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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD JULY, AUGUST, SEPTEMBER, 1949

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by

H. J. Paas and W. Singlevich
Development Division
Health Instrument Division

August 30, 1950

HANFORD WORKS
RICHLAND, WASHINGTON

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RADIOACTIVE CONTAMINATION IN THE ENVIRONS OF THE HANFORD WORKS FOR THE PERIOD JULY, AUGUST, SEPTEMBER 1949

INTRODUCTION:

The data discussed in this document were previously reported in the H. I. Environs Report on a monthly basis. This document is compiled for record purposes to complete the series of quarterly summations issued last year. The primary purpose of the quarterly report is to attempt an evaluation of the data with respect to defining specific trends in radioactive contamination in the environs which would not ordinarily be observed by a study of one month's data. An abstract of the results of measurements for radioactive contamination in the Hanford Environs during this period appears below:

SECTION I - METEOROLOGICAL DATA - HANFORD WORKS AREA:

Wind directions during this period did not differ significantly from the previous quarter; the wind prevailed 44 percent of the time from the northwest; 33 percent of the wind came from the west. The effect of the predominating wind directions on the pattern of deposited I-131 on vegetation in this area is shown; the expected pattern agrees reasonably well with the pattern determined by experimental measurement. Graphs and charts summarizing wind directions and atmospheric dilution factors in detail are included; a comparison of wind directions at the 100 Areas with those of the 200 Areas are presented in tables.

SECTION II - RADIOACTIVE CONTAMINATION ON VEGETATION:

Small decreases in activity from I-131 on vegetation was noted near the 200 Areas when comparing the current period with that of the previous months; activity in residential districts including Pasco, Kennewick, Richland, and Benton City remained below 2 muc/kg. As there were not significant changes in operating conditions, the decrease in levels of I-131 concentration was attributed to meteorological conditions, particularly due to the better dilution factors experienced during this quarter. Trace quantities of I-131 on vegetation were observed in the Wahluke Slope area. Graphs and charts reviewing the analytical data in detail and an iso-activity map showing the estimated distribution of I-131 in the environs of Hanford are included.

SECTION III - RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE:

No changes or trends were observed during this period using integrons; a a probable decrease in dosage rates using detachable ionization chambers was noted near the separations area during this quarter; dosage rates of 0.1 to 0.3 mrep/24 hours, well within background limits, were observed at outlying locations such as Richland and Benton City. Increases by factors of two over normal dosage rates were observed for the weeks ending September 16 and 23; increases in filterable beta activity as well as in the number of active particles in the atmosphere were also apparent. It was found that this increase was due to a source other than the Hanford Works. Activity from I-131 in the atmosphere was about 10^{-10} μc/liter outside the project perimeter.

SECTION IV - RADIOACTIVE CONTAMINATION IN RAIN:

An abnormally dry period during this quarter yeilded few samples. No trends or significant changes from past surveys were noted. The maximum activity measured in any rain sample was 15 mμc/liter, collected at the meteorology tower near the 200 West Area.

SECTION V - RADIOACTIVE CONTAMINATION IN THE COLUMBIA AND YAKIMA RIVERS:

The expected decrease in flow of the Columbia River during this quarter accounted for a corresponding increase in the radioactive contamination levels in the river throughout the quarter. Activity from alpha emitters was <6 dis/min/liter; the maximum activity measured in any river sample was 2130 μμc/liter sample near the south bank of the river at Hanford. Beta emitters in the river at Pasco and Richland averaged 190 uuc and samples taken from the shore of the river varied from 11 to 27 mμc/kg. The principal emitter in the river water was shown to be 148 hour sodium (Na-24) by decay study. An analyses of a 32 liter sample of Columbia River water from Bonneville Dam indicated 30 μμc/liter of beta emitter; a trace quantity Fe-59 was detected; no activity from Ca-45, P-32, or K-40 was measured in this sample.

SECTION VI - RADIOACTIVE CONTAMINATION IN HANFORD WASTES:

Levels of radioactive contamination measured in the 100, 200, and 300 Area waste systems are reviewed. In general, no significant changes or trends were observed during this quarter as compared with the previous three months except in the activity levels of the 107 effluent basins of the pile areas where a small decrease was noted. The average activity levels measured in the basins of the 100-B, 100-D, and 100-F Areas was 269, 301, and 275 mμc/liter, respectively.

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

No significant changes from past surveys were noted during this quarter. Uranium, presumably occurring naturally, averaged 32 dis/min/liter in a well from Benton City and from 6 to 11 dis/min/liter in Richland Wells. Beta emitters in drinking water averaged <10 μμc/liter except in the Pasco and Kennewick water, which uses the Columbia River as its source. The highest average activity measured was 52 μμc/liter with an individual maximum of 100 μμc/liter taken from the Kennewick Highlands supply. The principal beta emitter in this water was 14.8 hour sodium (Na-24) as determined by decay study; the concentration of Na-24 measured was well below the permissable concentration of this isotope in drinking water.

SECTION I

METEOROLOGICAL DATA HANFORD WORKS AREA

The meteorological conditions observed during the period July, August and September, 1949, were reviewed with respect to the effect they may have on the distribution and deposition of 8 day iodine discharged into the atmosphere from the separations area stacks of the Hanford Works. The meteorological observations summarized in this report were made by the Meteorology Group of the Health Instrument Division; the 400' meteorology tower is located near the 200 West Area at the 622 building. Wind direction and velocity measurements were also obtained from stations located in the 100-B, 100-D, and 100-F Areas. The data obtained at the Meteorology Tower represent measurements made at 50 foot intervals from ground level to 400 feet; the data from the 100- Area stations was obtained at an elevation of approximately 50 feet above ground level.

During this period, the prevailing wind direction at the Meteorology Tower was from the northwest 44 percent of the time and from the west 32 percent of the time. The prevalence of wind from the northwest quadrant was consistent with observations made during the previous quarter; during the period April, May, and June, 1949, the wind prevailed from the west 38 percent of the time and from the northwest 36 percent of the time. The amount of wind from the easterly directions was negligible. The southerly components accounted for 16 percent of the wind and wind from the southwest directions was observed 11 percent of the time. A comparison of the wind direction data with the estimated pattern of deposited I-131 on the vegetation agree reasonably well. (Figure 4 , Section II .) The maximum I-131 activity on the vegetation was found at locations directly down wind from the separations area stacks. Trace I-131 activity detected on the Wahluke Slope during the months of August and September was attributed to the winds from the southwest direction; the prevalence of the southwest direction becomes significant when compared with the remaining components of the eastern and southern

quadrants. Figure 1 is an eight point compass wind rose which summarizes the wind directions as recorded at the 200 foot level of the Meteorology Tower. The observations from the 200 foot level were used as they most closely represented the elevation of the separations area stacks.

Figure 2 presents a breakdown of the wind direction data on a month to month basis. With the exception of the north direction during the month of September, the data show very little fluctuation in wind directions. The monthly averages were consistent with previous observations and were representative of the quarterly average. The west direction tended to prevail during June; however, the northwestern quadrant accounted for 80 percent of the wind during this particular month. During September, more variation in wind direction was observed than during the two preceding months; prevailing winds from the north direction were observed 13 percent of the time as compared with 1 percent during the two preceding months.

A summary of the average wind directions observed in the 100 Areas stations as compared with corresponding measurements made at the Meteorology Tower is presented in Table I on page 7.

A review of Table I shows that the wind direction varied more at the 100 Areas stations than at the Meteorology Tower near the 200 West Area. The prevailing wind was from the northwest quadrant with the west direction accounting for the major part of the wind observed at the 100 Areas. The southern and eastern components tended to prevail more often in the vicinity of the 100 Areas; these directions were somewhat dwarfed when compared with the over-all prevailing west and northwest directions. Dormant air masses, as indicated by the calm condition (less than 1 miles per hour) were more prominent at the 100 Areas. A summary of the above data for the entire quarter appears in Table II on page 7.

TABLE I
SUMMARY OF WIND DIRECTION DATA *
HANFORD WORKS
JULY-AUGUST-SEPTEMBER
1949
Units in percent of time observed

AREA	MONTH	N	NE	E	SE	S	SW	W	NW	CLM
200 W Area	July	1	0	0	0	3	13	42	39	0
	Aug.	0	0	0	1	1	6	36	57	0
	Sept.	13	2	4	5	4	13	21	38	0
100-B Area	July	6	0	3	2	1	9	56	20	2
	Aug.	3	2	2	1	0	7	73	13	0
	Sept.	11	2	8	4	8	15	31	8	13
100-D Area	July	6	1	7	2	19	1	51	9	3
	Aug.	8	2	5	0	19	5	51	1	9
	Sept.	10	4	9	1	9	7	20	5	35
100-F Area	July	0	0	3	9	11	7	50	6	14
	Aug.	2	1	5	16	10	13	32	7	14
	Sept.	4	4	6	16	13	8	16	4	28

* Computed for dissolving hours only.

TABLE II
SUMMARY OF PREVAILING WIND DIRECTIONS *
JULY-AUGUST-SEPTEMBER
1949
Units in percent of time observed

AREA	N	NE	E	SE	S	SW	W	NW	calm
200 W Area	5	1	2	2	3	11	32	44	0
100-B Area	7	1	5	3	3	11	51	13	6
100-D Area	10	3	7	1	15	5	39	5	17
100-F Area	2	2	5	14	12	9	31	5	20

* Computed for dissolving hours only.

The atmospheric dilution ratio which existed during the hours of metal dissolution are graphically presented in Figure 3. The aloft condition (dilution ratio greater than 2000:1) existed 52 percent of the time. This figure was comparable with the previous quarter when the aloft condition was noted 47 percent of the time. Dilution ratios between 1000:1 and 2000:1 were observed during 34 percent of the dissolving hours. The more undesirable dilution ratio of less than 500:1 was observed only 3 percent of the total dissolving times as compared with 7 percent observed during April, May, and June.

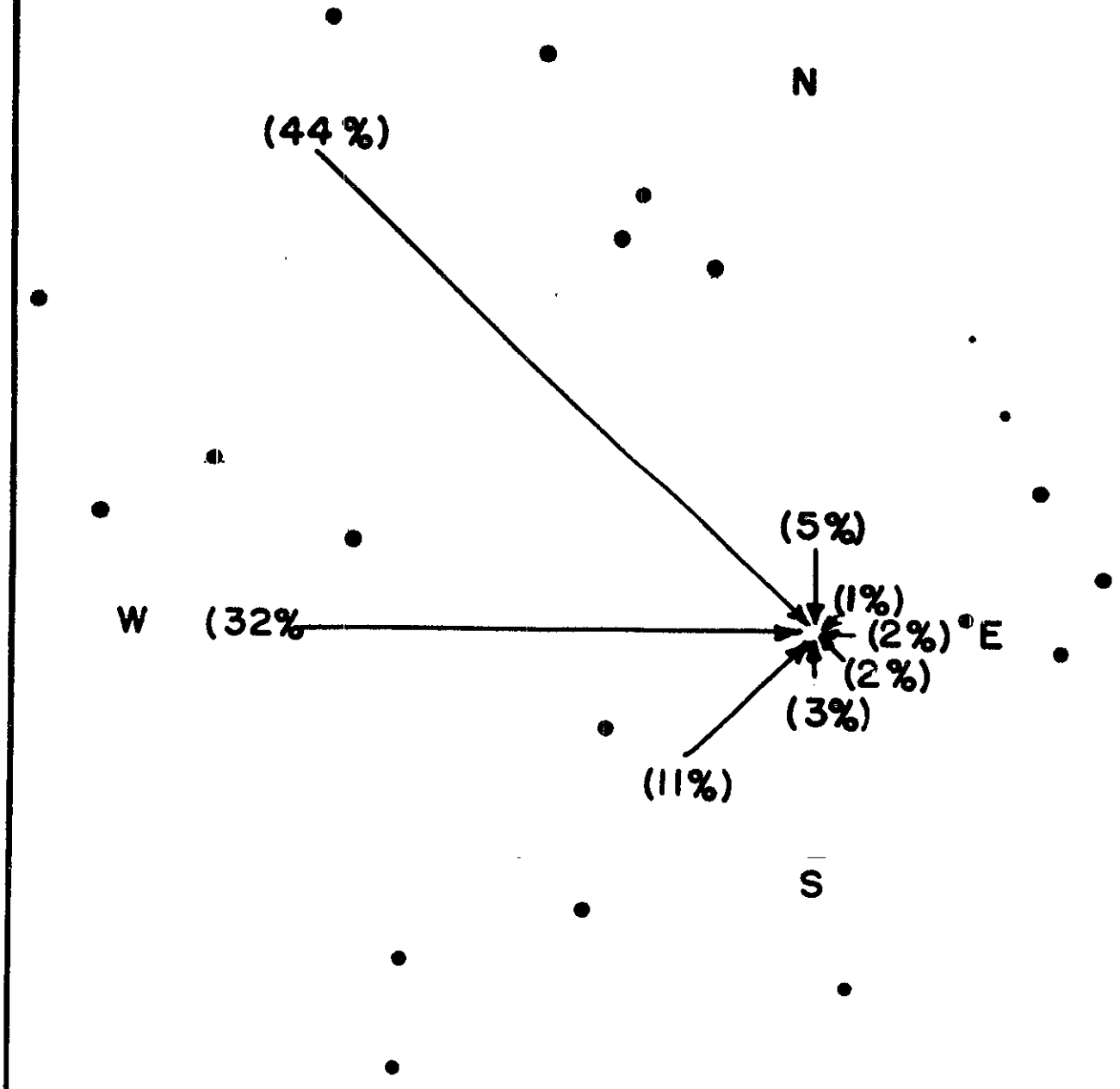
The meteorological conditions discussed in this section may be referred to when reading Sections II and III of this report which summarize the deposition of I-131 on vegetation and the atmospheric activity measurements for the quarter. More detailed summaries of the atmospheric conditions observed during this period are available in detailed monthly reports published by the Meteorology Group of the Health Instrument Division.(1)

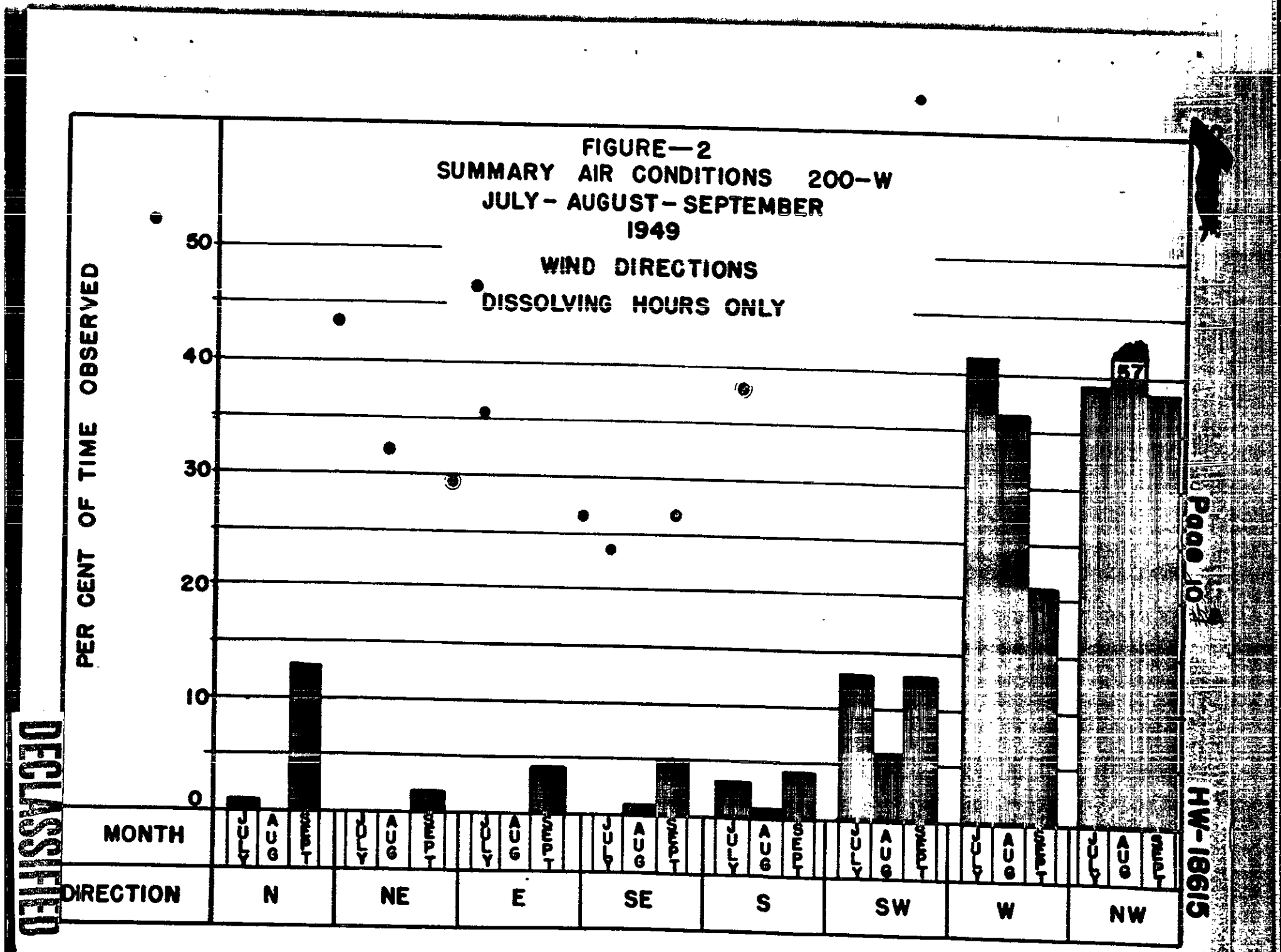
SECTION I

(Please refer to Figures 1, 2, and 3.)

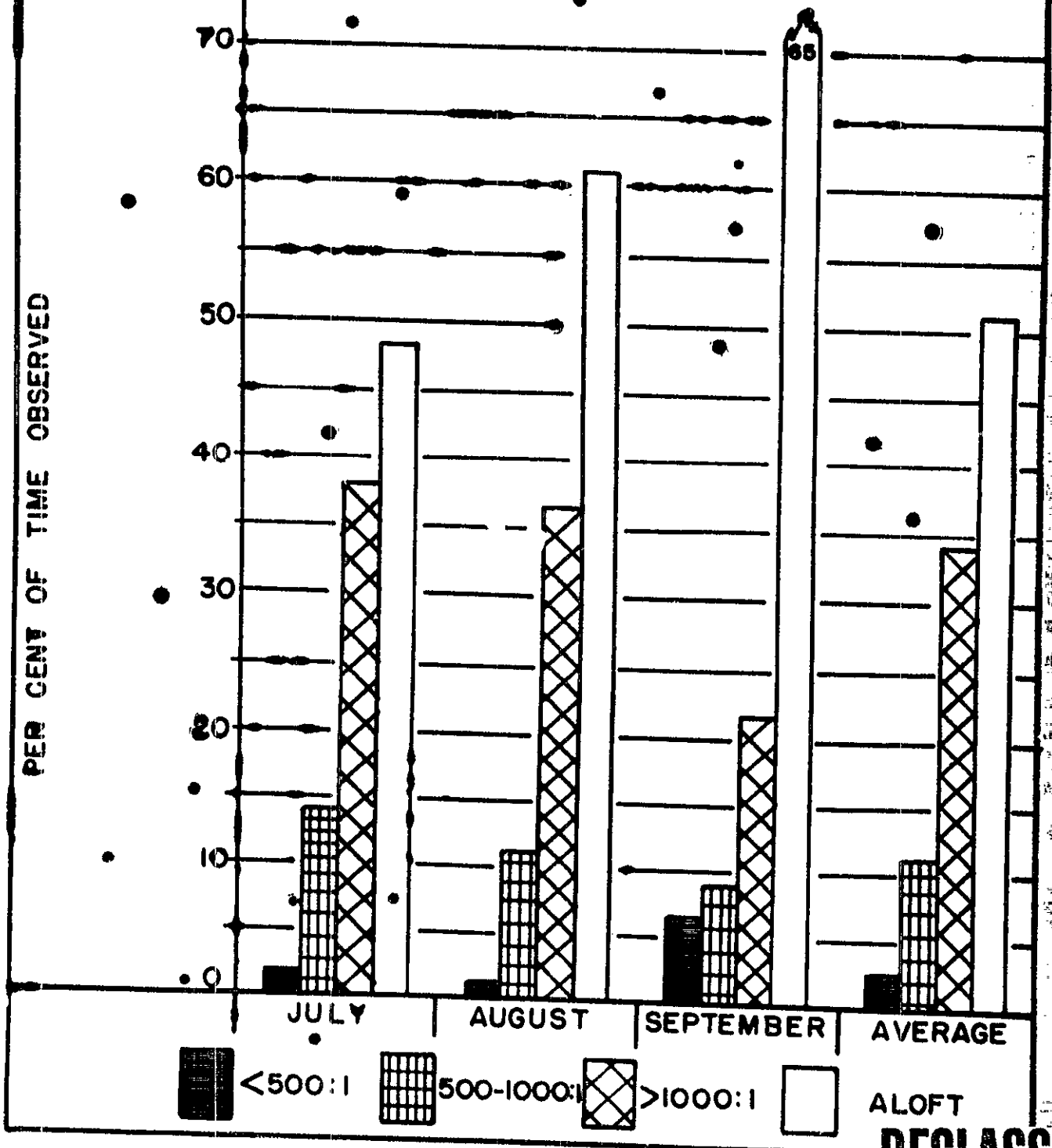
FIGURE-1

SUMMARY WIND DIRECTIONS - 200 W
DISSOLVING HOURS ONLY
JULY —— AUGUST —— SEPTEMBER
1949





FIGURE—3
WIND DILUTION ANALYSIS
622 BLDG.—200W AREA
DISSOLVING HOURS ONLY
JULY–AUGUST–SEPTEMBER
1949



SECTION II
RADIOACTIVE CONTAMINATION ON VEGETATION

The radioactive contamination on the vegetation in the environs of the Hanford Works results from the radioactive gasses admitted to the atmosphere via two 200 foot stacks in the separations area during the dissolution of irradiated uranium. One of the principal contaminants in this stack gas is 8 day iodine (I-131); other radioactive isotopes with longer half-lives are also emitted but in smaller quantities than the I-131.

The amount of I-131 calculated to have been formed in the dissolvers during July, August, and September, 1949, was estimated at 1061 curies. Five percent of this, or 53 curies of I-131, were estimated to be discharged into the atmosphere.(2) The amount of I-131 discharged during the quarter represented a negligible increase when compared with the previous quarter when it was estimated that 52 curies were discharged into the atmosphere. The cooling periods for each batch of irradiated uranium ranged from 84 to 98 days; this interval was relatively consistent with the previous quarter when the cooling periods varied from 84 to 102 days.

One thousand six hundred and thirty vegetation samples collected during this period were analyzed for the beta activity from 8-day iodine (I-131) and for the beta emitters from the non-volatile longer half-lived fission product isotopes. The analytical methods used for the measurement of I-131(3) and non-volatile activity(4) are discussed in previously issued reports.

Table I reviews the maximum and average I-131 and non-volatile beta activity measured on vegetation collected from representative locations during the quarter. The average activity measured during the previous quarter is included for comparison. Table I appears on the following page.

TABLE I
RADIOACTIVE CONTAMINATION ON VEGETATION
JULY AUGUST SEPTEMBER
1949

LOCATION	I-131 - muc/kg			Non-volatiles - muc/kg		
	Maximum	Average	Previous* Average	Maximum	Average	Previous* Average
North of 200 Areas	7	<2	<2	38	12	10
Near the 200 Areas	15	<2	3	68	13	12
Route 3	46	11	32	51	19	34
200 West Gate	78	28	93	103	43	74
Meteorology Tower	12	5	18	30	11	19
South of 200 Areas	18	<2	<2	53	11	10
Richland	2	<2	<2	31	11	<10
Pasco	6	<2	<2	52	14	<10
Kennewick	2	<2	<2	36	12	<10
Benton City	2	<2	<2	32	11	<10
Richland "Y"	4	<2	<2	27	11	<10
Hanford	10	<2	<2	26	13	<10
200 East Area	68	6	16	53	19	17
200 West Area	56	4	7	38	<10	11
Goose Egg Hill	13	3	6	27	10	14
Wahluke Slope	7	<2	<2	42	<10	<10
Pasco to Ringold	2	<2	<2	46	11	<10
Rattlesnake MP Posts	12	<2	2	19	<10	<10
Benton Gap	<2	<2	<2	14	<10	<10
Off Area Samples						
Yakima Barricade to Ellensburg	3	<2	<2	15	<10	<10
Pasco - Umatilla-Pendleton - Walla Walla	2	<2	-	12	<10	--
Plymouth to Kennewick to Haver	3	<2	<2	27	<10	<10
Pasco to Ringold	2	<2	<2	46	11	<10

* The period April, May, and June is included in this average value.

A review of the above table indicates a general decrease in the amount of I-131 measured on vegetation collected near the separations areas; other locations further removed showed little or no change; the average activity from I-131 remained essentially below the sensitivity limit of the analysis (2 muc/kg) at these latter locations.

The maximum I-131 activity was found on vegetation collected near the 200 West Area gate. This region has consistently showed higher levels of deposited activity in the past; the current data were indicative of no trend or change in

the deposition pattern. The decrease in amount of I-131 activity at most locations during this quarter was associated with meteorological conditions as the total I-131 liberated to the atmosphere remained essentially unchanged during the second and third quarters of 1949.

Reference to the Meteorology Section of this report (Section I) shows a change in the atmospheric dilution ratios existing during this quarter as compared with the previous three-month period. Dilution ratios below 1000:1 occurred during 14 percent of the dissolving time as compared with 23 percent of the dissolving time during the previous quarter. With other conditions remaining the same, a decrease in the low dilution ratios would result in lesser deposition of activity in the region near the separations areas' stacks. A review of the monthly estimated iso-activity maps (5), (6), & (7) shows that the amount of I-131 activity deposited on the vegetation decreased with each successive month. This month to month decrease can be associated with the increasing prevalence of the aloft (greater than 2000:1) dilution condition as portrayed in Figure 3. The aloft condition existed 47 percent of the time during July, and 65 percent of the time during September.

Trace indications of I-131 activity were observed on the vegetation of the Wahluke Slope during August and September. (6) & (7) Deposition of I-131 in this region was attributed to the southwest winds accompanied by high atmospheric dilution ratios in the 200 Areas and a calm condition indicative of a stagnant air mass near the 100 Areas. Most of the deposition on the Slope occurred directly across from the 100-B Area in a region along the bank of the Columbia River. An estimated iso-activity map showing the distribution of the deposition of I-131 on the vegetation in the environs of the Hanford Project may be referred to in Figure 4.

Periodic off-area vegetation samples included trips from the Yakima barricade to Ellensburg, Pasco to Umatilla, the Pendleton-Walla Walla area, and the Kennewick to Plymouth region. The I-131 beta activity averaged less than 2 mμc/kg in each

of these regions. The maximum activity detected in samples collected off the project was found in a sample taken from the Plymouth to Kennewick survey; the I-131 activity measured was 8 mμc/kg. The results obtained from off-area samples were consistent with previous measurements and were not indicative or any trend or change in the background activity levels.

Non-volatile beta activity measured on vegetation during this period was relatively the same as that noted during the previous quarter. In most of the outlying regions the non-volatile's beta activity averaged between 10 and 15 mμc/kg; these averages were not significantly different than the current best estimate of the natural occurring beta activity (K-40). Consistent with the I-131 measurements, the non-volatile activity in vegetation collected off the project was less than the estimated detection limit of the analysis.

An estimated iso-activity map showing the distribution of the non-volatile beta activity on the vegetation in the environs of the Hanford Works is presented in Figure 5. This estimation includes measurement of the beta activity from naturally occurring K-40 present in the potassium salts of the vegetation.

SECTION II

(Please refer to Figures 4 and 5)

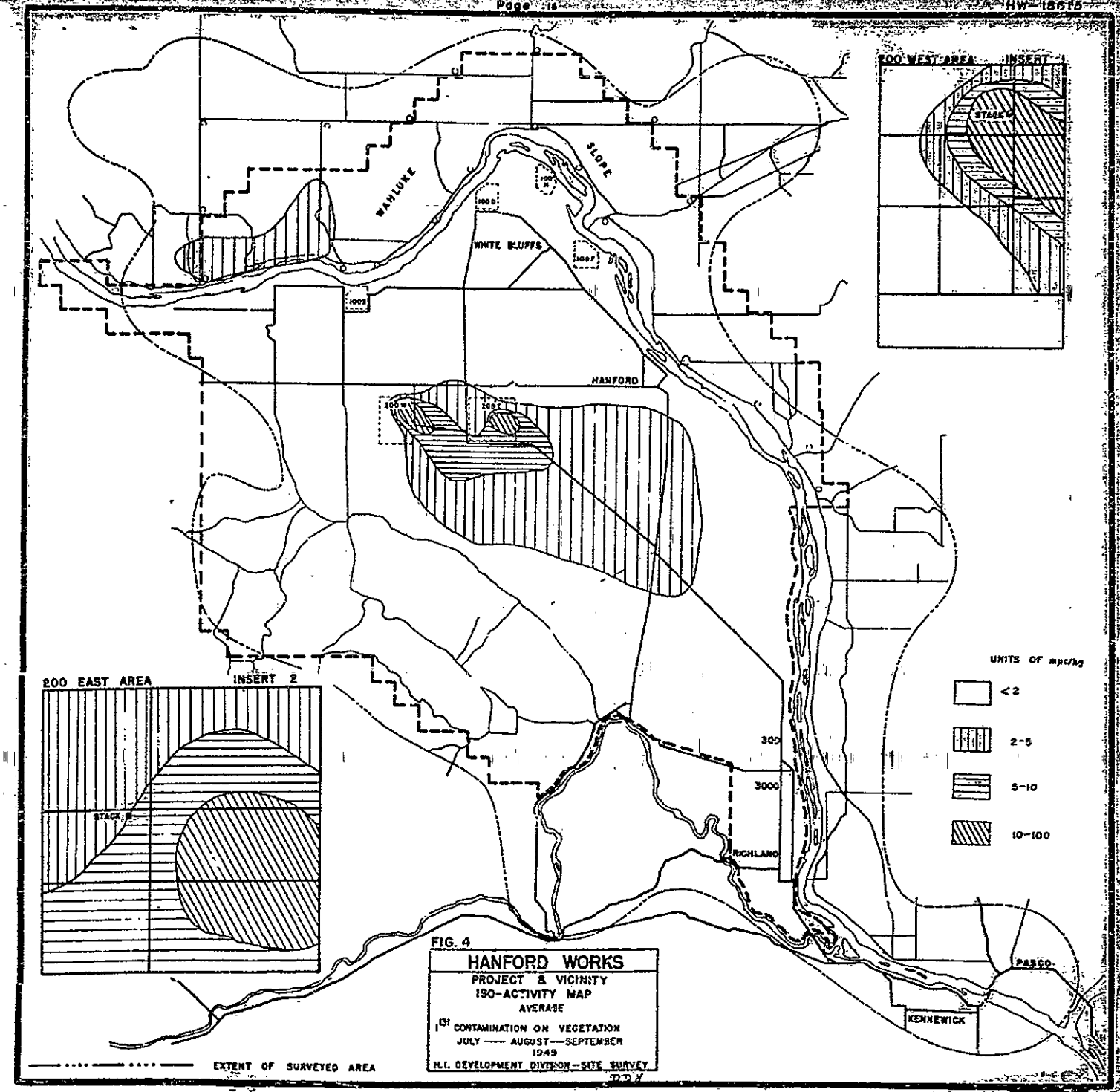


FIG. 4

HANFORD WORKS
PROJECT & VICINITY
ISO-ACTIVITY MAP
AVERAGE
I[131] CONTAMINATION ON VEGETATION
JULY — AUGUST — SEPTEMBER
1949
H.I. DEVELOPMENT DIVISION — SITE SURVEY

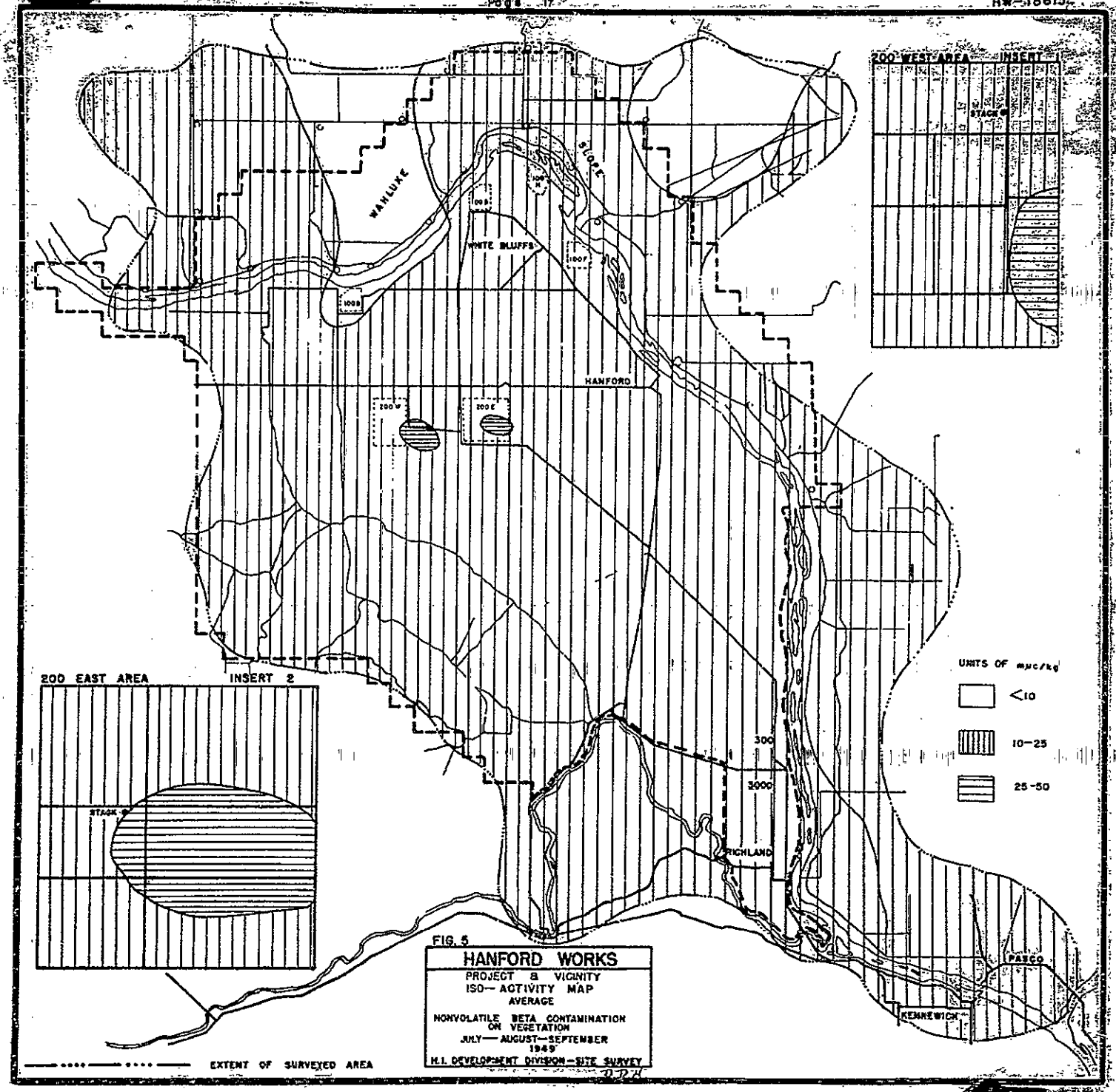


FIG. 5

HANFORD WORKS

PROJECT & VICINITY
ISO— ACTIVITY MAP
AVERAGE

NONVOLATILE BETA CONTAMINATION ON VEGETATION
JULY— AUGUST—SEPTEMBER 1949
H.I. DEVELOPMENT DIVISION—SITE SURVEY

SECTION III

RADIOACTIVE CONTAMINATION IN THE ATMOSPHERE

Measurement of the radioactive contamination in the atmosphere was accomplished by using fixed and detachable ionization chambers, air filters, scrubber solutions, and filter units used to monitor the presence of active particles in the atmosphere. The method of monitoring employed at the various locations was based on the source and type of activity measured and the trend of the current data as compared with measurements made during the previous quarter. The monitoring equipment is concentrated in the operating areas and nearby residential communities of Richland, Pasco, Kennewick, and Benton City; several units are located at points remote to the Hanford Works for the purpose of evaluating background activity in the atmosphere.

Air radiation levels were measured by fixed Victoreen Integrons located at the permanent 614 buildings. Several units were located in each operating area and single units were operating in the residential areas. The average dosage rates did not exceed 1.0 mrep/24 hours at any location during the period July, August, and September, 1949. The dosage rates were consistent from month to month and were comparable with background measurements as determined by detachable ionization chambers. The majority of integron readings were within the drift of the instrument (0.1 to 0.3 mrep/24 hours.) The averages which were greater than 0.6 mrep/24 hours were usually weighted by including several individual readings which were probably due to faulty instrumentation. Consecutive replacement of the integrons at these locations would show that the radiation levels were within the normal expected range as compared with other nearby monitoring units. Summaries of the dosage rates as measured by Victoreen Integrons for this period appear in Table I, which is shown on the following page.

TABLE I

AVERAGE DOSAGE RATES AS MEASURED BY VICTOREEN INTEGRONS

JULY AUGUST SEPTEMBER

1949

units - mrep/24 hours

LOCATION	Number of units	AVERAGE DOSAGE as mrep/24 hours			
		July	August	September	Quarter
100-B Area	3	0.2	0.2	0.3	0.2
100-D Area	3	0.2	0.2	0.3	0.2
100-F Area	3	0.1	0.4	0.4	0.2
200 West Area	3	0.2	0.4	0.1	0.2
200 East Area	2	0.2	0.2	0.3	0.2
Riverland	3	0.1	0.3	1.0	0.4
300 Area	1	0.7	0.5	0.7	0.6
700 Area	1	0.3	0.1	0.3	0.2
Pasco	1	0.3	0.5	0.4	0.4
Benton City	1	0.2	0.6	0.5	0.4
3000 Area (N)	1	0.5	0.7	0.7	0.6
3000 Area (S)	1	0.2	0.2	0.7	0.4

Dosage rates and air radiation levels were also measured by using detachable ionization chambers. Hanford type "C" chambers were used inside the 614 perimeter buildings in the operating areas. Type "M" and "S" chambers were used at representative locations between the operating areas and in the nearby residential communities. Two chambers were used at each location in order to obtain duplicate checks on the measured values and to eliminate those readings which could have been due to leakage. The frequency of reading the chambers was dependent on the amount of dosage previously measured at the location, and on the type of chamber employed for this measurement. A summary of the monthly and quarterly average dosage rates as measured by using these chambers is presented in Table II on page 20.

TABLE II
RADIATION LEVEL OBSERVED WITH DETACHABLE IONIZATION CHAMBERS
JULY AUGUST SEPTEMBER 1949
(mrep per 24 hours)*

"C" CHAMBER READINGS

LOCATION	JULY	AUGUST	SEPTEMBER	QUARTERLY AVERAGE
100-B Area	0.3	0.3	0.3	0.3
100-D Area	0.3	0.3	0.4	0.3
100-F Area	0.3	0.3	0.6	0.4
200 West Area	0.3	0.2	0.4	0.3
200 East Area	0.5	0.4	0.6	0.5
300 Area	0.5	0.4	0.5	0.5

"M" AND "S" CHAMBER READINGS

LOCATION	JULY	AUGUST	SEPTEMBER	QUARTERLY AVERAGE	GROUP AVERAGE
100 Area and Environs					
Route 1, Mile 8	0.44	0.39	0.54	0.46	
Route 2N, Mile 10	0.37	0.34	0.43	0.38	
Route 2N, Mile 5	0.34	0.38	0.55	0.42	
White Bluffs	0.39	0.37	0.60	0.45	
Route 11A, Mile 1	0.81	0.66	0.56	0.68	
Hanford 614 Building	0.48	<0.48	<0.48	<0.48	
Intersection R1 & 4N	0.55	**	0.95	0.75	
Hanford 101 Area	0.38	0.34	0.47	0.40	
100-H Area	0.37	0.37	0.53	0.42	0.49
Within 5 miles of 200 East					
Route 4S, Mile 6	0.94	1.11	1.00	1.02	
Batch Plant	0.54	0.47	0.70	0.57	
Route 11A, Mile 6	0.58	0.54	0.59	0.57	
Route 3, Mile 1	0.63	<0.48	0.71	0.60	
Meteorology 200'	0.94	0.48	0.48	0.63	
234-235 Area	0.36	0.33	**	0.35	0.62
Within 10 Miles of 200 East					
Route 4S, Mile 10	1.17	1.02	0.93	1.04	
Route 10, Mile 1	0.66	<0.48	0.53	0.55	
Route 10, Mile 3	0.78	<0.48	1.16	0.80	
Route 2S, Mile 4	0.94	<0.48	0.93	0.77	0.79
Near 300 Area					
Route 4S, Mile 16	0.86	0.63	0.62	0.70	
Route 4S, Mile 22	0.78	0.64	0.66	0.69	
3000 Area North	0.48	<0.48	<0.48	<0.48	
3000 Area South	0.48	<0.48	<0.48	<0.48	0.55
Outlying					
Richland	0.48	0.48	0.48	0.48	
Benton City	0.48	0.48	0.48	0.48	0.48

* The tabulated dosage rates included the background of the chamber used which varies between 0.3 and 0.5 mrep/24 hours.

** The chambers used during this period were found to be defective.

A review of the quarterly average dosage rates for the period of July, August, and September indicated a probable decrease when compared with similar measurements during the period April, May and June.(8) This decrease ranged from 0.1 to 0.2 mrep/24 hours; the greater decrease was noted in the region within 10 miles of the 200 East Area. In general, dosage rates in the 100 Areas environs and in the outlying communities of Richland and Benton City were within the background (0.3 to 0.5 mrep/24 hours) measured in these areas.

A month to month comparison of the average radiation levels indicated a slight increase during September as compared with the level measured during August. This increase was weighted by higher readings observed during the latter part of September. The weekly average dosage rates for the periods ending September 16 and September 23 were twice as high as previous weeks' measurements at many locations. The increase in air radiation levels observed by using detachable chambers was also confirmed by increased activity noted on the air filters and particle filters during the same period. Decay studies of the activity collected on air filters during these two weeks along with the laboratory analysis of the activity of the particles collected during the same period and comparison with similar measurements obtained at other projects at widely varied locations showed that this activity did not originate at Hanford, but was due to another source.

Table III summarizes the monthly and quarterly averages for filterable beta activity measured during the period July, August, and September, 1949. Table III is presented on page 22.

The filterable beta activity measurements were determined by measuring the activity deposited on CWS #6 filter paper while passing 2 cubic feet of air per minute through the filters. The filters were exposed for weekly periods. In addition to the filterable activity, which is arbitrarily defined to represent longer half-lived fission products (>8 day half life), a small amount of I-131 (contaminated on the order of 5 to 10%) is retained on the filters. Consistent with observations noted in the ionization chambers data, the quarterly averages tabulated

TABLE III
AVERAGE FILTERABLE BETA ACTIVITY IN AIR
JULY AUGUST SEPTEMBER
1949

units - uc/liter

LOCATION	JULY AVERAGE	AUGUST AVERAGE	SEPTEMBER AVERAGE	QUARTERLY AVERAGE
200 East SE	3.8×10^{-10}	4.7×10^{-10}	1.5×10^{-9}	7.5×10^{-10}
200 West, Tower 4	$<5.0 \times 10^{-12}$	*	5.1×10^{-10}	3.1×10^{-10}
Gable Mountain	2.4×10^{-10}	1.5×10^{-10}	5.0×10^{-10}	2.7×10^{-10}
Richland	1.1×10^{-10}	3.0×10^{-11}	3.1×10^{-10}	1.5×10^{-10}
Pasco	*	2.0×10^{-11}	3.3×10^{-10}	1.6×10^{-10}
300 Area	1.4×10^{-10}	8.0×10^{-11}	4.7×10^{-10}	2.2×10^{-10}
200 East, Tower 18	8.9×10^{-10}	4.5×10^{-11}	8.4×10^{-10}	6.9×10^{-10}
100-D Area	6.0×10^{-11}	5.0×10^{-11}	4.1×10^{-10}	1.7×10^{-10}
200 West Gate	6.0×10^{-11}	1.1×10^{-10}	3.9×10^{-10}	1.8×10^{-10}
Benton City	4.0×10^{-11}	2.0×10^{-11}	2.9×10^{-10}	1.1×10^{-10}
Hanford 614	9.0×10^{-11}	5.0×10^{-11}	3.1×10^{-10}	1.4×10^{-10}
105 DR	4.5×10^{-11}	4.0×10^{-11}	*	4.1×10^{-11} **
Hanford 101	1.5×10^{-11}	4.0×10^{-11}	*	3.2×10^{-11} **
White Bluffs	3.5×10^{-11}	3.0×10^{-11}	2.7×10^{-10}	1.1×10^{-10}
3000 Area N	7.5×10^{-11}	7.0×10^{-11}	3.3×10^{-10}	1.5×10^{-10}
200 West Tower 15	4.0×10^{-11}	3.0×10^{-11}	4.8×10^{-10}	1.7×10^{-10}

* Units were removed from construction zones on August 29.
** Quarterly average not representative of September conditions.

in Table III were higher than those observed during the previous period. Again, this increase was weighted by measurements made during the month of September when the average filterable activity showed an increase by a factor of about 10 over those averages obtained during August. The higher average during September was accounted for by a significant increase in filterable activity in the same two weeks during which an increased particle deposition was detected on the filters. With the exception of the September data, the average beta activity measured on the filter papers was consistent with previous observations; activity in the immediate environs of the separations areas was on the order of 10^{-10} uc/liter, and at the perimeter locations and residential communities on the order of 10^{-11} uc/liter. The maximum activity measured during a single week was 2.4 a 10^{-9} uc/liter at the 200 East southeast location during September.

Specific measurements of the average I-131 concentrations in the atmosphere which were started during the previous quarter were continued in this period. The results of I-131 measurements obtained by placing caustic scrubbers (1 liter of 0.5 N NaOH and 0.1 N Na_2CO_3) in series with the air filters are tabulated in Table IV:

TABLE IV
AVERAGE I-131 DETECTED IN SCRUBBERS
JULY-AUGUST-SEPTEMBER
1949

units - uc/liter

LOCATION	July Average	August Average	September Average	Quarterly Average
200 West Gate	5.2×10^{-10}	9.8×10^{-10}	2.7×10^{-9}	1.3×10^{-9}
Benton City	$<1.0 \times 10^{-11}$	3.0×10^{-11}	6.0×10^{-10}	2.5×10^{-10}
200 East SE	5.4×10^{-10}	8.2×10^{-10}	1.1×10^{-9}	8.2×10^{-10}
300 Area	4.0×10^{-11}	6.0×10^{-11}	1.0×10^{-10}	6.9×10^{-11}
Richland	1.0×10^{-11}	4.0×10^{-11}	2.0×10^{-11}	2.5×10^{-11}

The higher concentrations of I-131 were found in locations within the environs of the 200 Areas. Consistent with the air monitoring data summarized earlier in this section, a small increase was noted during the month of September and resulted in a slightly higher quarterly average at most of these locations during this

period. With the exception of the September data, the average I-131 measured in the atmosphere was consistent with previous observations. Activity in the environs of the 200 Areas was on the order of 10^{-10} uc/liter and on the order of x 10^{-11} uc/liter at the outlying stations.

In addition to the air filters used for measuring the filterable beta activity, special filter units were in operation at numerous locations on and ad acent to the Hanford Works for the purpose of determining the concentration of radioactive particles in the atmosphere. These filters consisted of an exposed area of approximately 26 square inches of CWS #6 filter paper through which air was filtered at rates of either 2 or 10 cubic feet per minute. After one week's exposure at a location, the filters were removed and exposed to K-type film for 168 hours. The number of radioactive particles were estimated by visually counting the number of darkened spots on this developed film. Normally, the filters removed from locations on the site were exposed to the film the same week that they were removed from the locations; those filters obtained from off-area locations were exposed approximately 2 weeks after their removal. Table V is a summary of the particle deposition rates at locations in the immediate environs of the separations areas. Table V may be referred to on the following page.

A review of the data summarized in Table V shows that very little fluctuation in the deposition rates was observed during July and August; the data for these two months were also consistent with measurements made during previous quarters. A significant increase in the number of active particles detected was observed on filters which were exposed during the week ending September 16. A slight trend was detected in the data obtained for the week ending September 9, but was not deemed significant. The latter increase was particularly noted at the Meteorology Tower where filtering units were established at 50 foot intervals from ground level to an elevation of 400 feet. This sudden increase was further confirmed when the filters exposed during the week ending September 23 were examined; a

TABLE V
SUMMARY OF PARTICLE DEPOSITION*
JULY-AUGUST-SEPTEMBER
1949
units of 10^{-3} particles/meter^3

LOCATION	JULY AVERAGE	AUGUST AVERAGE	SEPTEMBER AVERAGE	QUARTER AVERAGE
200 East & Vicinity				
2704 (Outside)	0.8	0.4	3.9	1.6
H. I. Garden	-	0.4	4.1	3.3
BY-SE	3.2	0.8	5.4	4.2
BY-NE	0.3	0.5	0.3	0.4
B-Gate	2.3	4.6	14.2	6.9
222- B (Outside)	4.4	3.0	22.6	9.8
2701 (Outside	0.8	0.2	6.6	2.5
2704 (Inside)	0.1	0.5	5.6	2.1
221-B (Outside Gallery)	1.3	1.8	6.7	3.2
222-B Hall	12.6	4.0	6.2	7.7
2701 (Inside)	0.8	1.0	3.5	1.7
222-B Laboratory	121.1	45.1	92.1	82.6
200 West & Vicinity				
2701 (Outside)	-0.3	4.2	9.1	5.0
2722	0.8	1.9	4.6	2.4
T-Gate	1.5	0.6	2.6	1.7
222-T (Outside)	11.8	11.4	7.3	10.6
231	0.3	0.4	22.1	7.0
SO. Guard Tower	0.3	0.2	9.0	2.8
U-Gate	1.1	0.2	0.7	0.7
W. Guard Tower	0.2	0.1	3.2	1.2
2701 (Inside)	2.0	5.8	9.8	8.4
272 (Inside)	1.0	1.5	6.2	2.7
222-T (Inside)	17.2	26.3	25.0	24.5
Meteorology Tower				
3' Level	1.1	0.7	10.2	3.8
50' Level	0.5	0.5	0.7	0.6
100' Level	0.6	0.6	16.1	4.7
150' Level	0.9	0.9	18.7	5.2
200' Level	0.9	0.3	9.5	2.9
250' Level	1.0	0.9	10.0	2.6
300' Level	0.5	1.1	3.6	1.3
250' Level	0.1	0.3	0.3	0.2
400' Level	0.5	0.4	11.0	2.8

* The indicated monthly averages varied slightly from those reported in the monthly Health Instrument Environs reports (5) (6) (7) as this tabulation included the data of the last week of the respective month.

general increase was observed at nearly every location during this period. Analyses of similar data from outlying locations (Table VI) showed that this increase in particles was relatively universal in occurrence and was not confined to the Hanford Site. It was apparent that the particles were not being dispersed from the Hanford stacks as comparisons with other locations indicated a widespread general pattern. Later date studies and correlations with measurements made by associated projects at other locations identified the source of this activity to have been located remote to the Hanford Works. Table VI reviews the particle deposition data for those locations at the perimeter of the project and in nearby stations. The deposition rates and increases discussed above were reflected at these locations in a manner consistent with measurements made on the site (Table V.)

TABLE VI
SUMMARY OF PARTICLE DEPOSITION
ON AREA AND OFF AREA LOCATIONS
JULY AUGUST SEPTEMBER
1949

units of 10^{-3} particle/meter^3

LOCATION	JULY AVERAGE	AUGUST AVERAGE	SEPTEMBER AVERAGE	QUARTERLY AVERAGE
HANFORD AREA LOCATIONS				
100-B Area	<0.2	<0.2	29.0	10.5
100-D Area	<0.1	<0.1	25.1	7.3
White Bluffs	0.3	<0.1	<1.2	0.1
100-F Area	0.1	0.1	27.4	6.1
OFF AREA LOCATIONS				
Benton City, Washington	<0.1	<0.1	6.6	1.6
Pasco, Washington	<0.1	<0.3	37.8	2.3
Richland, Washington	<0.2	0.4	23.2	9.5
Boise, Idaho	<0.3	<0.3	64.3	16.1
Klamath Falls, Oregon	<0.3	<0.3	51.9	12.6
Stampede Pass, Washington	0.5	<0.3	4.0	1.2
Great Falls, Montana	0.5	<0.4	40.1	11.2
Walla Walla, Washington	<0.4	<0.3	16.4	5.7
Meacham, Oregon	<0.3	<0.2	<0.4	<0.1
Lewiston, Idaho	<0.3	<0.3	<0.4	<0.1
Spokane, Washington	0.2	<0.3	61.6	14.7

Table VII is a summary of the number of particles detected on filters at representative locations during the weekly periods mentioned above. Weekly intervals were used in this summary as it was believed that a better evaluation of the sudden increase could be appraised in this manner.

TABLE VII
SUMMARY OF PARTICLE DEPOSITION *
SEPTEMBER
1949

LOCATION	NUMBER OF PARTICLES DETECTED FOR WEEKS ENDING				
	8/26	9/2	9/9	9/16	9/23
100-B	0	0	5	219	25
100-D	0	0	54	167	30
200 East Gate	0	1	3	50	21
231 Bldg. 200 West	0	0	0	194	6
Richland	0	1	0	75	82
Spokane, Wash.	0	0	0	25	153
Walla Walla, Wash.	0	0	0	14	59
Boise, Idaho	0	0	0	12	181
Great Falls, Mont.	0	0	0	2	107

* A complete summary of these data for all locations may be referred to in a previous report.(7)

Radiochemical analysis of the active particles collected during the weeks of September 16 and September 23 indicated the particle acitivty to be from the following radioactive elements: Strontium, 23%; Barium, 12%; Cerium, 7%; and Zirconium, 3%. Approximately 11 percent of the activity was present in the insoluble residues of the undigested portion of the particles examined. A trace amount of alpha activity was detected in a composite sample of the 300 particles which were analyzed while making the radiochemical analysis. A more detailed appraisal of the specific activity detected in the particles may be referred to in a separate report covering this work.(9)

SECTION III

SECTION IV

RADIOACTIVE CONTAMINATION IN RAIN

The opportunities for measurement of radioactive contamination in rainfall were at a minimum during the period July, August, September, 1949, due to the continuation of an abnormally dry summer. A total of only eleven rain samples were obtained from 8 locations in the environs of the Hanford Works during the period. The rain samples were collected in 500 ml. vessels which were placed at twenty-eight representative locations on and adjacent to the project. The absence of measurable rainfall during the major portion of the period presented no opportunity to evaluate beta activity in rainfall at 20 of the locations.

A summary of the rain data for the period July, August, September as measured at the Meteorology Tower near the 200 West Area is presented in Table I; rainfall measurements for the two previous years are included for comparison.

TABLE I
PRECIPITATION MEASURED AT HANFORD WORKS
JULY AUGUST SEPTEMBER
1949

units - inches

MONTHS	1947	1948	1949	35 Year Average*
July	0.71	0.40	0.01	0.15
August	0.68	0.39	0.03	0.20
September	1.34	0.16	0.23	0.34

* This average based on measurements made at Hanford previous to the existence of the Hanford project.

A review of the above table shows that the total rainfall during the quarter was 0.27 inches as compared to an average over the past 35 years of 0.69. The rainfall measured during this period was not a significant change from the previous quarter during which the measured amount of rainfall was 0.19 inches. A summary of the results of the beta activity measurement in rain samples is presented in Table II, which includes all rain analysis performed during the period.

TABLE II

RADIOACTIVE CONTAMINATION MEASURED IN RAIN SAMPLES
JULY AUGUST SEPTEMBER
1949

LOCATION	Number Samples	AVERAGE BETA EMITTERS units - mμc/liter
Meteorology Building	4	4.51
300 Area	1	0.43
Richland	1	0.12
100-B	1	2.28
100-[illegible]	1	0.13
100-[illegible]	1	0.14
Hanford	1	0.10
Riverland	1	0.69

As expected, the higher beta activity was measured in the rainfall at the Meteorology Tower, which is located near the 200 West Area stacks. The average activity of 4.5 mμc/liter included one sample which contained 15.2 mμc/liter. The beta activity measured in the few samples collected was somewhat lower than similar measurements made during the previous quarter; this difference was not deemed significant due to the small number of samples which represented the current period. Previous measurements have shown that the beta activity in the environs of the 200 Areas may approach 200 mμc/liter in individual samples with a predominance of measurements on the order of 20 to 50 mμc/liter. With the exception of the one sample collected from 100-B Area where the beta activity was 2.3 mμc/liter, the beta activity in rain did not exceed 1.0 mμc/liter at any location removed from the separations areas.

SECTION IV

SECTION V

RADIOACTIVE CONTAMINATION IN THE COLUMBIA AND YAKIMA RIVERS

The radioactive contamination in the Columbia River was measured by analyzing samples of river water collected at representative locations as affected by operation of the pile areas. Samples containing 500 ml. of river water were analyzed for the total beta and total alpha emitters; twelve liter samples were analyzed specifically for the alpha emitters and for the activity from uranium and/or plutonium. The activity measurements discussed in this report were made by evaporating the sample and mounting the residue on a flat 1½ inch diameter stainless steel plate. The activity on the plate was counted by employing thin mica-window counters in which the window thickness varied between 3 and 5 mg/cm^2. The counting rates were corrected for counter geometry, decay, background, back-scatter, and chemical recovery yields. The beta activity measurements discussed in this report included only those samples which were counted less than 12 hours after the sample was removed from the river, thereby minimizing exorbitant decay correction factors due to the short half-life sodium (Na-24) present in high concentrations in these samples. Alpha activity measurements were obtained by transfering the residue from the plate to a beaker and ether extracting the residue using aluminum nitrate as the salting out agent. The alpha activity was measured by counting the activity on standard alpha counters and employing corrections for the geometry of the counter and recovery yields of the chemical process.

Table I summarizes the results of the radiochemical analysis for the alpha and beta emitters measured in samples of the Columbia River for the period July, August, and September, 1949.

TABLE I
RADIOACTIVE CONTAMINATION IN THE COLUMBIA RIVER
JULY-AUGUST-SEPTEMBER
1949

LOCATION	Number Samples	ALPHA EMITTERS, dis/min/liter		BETA EMITTERS** µµc/liter	
		Maximum*	Average	Maximum	Average
Wills Ranch	13	10	<6	<50	<10
Above 100-B Area	7	<6	<6	<50	<10
181 B Building	12	<6	<6	58	<10
183-D Building	13	<6	<6	685	195
183-F Building	10	6	<6	400	270
Vantors Ranch	11	8	<6	300	170
Hanford South Bank	12	<6	<6	2130	1285
Hanford Middle	11	<6	<6	1825	615
Hanford North Bank	13	<6	<6	400	215
300 Area	13	<6	<6	480	215
Richland	15	6	<6	1100	375
Pasco Bridge (Kenn. Side)	11	22	<6	390	175
Pasco Bridge (Pasco Side)	10	18	<6	480	190

* Alpha activity results tabulated as greater than 6 dis/min/liter were not confirmed by resamples and subsequent analyses.
** The reporting level for individual results is 50 µµc/liter; for averages including four or more samples, a reporting level of 10 µµc/liter is employed.

The activity measurements tabulated above were made during the period in which the flow rate of the Columbia River continued to decrease from the peak flow observed during the month of May. The river flow as measured by the Power division on July 1 was 1,410,000 gallons per second; similar measurements made on September 26 showed the flow rate to be 533,000 gallons per second. The decreasing flow rate was significant during the months of July and August; however, very little change was noted during the month of September when the flow rate changed only 15,000 gallons per second. The decrease in flow rate observed during this quarter was consistent with observations made during the same period in previous years. Figure 6 is a graphic summary of the trend of the measured flow rate of the Columbia River; the data for the previous three months are included for a better evaluation of the decrease discussed above.

A comparison of the average beta activity summarized in Table I shows no significant difference when compared with similar measurements made during the

previous quarter. As each of the quarters represent periods during which significant changes in flow rate have occurred, the respective quarterly averages tend to agree because the increased flow rate noted during the period April, May and June was comparable in magnitude with the decrease noted during the period July, August and September. Previous correlations have indicated that the amount of activity measured at a location would vary inversely with the flow rates at the times of sampling.(8) A review of the beta activity measurements on a month to month basis during this period show a significant increase in the average activity at all locations sampled. In general, the maximum beta activity results tabulated in Table I were obtained during the latter part of the quarter when the flow rates were at a minimum.

The first significant trace of beta activity in the Columbia River was detected at the 181-D sampling location where the average activity during the quarter was 195 μμc/liter. This activity was representative of the 107 effluent activity as discharged from the 100-B Area effluent basin. The combined affect of the effluent from the 107- B and 107-D Areas were appraised at the 181-F Building where the average activity was 270 μμc/liter. The bulk of the activity was apparently carried along the south shore of the river; samples collected at Fosters ranch on the north side opposite the 181-F location averaged 170 μμc/liter. The contributing 107 effluent from 100-F Area increased the average activity in the Columbia River to 1,285 μμc/liter at the south shore of the Hanford Ferry. Horizontal channeling of the beta activity in the river was in evidence at the ferry crossing; the average beta activity in the middle of the river was 615 μμc/liter as compared with an average of 215 μμc/liter on the north side. The south shore at the Hanford Ferry represented the location at which the maximum beta activity in the Columbia River was detected; individual samples from this location exceeded 2.0 μμc/liter.

The effect of the decay of the 14.8 hour sodium (Na-24) along with the added dispersion of the activity in the river in the twenty-four miles below Hanford

might be appraised from measurements obtained at Richland where an over all average beta activity of 375 μμc/liter was detected. The beta activity in the river at Richland was computed from the results obtained from duplicate samples obtained from the middle of the Columbia River opposite Lee Boulevard, Richland.

Weekly samples were also obtained from one location between Richland and the Hanford Ferry at a point very close to the 300 Area. The waters that are accessible to sampling in this portion of the river are extremely dormant along the shore; an average activity of 215 μμc/liter was not believed representative of the activity carried in the main channel of the river at this location. Continuing down-stream, the added dilution effect of the waters of the Yakima River caused an additional decrease in average beta activity; the activity at the Pasco-Kennewick bridge was 175 μμc/liter on the Kennewick side and 190 μμc/liter on the Pasco side. As in the past, the average activity on the Pasco side was slightly higher than on the Kennewick side; the effect of the entering Yakima River tends to divert the activity in the water of the Columbia to the east shore of the river. (8) Figure 7 is a graphic portrayal of the average beta activity measured at some of the representative locations sampled along the Columbia River.

Measurement of the alpha activity by the ether extraction process for uranium and/or plutonium in the Columbia River water showed the average activity from these sources to be less than 6 dis/min/liter at all locations. Several indications of the alpha activity were obtained in individual samples; however, consecutive analysis of resamples did not confirm this activity. Results of the measurement for alpha emitters at the representative locations may be referred to in Table I. Background measurements for the alpha and beta emitters were evaluated from samples obtained in the Yakima River and in the Columbia River above the 100-B Areas. Samples obtained from the Yakima Horn, Yakima Mouth, irrigation ditch at Lee Boulevard, and in the upper Columbia River showed no detectable activity. The alpha and beta activity in these samples were below the detection limit of the analysis and were comparable with similar measurements made during previous quarters.

Two hundred twenty-six mud samples were obtained from representative locations along the shore of the Columbia River. Two mud samples were taken at each sampling point; one sample was taken from the shore at the water's edge and the second sample was obtained approximately five feet from the shore line below the surface of the water. A summary of the beta activity measured in these samples is presented in Table II.

TABLE II
COLUMBIA RIVER MUD SAMPLES
JULY, AUGUST AND SEPTEMBER
1949

LOCATION	Number Samples	BETA ACTIVITY - mμc/kg			
		On-shore Samples		Five feet from Shore	
		Maximum	Average	Maximum	Average
Near Wills Ranch	26	22	13	19	14
Allard Pump Station	26	81	19	20	14
At 100-H Area	20	21	11	43	15
Below 100-F Area	26	99	25	34	20
Richland Dock	26	27	16	52	20
At 300 Area	24	58	20	56	21
Pasco Bridge (Pasco Side)	26	43	17	21	14
Pasco Bridge (Kenn. Side)	26	32	16	54	18
Hanford Ferry	26	96	27	59	22

A review of the data in Table II shows the average beta activity in mud to have varied from 11 to 27 mμc/kg with a predominance of results around the lower figure. These averages appear slightly higher than those obtained during the previous quarter; however, statistical comparison showed no significant difference between the beta activity measured during the two periods. The maximum results summarized in Table II also appear to be somewhat higher than those observed in the past. On-shore beta activity measurements of 81 mμc/kg at the Allard Pumping Station and 99 mμc/kg at the 100-F Area were 3 to 4 times greater than the maximums of 21 and 35 mμc/kg measured at the same locations during the previous quarter. The wider range of individual results along with the higher maximum activity measured during this quarter was associated with the decreasing flow rate of the Columbia River (Figure 6.) During periods of decreasing flow it would be expected that the beta activity carried by the waters of the Columbia would be detected on

the residual mud along the shore lines when the water recedes.

The mud samples were analyzed for alpha activity due to uranium and/or plutonium by the ether extraction method. The average alpha activity due to these sources was less than 6 dis/min/liter at all locations. Uranium measurements showed activity from this source to be less than 2 ug U/gm of mud (<3 dis/min/gram.)

Ninety-four 500 ml. samples of raw water were obtained at the operating areas on the project. These samples were representative of the water that is carried via the export line from the pumping stations in the 100 Areas to the remaining areas for sanitary water purposes. With the exception of the 100-H Area, the samples were obtained at the 183 and 283 buildings in the 100 and 200 Areas, respectively. The raw water obtained in the 100-H Area was sampled at the temporary pumping station on the dock which is located on the river adjacent to the 100-H Area. A summary of the beta activity measurements made in these samples is presented in Table III.

TABLE III
BETA ACTIVITY IN RAW WATER - RIVER EXPORT LINE
JULY-AUGUST-SEPTEMBER
1949

LOCATION	NUMBER SAMPLES	BETA ACTIVITY - μμc/liter	
		MAXIMUM	AVERAGE
183 Building 100-B Area	14	<50	<10
183 Building 100-F Area	13	230	110
183 Building 100-D Area	13	130	40
283 Building 200-E Area	13	<50	12
283 Building 200-W Area	13	57	14
Dock at 100-H Area	28	270	72

Trace amounts of beta activity were detected at all sampling locations except 100-B Area. The positive beta activity in these raw water samples was primarily from 14.8 hour sodium (Na-24) as determined by decay studies of representative samples. The activity measured in the water corresponds favorably with the activity

measured in the Columbia River since it is the initial source of the export line water. Beta activity measured in the raw water supply in the 200 Areas was less than that measured at the 100-Areas due to the added decay period which results from the duration of the transportation time of the water between the 100 and 200 Areas.

Daily samples were obtained at the 100-H Area throughout the period. As the raw water was pumped directly from the river via the temporary pumping house on the dock, it was expected that higher activity would be found in this system. A review of the data over the three month period shows no significant difference when the measurements made at the 100-H Area were compared with similar measurements made at nearby 100-F Area.

Figure 8 is a graphic presentation of the maximum and average beta activity measured in the raw water samples collected at the Hanford Works operating areas during this quarter. This graph may be compared with Figure 11, Section VII, which shows the resultant beta activity in the sanitary water at the same locations.

The analysis for the alpha emitters in raw water indicated an average of less than 6 dis/min/liter at all areas.

Supplementing the direct sampling of the Columbia River in the immediate environs of the Hanford Works several samples of water, algae and silt were collected from the Columbia River at the Bonneville Dam. The analysis of the 32 liters of water showed the beta activity to be about 30 μμc/liter; one extreme sample showed beta activity of 300 μμc/liter. Quantitative analysis of the latter sample indicated trace amounts of radio-iron (Fe-59) and no detectable amounts of Ca-45, P-32, or K-40.

Analysis of four wet algae samples in which the moisture content was approximately 75% showed beta activity of 27, 27, 23, and 39 mμc/kg, respectively. Radiochemical analysis of this material showed about 14 μμc of beta activity from Fe-59 and about 11 uuc from P-32. The beta activity from Ca-45 and K-40

was less than 3 μμc in the total sample which weighed 11.6 grams, wet basis.

Measurement of beta activity in silt samples which were collected at the base of Bonneville Dam showed this activity to be in the same order of magnitude as that measured at background locations above 100-B Area; the beta activity in these samples ranged from 7 to 13 mμc/kg.

A 30 gallon sample of Columbia River water obtained at the McNary damsite showed a minute trace of beta activity on the order of one to two μμc/liter.

SECTION V

(Please refer to Figures 6, 7, and 8.)

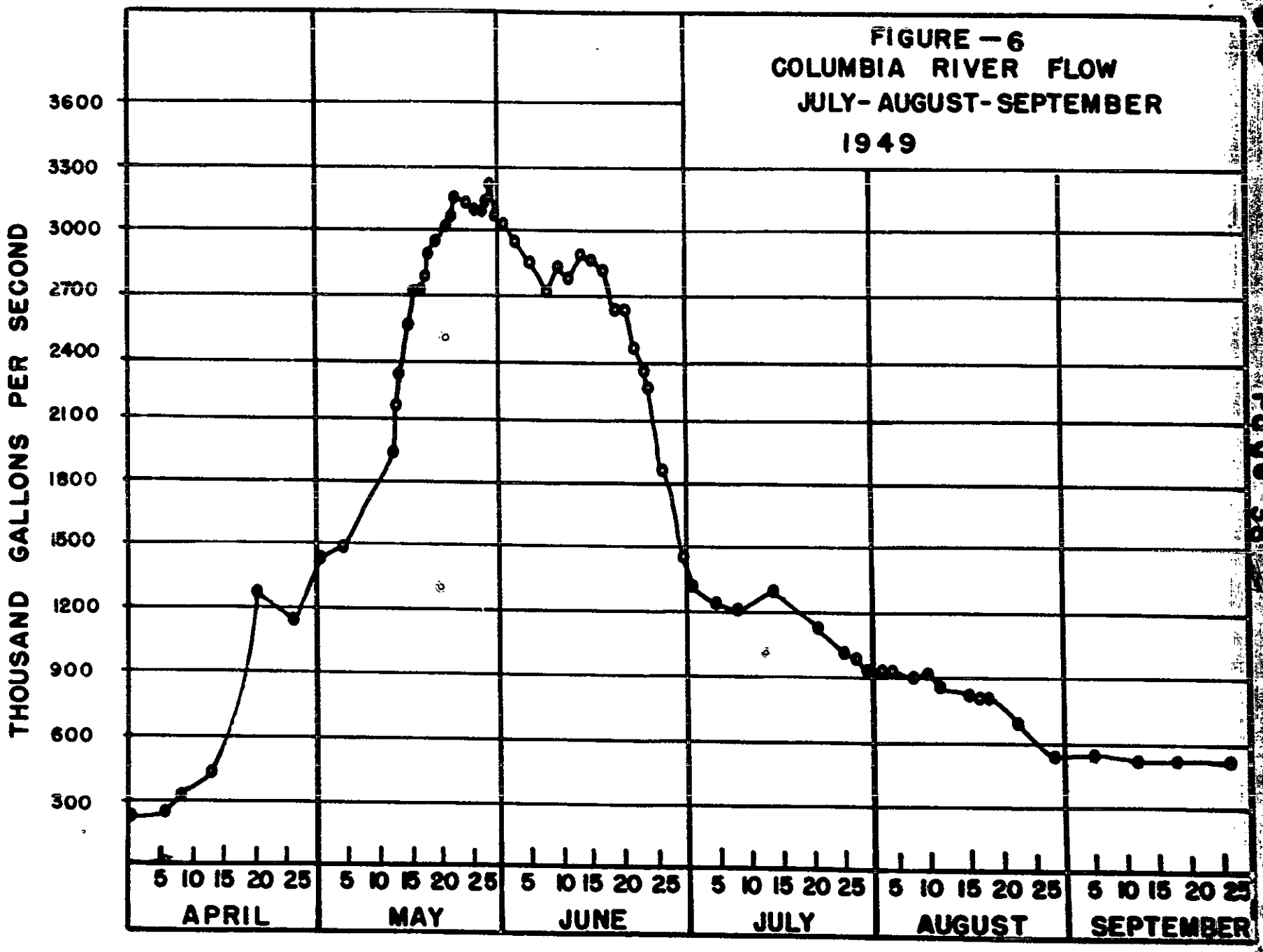


FIGURE-7

AVERAGE BETA CONTAMINATION

IN

COLUMBIA RIVER

JULY-AUGUST-SEPTEMBER

1949

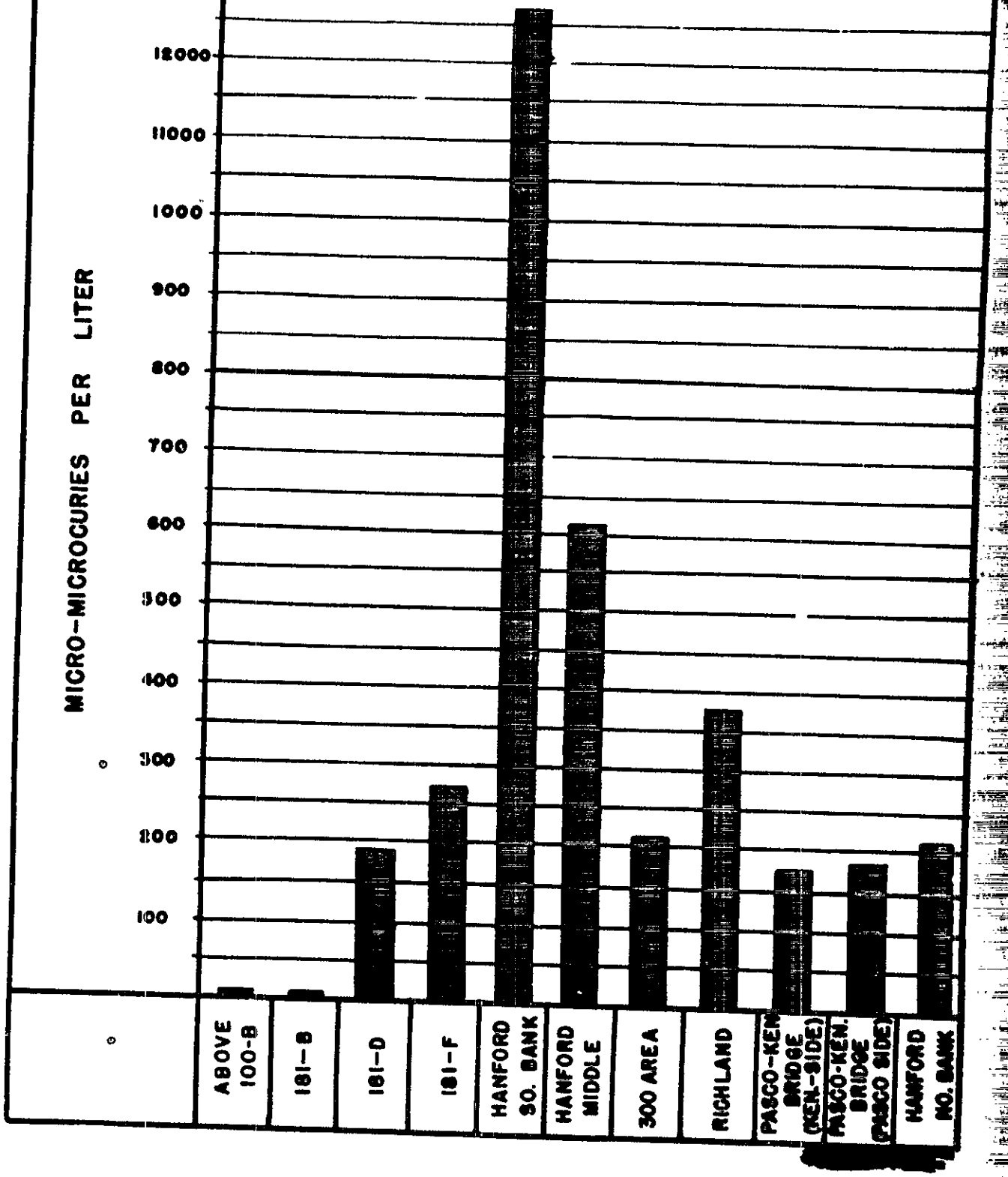
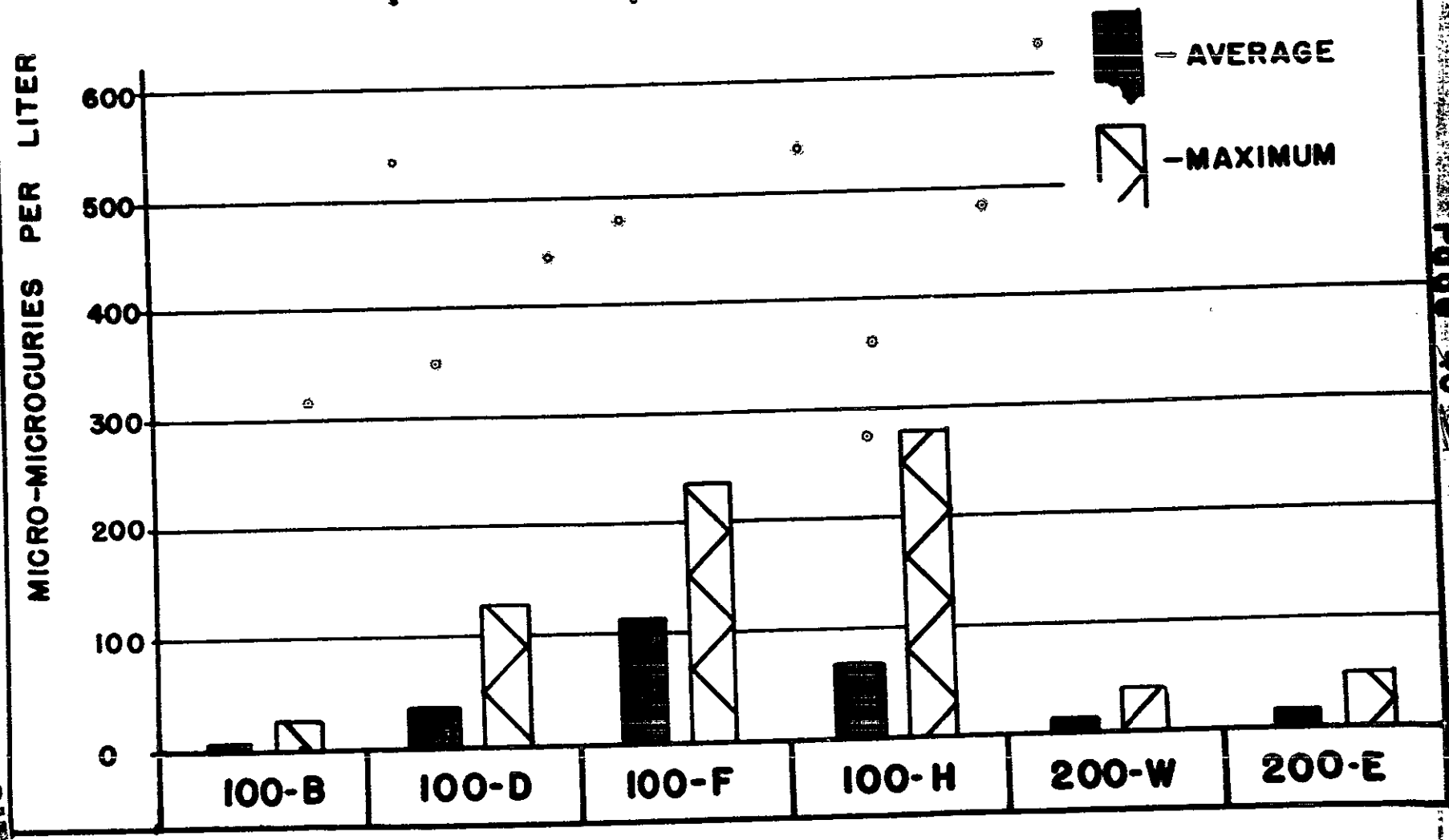


FIGURE- 8

BETA ACTIVITY MEASURED IN RAW WATER
HANFORD WORKS OPERATING AREAS
JULY—AUGUST—SEPTEMBER
1949



SECTION VI
RADIOACTIVE CONTAMINATION IN HANFORD WASTES

100-AREAS:

About one hundred and twenty samples of 100 Area wastes were collected during this quarterly period. The majority of these samples were taken from the 107 basins and were analyzed for both alpha and total beta emitters. The results of these analyses are tabulated below.

TABLE I
RADIOACTIVE CONTAMINATION IN THE 107 BASINS
JULY-AUGUST-SEPTEMBER
1949

LOCATION	AVERAGE ALPHA ACTIVITY dis/min/liter	TOTAL BETA ACTIVITY muc/liter	
		Maximum	Average
100-B Area	<30	427	269
100-D Area	<30	573	301
100-F Area	<30	431	275

The operating power levels during this period were 275, 305, and 275 MW at 100-B, 100-D, and 100-F Areas, respectively. This is the first complete quarter during which the 100-D area pile operated at 305 MW. The power levels at the other two areas remained unchanged from the previous reporting period. The average beta activity measured in each 107 basin is somewhat lower this quarter than last. The July and August averages were unusually low for each area while September showed a significant rise to an activity level comparable with that of the previous quarter.

Alpha activity in the effluent water generally remained below the reporting level of 30 dis/min/liter with occasional samples indicating values as high as 50 or 60 dis/min/liter. Fluorophotometer analysis for uranium in each sample and analyses for plutonium and polonium in spot samples showed no positive alpha activity attributable to these sources.

200 AREAS:

The following table summarizes the results of radiochemical analyses made on samples collected from the 200 Areas waste systems.

TABLE II

RADIOACTIVE CONTAMINATION IN 200 AREAS WASTES

JULY-AUGUST-SEPTEMBER

1949

LOCATION	Type Sample	No. Samples	TOTAL ALPHA ACTIVITY mμc/kg		TOTAL BETA ACTIVITY mμc/kg	
			Maximum	Average	Maximum	Average
T Swamp	Water	32	720*	<30	0.2	<0.1
T Swamp	Mud	22	4.4×10^5	2.0×10^5	300	120
U Swamp	Water	24	270*	<30	<0.1	<0.1
Laundry Ditch	Water	24	13000*	<30	5.3*	<0.1
Laundry Ditch	Mud	11	1.3×10^5	5.6×10^4	240	78
231 Ditch	Water	24	56	<30	0.1	<0.1
300 E "B" Ditch	Water	24	<30	<30	0.3	<0.1
200 E "B" Ditch	Mud	24	5.2×10^4	6.7×10^3	1820	340
234-35 Ditch	Water	12	1350*	<30	<0.1	<0.1
234-35 Ditch	Mud	12	5.0×10^3	2.0×10^3	25	12
Laundry Lint	Solid	11	6.7×10^5	1.9×10^5	250	55
Retention Ponds						
200 East	Water	12	<30	<30	<0.1	<0.1
200 West	Water	8	<30	<30	<0.1	<0.1

* The results so indicated are unusual with respect to other measurements during the quarter and are therefore not included in the average. Subsequent samples did not confirm activity of this magnitude.

With the exception of the indicated unusual high questionable values shown above, the activity levels measured in the 200 Area wastes during the quarter did not deviate more than normally expected from the measurements of the April, May, June quarterly period.

The sample of water collected from the Laundry ditch on September 16, 1949, yielded the highest total alpha activity measurement noted in three years while the beta activity measurement has been equalled only once during the same period. A fluorophotometer analysis of this sample showed 10600 ug U/liter which confirms the alpha activity to be from uranium.

The total alpha activity measured in maximum individual "T" and "U" Swamp water samples was not confirmed by spot fluorophotometer analysis. Previous analyses have occasionally indicated the presence of both uranium and/or plutonium at these locations.

The maximum total alpha activity measured in samples taken from the 234-235 Pipe Outlet was the highest yet measured at this location since sampling was initiated in April of this year. There were no confirming fluorophotometer or plutonium analyses run on this sample and subsequent sampling did not reproduce this high result.

Routine portable instrument (VGM) surveys of the waste swamps and ditches within the separations areas were made during this period. Maximum readings in the vicinity of the "T" and "U" swamps and the Laundry ditch in the 200 West Area were about 400 c/m above instrument background. The 200 East "B" Ditch surveys indicated the maximum contamination level to be 10,000 c/m above the mud near the ditch inlet. A survey of the 200 North ditches in September indicated maximum instrument readings which ranged from about 1000 c/m at the "N" ditch to >100,000 c/m at the "P" ditch inlet.

300 AREA:

Table III summarizes the total alpha and beta activity measured on samples obtained from the 300 Area waste ponds.

TABLE III
RADIOACTIVE CONTAMINATION IN 300 AREA WASTES
JULY-AUGUST-SEPTEMBER
1949

LOCATION	TOTAL ALPHA ACTIVITY dis/min/liter		TOTAL BETA ACTIVITY mμc/liter	
	Maximum	Average	Maximum	Average
Old Pond Inlet (Liquid)	10000	2600	2.5	0.7
New Pond Inlet (Liquid)	8600	2400	4.1	0.7
	dis/min/kg		μc/kg	
Old Pond Inlet (Solid)	5.3×10^6	2.0×10^6	6.2	0.8

The above values are consistent with previous measurements of activity made on samples obtained at these locations. Fluorophotometer analyses show the contaminant at this location to be principally uranium; maximum results measured 5700 ug U/liter and 4800 ug U/liter on liquid samples from the old and new pond

inlets, respectively. Uranium content in mud measured as high as 1.5×10^6 ug U/kg.

Sixty samples were obtained directly from the 300 Area waste line, which empties directly into the old and new ponds. Total beta activity averaged 0.2 mpc/liter excluding an unusually high maximum result of 30.6 mpc/liter. Alpha activity averaged about 500 dis/min/liter with a maximum result of 21000 dis/min/liter measured on a sample collected at the same time as the high beta result noted above. No confirming fluorophotometer analysis was obtained on this high sample; however, analyses of the majority of samples showed an average uranium content of about 250 ug U/liter. Analyses of waste line samples for plutonium showed two results of about 200 dis/min/liter from this source, while the large majority of samples showed no potitive plutonium activity.

SECTION VI

SECTION VII

RADIOACTIVE CONTAMINATION IN DRINKING WATER AND TEST WELLS

Eight hundred and fifty-three drinking water samples were analyzed during the period July, August and September, 1949. Two hundred and sixteen of these samples were 12 liter samples and the remainder were 500 ml. samples. The 500 ml. samples were analyzed for the total beta and alpha emitters; the 12 liter samples were analyzed for the alpha emitters only. The drinking water samples in which the total alpha activity was evaluated were also analyzed specifically for uranium by the fluorophotometer method. Samples which either showed questionable activity or showed alpha activity that was not confirmed to be uranium were further analyzed for plutonium by the TTA extraction process.

The drinking water sources were sampled at frequencies varying from daily to monthly; the frequency of sampling was determined by the sampling location, the probability of finding contamination in the water source, and the trend of past activity measurements.

The activity measurements discussed in this section were determined by evaporating the water samples and mounting the residue on flat 1½" diameter stainless steel plates. The beta activity was evaluated by counting the sample with thin mica-window counters in which the window thickness varied between 3 and 5 mg/cm^2. Corrections for counter geometry, backscatter effect, chemical yield, and decay were applied to the counting results. The alpha emitters from uranium and/or plutonium, were evaluated by transfering the residue from the steel plate to a beaker and ether extracting the residue using aluminum nitrate as the "salting out" agent. After transfering the residue to a stainless steel plate, the alpha activity was evaluated using a standard alpha counter. Corrections for the efficiency of the ether extraction as determined by control sample analysis were applied to this data.

Trace quantities of alpha activity were again detected in the well systems of Benton City and Richland. The amounts of alpha activity measured in these water

supplies were consistent with past data and were again confirmed to be due to uranium, which presumably occurs naturally in this region. The maximum alpha activity was found in the Benton City region where an average of 32 dis/min/liter was detected in the Benton City Water Company well. This average included a maximum alpha activity measurement of 47 dis/min/liter. Samples from the Benton City Store well showed a quarterly average alpha activity of 16 dis/min/liter including a maximum value of 42 dis/min/liter. The alpha activity in all samples was confirmed as uranium by fluorophotometer analyses; the average uranium in the Benton City Water Company Well was 16 µg U/liter and 15 µg U/liter in the Benton City Store Well. The maximum uranium activity measured in Benton City was 25 µg U/liter.

The alpha activity detected in the Richland wells did not approach the magnitude of that detected at Benton City. The well showing the highest alpha activity in the Richland supply was Richland Durand #14, where an average alpha activity of 11 dis/min/liter during the quarter included a maximum measurement of 19 dis/min/liter. Uranium activity in this well varied between 5 and 9 µg U/liter. In general, the total alpha activity at the Richland wells varied between 6 dis/min/liter and 11 dis/min/liter; measurement for uranium in these wells showed this activity to vary between 4 and 11 µg U/liter. The results of the alpha activity measured in samples obtained from the wells of the Richland and Benton City systems are graphically portrayed in Figures 9 and 10.

The only other supply outside of the Richland and Benton City wells which showed alpha activity was the 300 Area sanitary water. The alpha activity measured in the 300 Area water was attributed to occasional pumping of water from the 300 Area wells which are known to contain uranium. Due to the varying volumes of water pumped from day to day, the alpha activity measured in the sanitary water showed considerable fluctuation. Many individual samples showed alpha activity less than 6 dis/min/liter; however, the maximum alpha activity measured was 233 dis/min/liter. Uranium activity detected in the 300 Area sanitary water averaged 6 µg U/liter,

including a maximum of 141 μg U/liter. The 141 μg U/liter was exceptionally high for an individual measurement; the more general high results were on the order of 30 to 35 μg U/liter.

Table I is a summary of the drinking water locations where the alpha activity measured indicated an average above the detectable limit throughout the quarter;

TABLE I
ALPHA ACTIVITY IN DRINKING WATER
JULY-AUGUST-SEPTEMBER
1949

LOCATION*	ALPHA ACTIVITY - dis/min/liter 500 cc samples Maximum	500 cc samples Average	12 liter samples Maximum	12 liter samples Average	URANIUM μg U/liter Maximum	URANIUM μg U/liter Average
Richland Well #2	15	7	7	<6	7	5
Richland Well #4	20	10	13	<6	7	5
Richland Well #12	12	7	<6	<6	4	4
Richland Well #14	19	11	9	7	9	5
Richland Well #15	12	7	9	7	11	7
Richland Well #18	12	6	9	7	8	4
300 Area Sanitary	233	10	38	21	141	6
Benton City Water Company	47	32	22	11	25	16
Benton City Store	42	16	8	<6	25	15

* Weekly samples were obtained from each of the above locations except the 300 Area Sanitary water, which was sampled 63 times during the quarter.

Trace amounts of alpha activity were periodically detected in samples obtained from locations other than those listed in Table I, but in no case did the consecutive samples confirm the alpha activity measurements. A complete tabulation of the locations at which individual samples showed trace alpha activity is presented in Tables II and III. Table II, which is shown on page 48, summarizes the results which were based on 500 ml. samples, and Table III, which appears on page 49, summarizes the results based on 12 liter samples.

TABLE II

ALPHA ACTIVITY IN DRINKING WATER AS MEASURED BY ANALYZING 500 mL. SAMPLES

JULY-AUGUST-SEPTEMBER

1949

LOCATION	NO. SAMPLES	ALPHA ACTIVITY dis/min/liter MAXIMUM	ALPHA ACTIVITY dis/min/liter AVERAGE	URANIUM µg U/liter MAXIMUM	URANIUM µg U/liter AVERAGE
Foster's Ranch Well	3	<2	<2	-	-
Columbia Camp	13	4	<2	-	-
Headgate	13	9	<2	-	-
Hanford Well #1	4	4	2	-	-
Hanford Well #4	4	6	5	-	-
San. Water Hanford #7	44	17	2	7	<2
Raw Water Hanford #7	29	6	5	3	<2
3000 Area Well A	13	13	3	4	2
3000 Area Well B	12	8	2	56	6
3000 Area Well C	12	7	2	5	2
3000 Area Well D	12	43	6	6	2
3000 Area Well E	10	4	<2	3	2
3000 Durand #5	13	6	<2	6	2
Richland Well #13	56	15	5	8	4
Richland Well #2	12	15	7	7	5
Richland Well #4	12	20	10	7	5
Richland Well #5	12	11	4	14	7
Richland Well #12	5	12	7	4	4
Richland Well #14	11	19	11	9	5
Richland Well #15	7	12	7	12	7
Richland Well #16	13	5	2	2	<2
Richland Well #18	13	12	6	8	4
Tract House K 748	13	4	<2	<2	<2
Benton City H_2O Well	12	47	32	25	16
Cobbs Chevron Station	12	7	3	4	2
Barrott's Station	13	4	<2	<2	<2
Kennewick Highland	13	9	2	-	-
Kennewick Standard Sta.	12	8	4	4	3
Riverland	11	4	<2	2	<2
Midway	13	4	<2	<2	<2
Lower Knob	12	44	4	-	-
Will's Ranch	13	3	<2	2	<2
Pasco (H-R Dept)	13	11	<2	<2	<2
Segerson's Ranch	12	5	<2	-	-
Pistol Range	12	9	3	5	3
300 Area Sanitary	62	74	6	14	6
White Bluffs Ice House	12	5	<2	<2	<2
San. Water 100-B	12	5	<2	<2	<2
San. Water 100-D	12	3	<2	<2	<2
San. Water 100-F	12	5	<2	2	<2
San. Water 100-H	35	9	<2	6	<2
San. Water 200-East	13	3	<2	-	-
San. Water 200-West	13	5	<2	-	-

TABLE III

ALPHA ACTIVITY IN DRINKING WATER AS MEASURED BY ANALYZING 12 LITER SAMPLES

1949

LOCATION	NO. SAMPLES	ALPHA ACTIVITY dis/min/liter MAXIMUM	ALPHA ACTIVITY dis/min/liter AVERAGE	URANIUM ug U/liter MAXIMUM	URANIUM ug U/liter AVERAGE
Foster's Ranch	1	2	2	-	-
Raw Water	3	5	3	-	-
Columbia Camp	6	6	3	-	-
Headgate	3	1	<1	-	-
Hanford Well #1	1	<1	<1	-	-
Hanford Well #4	1	4	4	-	-
Hanford Well #7	2	5	2	7	<2
3000 Area Well A	7	4	2	4	2
3000 Area Well B	6	16	4	56	6
3000 Area Well C	7	4	2	5	2
3000 Area Well D	7	6	3	6	2
3000 Area Well E	5	3	2	3	<2
3000 Durand #5	7	6	2	6	<2
3000 Pond Inlet	6	5	2	-	-
Richland Well #13	7	10	6	8	4
Richland Well #2	7	7	2	7	5
Richland Well #4	7	13	5	7	5
Richland Well #5	6	8	4	14	7
Richland Well #12	2	5	5	4	4
Richland Well #14	7	9	7	9	5
Richland Well #15	4	9	7	11	7
Richland Well #16	7	4	2	2	<2
Richland Well #18	7	9	7	8	4
Tract House K-748	7	4	2	<2	<2
Tract House J-635	6	3	2	-	-
Benton City Store	5	8	5	-	-
Benton City Water Co.	7	22	11	25	16
Cobb's Corner	8	4	3	4	2
Kennewick Highlands	5	2	<1	-	-
Kennewick Standard Station	5	2	1	4	2
Barrott's Station	7	3	<1	<2	<2
Riverland	5	2	1	2	<2
Midway	5	2	1	<2	<2
Lower Knob	6	<1	<1	-	-
Will's Ranch	5	2	<1	<2	<2
Pasco H & R Dept	6	1	<1	<2	<2
Segerson's Ranch	5	1	<1	-	-
Pistol Range	4	6	3	5	3
300 Area San.	2	38	21	141	6
White Bluffs Ice House	5	5	2	<2	<2

As in the past, the beta emitters detected in drinking water were confined to those locations which were either located adjacent to the Columbia River or used the Columbia River as their source of water. Except for these few drinking water sources, the average beta activity detected in drinking water supplies was less than 10 μμc/liter at all sampling locations. The locations which were using the Columbia River as the source of their drinking water were confined to the Pasco and Kennewick systems. The maximum average beta activity during the quarter was found in the Kennewick Highlands drinking water, which averaged 52 μμc/liter, including a maximum measurement of 100 μμc/liter. The drinking water in Kennewick as measured by samples obtained from the Kennewick Standard Station on Avenue "C" showed an average beta activity of 26 μμc/liter, including a maximum of 123 μμc/liter. In Pasco, the drinking water showed average beta activity of 41 μμc/liter including a maximum of 69 μμc/liter. The amount of beta activity detected in the Pasco-Kennewick systems was consistent with trace amounts of activity measured in the past. Wells which were located adjacent to the river showing trace beta activity were Richland Well #2 and the White Bluffs Ice House Well; the average beta activity in these locations was 12 and 22 μμc/liter, respectively. The sanitary water at the 100-F and 100-H Areas averaged 24 and 33 μμc/liter of beta emitters, including maximums of 54 and 64 μμc/liter, respectively. The activity in the sanitary water was directly related to the beta activity detected in the raw water (Table III, Section V) in these areas. Figure 11 portrays the average and maximum beta activity measured in the sanitary water in the Hanford Operating Areas. This portrayal may be compared with Figure 8, Section V, which shows the results of similar measurements made in the raw water supply of these areas.

Two hundred and twenty samples were obtained from test wells during the period July, August, and September, 1949. One hundred and eighty-five of these samples were 500 ml. and thirty-five were 12 liter samples. Consistent with previous measurements, the only wells which showed alpha activity greater than

6 dis/min/liter were the wells in the 300 Area system. The maximum alpha activity in 300 Area well #2 was 2073 dis/min/liter; the quarterly average was 137 dis/min/liter. Uranium measurements showed an average of 55 µg U/liter in well #2; the maximum uranium detected in this well was 150 µg U/liter. Table IV summarizes results of the alpha activity measurements in the water obtained from the 300 Area Wells.

TABLE IV
ALPHA ACTIVITY IN 300 AREA WELLS
JULY-AUGUST-SEPTEMBER
1949

LOCATION	Number Samples	Alpha activity - dis/min/liter 500 cc Samples Maximum	500 cc Samples Average	12 liter samples Maximum	12 liter samples Average	Uranium activity µg U/liter Maximum	Uranium activity µg U/liter Average
Well #1	13	267	;05	---	---	187	62
Well #2	50	2073	137	262	84	150	55
Well #3	43	91	31	21	9	85	30
Well #4	11	321	128	---	---	250	102

In general, the alpha activity in each of the 300 Area wells was 3 to 4 times higher during this quarter than during the period of April, May, and June. This increase in activity during this period was consistent with previous years observations and was associated with the higher levels of the Columbia River during this period. It is believed that the seepage from the river tends to introduce the uranium from the 300 Area waste ponds into the 300 Area wells; the amounts of uranium activity tend to increase during periods of higher flow due to the additional seepage of the river at that time.

SECTION VII

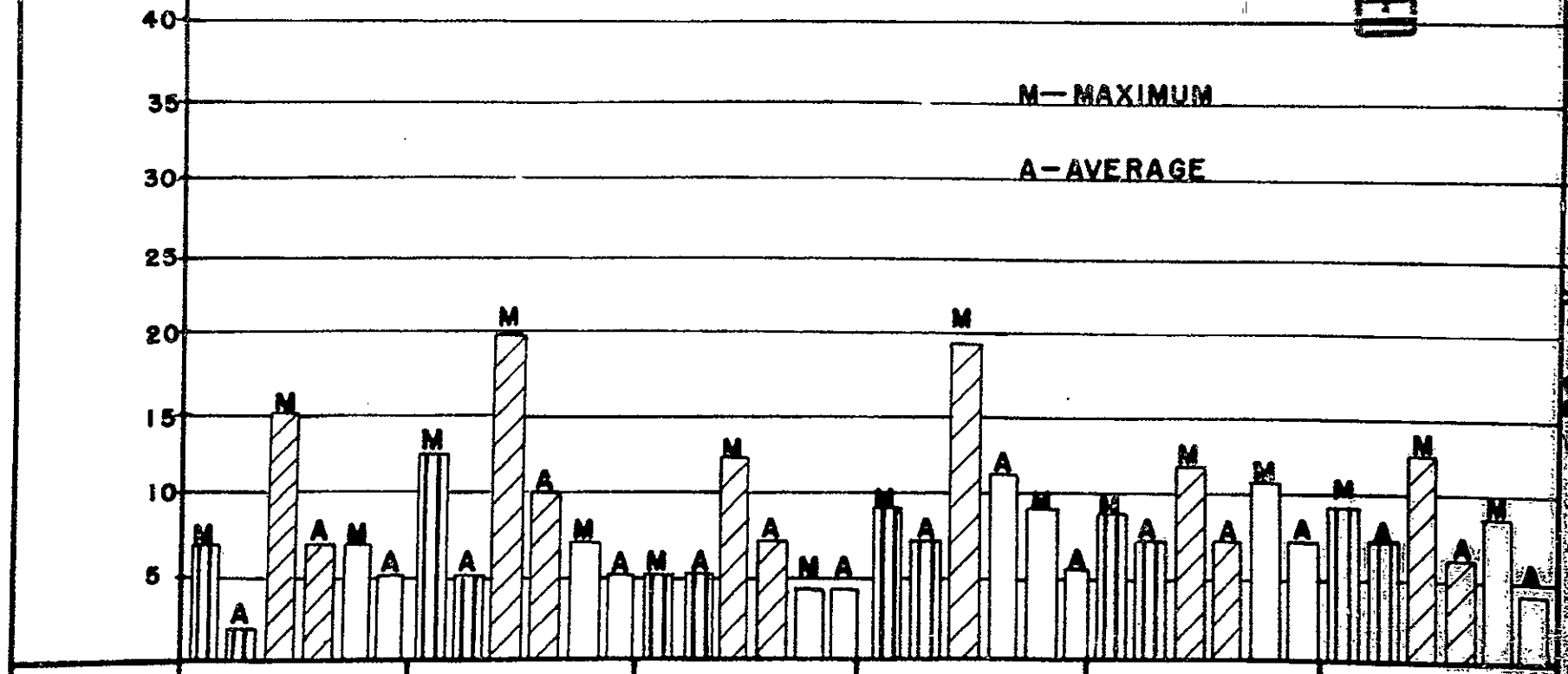
(Please refer to Figures 9, 10, and 11)

H.J. Paas and W. S. Singlevich
Development Division
Health Instrument Divisions

FIGURE — 9

ALPHA ACTIVITY in RICHLAND DRINKING WATER

JULY — AUGUST — SEPTEMBER 1949



FIGURE—10

ALPHA ACTIVITY
in
BENTON CITY DRINKING WATER
JULY—AUGUST—SEPTEMBER
1949

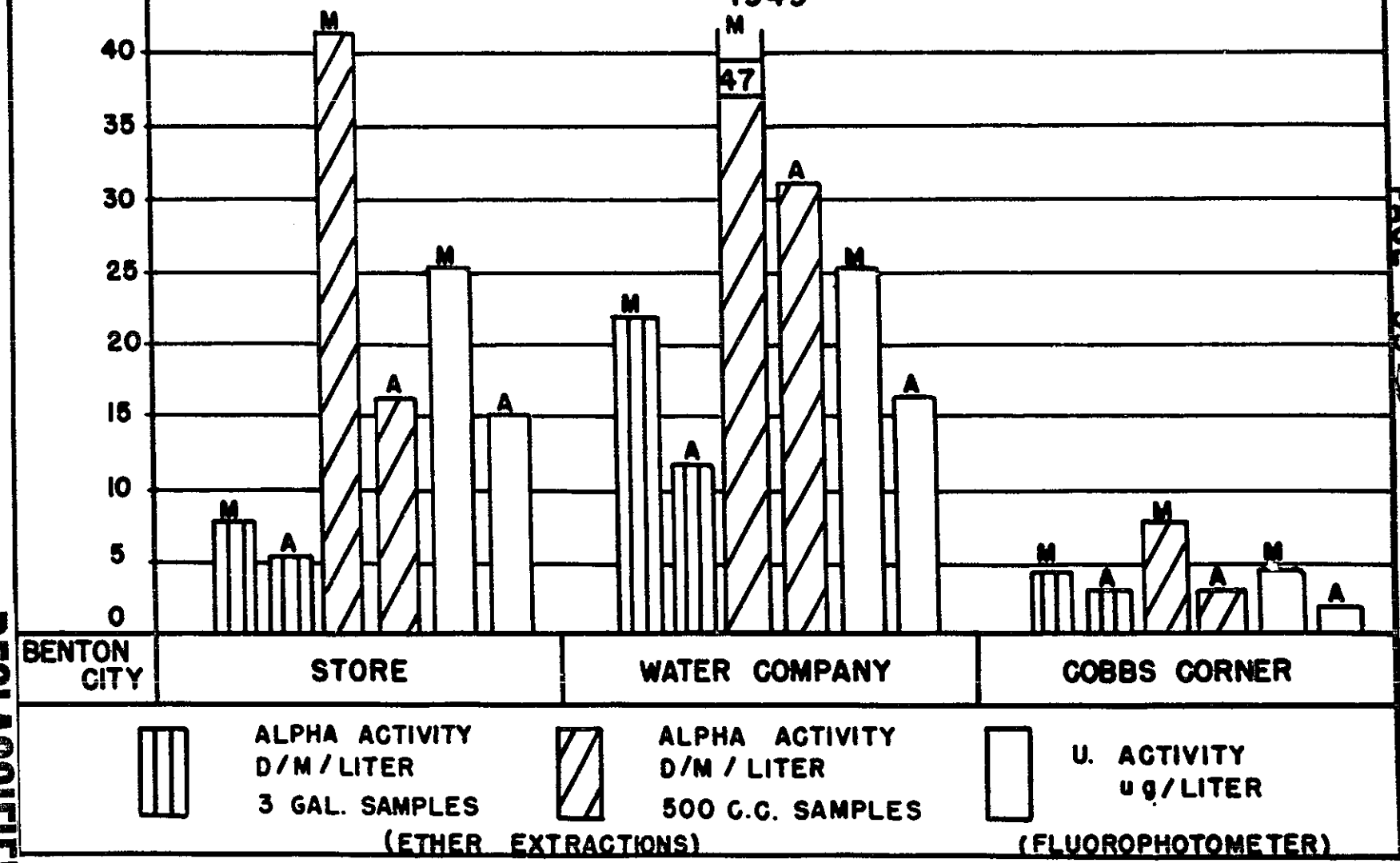
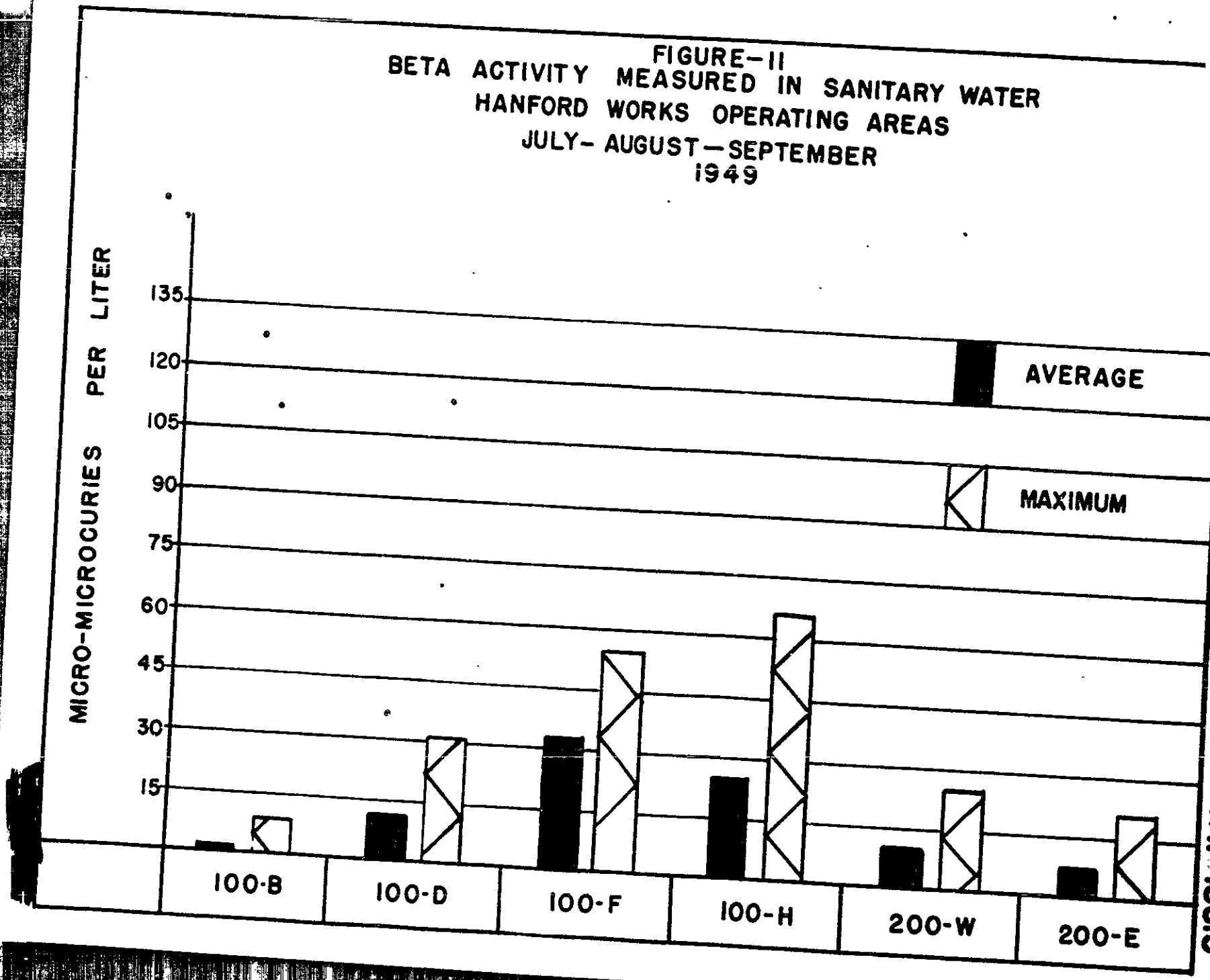


FIGURE-11

BETA ACTIVITY MEASURED IN SANITARY WATER
HANFORD WORKS OPERATING AREAS
JULY- AUGUST-SEPTEMBER
1949



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