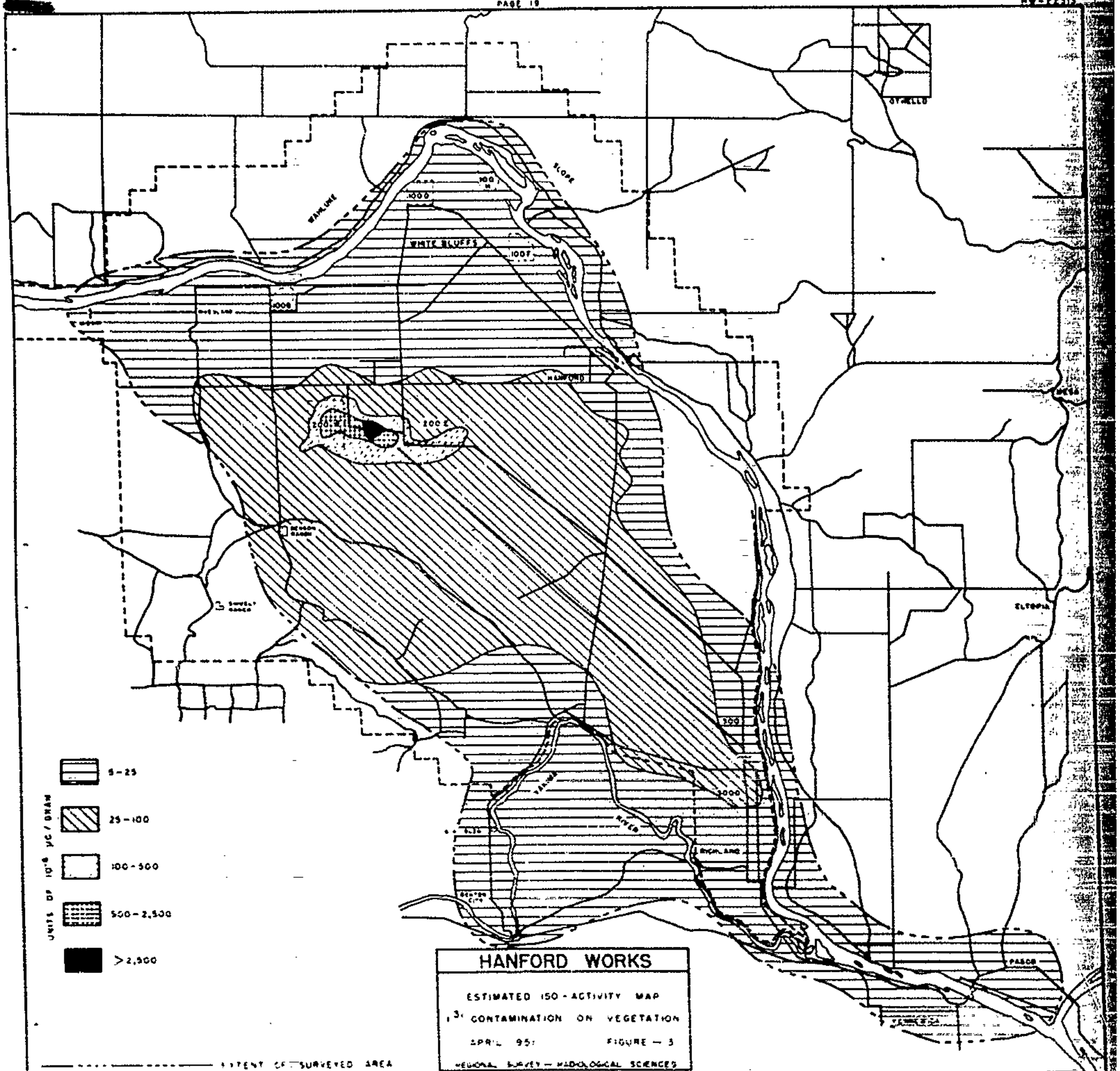
The majority of the vegetation samples collected from the locations discussed above were also analyzed for the activity density from non-volatile emitters. A review of these results (summarized in Table I) indicate that the activity density from non-volatile emitters was not significantly different from that noted during the period January, February, and March except in isolated sampling locations in the immediate environs of the 200 West Area. The latter locations include the 200 West Area gatehouse, nearby Route 3, and several spot locations inside the 200 West Area. At these locations, the activity density from non-volatile emitters averaged between 1.0 and 3.5×10^{-4} μc/gram; the average during the previous quarter was on the order of 4.5×10^{-5} μc/gram. These increases may have been associated with the increased operating schedule at the 200 West Area. It was interesting to note that those locations showing the higher activity density from non-volatile emitters were nearly identical to the locations showing the higher deposition from I-131. On a month to month basis, the activity density from non-volatile emitters indicates an upward trend; higher values were obtained during the latter part of the quarter.

The activity density from non-volatile emitters on vegetation collected around the project perimeter such as Prosser, Kennewick, Mesa, and Ringold, indicated the mean activity density to be in the range of 1.0 to 2.0×10^{-5} μc/gram. As these values were not significantly different from the detection limits of the analyses (1.0×10^{-5} μc/gram) the determination of the activity density from non-volatile emitters on samples collected at remote locations in the eastern part of the State of Washington was not performed during the period. [redacted]

During May, a number of samples obtained from random locations in the immediate environs were analyzed for the activity density from alpha emitters by the ether extraction method (HW-7002.) The activity density from alpha emitters in these samples was negligible in all cases (less than 2 dis/min/gram.) Although all individual results were essentially below the detection limits of this type of analyses, a statistical comparison of the average of all samples collected from within the 200 Areas with the average of those samples collected at Richland was made and did not show a significant difference.

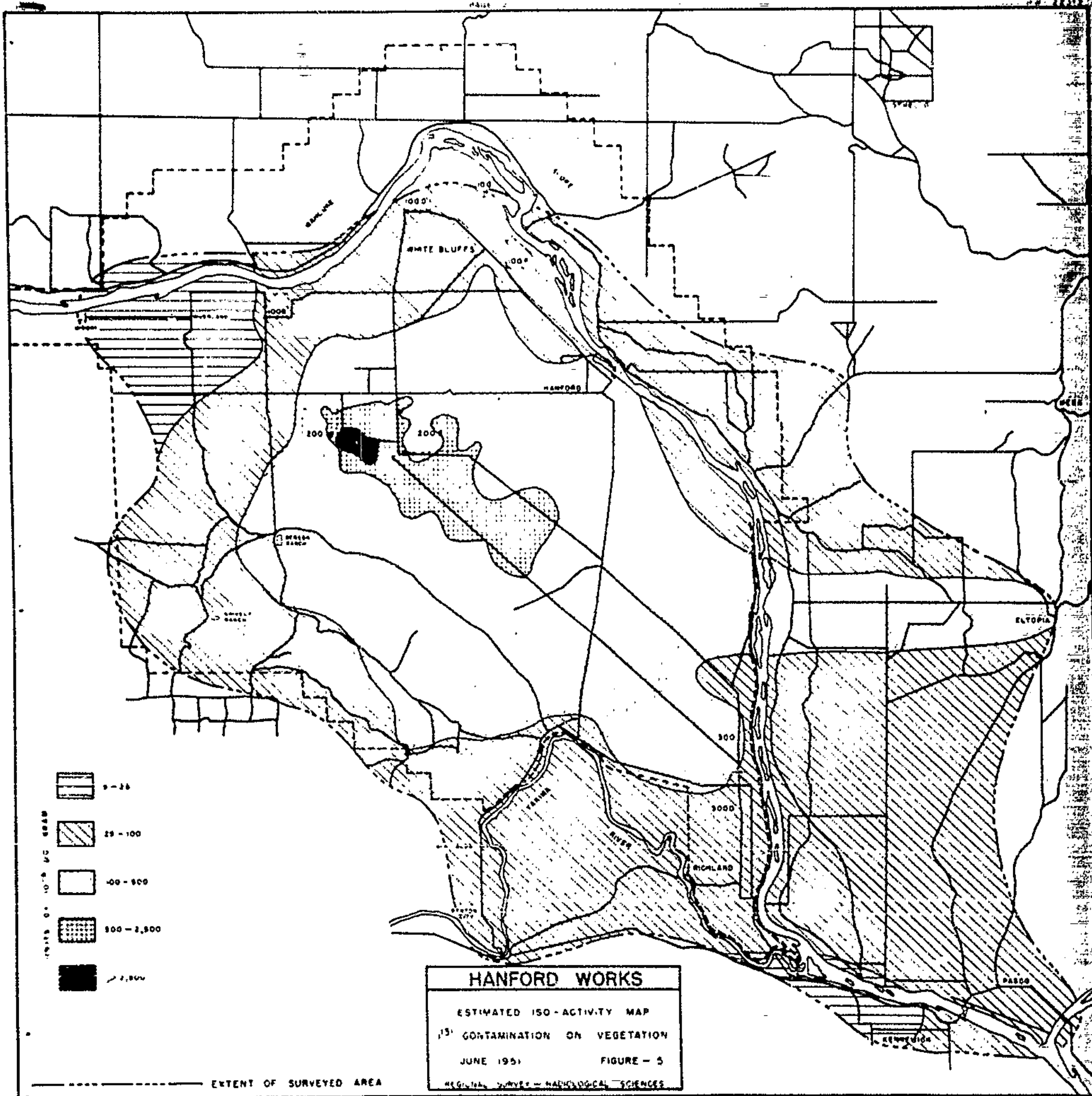
SECTION I

(Please refer to Figures 3, 4, 5, and 6.)


WAHLUKE
SLOPE
WHITE BLUFFS
100 N
100 D
100 F
100 B
HANFORD
200 E
200 W
300
OTHELLO
MESA
ELTOPIA
RICHLAND
BENTON CITY
PASCO
KENNEWICK
YAKIMA RIVER
5-25
25-100
100-500
500-2,500
>2,500
UNITS OF 10⁻⁶ μC / GRAM
EXTENT OF SURVEYED AREA
HANFORD WORKS
ESTIMATED ISO-ACTIVITY MAP
I³¹ CONTAMINATION ON VEGETATION
APRIL 1951
FIGURE - 3
REGIONAL SURVEY - RADIOLOGICAL SCIENCES

DECLASSIFIED

HW-22313



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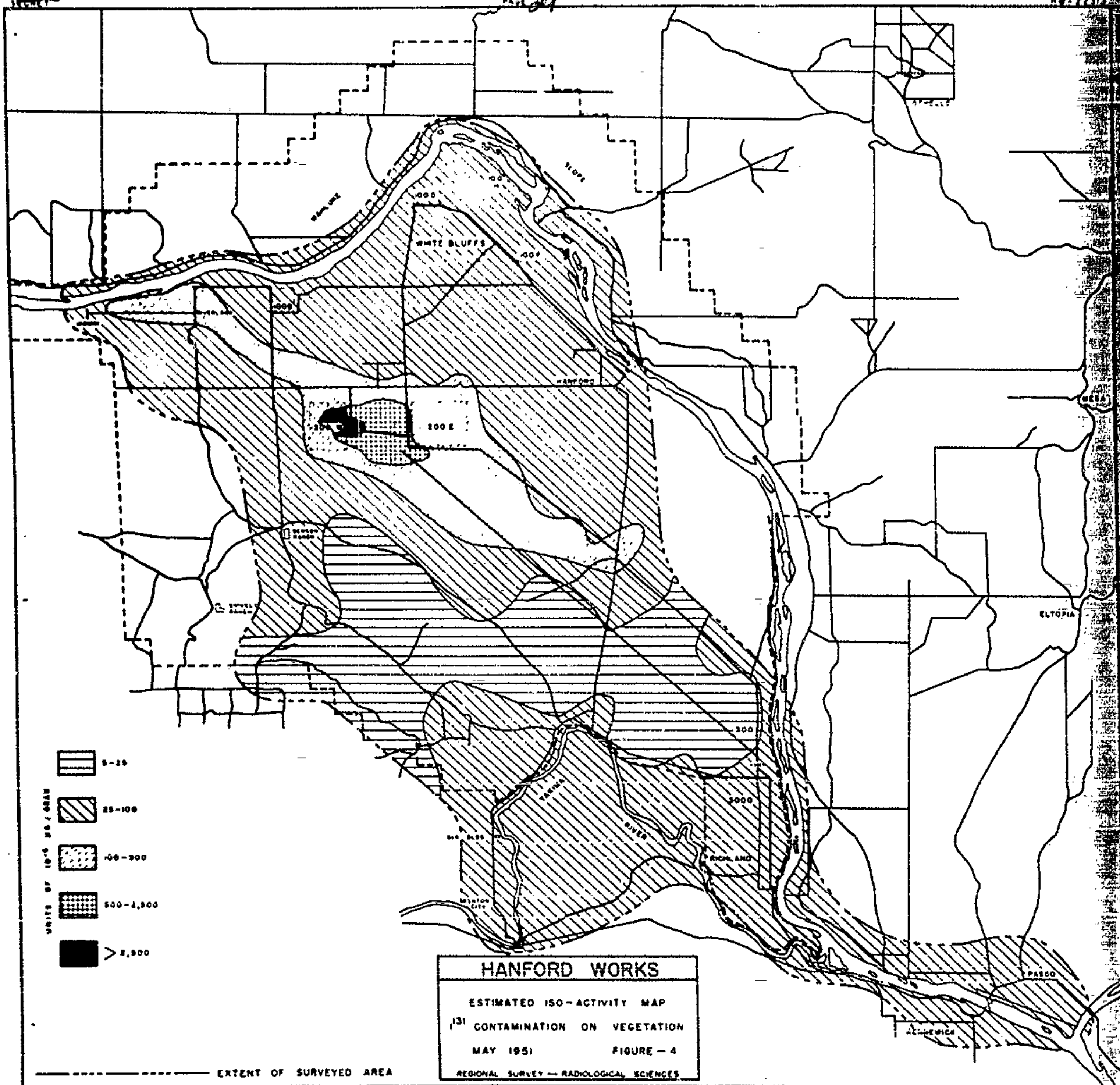
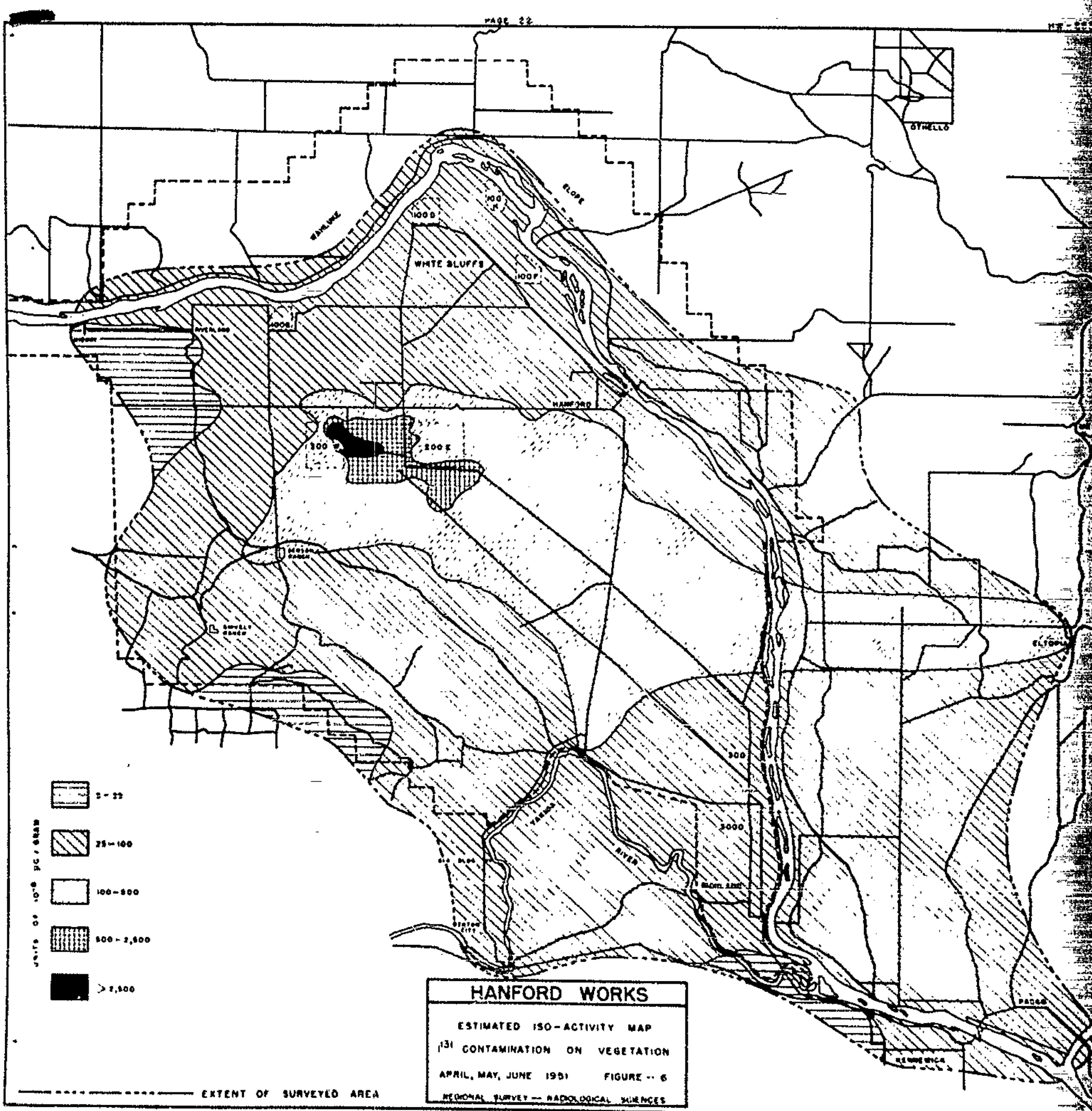
HW-22313


HANFORD WORKS
ESTIMATED ISO-ACTIVITY MAP
I131 CONTAMINATION ON VEGETATION
MAY 1951
FIGURE - 4
REGIONAL SURVEY — RADIOLOGICAL SCIENCES
UNITS OF 10-6 µC / GRAM
5-25
25-100
100-500
500-2,500
> 2,500
EXTENT OF SURVEYED AREA
WHITE BLUFFS
HANFORD
200 E
YAKIMA
RIVER
RICHLAND
PASCO
ELTOPIA
MESA
KENNEWICK
BENTON CITY
300
3000
100 F
100 B
SLOPE
WAHLUKE


PAGE 22
OTHELLO
WHITE BLUFFS
100 F
HANFORD
200 E
300
ELTOPIA
YAKIMA
RIVER
PASCO
KENNEWICK
25 – 100
100 – 500
500 – 2,500
> 2,500
EXTENT OF SURVEYED AREA
HANFORD WORKS
ESTIMATED ISO-ACTIVITY MAP
I131 CONTAMINATION ON VEGETATION
APRIL, MAY, JUNE 1951 FIGURE -- 6
REGIONAL SURVEY -- RADIOLOGICAL SCIENCES

SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

The magnitude and extent of radioactive contamination in the atmosphere at locations on and adjacent to the Hanford Works was determined by employing various types of monitoring devices. The bulk of the information was obtained from fixed Victoreen integrons, portable detachable type ionization chambers, air filtering devices, and air scrubbing monitors. The equipment was operated at fixed locations in and near the Hanford Works operating areas and in the residential areas around the project perimeter. In general, 2 or 3 units were employed in the operating areas and one unit was maintained in each of the residential areas. The fixed monitoring stations were supplemented at intermediate locations with various types of portable instrumentation and filtering devices. Several air monitoring stations were operated at remote locations in the States of Oregon, Idaho and Montana, for the purpose of evaluating background and to aid in identifying the source of activity which may originate at locations other than the Hanford Works. Maps showing the locations of the various types of monitoring equipment may be referred to in a previous document of this series (HW 21214.) The results obtained from the various methods of monitoring are presented in tabular form along with discussion of the methods and trends observed during the present period.

The average dosage rates as determined by evaluating readings from fixed Victoreen integrons at representative locations in the immediate environs for the period April, May, and June, 1951 is presented in Table I.

Average dosage rates at all locations except Riverland and Richland were well within the normal range of fluctuation expected and were comparable to the averages observed during the previous quarter. The higher readings recorded at Richland and Riverland were due to the inclusion of several questionable values which were believed due to faulty instrumentation at these locations. On a month to month basis, the only trend noticed when reviewing the data represented the values at the

TABLE I
AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS*
APRIL, MAY, JUNE
1 9 5 1
units of mrep per 24 hours

Location	No. of units	April	May	June	Quarterly Average
100-B Area	3	0.4	0.4	0.8	0.5
100-D Area	3	0.2	0.2	0.2	0.2
100-F Area	3	0.5	0.2	0.3	0.3
100-H Area	3	0.4	0.6	---	0.5
200 West Area	2	0.1	0.1	1.5	0.5
200 East Area	3	0.1	0.2	0.3	0.2
Riverland	1	1.1	2.3	0.9	1.4
300 Area	1	1.4	0.4	0.6	0.8
Richland	1	1.8	0.9	1.3	1.3
Pasco	1	0.2	0.4	0.3	0.3
Benton City	1	0.1	0.1	0.3	0.1
North Richland North	1	0.6	0.4	0.2	0.4
North Richland South	1	0.7	0.9	0.3	0.6
Hanford	1	0.5	0.3	0.1	0.3

* Individual readings were obtained for each 8 hour interval throughout the period; these readings were accumulated to determine the average dosage rate during the period.

200 West Area where the monthly average dosage rate increased from 0.1 mrep/day during April to 1.5 mrep/day during June. This increase was directly associated with the reduced efficiency of the silver reactor in the off gas line at the 200 West Area during the month of June (Section I.)

Detachable "C" type chambers were exposed at each of the integron monitoring stations in the operating areas for the purpose of confirming any significant integron reading. Two chambers were used at each installation; the radiation level was determined by evaluating the reading which indicated the least discharge. Table II summarizes the results obtained from these measurements:

TABLE II
"C" TYPE DETACHABLE IONIZATION CHAMBERS
APRIL, MAY, JUNE
1 9 5 1
Units of mrep per 24 hours

Location	April	May	June	Quarterly Average
Within 100-B Area	0.4	0.3	0.3	0.3
Within 100-D Area	0.4	0.3	0.4	0.4
Within 100-F Area	0.4	0.3	0.3	0.3
Within 200 West Area	0.2	0.4	0.3	0.3
Within 200 East Area	0.7	0.6	0.7	0.7

A review of the above data indicates that the average values tabulated for the individual months and the quarterly period were not significantly different than those obtained from the integron readings. A further comparison to the results of similar measurements obtained during previous periods indicates no significant trend or change. The bulk of the readings during each of the past 2 quarterly periods were within the fluctuation of natural background (0.3 to 0.5 mrep/day.)

The air radiation levels at intermediate locations between the Hanford Works operating areas and the residential communities around the project perimeter were determined by evaluating the readings obtained from detachable M and S type ionization chambers placed on small wooden stands about 5 feet above ground level. Again, two chambers were used at each location and the minimum reading was evaluated in a manner similar to that described for the "C" type ionization chambers. A summary of the radiation levels measured in this manner is presented in Table III.

The air-borne radiation levels increased at all monitoring locations within a 5 mile radius of the 200 Areas during this period. Indications of this increase during the early part of April at locations immediately outside of the 200 Areas such as Route 4S, Mile 2.5 and the Redox Construction Area, where the average dosage of 1.6 mrep/24 hours measured during the month of April, represented a significant increase over the March average of 1.1 mrep/24 hours. Small increases were also noted in April at more distant locations along Route 4, Route 11-A, and at the Batch Plant. The data obtained during the month of May show that these small increases were actually the first indications of an over-all increase in radiation level throughout the immediate environs of the 200 Areas; readings at many of the locations averaged between 2.0 and 3.0 mrep/24 hours during May and June and in one extreme case averaged 5.4 mrep/24 hours. The latter value was measured inside the military encampment (PSN 330) which is located southeast of the 200 East Area and apparently is in the path of atmospheric activity which originates from each of the 200 Areas. The initial measurements inside PSN 330 were obtained from M type ionization chambers; these readings were supplemented with S type chamber readings

 [redacted]

TABLE III
RADIATION LEVEL OBSERVED WITH "M" AND "S" TYPE DETACHABLE IONIZATION CHAMBERS APRIL, MAY, JUNE 1951

Units-mrep per 24 hours

Location	April	May	June	Quarterly Average	Group Average
100 Areas & Environs					
Route 1, Mile 8	0.46	0.48	0.51	0.48	
Route 2N, Mile 10	0.41	0.49	0.35	0.42	
Route 2N, Mile 5	0.38	0.39	0.38	0.38	
White Bluffs	0.40	0.37	0.37	0.38	
Route 11-A, Mile 1	1.48	0.51	0.68	0.89	0.46
Hanford 614 Building	0.36	0.60	0.41	0.46	
Intersection-Rt. 1 & Rt. 4N.	0.41	0.36	0.37	0.38	
Hanford 101 Building	0.42	0.42	0.41	0.42	
100-H Area	0.42	0.37	0.36	0.38	
P-11 Area	0.43	0.41	0.48	0.44	
Within 5 Miles of 200 East Area					
Route 4S, Mile 6	0.97	1.35	2.14	1.49	
Batch Plant	0.68	0.69	1.86	1.08	
Route 11-A, Mile 6	0.66	0.79	1.36	0.94	
Route 3, Mile 1	0.84	3.48	2.57	2.30	
Meteorology 200'	0.69	1.29	1.73	1.24	
Route 4S, Mile 2.5	1.68	1.99	2.79	2.15	
Redox Area	1.63	1.45	1.62	1.57	1.67
Route 4S, Mile 4.5	1.22	1.05	2.48	1.58	
Semi-Works #1	1.27	1.76	2.05	1.69	
Semi-Works #2	1.19	1.77	2.75	1.90	
200 East PSN 300*	----	0.48	0.55	0.52	
PSN 310*	----	0.51	0.84	0.68	
PSN 320*	----	0.43	0.91	0.67	
PSN 330* (m)	----	2.45	1.05	1.75	
PSN 330* (s)	----	----	5.42	5.42	
Within 10 Miles of 200 East Area					
Route 4S, Mile 10	0.95	1.63	1.17	1.25	
Route 10, Mile 1	0.67	0.59	1.38	0.88	1.01
Route 10, Mile 3	0.95	1.57	0.13	0.88	
Route 2S, Mile 4	0.80	1.14	1.11	1.02	
Near 300 Area					
Route 4S, Mile 16	1.74	0.86	0.77	1.12	
Route 4S, Mile 22	0.47	0.43	0.77	0.56	
North Richland North	0.46	0.38	0.78	0.54	0.62
North Richland South	0.52	0.35	0.52	0.46	
300 Area	0.34	0.36	0.51	0.40	
Outlying					
Richland	0.43	0.42	0.51	0.45	
Benton City	0.48	0.45	0.20	0.38	0.42

* Monitoring facilities were established in these Military Encampments during this period.

during the latter part of the quarter because the M type chambers were found discharged after exposure periods which were in excess of 24 hours. The readings from each type of monitoring are included in Table III. Many of the chambers were found completely discharged during the quarter; the average values summarized in Table III do not include any appraisal of the data which accompanied discharged chambers.

The over-all increase mentioned above was barely noticed at monitoring stations located over 5 miles from the point of emission; the average radiation level at four stations located within 10 miles of the 200 Areas was 1.0 mrep/24 hours as compared to an average of 0.9 mrep/24 hours during the previous quarter. There was no apparent increase in the radiation level near the 300 Area, near the 100 Areas, or in the residential communities of Richland and Benton City.

The activity density from filterable beta emitters in the atmosphere was determined by counting the deposition on small discs of CWS #6 filter paper through which an air flow of 2.0 or 2.5 cfm was passed over a period of one week. Thin mica window counters were used; the filters were allowed to decay for 2 or 3 days previous to counting to allow decay of the daughter products of Radon and Thoron. Table IV summarizes the results of measurements obtained in this manner during the period.

A review of the data summarized in Table IV indicates that an over-all increase occurred in the mean activity density of filterable beta emitters in the atmosphere during this period. Again, this increase approached significance at many of the stations during the month of April after which date the average activity density continued to increase with a general leveling off noticed during the latter part of June. Maximum measurements were noted at the 200 West Area gatehouse where the average activity density over the three month period was 9.7×10^{-11} μc/cc including a one week period during which the activity density averaged 1.3×10^{-9} μc/cc. The quarterly average in this location represented an increase by a factor of 60 when compared to the mean measurement during January, February, and March.

TABLE IV
AVERAGE FILTERABLE BETA EMITTERS IN AIR
APRIL, MAY, JUNE
1 9 5 1

Location	April	May	June	Quarterly Average	Maximum Weekly
	BETA EMITTERS - AVERAGE ACTIVITY DENSITY x 10^{14} μc/cc				
200 Areas & Vicinity					
200 East Southeast	32	156	163	120	365
200 East Tower #16	112	394	309	281	903
200 East Semi-Works	215	525	903	548	2538
200 West Tower #4	81	99	44	76	186
200 West Gatehouse	225	20021	2887	9718	130298
200 West Redox Area	179	188	226	197	610
Gable Mountain	38	75	88	65	213
200 East Tower #15	61	353	500	308	1304
100 Areas & Vicinity					
100-D	47	73	43	56	208
100-H	67	118	57	83	281
Hanford 101 Building	44	65	121	76	272
Hanford 614 Building	28	43	70	47	99
White Bluffs	30	47	71	49	171
300 Area 614 Building	36	80	54	57	327
Outlying					
Richland	20	85	49	54	314
North Richland	22	151	146	110	581
Pasco	18	60	62	48	266
Benton City	16	10	33	19	54
Riverland	23	25	16	21	67

Smaller increases which were within a factor of 2 when compared to previous measurements were noted in residential areas at the project perimeter; maximum concentrations in a populated region were observed at North Richland where the average over the three month period was 1.1×10^{-12} μc/cc.

[redacted]

The increase in the activity density from filterable beta emitters was associated with the increased aerosol concentrations which occurred when the silver reactor in the off gas line at the 200 West Area failed. The effect of the latter item tended to be more pronounced at nearby locations such as 200 West Area gatehouse and the random fluctuation observed at more distant locations was apparently associated with the meteorological conditions during the time of emission.

Supplementary evaluations of the activity density from filterable beta emitters were obtained by counting the small filters from the dual air monitors operated in the 200 Areas and at 3 levels of the Meteorology Tower. The results from this program indicate increases in activity density comparable to those noted at the air monitoring stations listed in Table IV; again, maximum measurements prevailed during the month of May at all locations. One of the filters removed from the dual unit operated near the 200 West Area gatehouse showed an average activity density of 3.0×10^{-9} µc/cc over a one week period during May. This was the highest measurement obtained from this type of monitoring during the period. Data obtained from 3 stations located on the Meteorology Tower indicated that the higher concentrations prevailed at ground level; average values at the 200' and 400' levels were lower by a factor of 0.5 when compared to ground measurements. Table V summarizes these data on a month to month basis.

 [redacted]

TABLE V
AVERAGE FILTERABLE BETA ACTIVITY IN AIR
DUAL UNIT AIR MONITORS
APRIL, MAY, JUNE
1951

Location	April	May	June	Quarterly Average	Maximum Weekly
	Beta Emitters - Activity Density x 10^{-14} µc/cc				
200 West East Center #1	238	45082	5341	21452	302251
200 West East Center #2	133	1082	1088	817	3448
200 East Southeast #1	55	497	214	274	2011
200 East Southeast #2	239	816	166	439	3740
200 East East Center #1	---	410	418	415	1279
200 East East Center #2	---	532	263	352	625
200 East 2707 EA Bldg. #1	243	3032	405	1485	15986
200 East 2707 EA Bldg. #2	264	401	356	349	1154
Meteorology Tower					
Ground level	224	1099	609	786	3063
200' level	129	778	291	490	1989
400' level	97	660	312	443	2126

During the latter part of the quarter, a program was inaugurated to determine activity density in air from alpha emitters by counting the small filters obtained from locations summarized in Tables IV and V with standard alpha counters. Counting corrections include 52 percent for counter geometry and a 50 percent "efficiency" factor to correct for losses from self - absorption. Preliminary measurements indicate negligible activity from this source in the environs as only 4 locations had an average above the detectable limit (8×10^{-15} µc/cc) of the analysis. A summary of the results of the measurements performed during this period is presented in Table VI.

The measurements shown in Table VI indicate that trace quantities of alpha emitters may be found in the immediate environs of the 200 Areas; however, the locations which indicated positive averages were weighted considerably by one or two positive measurements which were on the order of magnitude indicated in the maximum column above. Statistical appraisals of trends or changes in respect to the above measurements were not made because previous data represented spot checks performed during periods in which detectable quantities of alpha activity were believed present in the atmosphere.

[redacted]

TABLE VI
AIR FILTER MONITORS
APRIL, MAY, JUNE
1951

Location	Number Samples	Alpha Emitters - Activity Density x 10^{15} µc/cc Maximum	Average
200 East Southeast	6	12	<8
200 West Tower #4	6	9	<8
200 East, Semi-Works	5	10	<8
200 East, Tower #16	6	10	<8
Gable Mountain	6	<8	<8
Richland	6	<8	<8
Pasco	6	9	<8
300 Area	6	<8	<8
100-D Area	6	12	<8
200 West Gate	7	10	<8
Benton City	6	<8	<8
Hanford 614 Building	6	<8	<8
White Bluffs	6	<8	<8
North Richland North	6	<8	<8
200 West Redox Area	5	127	31
100-H Area	6	210	11
Hanford 101 Building	6	23	<8
Riverland	6	<8	<8
200 East Tower #15	5	10	<8
Meteorology Tower Ground level	5	11	9
Meteorology Tower 200' level	5	<8	<8
Meteorology Tower 400' level	5	<8	<8
DUAL MONITORING UNITS:			
200 West East Center #1	7	32	13
200 West East Center #2	7	13	<8
200 East Southeast #1	6	23	<8
200 East Southeast #2	6	<8	<8
200 East 2707 EA Building #1	6	<8	<8
200 East 2707 EA Building #2	6	<8	<8
200 East East Center #1	4	<8	<8
200 East East Center #2	4	<8	<8

Specific determination of the activity density from I-131 in the atmosphere was accomplished by passing air (2 cfm) through a caustic scrubber solution placed in series with a small filter and a motoair pump. The results obtained from this type of monitoring for the period April, May, and June, 1951 are summarized in Table VII.

[redacted]

TABLE VII
AVERAGE ACTIVITY DENSITY OF I-131 DETECTED IN SCRUBBERS
APRIL, MAY, JUNE
1 9 5 1

Location	April	May	June	Quarterly Average	Maximum Weekly
	Activity Density x 10^{12} µc/cc				
200 Areas & Vicinity					
200 East Southeast	8.4	22.0	110.5	45.0	338.2
200 East Tower #16	37.8	248.8	240.0	170.3	2415.1
200 West Gatehouse	54.2	750.6	559.1	477.3	3313.0
Gable Mountain	1.6	8.1	4.9	5.1	13.4
Outlying Locations					
100-H Area	0.5	2.9	15.9	6.2	34.4
300 Area	0.7	23.6	10.3	12.5	65.9
Richland	1.1	4.4	5.7	3.8	10.1
North Richland	0.8	8.9	20.0	8.0	38.2
Benton City	0.6	2.1	6.3	2.6	10.6

Significant increases were noted in the activity density from I-131 in the atmosphere at all monitoring locations during this period. These increases were on the order of a factor of 50 at locations in the 200 East and 200 West Area and ranged from a factor of 4 to 30 at locations around the project perimeter and in residential areas. Maximum measurements prevailed at the 200 West Area gatehouse where the average activity density over the three month period was 4.8×10^{-10} µc/cc including one exceptionally high measurement of 3.3×10^{-9} µc/cc. These values were observed in the same general region that indicated the highest activity density from I-131 on vegetation (See Section II.) Higher measurements occurred during the month of May and early part of June when the silver reactors in the off gas line from the 200 West Area dissolver were not operating properly.

Maximum measurements obtained in residential areas such as Richland and Benton City (1.0×10^{-11} µc/cc over a one week period) represented increases by a factor of from 5 to 10 when compared to maximum readings obtained during the previous quarter. A more detailed summary and evaluation of the trend of the activity density from I-131 in the atmosphere during the period from September 1950 through June of 1951 may be referred to in a separate publication (HW 21891.)

A number of spot samples were obtained by using hand operated portable scrubbers at random field locations when the stack gases were observed to be looping toward ground level. These observations were usually associated with adverse meteorological conditions and in general were confined to the area within a radius of 3 miles of the 200 Area stacks. The average activity density from I-131 in 71 portable scrubber samples obtained during this period was 3.0×10^{-8} μc/cc. Thirty-two samples collected during May averaged 2.2×10^{-8} μc/cc and 46 samples collected during June averaged 3.7×10^{-8} μc/cc. Maximum measurements obtained from this type of monitoring were on the order of 1.0 to 2.0×10^{-7} μc/cc. Sixty of the seventy-one samples showed values in excess of 3×10^{-9} μc/cc.

Six evaluations of the activity density from I-131 in the atmosphere were obtained over intervals of one or two hours by employing mobile equipment at random field locations during periods when peak emission was observed. The average activity density from I-131 in these samples was 7.9×10^{-9} μc/cc with maximum measurements on the order of 3.3×10^{-8} μc/cc.

The small filters obtained from the locations listed in Tables V, VI, and VII were radioautographed for the purpose of determining the number of radioactive particles in the atmosphere. These filters were exposed to type K X-ray film for 168 hours, after which time the number of radioactive particles was determined by counting the number of darkened spots on the developed film. The filters were radioautographed approximately one week after their removal from a location. Table VIII summarizes the results obtained from this type of measurement.

A review of the data summarized in Table VIII indicates that with the exception of a few isolated locations the average number of particles in the atmosphere during this quarter was not significantly different from the average noted during the previous three month period. The latter fact was unexpected since the number of particles in the atmosphere during the period January, February, and March was considerably higher than normal due to the Nevada A bomb tests (HW 20810) The higher concentrations observed during the current period do not seem to be identified with

TABLE VIII
PARTICLE DEPOSITION - SMALL FILTERS

Units of 10^{-3} particles/meter^3

APRIL, MAY, JUNE

1 9 5 1

Location	Total Volume of air sampled m^3	April	May	June	Second Quarter 1950 Average	First Quarter 1950 Average
200 East Area						
Semi-Works	7773	22.0	10.0	25.0	20.0	11.0
200 East Tower #15	7708	10.0	7.2	18.0	13.0	3.8
200 ESE Decade Filter	6229	4.0	8.8	9.2	5.5	17.0
200 ESE Twin Scaler #1	3600	10.0	4.8	24.0	14.0	15.0
200 ESE Twin Scaler #2	3787	10.0	1.8	33.0	17.0	11.0
2707 EA Twin Scaler #1	3629	3.7	1.9	14.0	7.4	25.0
2707 EA Twin Scaler #2	4050	11.0	6.5	33.0	19.0	19.0
200 East Tower #16	6169	17.0	5.4	24.0	17.0	14.0
200 West Area						
200 West Decade Filter	6707	19.0	12.0	16.0	16.0	14.0
200 West Twin Scaler #1	3300	30.0	16.0	23.0	24.0	42.0
200 West Twin Scaler #2	4840	19.0	18.0	30.0	23.0	21.0
Redox Area	7017	1.4	1.4	5.0	2.9	13.0
200 West Tower #4	6849	23.0	3.0	7.0	12.0	13.0
200 Area Environs						
Gable Mountain Decade	6825	6.2	6.4	4.6	5.5	1.8
Hanford 101 Bldg.	7658	6.8	1.9	3.0	3.9	3.1
100-H SE	6724	7.7	4.1	6.0	6.1	3.0
100-D	8375	7.3	4.7	3.6	5.1	2.1
Hanford 614 Bldg.	7734	7.8	1.9	3.2	4.5	10.0
White Bluffs	8533	4.9	1.9	5.0	4.2	2.3
300 Area	6858	4.8	2.9	4.5	4.3	16.0
Meteorology Tower Ground level	5068	*	7.6	17.5	13.0	*
Meteorology Tower 200'	5639	*	6.7	33.0	23.0	*
Meteorology Tower 400'	5747	*	9.3	11.0	10.0	*
Adjacent to Environs						
Benton City	6143	8.2	1.2	4.9	5.0	8.5
Pasco 614 Bldg.	7975	2.1	0.9	1.3	1.5	2.3
North Richland North	6852	7.0	2.9	9.8	7.1	2.2
Riverland	8414	8.9	2.4	4.8	5.5	11.0
Richland	6211	3.1	2.5	3.8	3.2	7.0
Dual Units						
EEC Dual Monitor #1	1079	**	**	54.0	54.0	**
EEC Dual Monitor #2	1384	**	**	14.0	14.0	**

any particular location. In general, the results obtained during the month of June were consistently higher than those obtained during April and May. A more detailed appraisal of the number of radioactive particles in the atmosphere may be obtained by reviewing the results evaluated from air monitoring units established for the specific purpose of determining particle concentrations. The latter units are operated at many locations on the site and at remote locations throughout the neighboring states. These units operate at an air flow of 2.5 or 10 cfm and employ type 6 CWS filter paper as their filtering media. The exposed surface area is 6.3 square inches in the smaller volume and 23.5 for the 10 cfm filter. These filters were radioautographed in a manner similar to that for the small air filters discussed above. A summary of these data is presented in Tables IX and X.

The average number of particles in the atmosphere at locations summarized in Tables IX and X does not reflect the magnitude of difference expected between the two quarterly periods when considering that the values for the first quarter were higher than normal due to causes other than operation at Hanford (HW 20810.) In some instances, the current values were higher than those noted during the first quarter; however, the increases appear at random locations and do not define the source of emission for these particles, indicating a possible source other than the Hanford Works. The latter fact is confirmed when reviewing the number of particles in the atmosphere at remote locations in the States of Washington, Oregon, Idaho, and Montana where normal levels are on the order of less than 1.0 particle/meter^3. Also, a comparison of the averages noted at Boise, Klamath Falls, and Lewiston with those observed at various elevations on the Meteorology Tower show no significant difference between the group averages; similarly, a comparison of average values obtained at remote monitoring stations with the average value at Richland does not show a significant difference. A detailed appraisal of this data is currently being summarized in a special document which includes the results of decay studies, absorption studies, and chemical analyses (HW 22072.)

 [redacted]

TABLE IX
SUMMARY OF PARTICLE DEPOSITION
APRIL, MAY, JUNE
1951

Units of 10^{-3} particles/meter^3

Location	Total Volume of air sampled m^3	April	May	June	Second Quarter Averages 1951	First Quarter Averages 1951
200 East & Vicinity						
2704 Outside	7339	10.0	15.0	13.0	13.0	16.0
H. I. Garden	8765	22.0	16.0	31.0	26.0	23.0
BY-SE	6576	150.0	36.0	16.0	83.0	133.0
BY-NE	8600	36.0	8.5	21.0	20.0	30.0
"B" Gate	7342	18.0	14.0	25.0	20.0	26.0
222-B Outside	5371	100.0	36.0	30.0	52.0	54.0
2701 Outside	6830	16.0	14.0	25.0	18.0	24.0
2704 Inside	8761	11.0	16.0	11.0	12.0	26.0
221-B	6472	17.0	43.0	32.0	28.0	49.0
222-B Hall	8762	71.0	165.0	120.0	110.0	94.0
222-B Laboratory	8060	1100.0	>900.0	900.0	>820.0	650.0
2701 Inside	7286	17.0	8.5	17.0	15.0	31.0
200 West & Vicinity						
2701 Outside	7507	28.0	57.0	22.0	35.0	21.0
2722	7956	36.0	42.0	25.0	34.0	28.0
"T" Gate	5528	67.0	32.0	75.0	77.0	34.0
222-T Outside	7323	140.0	110.0	89.0	120.0	47.0
231	10777	71.0	25.0	6.0	28.0	44.0
South Guard Tower	7764	9.6	16.0	8.8	11.0	22.0
West Guard Tower	8102	9.6	14.0	11.0	11.0	30.0
2701 Inside	6949	24.0	33.0	23.0	26.0	46.0
272	7742	18.0	14.0	12.0	15.0	15.0
222-T Hall	8912	92.0	86.0	100.0	95.0	79.0
222-T Laboratory	8755	680.0	340.0	270.0	430.0	370.0
Meteorology Tower						
3'	38083	4.8	9.8	5.7	5.3	28.0
50'	39083	2.7	6.1	5.8	4.3	33.0
100'	34588	4.2	6.6	5.9	4.6	21.0
150'	27126	5.8	5.3	5.0	5.5	30.0
200'	12774	*	15.0	7.1	10.0	37.0
250'	25058	4.9	6.9	9.0	6.1	23.0
300'	23218	6.6	3.9	6.4	5.9	34.0
350'	23222	4.4	4.1	6.0	4.8	37.0
400'	7968	*	5.2	6.5	6.0	45.0

* This unit was taken out of service to allow installation of scaler unit.

TABLE VIII
SUMMARY OF PARTICLE DEPOSITION
APRIL, MAY, JUNE
1 9 5 1

Units of 10^{-3} particles/meter^3

Locations	Total Volume of air sampled m^3	April	May	June	Second Quarter 1951 Average	First Quarter 1951 Average
Area Locations						
100-B Area	32045	3.1	3.6	4.9	4.0	9.2
100-D Area	22780	7.1	15.0	39.0	18.0	9.7
White Bluffs	22132	4.4	0.8	4.1	3.1	9.1
100-F Area	34255	9.0	3.6	7.3	6.9	14.0
300 Area	32232	7.4	5.0	9.0	7.2	12.0
Foster's Ranch	33915	6.1	1.8	6.4	5.1	10.0
Off Area Locations						
Benton City, Wash.	33830	4.6	3.9	6.6	5.2	3.3
Pasco, Wash.	31688	6.0	4.7	5.1	5.3	7.8
Richland, Wash.	23154	*	4.1	9.1	6.9	24.1
Boise, Idaho	8561	13.0	12.0	20.0	15.0	13.0
Klamath Falls, Ore.	8550	11.0	40.0	15.0	20.0	5.0
Stampede Pass, Wash.	9487	1.9	3.3	3.7	2.7	0.6
Great Falls, Mont.	2721	**	0.9	9.9	6.2	14.0
Walla Walla, Wash.	11744	4.9	1.6	11.0	6.9	20.0
Meacham, Ore.	8643	3.5	2.2	11.0	6.0	17.0
Lewiston, Idaho	8249	4.6	3.3	14.0	8.3	24.0
Spokane, Wash.	31586	5.3	1.4	6.8	4.8	16.0

* The measurements which represented this period were lost while processing.
** The filtering unit was out order during this period.

Four of the particle monitoring filters from stations inside the T Plant at the 200 West Area were analyzed by the LaF_3 precipitation method to determine the activity density from the alpha emitters of plutonium. Three of these filters showed 15 dis/min/filter; the remaining filters showed negligible activity.

SECTION III

[redacted]

SECTION IV

RADIOACTIVE CONTAMINATION IN HANFORD WASTES

The levels of radioactive contamination in Hanford Wastes were determined by evaluating the activity density from alpha and beta emitters in over 1100 samples which were collected in the 100, 200, and 300 Areas. These measurements were supplemented with readings obtained from portable instruments such as VGMs and CP meters in the open waste zones and over the adjoining terrain. The results obtained from this program for the period April, May, and June, 1951, are discussed separately for the 100, 200, and 300 Areas.

100 AREA WASTES:

The activity density of alpha and beta emitters admitted to the Columbia River from the pile effluent water was evaluated by collecting samples at the outlet end of the 107 basins in the five pile areas. The methods and techniques used in the radiochemical analyses of these samples were identical to those discussed in previous documents of this series and outlined in the Standard Procedure Manual of the Control Laboratory (HW-20136.) These samples were analyzed within 16 hours of the time of collection, thereby minimizing the application of exorbitant decay corrections. Table I summarizes the results obtained from analyzing samples collected during periods when the piles were operating.

TABLE I
RADIOACTIVE CONTAMINATION IN THE 107 BASINS
DURING PERIODS OF NORMAL PILE OPERATION
APRIL, MAY, JUNE
1 9 5 1

Location	No. Samples	Alpha Emitters Average Activity Density dis/min/liter	Beta Emitters Activity Density x 10^4 µc/cc Maximum	Average
100-B Area	58	<8	18	9.2
100-D Area	55	<3	13	6.6
100-DR Area	54	<8	21	8.7
100-F Area	55	<8	29	9.5
100-H Area	51	<8	23	7.6

[redacted]

A review of the data presented in Table I indicates that the average activity density from beta emitters in the effluent water remained at the high level reached during the previous quarter. It was expected that the mean activity density would approach 1 x 10^{-3} μc/cc as the power levels of the piles remained essentially the same as that noted during the month of March, 1951. Small increases in the activity density of beta emitters were noted for short intervals during April and May and were usually associated with power level changes; these spot trends were not significant when compared with the balance of the data and in general, the fluctuation in values during the current period were well within the normal variation expected for this type of sample.

The average activity density from alpha emitters in the effluent water was less than 8 dis/min/liter at all areas. Trace quantities of alpha emitters were detected in isolated samples but were not confirmed by subsequent resampling; these included 78 dis/min/liter at 107-H in April, 44 dis/min/liter at 100-F and 35 dis/min/liter at 100-H during May. The resamples mentioned above were not necessarily representative of the same composition as the first sample due to the interval required for the initial analysis.

Radiochemical analyses for activity density from the alpha emitter of uranium indicated that all samples except one showed values less than 5 μg U/liter. One sample collected from the 107-F Area basin during June showed a value of 9 μg U/liter.

Two samples were collected from each of the 107 basins each month and analyzed for the activity density from alpha emitters of polonium. The activity density from this source was less than 6 dis/min/liter in each sample analyzed.

Several spot samples from each of the 107 basins were analyzed for plutonium by the LaF_3 method with the results from these determinations showing negligible activity from this source.

Portable instrument surveys were conducted at the burning grounds in the 100-F and 100-H Areas during the quarter. The readings obtained from VGM did not exceed normal background variation at each of these areas.

Daily samples were obtained from the waste sump at the Biology Farm in the 100-F Area. The method of sampling at this location was changed during this period; previously, one sample was collected prior to the flushing operation and one sample was collected immediately after the completion of the flushing, whereas the current sample represents a composite of samples taken from the sump throughout the 24 hours of operation. These samples were analyzed for I-131 according to standard procedures and techniques (HW-20136.)

The average activity density from I-131 in the Biology Farm effluent was 1.5 10^{-5} μc/cc; the maximum measurement was 5.1×10^{-4} μc/cc. The latter value was exceptionally high for this type of measurement as the more usual maximum value was on the order of 5.0 to 7.0×10^{-5} μc/cc. The amount of I-131 discharged to the river on a daily basis as determined from the average activity density in the samples and the metered volume of water used in the flushing process ranged from 0.7 to 5.0 mc/day. This value represented a decrease from the previous quarter when the daily emission was on the order of 7 to 8 mc/day. The current appraisal does not include a short interval during the latter part of June when the meters on the pumps were not operating properly.

Twenty-five samples of Columbia River water were collected along the Benton County Shore at the Hanford Ferry and analyzed specifically for activity density from I-131. The average activity density from I-131 in these samples was 1.8×10^{-7} μc/cc with several individual samples showing values on the order of 4.0 to 5.0×10^{-7} μc/cc.

200 AREA WASTES:

Nearly 500 samples of liquid and solid material were collected from the open waste zones in and near the 200 Areas. A summary of the results obtained from the radiochemical analyses for the activity density from alpha and beta emitters is presented in Table II.

[redacted]

TABLE II
RADIOACTIVE CONTAMINATION IN THE 200 AREA WASTE SYSTEMS
APRIL, MAY, JUNE
1 9 5 1

LIQUID SAMPLES

Location	No. Samples	Alpha Emitters Activity Density dis/min/liter Maximum	Average	Beta Emitters Activity Density x 10^7 μc/cc Maximum	Average
T Swamp	39	78	<6	37	4.4
U Swamp	25	63	8	3.6	<1
Laundry Ditch	26	79	21	23	3.3
231 Ditch	26	44	9	31	1
200 E "B" Ditch	36	18	<6	69	17
200 E "B" Swamp	23	7	<6	29	1.1
234-35 Ditch	13	80	8	1.5	<1
200 E Retention Pond	48	16	<6	110	23
200 W Retention Pond	48	17	<6	16.	5.1
234 Retention Pond	13	390	40	----	----

SOLID SAMPLES

Location	No. Samples	dis/min/gram Maximum	Average	Activity Density x 10^5 μc/gram Maximum	Average
T Swamp	26	560	60	64	9.2
Laundry Ditch	12	28	15	5.1	3.5
200 E "B" Ditch	39	19	<6	480	95
200 E "B" Swamp	26	8	<6	230	59
234-35 Ditch	13	460	140	6.8	1.9

With the exception of several isolated cases, the results summarized above were not indicative of a significant departure from the magnitude of previous measurements. The activity density from gross alpha emitters appears to be increasing at the 234-35 ditch; the average activity density of 140 dis/min/gram represents about a 6 fold increase over the average during the previous quarter (24 dis/min/gram.) All samples from the 234-35 ditch which indicated values in excess of 8 dis/min/liter were analyzed for uranium and/or plutonium. Several of these samples indicated detectable quantities of plutonium on the order of 10 to 30 dis/min/liter. In one extreme case, when the gross alpha activity was found to be 457 dis/min/liter, 90 percent of the activity was defined as plutonium by the LaF_3 method analysis. Several spot samples of mud from the T swamp indicated also that the activity density from alpha emitters was greater than previously found; an increase by a factor of 5 was noted in this activity during this quarter.

 [redacted]

The activity density from beta emitters in the 200 Areas waste increased at the 200 East Area retention pond and at the 200 East B ditch and swamp which receives the retention pond water. On an average basis, the increases at the latter location were not significant; however, isolated measurements which indicated values on the order of 5×10^{-3} μc/gram represented a two to three fold increase over and above previous measurements. The activity density from beta emitters in the 200 East Area retention pond showed a near two fold increase.

Portable instrument surveys were performed on a weekly basis around the perimeter of the open waste areas in the 200 Areas. Maximum radiation levels were observed at the inlet of the "R" ditch in the 200 North Area where during April, the dosage rate was 88 mrep/hr including 33 mr/hr over the mud along the edge of the inlet. Readings over the surface of the water in this same region were 18 mr/hr. Maximum readings obtained at the "P" ditch in the 200 North Area were 18 mr/hr. over mud and 28 mr/hr over the water. During the latter part of the quarter the radiation levels decreased at the 200 North Area with the bulk of the readings being on the order of 5 to 10 mr/hr. Estimated average water levels in these ditches at the time the surveys were completed were 6, 8, and 10 inches in the N, P, and R ditches, respectively.

Instrument surveys at the West swamps and ditches in the 200 West Area showed the bulk of the readings on the order of background; however, the radiation level in the inlet of the T ditch ranged from 400 to 1600 c/m above background during the latter part of the month of May. During the latter part of June, readings in the same location were on the order of 250 c/m above background.

Maximum radiation levels near waste zones were observed at the B ditch in the 200 East Area. VGM readings over mud near the inlet of this ditch approached 15000 c/m during June and averaged between 1000 and 3000 c/m throughout the major portion of the quarter. The results of the instrument surveys discussed above represent selected locations in each of the waste zones and do not necessarily constitute the maximum radiation level in any case; access to many of the sampling locations previously used for this type of measurement was hampered by an extremely heavy growth of weeds and underbrush at the edges of the waste areas during this period.

300 AREA WASTE:

A summary of the results obtained from the radiochemical analyses of liquid and mud samples obtained in the 300 Area waste pond is presented in Table III.

TABLE III
RADIOACTIVE CONTAMINATION IN 300 AREA WASTES
APRIL, MAY, JUNE
1 9 5 1

Location	No. Samples	Beta Emitters Activity Density x 10^7 µc/cc Maximum	Beta Emitters Average	Alpha Emitters Activity Density dis/min/liter Maximum	Alpha Emitters Average	Fluorophotometer µg U/liter Maximum	Fluorophotometer Average
Old Pond Inlet Liquid	9	12	3	28000	3200	25000	3600
New Pond Inlet Liquid	11	4	2	5600	2000	2900	940
300 Area Waste Line	63	84	7	45000	1600	8200	580
		Activity Density x 10^3 µc/gram		Activity Density dis/min/gram		µg U/gram	
Old Pond Inlet Solid	9	3.1	1.7	14000	6000	7400	4200
New Pond Inlet Solid	7	<1	< 1	7800	2000	740	360

The only significant change noted when comparing the results summarized above with similar measurements obtained during the previous quarter was in the activity density from alpha emitters in the old 300 Area pond. The activity density from gross alpha emitters and from the alpha emitter of uranium increased in both the liquid and mud samples; average values showed increases approaching a factor of 2 and in the extreme case of mud samples obtained at the inlet, the average activity density from the alpha emitter of uranium increased 5 fold. This over all increase in contamination level at the old pond was associated with the fact that the volume of liquid in the old pond had decreased to a point where higher concentrations per volume became pronounced. The decrease in liquid volume was significant throughout the entire period and during the latter part of the quarter the base of the pond was almost entirely exposed. The Operating Division purposely allowed the pond to dry wo that they would be able to resurface the base in a manner which would allow more uniform and quicker seepage of the liquid admitted.

Sixty three samples obtained directly from the 300 Area waste line were analyzed for the activity density of the alpha emitter of plutonium. The average activity density from this source was 27 dis/min/liter including a maximum measurement of 239 dis/min/liter.

As a result of the drying of the old pond, a study was undertaken to determine the deposition and distribution of the activity density from alpha emitters at the base of the pond.

Estimations of the distribution of the activity density from alpha emitters of uranium and/or plutonium at the bottom of the old 300 Area pond were obtained from the results of a survey completed on May 24, 1951. These measurements were per formed in a manner comparable to that of a similar survey during December, 1950 (HW-21566.) However, the pond was dry at the time of the current survey, whereas during December, the liquid volume in the pond was estimated to be on the order of 5.5×10^6 gallons. A total of 51 core samples of mud were obtained from representative locations (Figure 7) across the surface of the pond base; these samples were obtained with a core sampler and represented the mud between the surface and a depth of 3 inches. A representative 10 gram portion of this sample was analyzed by standard radiochemical methods for the activity density from gross alpha emitters by the ether extraction method and for uranium by the fluorophotometer method. Estimations of the activity density from the alpha emitter of plutonium were based on the difference in the results of the 2 former analyses. Previous surveys during the last several years have indicated that the gross alpha activity in this pond was due to the combination of varying amounts of uranium and plutonium with the former usually the predominant contaminant.

The results from the analyses for the activity density from gross alpha emitters indicated that the average activity density was 540 dis/min/gram with maximum measurements on the order of 2300 dis/min/gram. In general, the bulk of the measurements indicated values less than 1000 dis/min/gram; however, the higher values (greater than 1000 dis/min/gram) predominated in a confined region near the inlet and extending northward to the far north bank of the pond. The activity density varied between 100 and 500 dis/min/gram around nearly the entire pond and minimum deposition was detected in the most central part of the pond where values on the order of 25 to 100 dis/min/gram prevailed. An estimated distribution of the activity density from gross alpha emitters on the bottom of the pond is presented in Figure 8; the extent of the various contamination levels may be reviewed in respect to the 400 ft. coordinate identification. (Figure 7.)

The average activity density from the alpha emitter of uranium in the 51 samples was 350 dis/min/gram; again, maximum measurements were on the order of 2300 dis/min/gram. As indicated in Figure 9, which shows the estimated distribution of the activity density from uranium, the higher uranium deposition was somewhat removed from the inlet proper and also accounted for the bulk of the activity in the region of higher contamination. Again, the activity density was less than 500 dis/min/gram over most of the area. The estimated distribution of uranium may be compared with the gross activity deposition by reviewing Figure 9 in respect to Figure 8.

Estimations of the amount of plutonium in the base of the pond as determined by the difference between the results of the 2 former surveys showed that with the exception of three small isolated regions, the activity density from this source was less than 500 dis/min/gram. An approximated average showed the mean activity density from plutonium to be on the order of 200 dis/min/gram; only two of the samples showed values exceeding 1000 dis/min/gram; estimated distribution of this activity is presented as an iso-map on Figure 10.

It is worthy of mention that the results discussed above were believed representative of the type of distribution at the base of the pond but were not necessarily a true quantitative evaluation of the activity density due to the lack of means of determining the exact depth of the activity seepage in the soil. Three representative locations were selected for the purpose of determinig the extent of this seepage; the results obtained from the analyses of these samples indicated considerable variation at depsht of 6, 12, and 18 inches. In all cases, the maximum activity was found at the surface with a general decrease in excess of a factor of 2 occurring between the surface and a depth of 6 inches. A comparable reduction in the activity density was noted between 6 inches and 12 inches; at 18 inches, the over all activity density was negligible when compared to the surface. The activity density from gross alpha emitters in the three samples at a depth of 18 inches was 32, 54, and 19 dis/min/gram; the activity density from the alpha emitter of uranium at this same depth was 29, 12, and 10 dis/min/gram.

SECTION IV

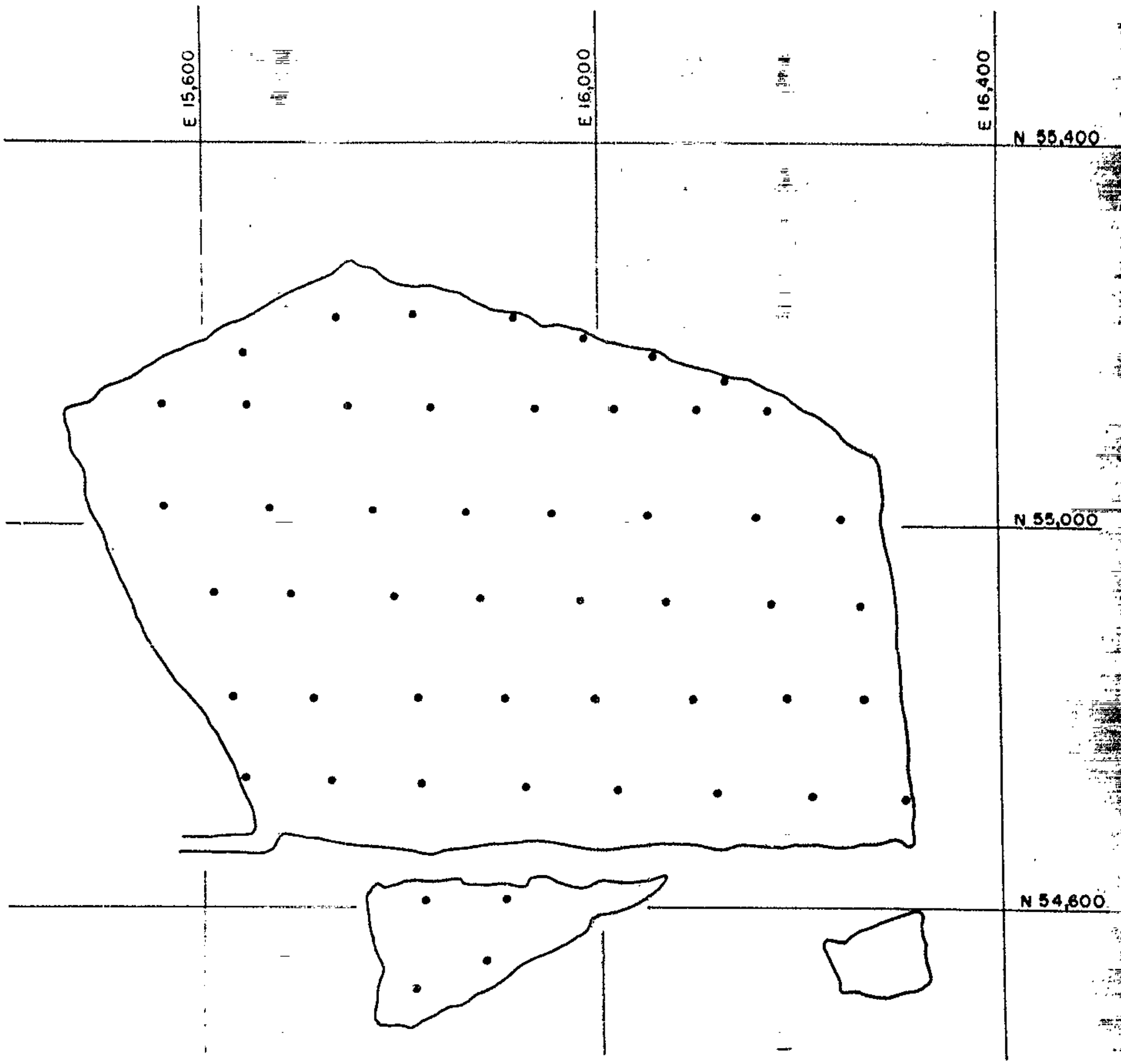
(Please refer to Figures 7, 8, 9, and 10.)

OLD 300 AREA WASTE POND

MAY 24, 1951

FIGURE - 7

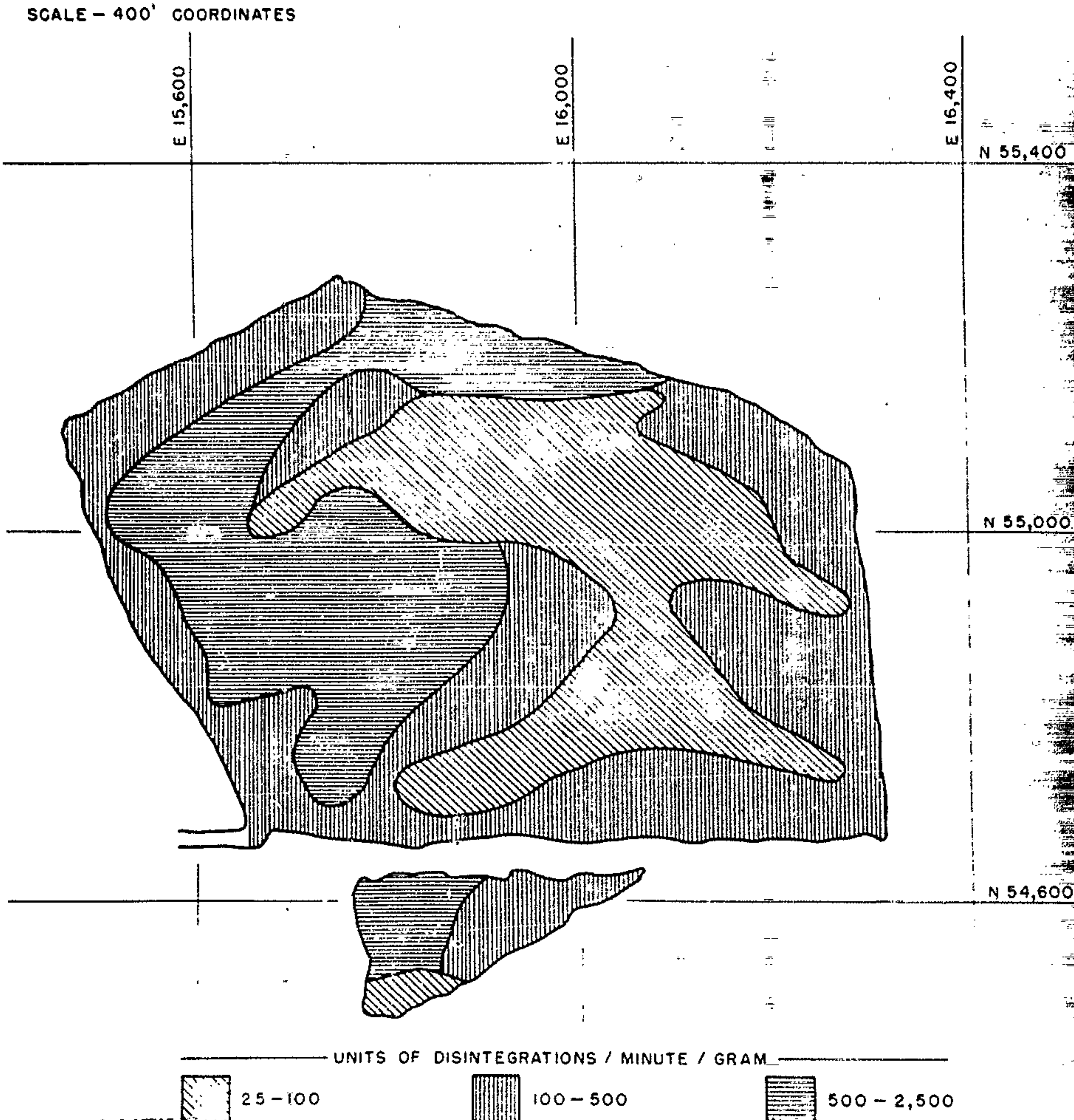
• - SAMPLE LOCATION
SCALE - 400' COORDINATES



ESTIMATED DISTRIBUTION OF ACTIVITY DENSITY FROM GROSS ALPHA EMITTERS ON BOTTOM OF OLD 300 AREA POND

MAY 24, 1951

FIGURE — 8

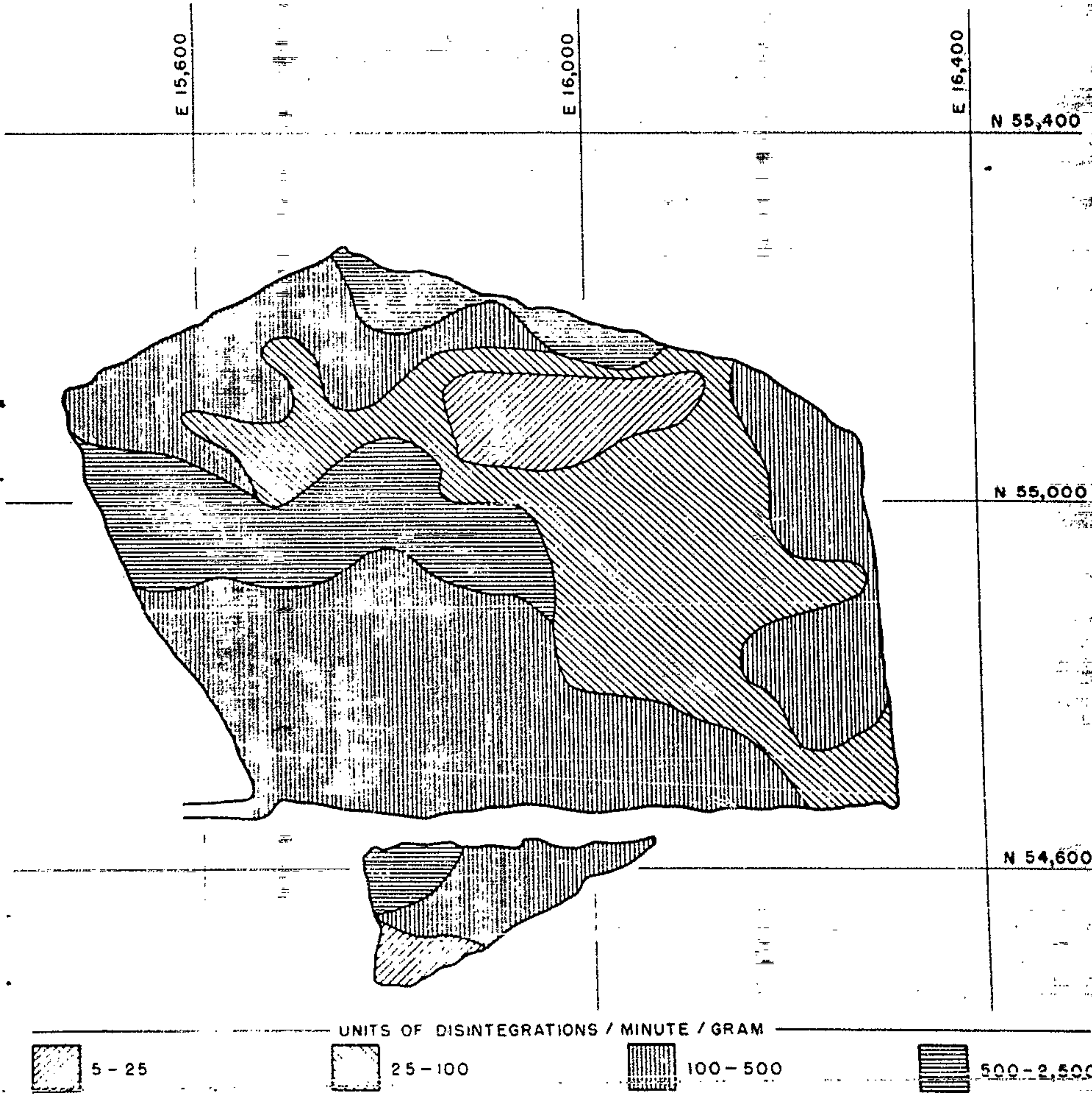


ESTIMATED DISTRIBUTION OF ACTIVITY DENSITY FROM URANIUM ON BOTTOM OF OLD 300 AREA POND

MAY 24, 1951

FIGURE — 9

SCALE — 400' COORDINATES

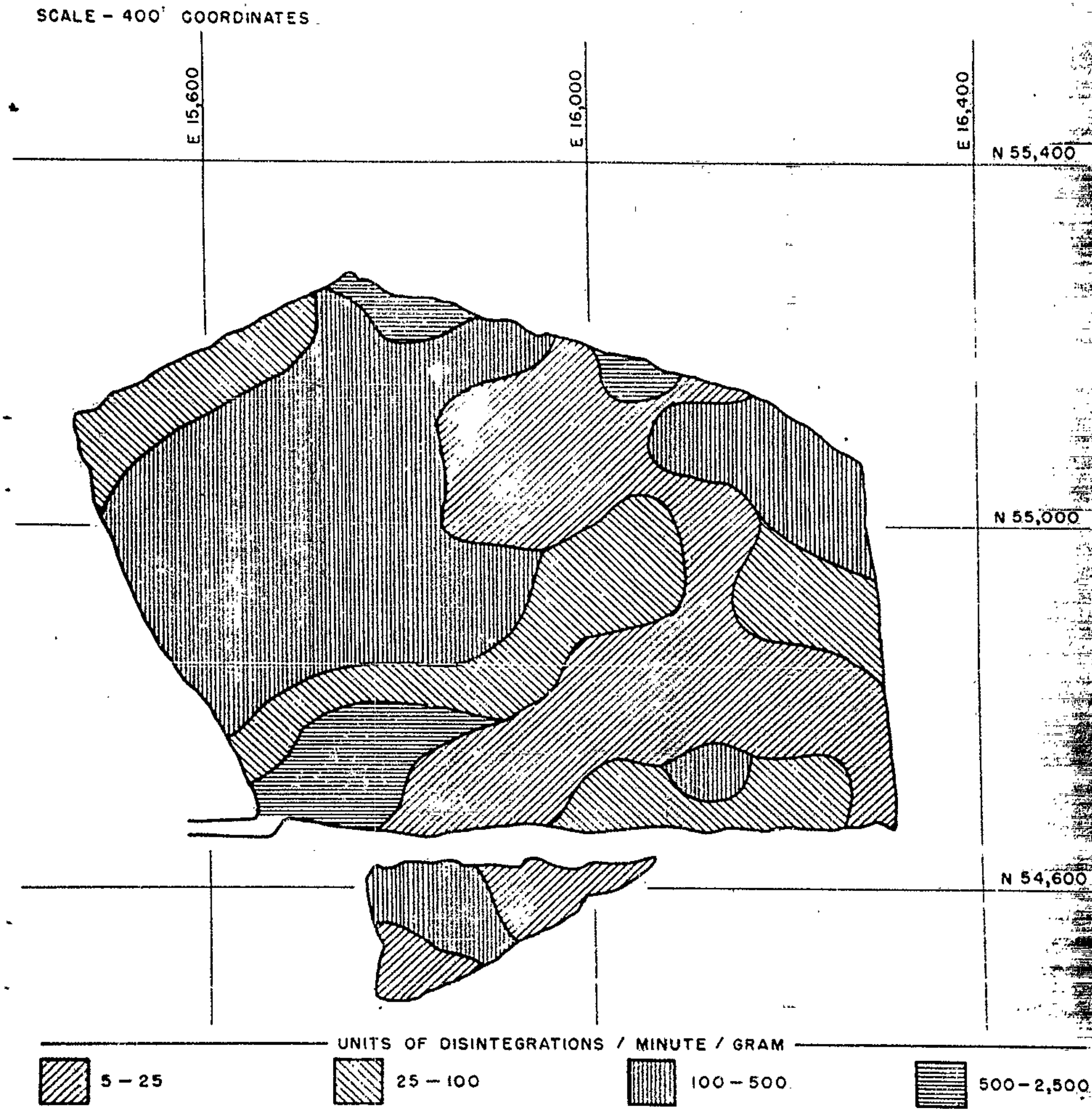


ESTIMATED DISTRIBUTION OF ACTIVITY DENSITY FROM ALPHA EMITTERS OTHER THAN URANIUM ON BOTTOM OF OLD 300 AREA POND

MAY 24, 1951

DECLASSIFIED

FIGURE — 10



SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER

Radioactive contamination in the Columbia River was determined by analyzing 500 ml. samples of river water for the activity density of alpha and beta emitters according to procedures described in previous documents of this series (HW-19454.) Weekly samples were obtained from 20 locations between the upper source at 100-B Area and McNary Dam, located approximately 100 miles downstream from the northwest perimeter of Hanford Works. The weekly sampling program was extended below the Pasco-Kennewick area on a repetitive basis for the first time during this quarter, with samples from Sacajawea Park, Patterson Ferry, and McNary Dam. Background evaluations for beta emitters which occur naturally in the Columbia River and its tributaries were obtained from samples collected from the Columbia River at locations upstream to the Hanford Works, from the Yakima River at locations near the mouth and several miles upstream and from the mouth of the Snake River. Daily control sampling was maintained at the Benton County shore near the Hanford Ferry where maximum levels of contamination have been detected in the past. The cross section dispersion and distribution pattern of the activity admitted from the 5 operating pile areas was also studied at the Hanford Ferry with weekly surface samples from locations along each shore and from the middle of the river.

Table I summarizes the results obtained from the radiochemical analyses for the activity density from gross beta emitters at the weekly monitoring locations. Quarterly averages, the maximum measurement obtained, and the averages of last quarter are given for comparison.

In general, the average activity density decreased at all monitoring locations during this period. This decrease was caused by a comparable increase in river flow rate after April 15, 1951. The average river flow determined from 91 measurements was 1,890,000 gallons/second; the average during the previous 3 month period was about 800,000 gallons/second. This change was comparable to that observed during the same 3 month period in previous years; however, the peak flow rate

 [redacted]

during 1951 (3,173,000 gallons/second) was lower than that observed during 1950. Figure 11 summarizes the flow data during this period.

TABLE I
AVERAGE ACTIVITY DENSITY OF GROSS BETA EMITTERS
IN THE COLUMBIA RIVER
APRIL, MAY, JUNE
1 9 5 1

Activity Density x 10^8
μc/cc

Location	April Average	May Average	June Average	Quarter Average	Last Quarter Average	Maximum* Measurement This Quarter
Wills Ranch	<5	<5	<5	<5	<5	<5
100-B 181 Bldg.	8	<5	<5	<5	9	20
Allard Pumping Station	7	9	19	12	77	38
100-D 181 Bldg.	45	20	22	29	65	95
100-H 181 Bldg.	105	60	31	65	127	157
Below 100-H	307	107	75	156	267	422
100-F 181 Bldg.	168	147	87	134	233	318
Below 100-F	401	163	83	206	367	785
Foster Ranch	102	47	40	62	98	169
Hanford South Bank	526	207	140	275	388	871
Hanford Middle	370	140	78	192	283	741
Hanford North Bank	165	74	52	95	164	262
300 Area	177	121	69	117	183	268
Richland	345	72	61	95	164	254
Highland Pumping Station	101	71	34	69	123	157
Pasco-Kennewick Bridge						
Kennewick side	88	49	45	60	82	126
Pasco side	94	57	39	63	90	146
Sacajawea Park	49	32	26	36	63	69
McNary Dam	28	24	22	25	49	43
Patterson	22	19	16	19	32	34
Snake River Mouth	<5	<5	<5	<5	<5	<5
Yakima River Mouth	<5	<5	<5	<5	<5	<5

* All maximum results were obtained early in the period during low river flow.

A comparison of the values given in Table I with those obtained during the same 3 month period in 1950 indicated that the current measurements are somewhat higher. The increase in contamination was expected for the year 1951 and was caused by the operation of the 100-DR pile which started up during October of 1950. Another contributing factor to the higher contamination levels noted during the present period was the fact that the peak flow of the Columbia River was almost 1,000,000 gallons/second below that of 1950. The magnitude of this increase may be appraised by reviewing Figure 12 which shows the average values obtained at representative locations for this 3 month period during 1950 and 1951.

The results obtained from the radiochemical analysis for the activity density from alpha emitters of uranium and/or plutonium indicated that this activity averaged less than 6 dis/min/liter at all locations throughout the period. An occasional value on the order of 10 to 12 dis/min/liter was obtained at several random locations; however, resamples from the same region did not confirm the initial measurement in any case.

Six spot samples were obtained from Bonneville Dam during the period. The activity density from beta emitters was less than 5×10^{-8} µc/cc in each sample analyzed. The activity density from alpha emitters in these same samples averaged less than 6 dis/min/liter.

On April 11, 1951, a special survey similar to that performed during December, 1950 (HW-21566) was conducted to determine the relationship between the distribution pattern of the radioisotopes emitted from the 107-B effluent basin and the concentrations and turbidity of ferro-floc emitted to the river via the effluent line. The ferro-floc, accumulated at the bottom of 2 filter basins in the 100-B Area, was washed into the river in a controlled manner. Duplicate samples of river water were taken across the surface of the river at 2 locations and surface and depth samples were taken at one location below the area. The latter study was conducted 6 miles below the point of emission and the surface studies were conducted at locations 0.5 and 2.0 miles below the effluent outlet. A total of 108 samples were collected in duplicate; one sample was used to evaluate the activity density from gross beta emitters and the other sample was submitted to the Technical Division for the determination of the turbidity and iron content. A series of samples was also collected at the 1904-B Building (between the 107 basin outlet and the Columbia River) for the purpose of determining the exact time of peak emission.

Figure 13 shows the results obtained from the analysis of samples collected to determine the exact time of maximum evolution. During the experiment, visual examination of these samples was used as a basis to determine the time of maximum emission. As indicated in Figure 13 significant quantities of iron did not appear in the effluent water until approximately 10:00 a.m. after which time a very significant increase in turbidity and iron was noted. The direct sampling program was initiated at 10:00 a.m. at the location 0.5 miles below the point of emission. Sampling times at the locations 2.0 and 6.0 miles below the point of emission were based on studies of velocity measurements taken in this portion of the river. The chemical analysis of the evolution samples for iron and turbidity were performed on the following day. The results (Figure 14) indicated that the sampling program on the river was conducted during the period in which maximum evolution was occurring.

An analysis of the results obtained from the measurements for activity density, iron, and turbidity indicated a highly significant relationship existed between these variables at all locations sampled during the downstream survey except at the 6 mile point where activity and turbidity did not correlate. Figure 14 presents the results obtained from these 3 measurements.

Results of the combined surface and depth study (conducted 6 miles below 100-B) are given in Figure 15 . Results of velocity measurements made at this point are also presented in Figure 15 and 16 . The latter figure is an estimated isoactivity and velocity pattern based on the individual readings.

Nearly 200 mud samples were obtained from locations along the shore of the Columbia River and its tributaries during the period April, May, and June, 1951. Samples were collected from 15 control locations along the Columbia River, from 2 locations on the Yakima River and from the mouth of the Snake River. Two samples were collected each time a location was monitored; one sample was collected at the river's edge and the other sample was taken from below the surface of the water at a location approximately 5 feet from the shore. These samples were analyzed for the activity density from alpha and beta emitters according to standard procedures and techniques which have been described in previous documents of this series(HW-21214.) The over-all frequency of sampling was minimized during the month of April and increased toward the latter part of the period when the flow rate of the Columbia River was increasing. Table III summarizes the results obtained from the radiochemical analyses for the activity density of gross beta emitters in these samples.

TABLE III
RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER MUD SAMPLES
APRIL, MAY, JUNE
1 9 5 1

	Beta Emitters - Activity Density x 10^{-5} µc/gram					
Location	April Average	May Average	June Average	Quarter Average	Last Quarter Average	Maximum This Quarter
Wills Ranch, Shore	2.0	1.4	1.3	1.6	1.5	3.5
5' out	1.1	1.8	1.0	1.3	1.3	1.9
Allard Pumping Sta., Shore	0.8	1.8	1.6	1.4	1.5	3.1
5' out	0.7	1.6	2.1	1.5	1.2	2.4
100-H Area, shore	1.5	1.1	1.7	1.5	2.3	2.3
5' out	1.2	1.2	1.9	1.5	1.5	2.1
Below 100-F Area, shore	3.4	1.1	4.7	3.3	2.8	10.6
5' out	21.2	1.5	4.1	6.1	2.3	21.2
Richland Dock, shore	2.1	1.6	1.7	1.8	1.6	2.8
5' out	2.0	1.3	2.1	1.8	1.6	3.3
300 Area, shore	3.3	1.8	1.8	2.0	3.6	3.5
5' out	2.3	1.6	2.5	2.2	2.3	4.4
Pasco Bridge (Pasco side)	1.7	1.2	1.4	1.4	1.4	1.7
5' out	1.7	1.1	1.5	1.4	1.4	1.7
Pasco Bridge (Kenn. side)	1.2	2.9	1.3	1.4	1.6	2.9
5' out	2.6	1.6	1.4	1.7	1.7	2.6
Hanford Ferry, shore	1.1	1.6	1.7	1.5	2.2	2.5
5' out	1.4	1.5	1.9	1.7	1.7	2.5
Highland Pumping Sta. shore	1.2	1.7	0.9	1.4	2.2	2.2
5' out	1.9	0.8	1.3	1.2	1.5	1.9
Byers Landing	--	---	---	---	2.1	---
Sacajawea Park 5' out	2.9	1.3	1.6	1.7	1.2	2.9
Patterson, 5' out	1.1	1.5	1.8	1.5	1.1	2.9
McNary Dam, 5' out	1.3	1.3	2.1	1.6	1.3	2.9
Snake River Mouth, 5' out	1.4	1.2	1.2	1.2	1.3	1.4

A review of the results summarized in Table III indicates that the activity density from beta emitters in mud samples was on the same order of magnitude during April, May, and June as noted during the previous period. The month to month variation was negligible and with the possible exception of those samples collected immediately below the 100-F Area, the maximum values summarized in Table III were not significantly different than those averages for any given month. The samples obtained below the 100-F Area indicated that the activity density in this region was greater than that at any other location along the river; differences have been noted immediately below some of the 100 Areas in the past and were associated with seepage from the effluent basins. No specific indication of a basin leak at the 100-F Area was noted during this period, however.

Radiochemical analyses for the activity density from alpha emitters in mud samples obtained from the locations summarized in Table III showed the average activity density from this source to be less than 4 dis/min/gram at all locations. Several samples from random locations indicated values on the order of 10 to 15 dis/min/gram; however, the analyses of resamples did not confirm the presence of this activity in any of these isolated cases.

Six mud and silt samples were obtained from the base of Bonneville Dam and analyzed for the activity density from alpha and beta emitters. The activity density from beta emitters in these samples ranged from 1.2 to 2.3 x 10^{-5} μc/gram; these values were not significantly different than those found in mud samples collected from the non-contaminated water of the Yakima and Snake Rivers. The activity density from alpha emitters in the Bonneville Dam mud samples was less than 4 dis/min/gram in all samples.

Two samples of algae collected in the vicinity of Bonneville Dam indicated the activity density from beta emitters to be 1.4 and 2.8 x 10^{-5} μc/gram.

The raw water supplies of each of the Hanford Works operating areas were sampled on a weekly basis throughout the period. This water is pumped from the Columbia River to the 100 Areas and transported to the remaining areas for consumption after purification and chlorination. These samples represent the water prior to the purification and chlorination. A summary of the results obtained from the radiochemical analyses for the activity density of beta emitters in this water is presented in Table IV.

 [redacted]

TABLE IV
RADIOACTIVE CONTAMINATION IN RAW WATER - RIVER EXPORT LINE
APRIL, MAY, JUNE
1951

BETA EMITTERS - ACTIVITY DENSITY x 10^8 µc/cc

Location	April Average	May Average	June Average	Quarter Average	Last Quarter Average	Maximum This Quarter
183 Building, 100-B Area	<5	<5	<5	<5	<5	18
183 Building, 100-D Area	6	<5	<5	<5	14	8
183 Building, 100-DR Area	10	<5	<5	<5	<5	29
183 Building, 100-F Area	43	14	13	22	57	66
183 Building, 100-H Area	20	7	6	11	22	26
283 Building, 200 East Area	26	<5	<5	11	8	97
283 Building, 200 West Area	9	<5	13	6	9	29

A decrease in the mean activity density from beta emitters in raw water occurred at the 100 Areas but was not particularly noticeable at the 200 Areas. The decrease in activity was expected at the 100 Areas because of lower activity levels in the river. The trends do not appear as pronounced at the 200 Areas because the activity density from the shorter half-lived isotopes, such as sodium, magnesium, and copper is minimized as a result of the added time it takes to transport the water from the 100 Areas to the 200 Areas.

Analysis for the activity density from alpha emitters in samples of raw water obtained from these locations indicated negligible activity from this source.

The sampling of the raw water at the 283 buildings in the 200 Areas was supplemented with direct samples obtained from the retention basins. The activity density of beta emitters in the water of the retention basins averaged 8.8 and 6.7 x 10^{-8} µc/cc in the 200 East and 200 West Areas, respectively. Maximum measurements were on the order of 2.0 to 4.0 x 10^{-7} µc/cc; the latter values were obtained during the month of April when the activity density from beta emitters in the Columbia River was at a maximum for the 3 month period. The activity density from alpha emitters in the water samples obtained from the retention basins averaged less than 6 dis/min/liter during each of the 3 months during the period.

Weekly samples obtained from the inlet of the North Richland pond, the source of drinking water at North Richland, were analyzed for the activity density from alpha and beta emitters. The average activity density from beta emitters was less than 5×10^{-8} μc/cc; the activity density from alpha emitters averages less than 6 dis/min/liter; however, two individual samples indicated values of 7 and 10 dis/min/liter. The latter 2 values were questionable as the source of this water supply is the Yakima River, which from all indications based on direct sampling, is a non-contaminated source.

SECTION V

(Please refer to Figures 11, 12, 13, 14, 15, and 16.)

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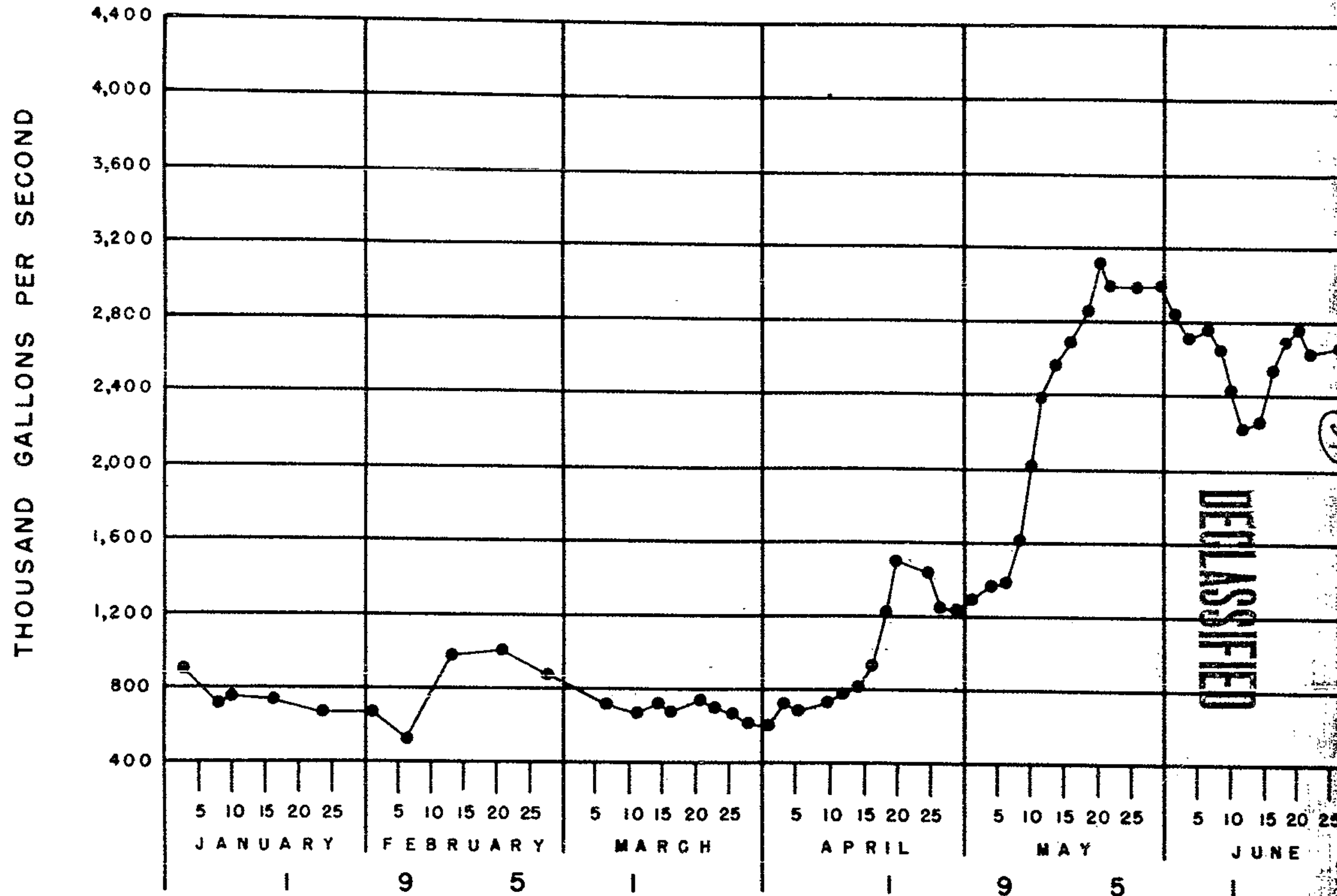
COLUMBIA RIVER FLOW

APRIL — MAY — JUNE

1951

FIGURE — II

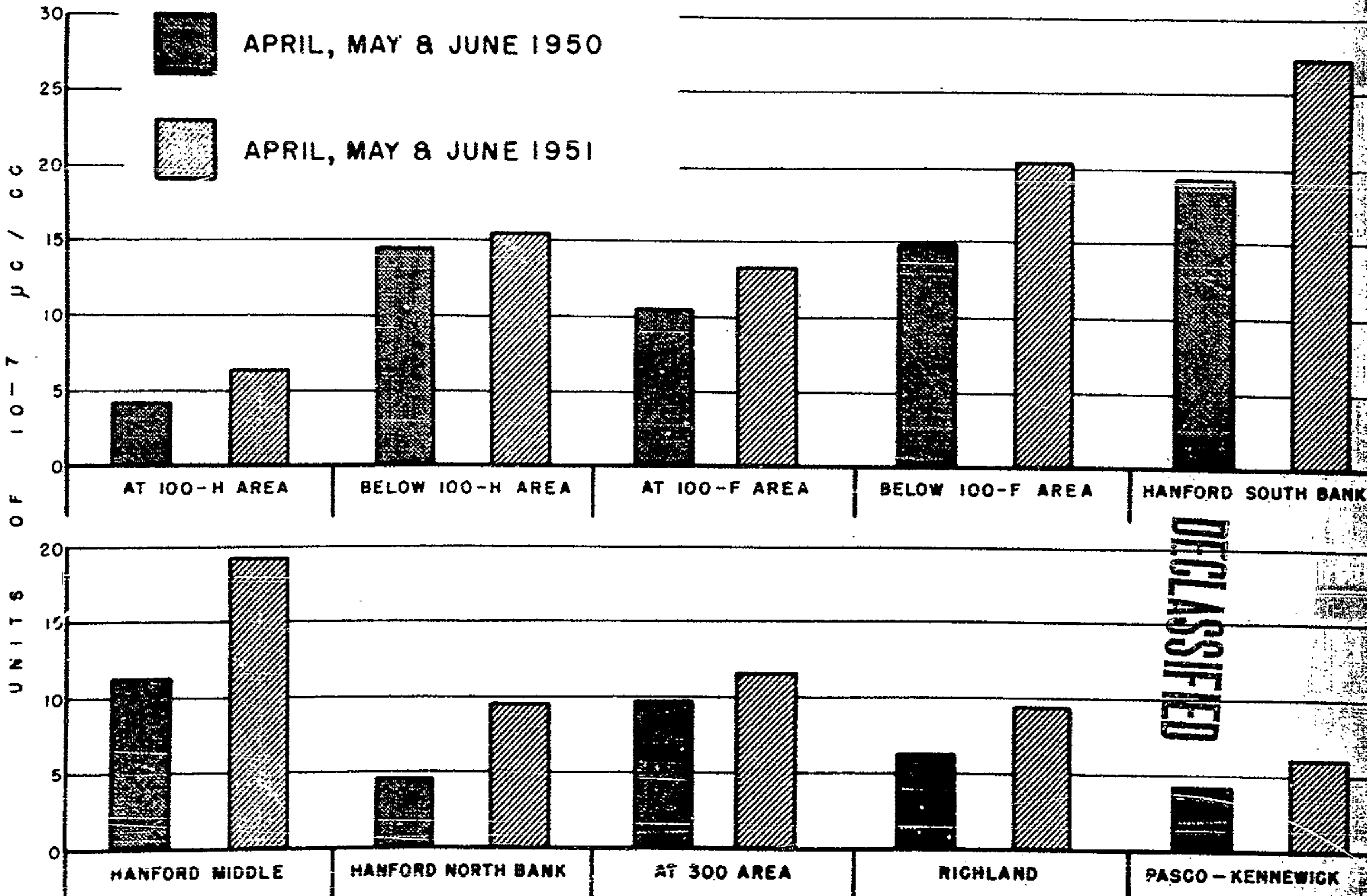


(59)

HW-22313

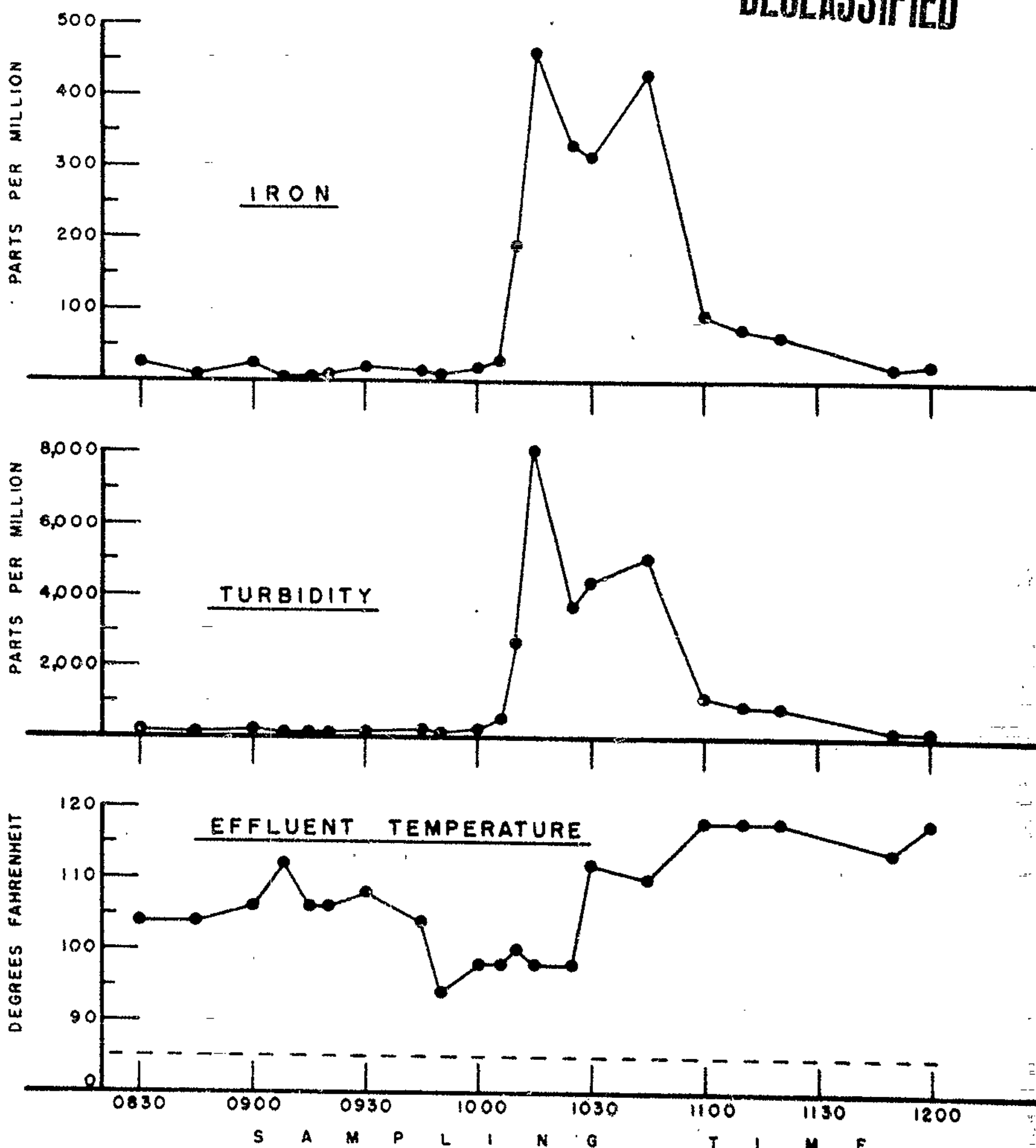
TREND OF RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER
AVERAGE ACTIVITY DENSITY FROM GROSS BETA EMITTERS

FIGURE — 12



EVOLUTION MEASUREMENTS FERRO FLOC EXPERIMENT APRIL 11, 1951

FIGURE-13

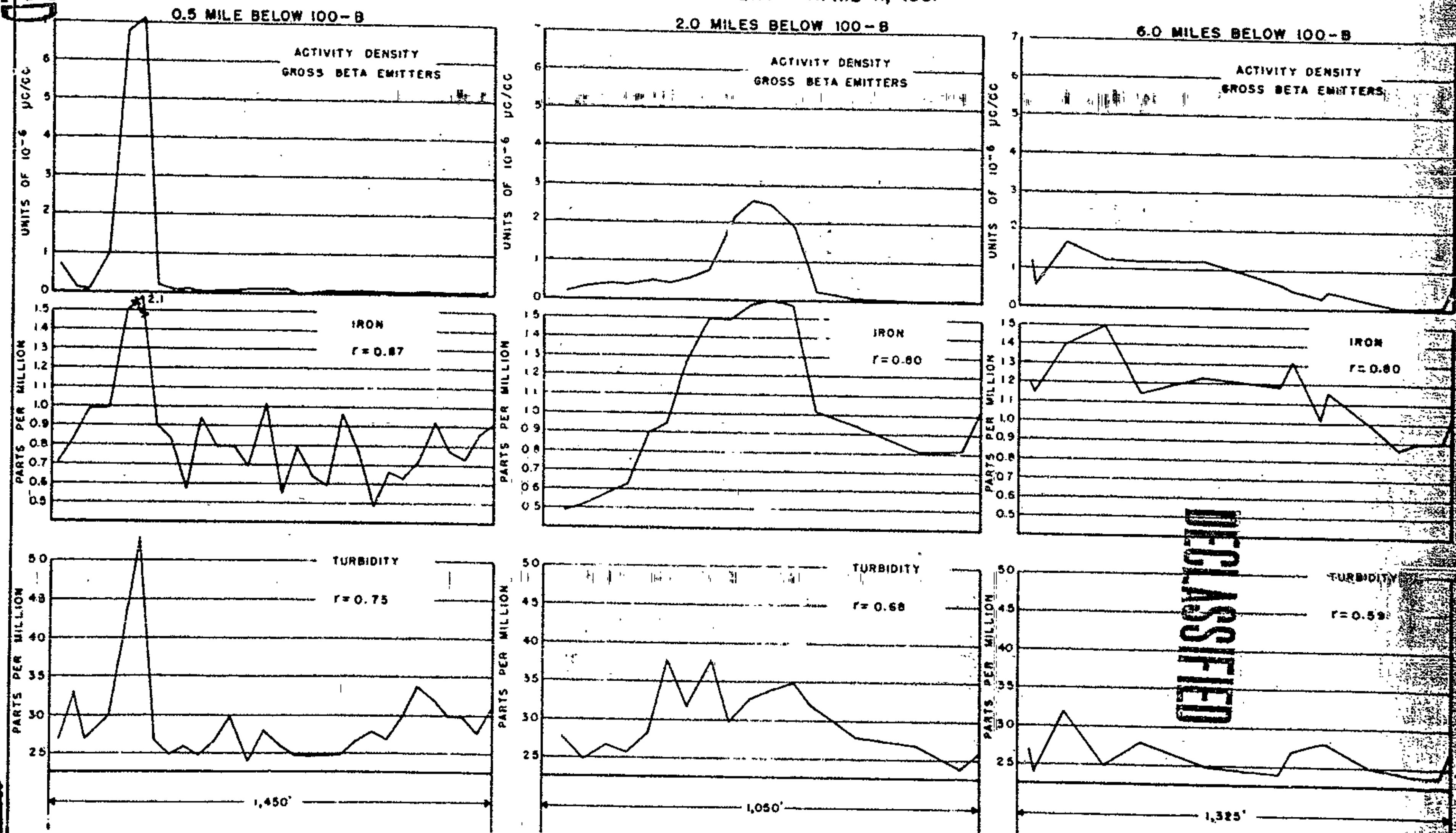


CORRELATION BETWEEN RADIOACTIVE CONTAMINATION IN COLUMBIA RIVER AND IRON AND TURBIDITY CONCENTRATIONS

FERRO FLOC EXPERIMENT — APRIL 11, 1951

r = CORRELATION COEFFICIENT

FIGURE — 14



HW-22313

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ESTIMATED ISO ACTIVITY & VELOCITY PATTERN

COLUMBIA RIVER

SIX MILES BELOW 100-B AREA

APRIL 11, 1951

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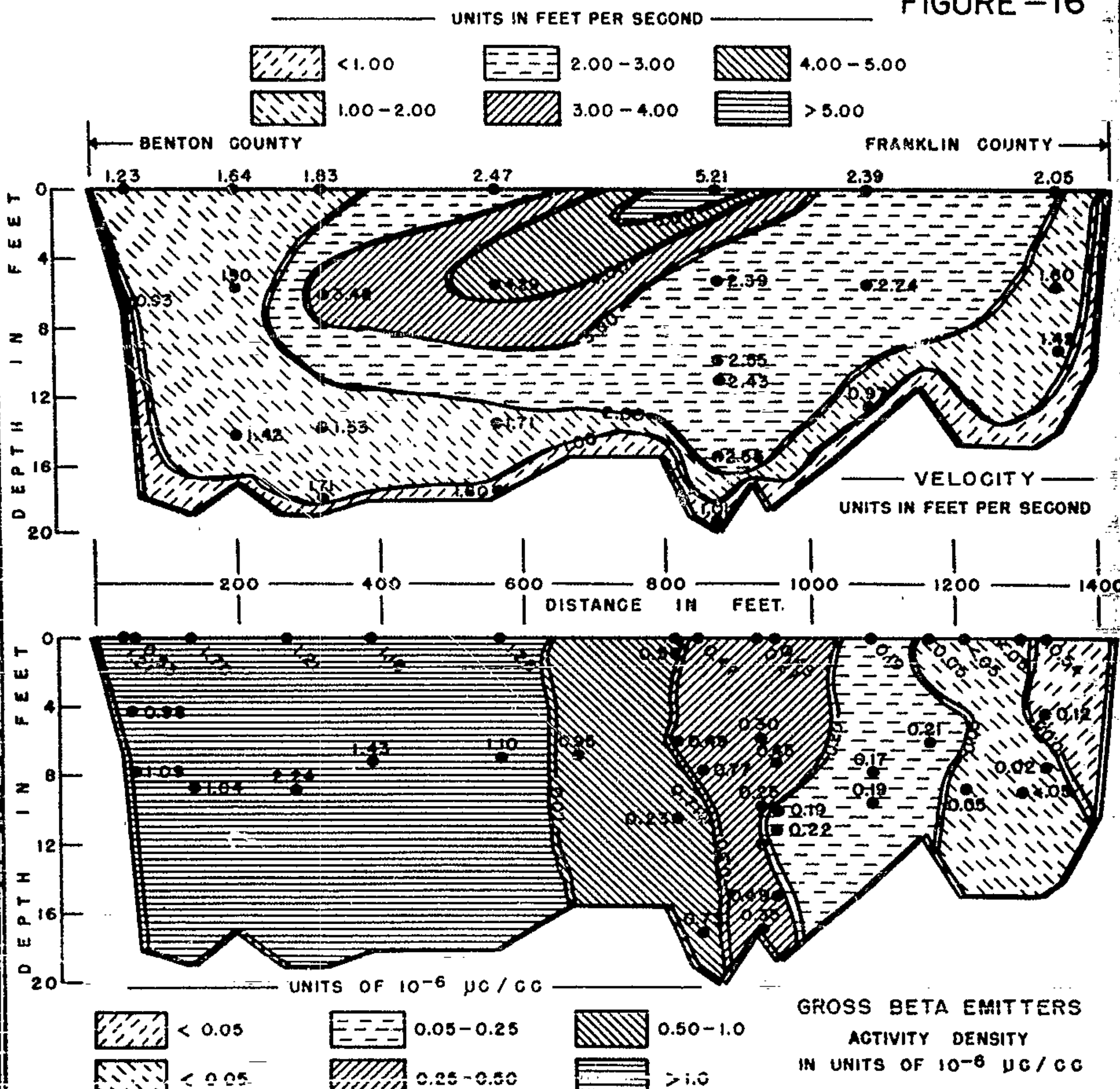
FIGURE—15
FIGURE—16



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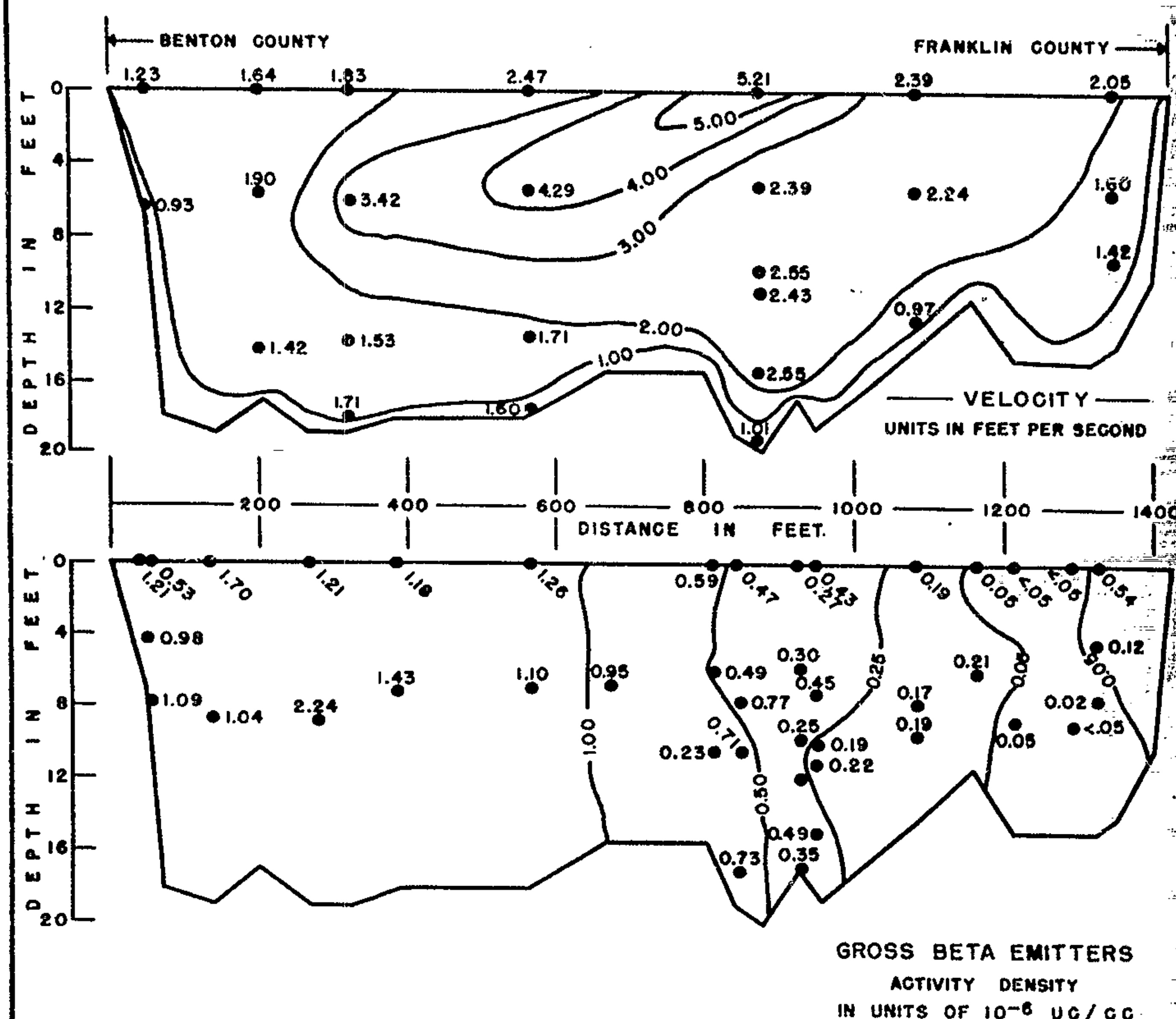
ESTIMATED ISO ACTIVITY & VELOCITY PATTERN
COLUMBIA RIVER
SIX MILES BELOW 100-B AREA
APRIL 11, 1951

FIGURE—15



SECTION VI

RADIOACTIVE CONTAMINATION IN RAIN

Qualitative estimations of the air-borne activity density from gross beta emitters during periods of precipitation were obtained by analyzing rain samples collected from locations on and adjacent to the Hanford Works. A map identifying the location at which rain collectors were maintained during this period may be referred to in a previous document of this series (HW-21214.)

During this period, 99 rain samples were obtained from 27 different locations; the volume of rain collected varied from 3 ml. to 500 ml. The activity density from gross beta emitters was determined by analyzing these samples according to standard procedures and techniques at the 222-U laboratory of the Control Unit of the Radiological Sciences Department (HW 20136.) The number of samples collected from a given location varied from 2 to 9; the latter figure representing the number of rain samples obtained from the Meteorology Tower near the 200 West Area where a sample was collected from each individual rainfall. Samples were collected from the remaining locations on a weekly basis.

The number of rain samples analyzed during April, May, and June, 1951, (99) was less than the number analyzed during the same period in 1950. due to infrequent rainfall. Only 2.34 inches of rain fell at Hanford this year as compared to 3.66 inches measured during the same period in 1950. The measured rainfall during this quarter of 1950 and 1951 represented abnormal precipitation for this time of the year as compared to the over-all 35 year average of 1.36 inches at Hanford. A summary of rainfall data for the period April, May, and June as obtained from the Synoptic Meteorology unit of the Control Unit of the Radiological Sciences Department is presented in Table I.

A review of the results obtained from the measurement for the activity density from gross beta emitters during this period indicates a general increase in this activity at nearly all locations when compared with results obtained during the previous quarter. This increase was by a factor of 3 to 5 in the region of higher

TABLE I
PRECIPITATION MEASURED AT HANFORD WORKS
APRIL, MAY, JUNE
1951
Units - Inches

Year	April	May	June	Quarterly Total
1948	0.95	1.71	1.47	4.13
1949	0.02	0.16	0.01	0.19
1950	0.47	0.27	2.92	3.66
1951	0.53	0.43	1.38	2.34

contamination near the 200 Areas. Comparable increases were noticed at many of the perimeter and intermediate locations and in many cases trace quantities of activity were detected at locations which had previously indicated values below the detection limit of the analysis (1×10^{-6} µc/cc.) The average activity density in rainfall collected inside the separation areas was 2.9×10^{-5} µc/cc and 4.5×10^{-5} µc/cc in the 200 East and 200 West Areas, respectively. Maximum measurements obtained 8000' southeast of the 200 West Area stack were on the order of 1.6×10^{-4} µc/cc. The latter value was obtained in the same region in which higher deposition was noted on vegetation (Section II.) The higher values obtained from samples collected in the 200 West Area were in general agreement with previous data which has indicated that the concentrations are generally higher around the 200 West Area than they are at the 200 East Area. The over-all increase in the mean activity density from beta emitters in rainfall paralleled similar increases noted in the activity density from I-131 in the atmosphere and on vegetation (Sections II and III.) during this period. In all cases these increases were attributed to a reduction in the over-all efficiency of the silver reactor which is installed in the off gas line of the 200 West Area dissolver.

Twenty-five samples collected from locations in the environs of the 100 Areas, Hanford, and White Bluffs indicated the average activity density to be 4×10^{-6} µc/cc. Maximum measurements in this region were obtained at the 100-H Area where a sample indicated 2.0×10^{-5} µc/cc. The activity density from beta emitters measured in 69 samples obtained from 7 locations in this region during the previous quarter showed an over-all average of less than 1 x 10^{-6} µc/cc with only 2 samples indicating detectable activity.

Similar increases were noted in samples which were collected from perimeter locations and in the residential communities of Pasco, Benton City, and Richland. The average activity density in 19 samples collected during this period was 4 x 10^{-6} µc/cc as compared to a previous average of less than 1 x 10^{-6} µc/cc. Maximum values in residential regions were noted at Benton City where a sample indicated 4.7 x 10^{-5} µc/cc. The maximum in this location during the previous quarter was 2 x 10^{-6} µc/cc.

Several samples were collected from various construction areas inside the perimeter barricade. In general, the activity density in these samples were comparable to that found at nearby stations. The maximum activity density measured in a sample collected from a construction zone was 7.1 x 10^{-5} µc/cc at the Redox Area, the average activity density in 4 samples collected at this location was 2.6 x 10^{-5} µc/cc.

A summary of the results obtained from the measurements of the activity density from gross beta emitters in rainfall during this period is presented in Table II.

The program inaugurated during the previous quarter to determine the activity density of alpha emitters in large volume rain samples was discontinued during April pending the improvement of analytical methods and techniques. Efforts are being extended to develop other methods which will insure detection of emitters from this source at extremely low levels on the order of 1 dis/min/liter.

TABLE II
ACTIVITY DENSITY FROM GROSS BETA EMITTERS IN RAIN
APRIL, MAY, JUNE
1951

Location	Number Samples	Activity Density x 10^6 µc/cc Maximum	Average
In 200 East Area			
250' E of stack	4	95	38
2000' E of stack	4	63	24
750' SE of stack	4	78	44
3500' SE of stack	2	12	10
Summary	14	95	29
In 200 West Area			
1000' E of stack	3	56	40
7000' E of stack	4	62	46
8000' SE of stack	4	155	89
4900' SE of stack	3	29	23
Redox Area	4	71	26
Summary	18	155	45
100 Area Environs			
100-B SE	2	4	2
100-D SW	3	7	3
100-F SW	3	1	1
Hanford 614	5	5	3
Hanford 101	5	16	7
White Bluffs	4	10	4
100-H SE	3	20	8
Summary	25	20	4
Perimeter Locations			
Richland	2	1	1
Pasco H & R	5	3	1
Benton City	5	47	11
Riverland	4	14	4
North Richland North	3	6	3
Summary	19	47	4
Intermediate Locations			
Route 4S, Mile 6	4	37	13
300 Area 614	3	2	2
200 North 614	3	5	4
Gable Mountain	2	1	1
Batch Plant	2	12	11
622 Building	9	58	17
Summary	23	58	8

SECTION VI

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SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER SUPPLIES AND TEST WELLS

One thousand and twenty-two samples were obtained from drinking water supplies on and adjacent to the Hanford Works during the period April, May, and June, 1951. Nearly 800 of these samples were 500 ml. and the remainder were 11.7 liters. The smaller samples were analyzed for the activity density from alpha and beta emitters and the larger volumes were used for the specific determination of uranium and/or plutonium. The procedures used for the determinations may be referred to in the Standard Procedures Manual of the Control Functions Analytical Group (HW-20136.)

Table I summarizes the results obtained from the measurement of the activity density from alpha emitters at all locations where this average exceeded the sensitivity limit of the analysis (6 dis/min/liter) during the quarter.

TABLE I
ACTIVITY DENSITY IN DRINKING WATER
APRIL, MAY, JUNE
1 9 5 1
500 ml. samples

Location	No. Samples	Ether Extraction dis/min/liter		No. Samples	Fluorophotometer* ug U/liter	
		Maximum	Average		Maximum	Average
Richland Well #2	12	21	11	12	8	6
Richland Well #4	63	33	15	61	10	6
Richland Well #12	13	17	8	13	9	6
Richland Well #13	11	17	10	11	7	4
Richland Well #14	13	23	12	13	9	6
Richland Well #15	7	17	14	7	11	10
Richland Well #18	3	52	28	4	4	4
Hanford Well #1	11	15	7	11	4	<2
Hanford Well #4	11	21	6	7	2	<2
Columbia Field Well "C"	12	18	7	0		
Benton City Store	13	43	19	11	19	9
Benton City Water Co.	13	41	28	12	16	8
Pistol Range	13	17	6	9	5	4
251 Bldg. Sanitary	13	18	6	12	3	2
Sacajawea Park	13	17	12	7	9	9
Patterson	13	20	12	4	16	9

*Specific analysis of Benton City samples for radium and plutonium showed an activity density of < 2 dis/min/liter. The discrepancy observed in some of these results is unexplained but is not due to plutonium or process uranium.

The values obtained for well supplies in the Benton City and Richland areas were not significantly different from similar measurements obtained during the early part of the year. In general, the wells in the Benton City region average between 20 and 30 dis/min/liter, whereas those in the Richland region usually range from 6 to 20 dis/min/liter. As in the past, trace quantities of uranium were detected in each of the Richland and Benton City supplies that showed the activity density from alpha emitters to exceed 6 dis/min/liter.

The sampling program inaugurated during the previous quarter at Sacajawea Park and Patterson was continued on a weekly basis during this period. The results obtained from the measurement for the activity density from alpha emitters show this activity to average 12 dis/min/liter with maximum values of 20 dis/min/liter. These measurements confirm the preliminary estimations which showed the average to be on the order of 13 to 16 dis/min/liter (HW-21214.) The identity of the contaminant was found to be uranium; 11 samples from these supplies analyzed by the fluorophotometer method showed an average of 9 µg U/liter with a maximum of 16 µg U/liter.

In addition to the locations summarized in Table I, many of the wells showed detectable quantities of alpha emitters at some time during the three month period. In the majority of cases, the values barely exceeded the detection limit of the analysis and for the most part were not confirmed by resample and subsequent analysis. A complete tabulation which includes the locations of all drinking water supplies sampled routinely with the results of the activity measurements for alpha and beta emitters for the period April, May, and June, 1951 is presented in Tables II and III. Table II includes the results from 500 ml. samples and Table III, the results from the 12 liter samples.

Radiochemical analysis for beta emitters in drinking water supplies indicated detectable quantities of this activity at several locations which were located adjacent to or had the Columbia River as their source of water supply. The maximum activity density from beta emitters was found in samples obtained at the Pasco

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TABLE II

SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN WATER SUPPLIES

500 ml. samples

APRIL, MAY, JUNE

1951

Location	Number Samples	Alpha Emitters Activity Density dis/min/liter		Beta Emitters Activity Density x 10^8 µc/cc	
		Maximum	Average	Maximum	Average
Richland Well #2	12	21	11	2	<1
Richland Well #4	63	33	15	2	<1
Richland Well #5	13	11	5	2	<1
Richland Well #12	13	17	8	4	<1
Richland Well #13	11	17	10	2	<1
Richland Well #14	13	23	12	1	<1
Richland Well #15	7	17	14	4	1
Richland Well #18	3	52	28	2	<1
Tract House J-685	12	11	5	7	<1
Foster's Ranch	13	7	2	3	<1
Headgate Well	13	7	<2	3	<1
Hanford Well #1	11	15	7	5	1
Hanford Well #4	11	21	6	2	<1
Hanford Well #7 Sanitary	13	8	2	2	<1
North Richland Well "A"	12	10	3	<1	<1
North Richland Well "B"	13	8	4	4	<1
North Richland Well "C"	13	10	4	2	<1
North Richland Well "D"	12	13	4	5	1
North Richland Well "E"	5	11	4	<1	<1
North Richland Durand Well #5	13	9	5	4	1
Columbia Field Well "A"	11	10	<2	16	2
Columbia Field Well "B"	13	13	4	3	1
Columbia Field Well "C"	12	18	7	2	<1
1100 Area Well #8	11	10	3	1	<1
Benton City Store	13	43	19	1	<1
Benton City Water Co. Well	13	41	28	1	<1
Cobb's Corner	13	9	4	<1	<1
Enterprise Well	13	7	<2	2	<1
Kennewick Standard Station	13	10	3	10	5
Riverland	13	6	<2	1	<1
Midway	13	7	3	1	<1
Lower Knob	13	18	3	5	<1
Wills Ranch	13	8	2	4	<1
P-11 Well	13	8	4	1	<1
Pistol Range	13	17	6	4	<1
White Bluffs Ice House	13	14	5	4	2
Pasco Filter Plant					
Sanitary Water	13	--	--	36	13
First backwash water	13	--	--	50	16
First backwash, coal filtrate	1	--	--	9	9
300 Area Sanitary	25	9	3	4	<1
200 East Sanitary	12	5	<2	6	2
200 West Sanitary	13	6	2	20	3
100-B Sanitary	13	7	2	<1	<1
100-D Sanitary	13	5	<2	4	2
100-DR Sanitary	13	8	3	5	1
100-F Sanitary	13	9	<2	20	8
100-H Sanitary	13	4	<2	6	3

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TABLE II (con't)
SUMMARY OF ALPHA AND BETA EMITTERS MEASURED IN WATER SUPPLIES
500 ml. samples
APRIL, MAY, JUNE
1951

Location	Number Samples	Alpha Emitters Activity Density dis/min/liter		Beta Emitters Activity Density x 10^8 µc/cc	
		Maximum	Average	Maximum	Average
White Bluffs Telephone Exchange	10	6	3	9	3
Redox Administration Building	13	7	2	9	2
251 Building Sanitary	13	18	6	2	<1
Sacajawea Park	13	17	12	<1	<1
McNary Dam	13	4	<2	7	4
Patterson	13	20	12	1	<1
Plymouth	12	6	3	1	<1
Prosser	13	9	<2	2	<1

The above summary does not include the values obtained when laboratory contamination was suspected.

Filter Plant where the waters leaving the plant for consumption showed an average of 1.3×10^{-7} µc/cc with maximum measurements of 3.6×10^{-7} µc/cc. These values were comparable to those found during the previous 3 month period when the average was 1.5×10^{-7} µc/cc including a maximum measurement of 2.4×10^{-7} µc/cc. Trace activity was also detected in Kennewick drinking water where the average activity density was 5×10^{-8} µc/cc with maximum measurements on the order of 1.0×10^{-7} µc/cc. The only other drinking water supply which showed average values to exceed 5×10^{-8} µc/cc were located on Hanford Works and were associated with the raw water obtained from the Columbia River. Individual samples collected at the 100-F and 200 West Areas showed activity density from beta emitters to be 2.0×10^{-7} µc/cc; maximum measurements obtained from other locations which were dependent on the raw water river export line for the source of their drinking water ranged from 5 to 9×10^{-8} µc/cc. The only area drinking water supply which showed a positive average throughout the quarterly period was 100-F Area where the activity density from gross beta emitters averaged 8×10^{-8} µc/cc. The magnitude of beta activity and the locations at which it was detected were nearly identical to the findings during previous periods.

TABLE III
SUMMARY OF ALPHA EMITTERS MEASURED IN DRINKING WATER
12 liter samples
Activity Density - Units - dis/min/liter
APRIL, MAY, JUNE
1951

Location	Number Samples	Maximum	Average
Richland Well #2	6	13	8
Richland Well #4	7	18	9
Richland Well #5	6	3	3
Richland Well #12	6	8	6
Richland Well #13	6	6	3
Richland Well #14	6	25	10
Richland Well #15	3	13	7
Richland Well #18	2	4	3
Foster Ranch	2	4	3
Hanford Well #1	6	3	3
Hanford Well #4	6	4	<2
Hanford Well #7	6	2	<2
North Richland Well "A"	5	3	<2
North Richland Durand Well #5	6	3	<2
Columbia Field Well "A"	5	2	<2
Columbia Field Well "B"	6	3	<2
Columbia Field Well "C"	5	2	<2
1100 Area Well #8	7	4	<2
Benton City Store	7	25	12
Benton City Water Co. Well	7	35	22
Cobb's Corner	7	5	4
Enterprise Well	7	4	<2
Kennewick Standard Station	6	4	<2
Wills Ranch	6	5	<2
P-11 Well	6	6	2
Pistol Range	6	5	4
White Bluffs	6	4	<2
251 Building Sanitary	6	4	<2

Weekly samples were collected from the various filtering basins and settling basins at the Pasco Filtering Plant. Samples of backwash material collected during the first bachwashing of the sand filter were filtered prior to analyses. The activity density from beta emitters averaged 1.6×10^{-6} μc/cc in the liquid portion of these samples and 1.3×10^{-3} μc/gram in the solid portion. Maximum measurements were 5.0×10^{-7} μc/cc and 2.2×10^{-3} μc/gram in the liquid and solid portions, respectively. Direct sampling of the sand on the surface of the sand filter showed the activity density from gross beta emitters to average 9×10^{-3} μc/gram with maximum values of 3.1×10^{-2} μc/gram. One sample obtained from the backwash material of the newly constructed coal filter showed the activity density from beta emitters to be 9×10^{-8} µc/cc in the liquid portion. Samples from the coal filter will be obtained on a repetitive basis in the future and specific measurements similar to those for the sand filter will be performed.

Approximately 200 samples were obtained from test wells located on and adjacent to the project during the period. The bulk of these samples were 500 ml.; however, 12 liter samples were analyzed when the activity density from alpha emitters approached the sensitivity limit of the analysis for the smaller volume (6 dis/min/liter.) Specific determinations for the alpha emitters of uranium and/or plutonium were performed on all test well samples in which the ether extraction indicated the activity density to exceed 6 dis/min/liter. Table IV summarizes the results from all locations showing a positive activity density from alpha emitters during the period.

TABLE IV
ACTIVITY DENSITY IN TEST WELLS
APRIL, MAY, JUNE
1951

Location	No. Samples	Alpha Activity Density dis/min/liter Maximum	Alpha Activity Density dis/min/liter Average	No. Samples	Uranium Activity Density µg U/liter Maximum	Uranium Activity Density µg U/liter Average
300 Area Well #1	10	420	160	10	340	100
300 Area Well #2	21	480	190	22	280	110
300 Area Well #3	20	210	130	22	140	70
300 Area Well #4	10	300	170	12	160	70
300 Area North Well	11	1100	610	9	4300	1800
BY Well	13	14	7	10	5	4
Spring #13	1	10	10	0		
200 North Area Well #5	10	23	9	3	2	<2

The activity density from alpha emitters in the four wells in the 300 Area increased during this period. This increase was expected as a review of the data collected during previous years indicates that the activity density from alpha emitters in these wells increases during periods in which the flow rate of the Columbia River increases. (Refer to Section V, Figure 11 .) The magnitude of increase of this activity was on the order of a factor of 2 with several of the individual measurements being 3 times greater than those obtained during January, February, and March. The contaminant in these wells was identified as uranium; the activity density from uranium showed increases comparable to those noted in the total alpha activity as determined by the ether extraction method.

A continuation of the sampling program inaugurated during the previous quarter in the 300 North Area well showed that the activity density from alpha emitters increased about two fold during this period. Although considerable variation was noted between successive samples from this location, the contaminant was identified as uranium in all samples analyzed. This well continues to be the most contaminated well in the sampling program and from all indications the contaminant appears to be steadily increasing. The activity density from the alpha emitter of uranium was 1.9×10^{3} µg U/liter during the present period as compared with an average of 6.3×10^{2} µg U/liter during January, February, and March. The maximum measurement of 4.3×10^{3} µg U/liter was 3 times greater than the maximum measurement during the previous period.

Several samples were obtained from many random locations on the site which do not normally represent established drinking water supplies. These locations usually represented construction zones, military encampments, or irrigation ditches. The activity density from alpha and beta emitters in these sources was below the detection limit of the respective analyses in each sample analyzed. Several spot samples analyzed specifically for I-131 indicated negligible activity from its source.

SECTION VII

H. J. Paas
Regional Survey-RADIOLOGICAL SCIENCES

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