HW--8549

Techn

DE91 002386

HW-854

This document consists of 270 pages,

THE TREND OF CONTAMINATION IN THE AIR, THE COLUMBIA RIVER, RAIN, SANITARY WATER, VEGETATION, AND WASTES, AT THE HANFORD WORKS FOR THE PERIOD JULY, AUGUST, SEPTEMBER, --- 1947

[redacted]

By: W. Singlevich

Date: December 28, 1947

[redacted]

Medical Department (H.I. Section)

General Electric Company

Hanford Works

THE TREND OF CONTAMINATION IN THE AIR, THE COLUMBIA RIVER, RAIN, SANITARY WATER, VEGETATION, AND WASTES, AT THE HANFORD WORKS FOR THE PERIOD JULY, AUGUST, SEPTEMBER -- 1947

INTRODUCTION

This report summarizes the contamination observed at the Hanford Works and vicinity for the period July, August, and September, 1947.

Daily or weekly trends for all sampling locations as included in previous reports are omitted except in those cases where a true trend can be established. Statistical analysis to determine significant values and differences is used whenever possible.

The report is divided into the following topic sections:

SECTIONS:

Section I	Meteorological - Wind conditions
Section II	Extent of beta contamination in air and radiation level in air
Section III	Extent of contamination in the Columbia River
Section IV	Extent of beta contamination in rain
Section V	Extent of alpha and beta contamination in sanitary water
Section VI	Extent of beta contamination on vegetation
Section VII	Extent of contamination in Hanford wastes.

An appraisal and review of all the results is considered in detail for each section.

Map 1 is a Project map in which are shown the types of samples taken, and the locations from which the data in this report were gathered.

SECTION I
Meteorology Data

A summary of the meteorological conditions as observed and measured at the Meteorology Station, 622 Building, 200 West Area, is graphically represented in Figures 1-A, 1, and 2. Figure 1 shows the fraction of time that the winds prevailed as broken down in averages per month for the period July, August, and September, 1947. Figure 1-A shows the overall three month average wind direction expressed as percent of time observed.

For this period, the wind direction prevailed 22% of the time from the WNW with the prevailing quadrant for the wind direction being from the West 66% of the time. This varies somewhat from the prevailing wind from the North (54% of the time) for the last quarter (April, May, June, 1947).

Figure 2 shows the wind dilution factors observed. A study of the graph indicates a trend towards dilution factors which are greater than 500:1 ratios. It is of interest to observe that the fraction of time when the dilution factor was in a ratio of less than 500:1 for the overall period of July, August, and September was about 11% of the time while a study of the wind dilution factors during actual hours of dissolving shows that the fraction of time at which the dilution factor was less than 500:1 ratio is negligible. (Actually, only one hour of dissolving time was during a period when the dilution factor was less than 500:1 ratio).

These dilution factors are considerably more favorable towards dispersing the 200 stack gases formed during dissolving in the 200 Area than those observed during the last quarter in which the dilution factor was less than 500:1 about 10% of the time, and 500 - 1000:1 about 20% of the time.

SECTION II
Air-Borne Contamination and Air Radiation Level

Radiation levels in the air and airborne contamination have been measured using detachable ionization chambers and filters, respectively. Map 2 is a location map of the air sampling equipment.

Table I summarizes the radiation levels observed using the "M" and "S" type detachable ionization chambers. The readings vary from 0.45 mrep per 24 hours at the 100 Area region to 0.88 mrep for 24 hours near the 300 Area. These readings are lower by a factor of 2 to 4 from the levels observed for the last period.

C" Chamber readings (see Table I) varied from 0.24 mrep per 24 hours at 100-B Area to 0.50 mrep per 24 hours at 200-East Area

Table II shows results obtained by use of filters. 200-East Area showed less than one-half as much airborne contamination as for the previous quarter. Gable Mountain Area was about four times less for this quarter as compared to the last quarter. Benton City, Richland, 300 Area, and Pasco, were all slightly lower than that observed in the last period.

Figure 3 is a graphical representation of the beta activity found on the filters at the listed locations. A statistical analysis of these data indicated that on the basis of twelve to thirteen samples taken at each location over a period of three months, no significant difference was found among samples taken at Pasco, Richland, 300 Area, and Hanford. The highest T value of 1.40 was found in comparing Pasco and Richland. Benton City was found to be significantly higher than the above mentioned locations.

METHODS AND EVALUATION

The M and S Chambers are cylindrical type, aluminum covered ionization chambers, placed in pairs at the various locations. These chambers are charged by a minometer and the rate of discharge is measured at regular intervals using the same minometer. The C chamber is basically the same as the M and S chamber except that the sides are constructed of heavy semi-waterproof cardboard.

The filter program consists of a continuous intake of air through a filter about 1-3/4 inches in diameter. The rate of air flow through the filter is about two cubic feet per minute. These filters are counted directly on thin mica-window counters. Corrections are made on these filters for geometry and decay with the assumption that all beta activity comes from 8 day I^{131}.

(SEE TABLES I AND II)

SECTION III
Columbia River Contamination

The average flow of the Columbia River during the period July, August, and September, 1947, as measured by the Power Department near Richland was 1,090,000 gallons per second; the peak flow during this period was 2,025,000 gallons per second. The river flow is now receding and the recorded flow for the latter part of September was only about 540,000 gallons per second; this is still slightly higher than the average flow for the first three months of 1947 which was about 350,000 gallons per second. Figure 5 shows graphically the trend of Columbia River flow for the period, July, August, and September, 1947.

Figure 6 shows the average beta contamination in the Columbia River at various locations. The lowest levels observed were at 181-F and 181-D; the activity was less than 10^{-5} μc per liter. Contrary to previous findings, the north and south banks of the Columbia River at Hanford were not significantly different in the average beta activity found. The middle of the river was significantly lower than the north and south banks. Findings for the last quarter indicated that the south bank of the river was significantly higher than the middle and north bank, respectively. The river showed somewhat higher concentrations of activity than that observed for the last quarter; this is an anticipated trend following the decrease in flow of the Columbia River.

Figures 7 and 8 portray graphically the results of a special survey of the Columbia River in which samples of the river were taken at various locations within a time interval of 2-3 hours and measured for beta activity within another two hours. The purpose of this test was to determine the activity of the river at various locations at a given time, and to determine how much of this activity was present in some of the Kennewick drinking water which is supplied from the Columbia River.

Positive indications of beta activity were found in the Columbia River ranging from 7.6×10^{-4} μc/liter at a point two miles below 100-D Area, to 2.7×10^{-5} μc/liter in the Columbia River near Sacajawea Park. A reading of 4.0×10^{-5} μc/liter was measured in the Kennewick drinking water as supplied from the Columbia River; this is significantly lower (about 1/2) than 7.8×10^{-5} μc/liter measured at the Kennewick Pump House on the Columbia, but significantly higher than the 1.8×10^{-5} uc/liter observed in a sample of water from the Bus Depot in Kennewick (source of supply - Municipal Well in Kennewick). Absorption and decay studies of the activity in the Kennewick domestic water showed that most of the activity was due to 14.8 hour radio-sodium. The observed readings of 4.0×10^{-5} μc/liter for radio-sodium is well below the present established tolerance of 4.9×10^{-7} μc/liter of water. No significant alpha activity was found in the Kennewick water.

METHODS AND EVALUATION:

All river water is analyzed by evaporating a 500 ml. portion of the sample and transferring the residue to a 1-1/2 inch diameter stainless steel plate. The residue is counted directly for beta and alpha activity on a thin mica-window counter and on a standard 52% geometry alpha counter, respectively.

Laboratory tests indicate essentially a 100% yield for measuring the beta activity with 1.0 MEV energy beta, and slightly less than 50% for alpha activity.

All counting rates are corrected for geometry and decay.

SECTION IV
Extent Beta Activity in Rain

Figure 9 shows the average beta activity found in rain at various locations around the Project. A maximum average activity of 3.5×10^{-2} μc/liter was found in the 200-West Area; this reading is significantly higher than the 2.6×10^{-2} μc/liter found in the 200-East Area. This condition is the reverse of what one would expect after observing that the overall average on airborne (Fig. 3) and vegetation (Fig. 10) contamination found was consistently higher in 200-East Area rather than 200-West Area.

Because of the relatively small number of samples analyzed (ranging from a total of 3 to 6 samples per area), a T test shows that there is no significant difference among the activities found at Pasco, Benton City, Richland, 700 Area, 300 Area, Hanford, and the 100 Areas.

[redacted]

12/23/44

METHODS AND EVALUATION:

Rain samples are collected in open vessels placed at the various locations. The rain is evaporated (after reducing the free iodine with sodium thiosulphate to prevent loss by volatilization), and counted directly on a thin-mica-window counter. It is assumed that all the activity is due to 8-day iodine, average energy 0.6 MEV.

It should be noted that current experimental evidence indicated the presence of an active filterable substance in some rain samples. Preliminary investigation revealed that filtering of the rain removes most of the activity from the rain; a radiograph of the filter showed that most of the activity was sorbed out on the filter paper; small individual particles which were slightly more active than the overall contamination on the filter were isolated. The exact origin of these particles is not yet known. Decay curves of some of these very active rain samples indicate a relatively long half-life.

Rain samples analyzed for this quarter were not filtered and some of them may be in error as all corrections were made with the assumption that all activity was due to I^{131}. All current rain samples are being filtered and both filtrate and filter are measured for contamination.

SECTION V
Extent of Contamination in Sanitary Drinking Water

Table III summarizes the average beta contamination found in the sanitary and drinking water. No significant alpha contamination was found in any of the drinking water which could be duplicated on a resample except for the 300 Area Sanitary Water and 300 Area Wells #1 and #2 which are known to be contaminated with uranium. Some minute quantities of alpha activity from uranium are being found in Richland Well #13, Benton City water, and White Bluffs water, ranging from 2 to 10 parts per billion; this quantity of uranium is probably a natural amount present in this water.

Figure 12 shows the trend of alpha activity from uranium in the 300 Area Well #1. With the river flow reaching its minimum level, and with a corresponding drop in the level of water in the well, the contamination in the well is dropping off to negligible quantities. The 300 Area Sanitary water and Well #2 are following the same trend.

A statistical analysis of some of the sanitary waters was made with the following summary: (Please refer to Table III for levels of contamination).

No significant difference was found in comparing the average activity found in Richland Durand #13 and 200-West Area sanitary water; between Kennewick and Pasco, and between 100-F and 100-D sanitary water. There was a doubtful significant difference found in the beta activity when Richland Well #13 and Kennewick drinking water at 614 Building were compared; White Bluffs water was found to be significantly higher in beta activity than that detected in Richland Durand Well #13.

METHODS AND EVALUATION:

The procedures and limitations for analyzing sanitary water are essentially the same as described for analyzing river water. All sanitary water is analyzed in laboratory areas free from all contamination.

[redacted] UNCLASSIFIED

SECTION VI
Extent Vegetation Contamination

The total amount of radioactive iodine and xenon expelled from the 200-East and West Area stacks, which accounts for the contamination found on the vegetation at the Hanford Works and vicinity, as calculated for the period July, August, and September, 1947, is tabulated below:

	200-East Area		200-West Area	
Month	8-Day Iodine	Xenon	8-Day Iodine	Xenon
July	1176	103.5	891	74
August	851	71.5	717	53.5
September	566	37.5	309	33.5

Note: All above values are in curies (c).

The overall average beta contamination on vegetation (see Fig. 10) found for this quarter is lower by a factor of about 2 when compared to the previous quarter.

The overall average vegetation contamination found at Pasco, Kennewick, Benton City, Richland, Hanford, and the 100 Areas was well below one-half the tolerance value of 0.2 μc/kg. The levels in the 200 East and 200 West Areas have dropped by more than a factor of 2 when compared to the average level found in the last quarter.

A series of T tests were calculated in an effort to determine significant differences between averages of contamination found at the various locations.

A summary of this study follows: (Please refer to Fig. 10 for relative levels of contamination).

No significant difference between Richland NE and Pasco NE was found: comparison between Pasco and Benton City, Richland NE and Benton City indicated a doubtful significant difference. Samples taken at the meteorology station, 200-West Area, Hanford Gate, and Gable Mountain were significantly higher than those taken in Richland.

Map 3 is an isodose chart showing the spread of stack gas contamination (8-day radioiodine) on vegetation lying to the west and southwest of the 200 Areas stacks; this trend is in accordance with the average overall wind direction observed as shown on Map 3. The overall contamination is less this quarter than that observed last quarter. The spots found at the 100 Areas, which are higher than the immediate surroundings, were found to be significantly higher. However, the average value of 0.105 μc/kg found near Kadlec Hospital in Richland was found, by statistical analysis, not to be

significantly different from the average value of 0.044 μc/kg found in the northeast section of Richland. The value 0.106 μc/kg is still below the currently accepted tolerance value of 0.2 μc/kg for 8 day I^{131}.

A special survey of the Benton Gap region was made in August. Samples were taken at 50 feet elevations from river level of about 460 feet to summit of about 3400 feet. The average beta contamination found on that part of the Gap to the northwest side of the Yakima River was 0.023 μc/kg; the maximum value found was 0.085 μc/kg at 2750 feet. A statistical analysis shows that this maximum value is significantly higher than the overall average. The average beta contamination found on the part of the Gap to the southeast of the Yakima River was 0.035 μc/kg; the maximum value was 0.071 μc/kg at an elevation of 600 feet. A statistical analysis of the averages of contamination found on each side of the Gap yielded a T value of 1.12 which indicated no significant difference between the amount of contamination found on each side of the Gap. Figure 11 shows graphically the individual amounts of contamination found at the various altitudes of one side of the Benton Gap region. Points 1, 2, and 3, shown on the graph are values significantly higher than the overall average found for the beta vegetation contamination there. Figure 4 summarizes the beta contamination found in areas off the reservation and beyond Pasco.

METHODS AND EVALUATION:

For the measurement of activity in vegetation, one gram samples are weighed, mounted on standardized mounting cards and counted directly on a thin mica-window beta counter. Corrections for self-absorption losses, geometry, and decay are based on the assumption that all the activity was due to 8-day radioiodine, (I^{131}).

SECTION VII
Waste Contamination

The average contamination observed in the 100 Area wastes for the period July, August, and September 1947, was:

Location	Beta Contamination	Alpha Contamination
1904-B	4.0×10^{-3} μc/liter	$1.0 \pm [1.5]$ d/m/liter
107-D	14.4×10^{-2} " "	$0.6 \pm [1.2]$ " " "
107-F	16.1×10^{-2} " "	$0.6 \pm [1.2]$ " " "

The average contamination detected by means of a portable GM counter at the 200 North Area ditches for this period was:

"H" Ditch	- - - - - - - - - - - -	about 56,000 counts per minute
"P" Ditch	- - - - - - - - - - - -	" 44,000 "
"R" Ditch	- - - - - - - - - - - -	" 63,000 " " "

Eight surveys of the fourteen test holes around the waste lines in the 200 West Area as measured by a GM probe indicated no unusual readings except Test Hole "E" which consistently read higher than the background of 50 counts per minute by a factor varying from 2 to 5.

Two complete surveys of the 16 test holes in 200-East Area by the same method indicated no unusual readings except at Test Holes #1, #4, #12, and #13 which were about twice the background of about 50 c/m.

Twelve surveys of the 200-West and 200-East waste lines for this period by means of a GM portable counter showed no consistently significant readings above the normal background.

A brief summary of the 241-T Swamp Area contamination is tabulated below. This summary covers the period from January to August, 1947.

Water Samples	Beta Activity		Alpha Activity	
Location	μc/liter Maximum	μc/liter Average	d/m/liter Maximum	d/m/liter Average
T Swamp - Inlet	5.1×10^{-4}	4×10^{-5}	100	20
T Swamp - W. Side	5.6×10^{-4}	1×10^{-4}	960	150
T Swamp - So. Side	0.31	1.2×10^{-3}	800	150

Mud Samples	Beta Activity		Alpha Activity	
Location	μc/kg Maximum	μc/kg Average	d/m/gm Maximum	d/m/gm Average
T Swamp - W.Side	1.2	0.27	60	30
T Swamp - So.Side	1.4	0.5	120	40

A brief summary of the beta contamination found in the 300 Area Retention Basin based on twenty-eight waste solution samples and thirty waste solid samples for this period is tabulated below:

Type Sample	μc per liter			μc per liter
	July	August	September	Overall Average
Waste Solutions	1.1×10^{-3}	6.7×10^{-3}	2×10^{-3}	3.3×10^{-3}
		μc per kg		μc per kg
Waste Solids	0.8	3.2	1.0	1.7

METHODS AND EVALUATION

The test holes surveys were made by lowering a G.M. probe to within six inches of the approximately eleven foot deep hole and taking an overall count for a period of five minutes.

The waste line surveys are made by use of a G.M. probe mounted on the side of a carryall truck such that the probe rests about six inches from the ground. The truck is driven along at a slow constant speed. The rate of activity contamination, if any, is automatically recorded on a Micromax recorder.

Analysis for waste solutions is made by evaporation of a 100 ml. sample and counting the residue directly for alpha activity in the standard alpha counter and for beta activity on a thin mica-window counter. No correction is made for self-absorption losses, but recent preliminary investigations indicate that the alpha activity reported for direct counts without corrections is low by a factor varying from 2 to 10, depending upon location of sampling.

Waste solids are analyzed by drying a one-gram sample and counting directly for alpha and beta activity. In this report the waste solid data is not corrected for self-absorption losses, but preliminary investigation indicates that the direct counts are low by a factor varying from 2 to 20, depending upon where the samples are taken. These current correction factors are only approximations; more data is needed before these factors can be used.

W. Singlevich

WS:swc

W. Singlevich

TABLE I

Radiation Levels Observed With Detachable Ionization Chambers (Mrep per 24 Hours)

CHAMBER READINGS

"C" Chambers in mrep per 24 Hours				1947
Location	July	August	September	Average
100-D	.25	.28	.34	.29
100-B	.26	.21	.26	.24
100-F	.31	.31	.33	.32
200-E	.58	.51	.40	.50
200-W	.32	.49	.33	.38
300	.33	.35	.41	.36

"M" & "S" Chambers in mrep per 24 hours				1947
Location	July	August	September	Average
100 Area and Environs				
Rt. 1 Mile 8	0.48	0.24	0.48	
Rt. 2 Mile 10	0.48	0.24	0.24	
Rt. 2N Mile 5	0.48	0.48	0.24	0.45
Rt. 11A Mile 1	0.72	0.72	0.72	
Rt. 1 Mile 5	0.24	0.48	0.48	
Within 5 miles of 200 Areas				
Rt. 4S Mile 6	1.44	0.72	0.48	
Rt. 11A Mile 6	0.72	0.72	0.72	0.76
Rt. 3 Mile 1	0.72	0.72	0.48	
622 Building	0.72	1.20	0.48	
Within 10 miles of 200 Areas				
Rt. 4S Mile 10	0.96	0.96	0.72	
Rt. 10 Mile 1	0.48	0.72	0.48	0.76
Rt. 10 Mile 3	0.96	0.72	0.48	
Rt. 2S Mile 4	0.72	0.72	1.20	
Near 300 Area				
Rt. 4S Mile 16	0.72	1.44	0.48	0.88
Rt. 4S Mile 22	0.72	1.44	0.48	

All the above values include the background measurements at the monitored locality.

TABLE II

AIR SAMPLING PROGRAM

Period - July, August, Sept.

1947

Location	μc per liter
1. Pasco	4.9×10^{-10}
2. Richland	2.2×10^{-10}
3. Benton City	8.8×10^{-10}
4. 300 Area	4.0×10^{-10}
5. 200 East SE	3.1×10^{-10}
6. 200 East Tower	30.7×10^{-10}
7. 200 East Tower #18	64.4×10^{-10}
8. 200 West - East Center	57.8×10^{-10}
9. Hanford	3.6×10^{-10}
10. Gable Mountain	10.3×10^{-10}
11. 100-D	26.4×10^{-10}

TABLE III

Sanitary Water Surveys

Hanford Works and Vicinity

July - August - September

1947

Location of Sample		Average Beta Activity
	No. Samples	μc per liter
Columbia Camp	13	4.1×10^{-6}
Kennewick (at 614 Bldg.)	13	9.3×10^{-6}
Pasco	13	7.2×10^{-6}
Richland Durand #13	64	4.5×10^{-6}
3000 Area #2	13	5.3×10^{-6}
Kennewick - Std. Station Rt. 41C	2	0.9×10^{-6}
300 Area Well #1	62	5.1×10^{-6}
300 Area Well #2	63	6.9×10^{-6}
300 Area Sanitary	62	6.0×10^{-6}
200 East Sanitary	9	3.6×10^{-6}
200 West Sanitary	14	3.5×10^{-6}
White Bluffs	58	7.2×10^{-6}
100-B Sanitary	13	10.0×10^{-6}
100-D Sanitary	13	4.4×10^{-6}
100-F Sanitary	13	6.1×10^{-6}
Hoadgate	13	3.1×10^{-6}

13 B70

FIG 1

SUMMARY AIR CONDITIONS—622 BLDG.

JUL AUG SEPT — 1947

WIND DIRECTIONS

OVERALL AVERAGES

PER CENT TIME OBSERVED

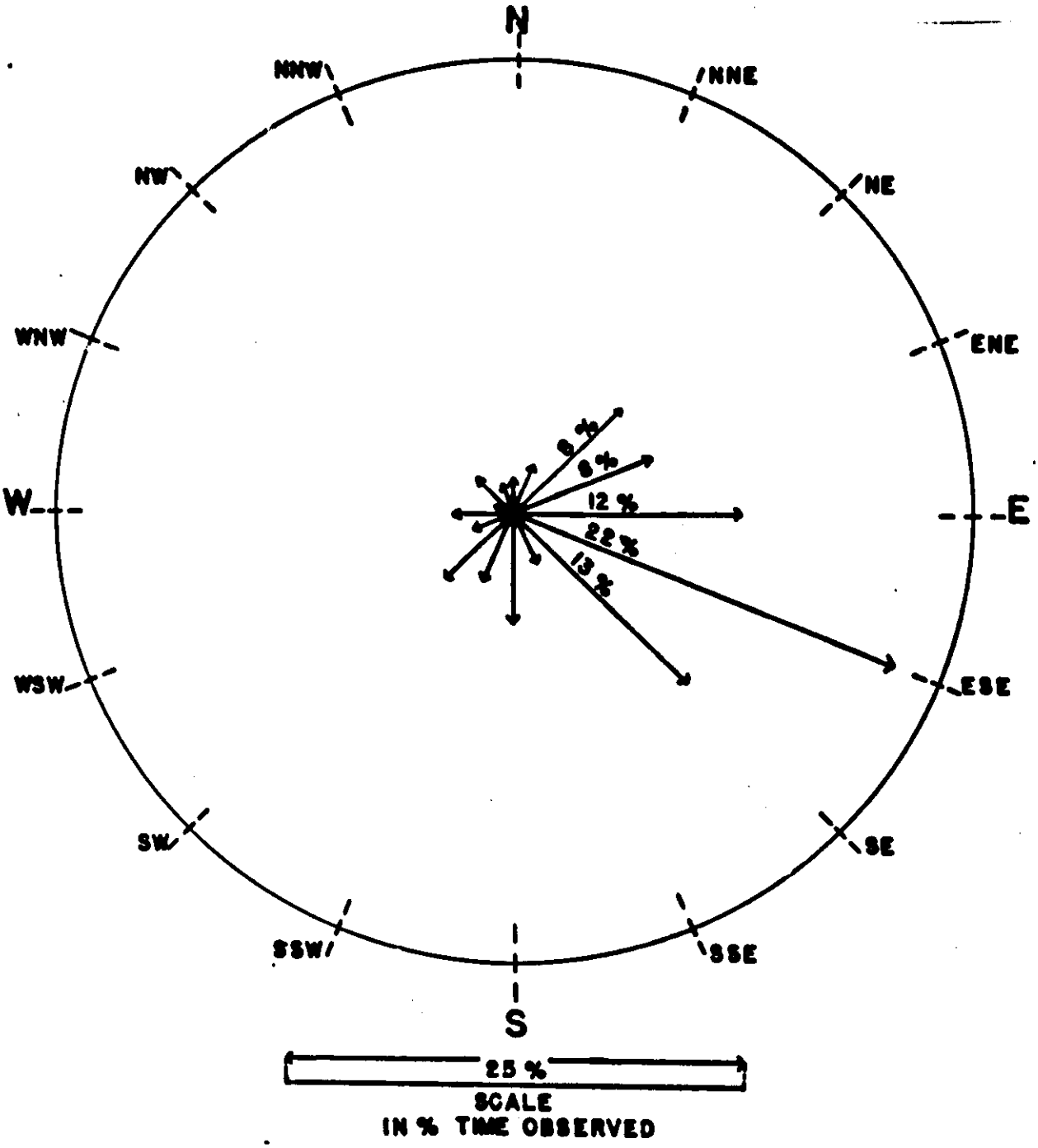
0 10 20 30 40 50 60 70 80 90 100

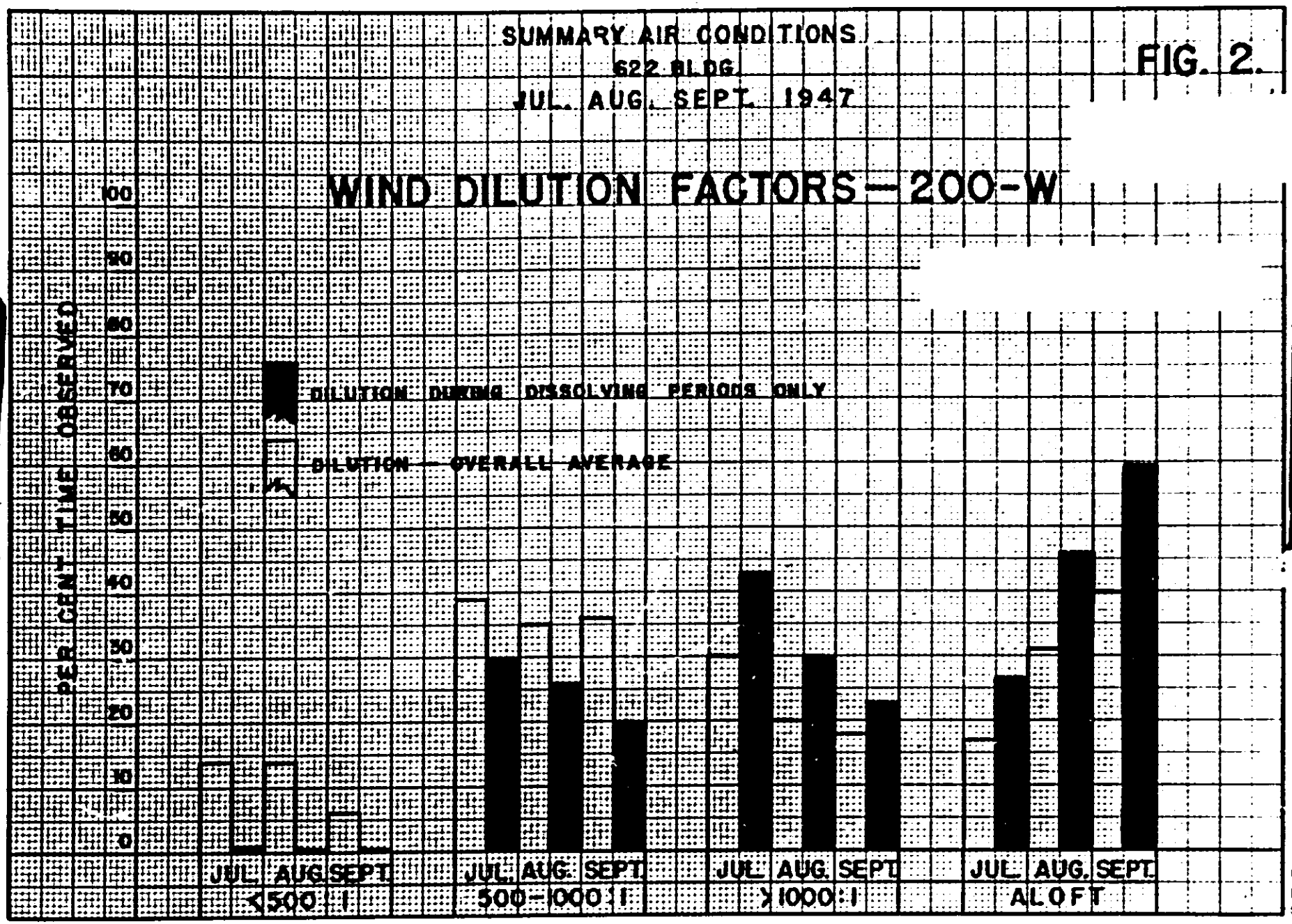
MONTH J A S J A S J A S J A S J A S J A S J A S J A S J A S J A S J A S J A S J A S J A S J A S J A S J A S

N NE E SE S SW W NW NNW WNW

FIG. 1-A

SUMMARY WIND DIRECTIONS — 200-W AVERAGE — JUL. AUG. SEPT. 1947




SUMMARY AIR CONDITIONS
622 BLDG.
JUL. AUG. SEPT. 1947
FIG. 2.
WIND DILUTION FACTORS—200-W
PER CENT TIME OBSERVED
100
90
80
70
60
50
40
30
20
10
0
DILUTION DURING DISSOLVING PERIODS ONLY
DILUTION — OVERALL AVERAGE
JUL. AUG. SEPT.
<500 : 1
JUL. AUG. SEPT.
500—1000 : 1
JUL. AUG. SEPT.
>1000 : 1
JUL. AUG. SEPT.
ALOFT

[redacted]

AIR FILTER PROGRAM FOR PERIOD JULY AUGUST SEPT 1947

FIG. 3

[redacted]

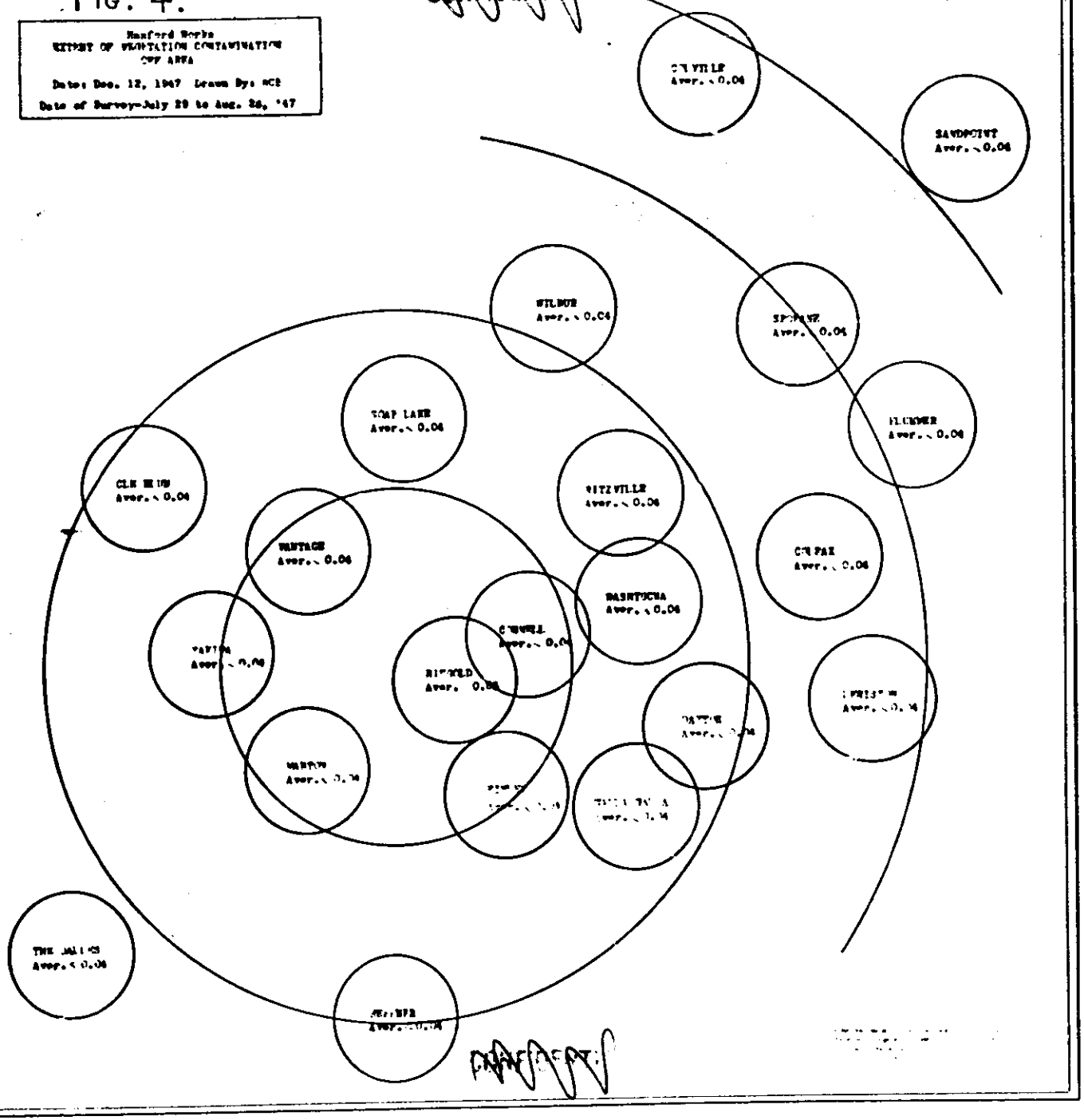
FIG. 4.

CONFIDENTIAL

Hanford Works
EXTENT OF CONTAMINATION
OFF AREA

Date: Dec. 12, 1947 Drawn By: HCS

Date of Survey-July 29 to Aug. 28, '47



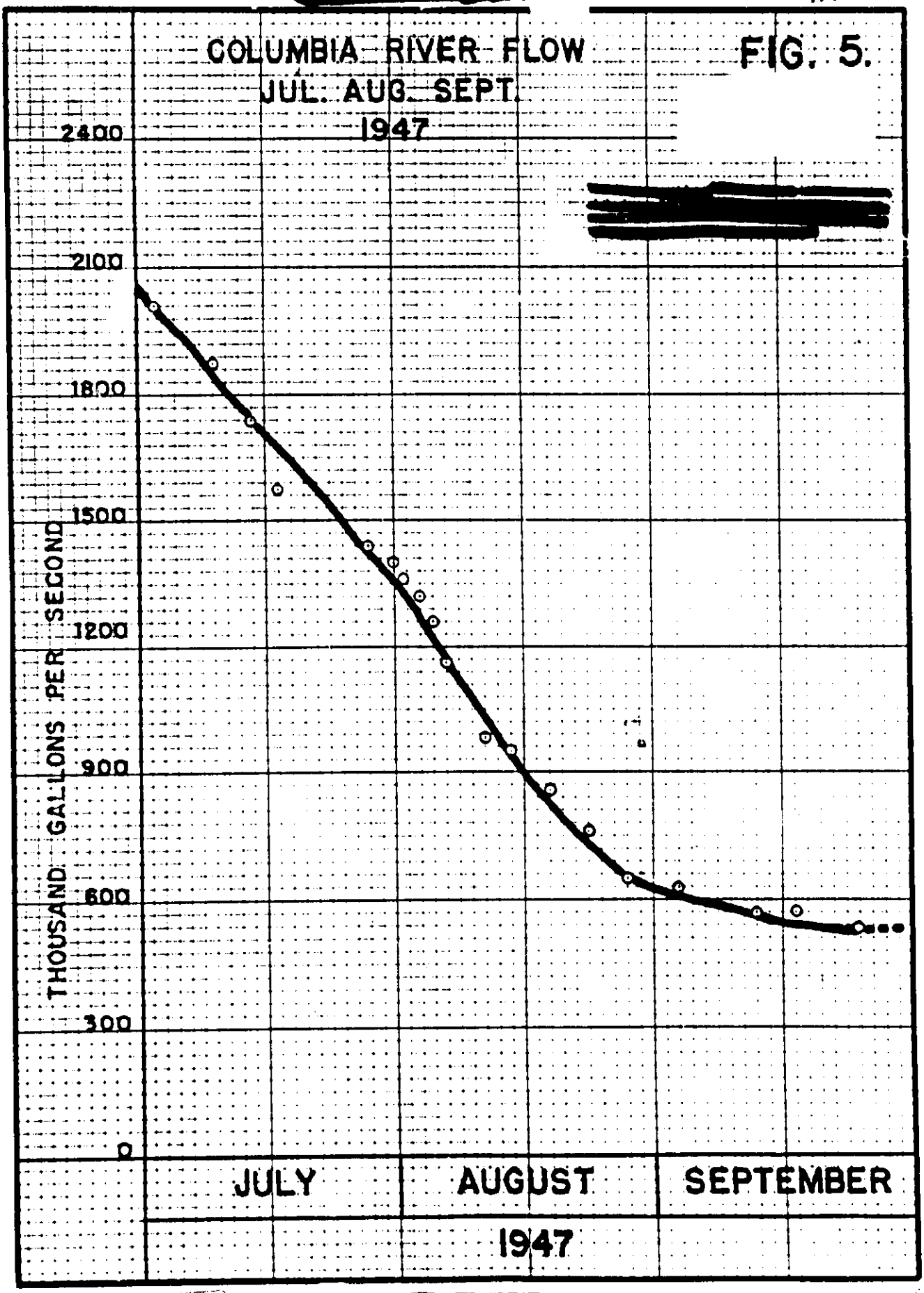
DECLASSIFIED

19

HW-8539

19

[redacted]

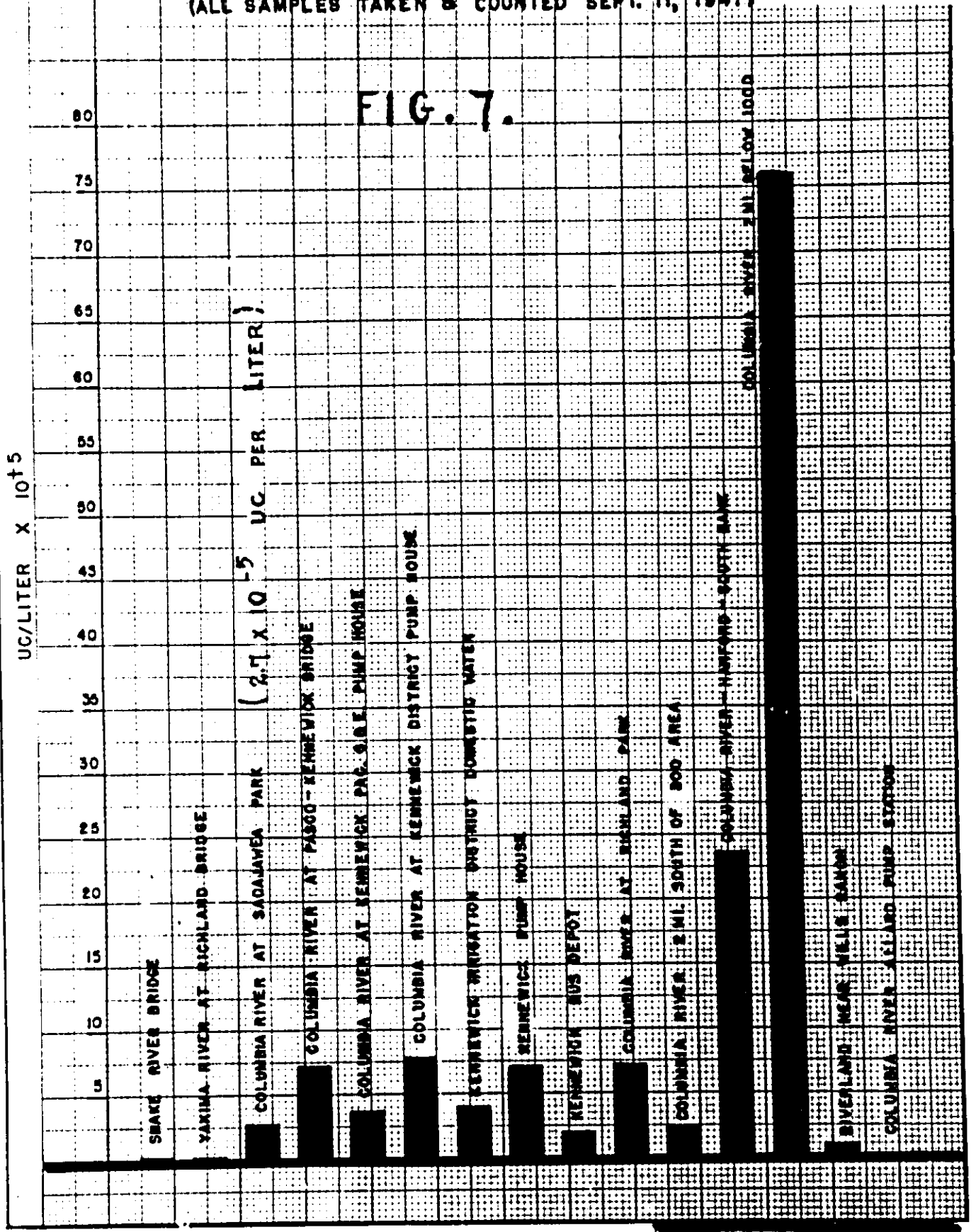


[redacted]

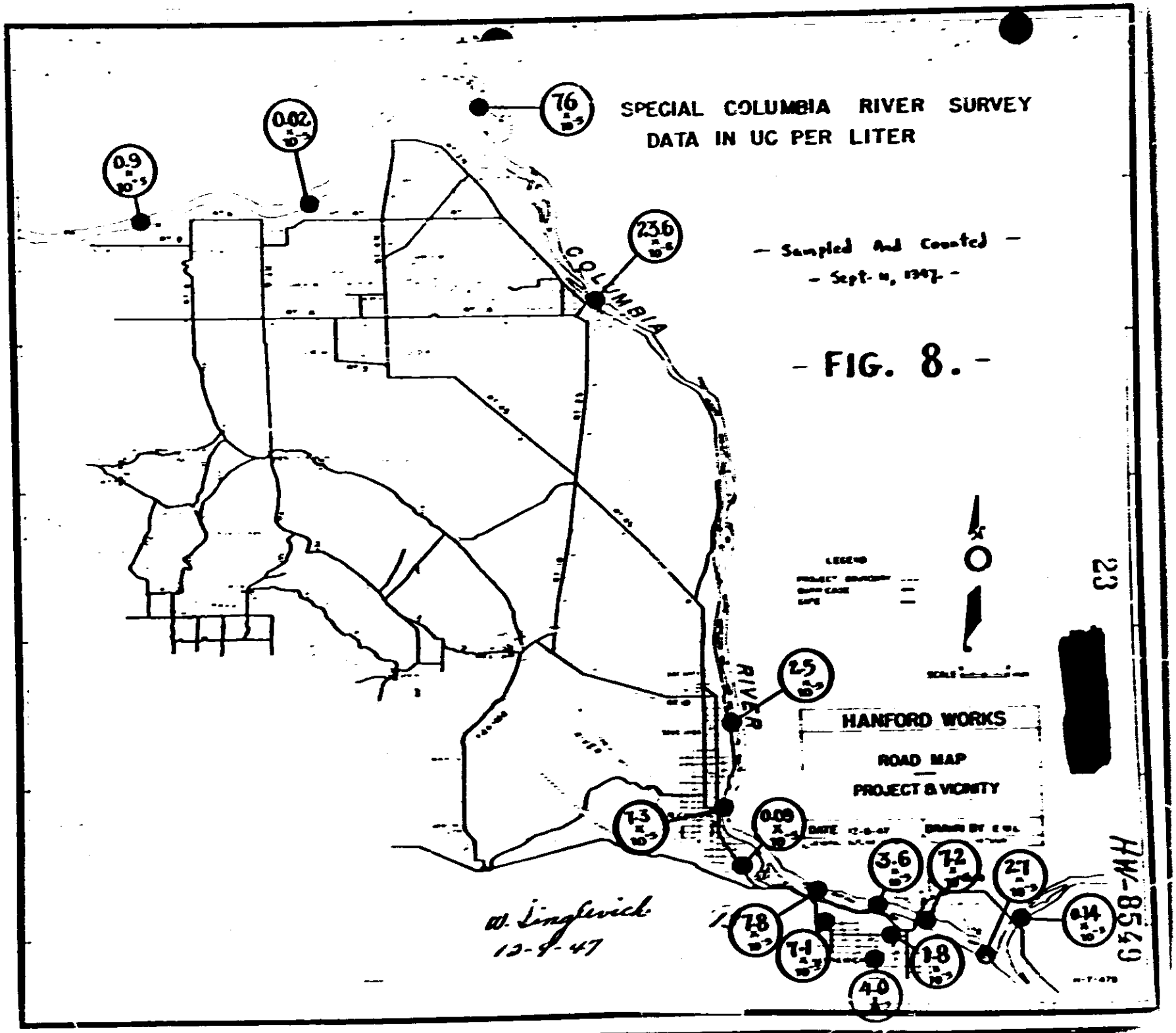
[redacted]

SPECIAL COLUMBIA RIVER SURVEY
FOR PERIOD
JULY - AUG. - SEPT.
(ALL SAMPLES TAKEN & COUNTED SEPT. 11, 1947)

FIG. 7.



[redacted]



23

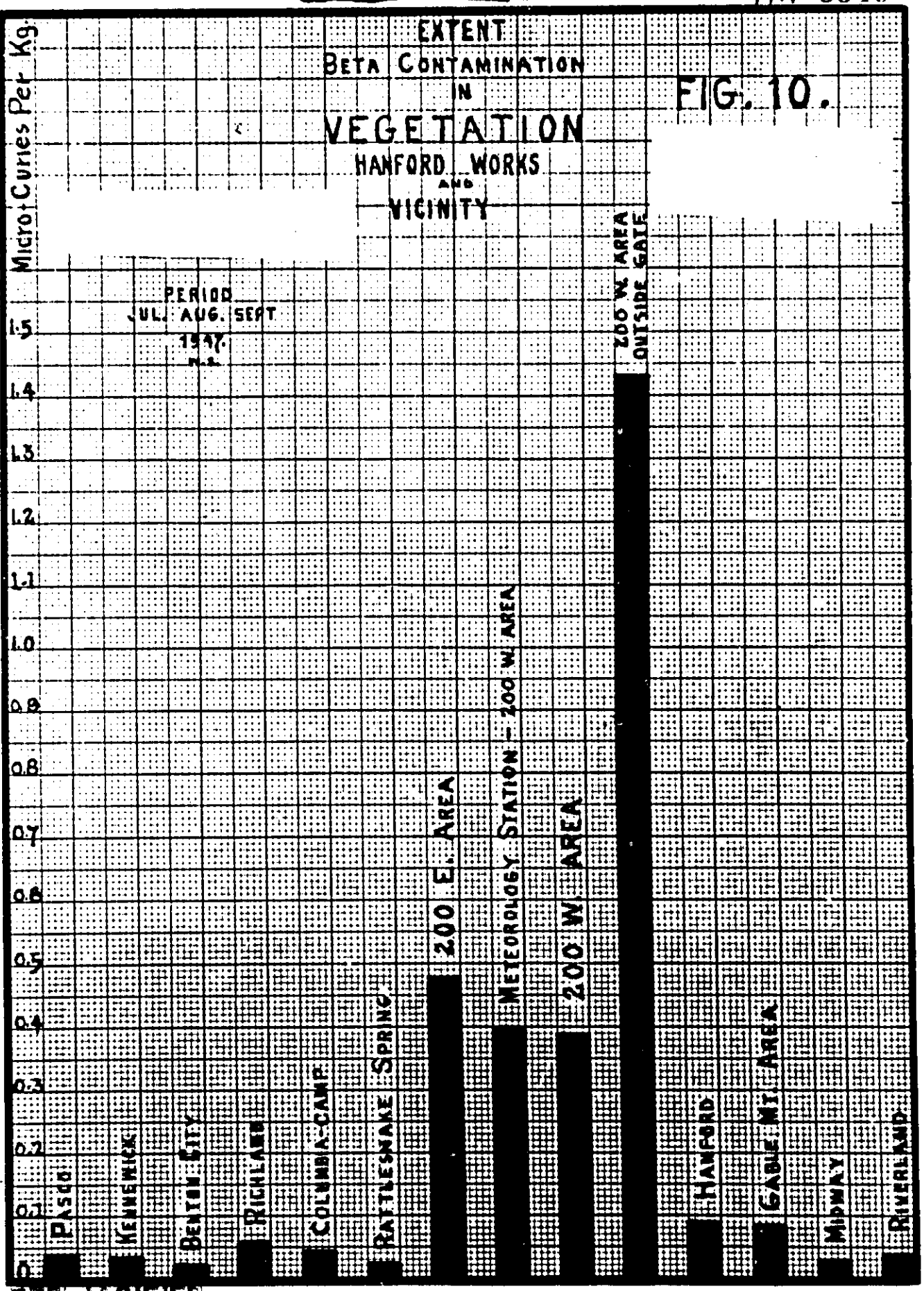
FIG. 9.

EXTENT BETA ACTIVITY IN RAIN at HANFORD WORKS & VICINITY

JULY - AUG. - SEPT. 1947.

EXTENT BETA CONTAMINATION IN VEGETATION HANFORD WORKS AND VICINITY

FIG. 10.



[redacted]

PLATE I.

FIG. 11.

VEGETATION

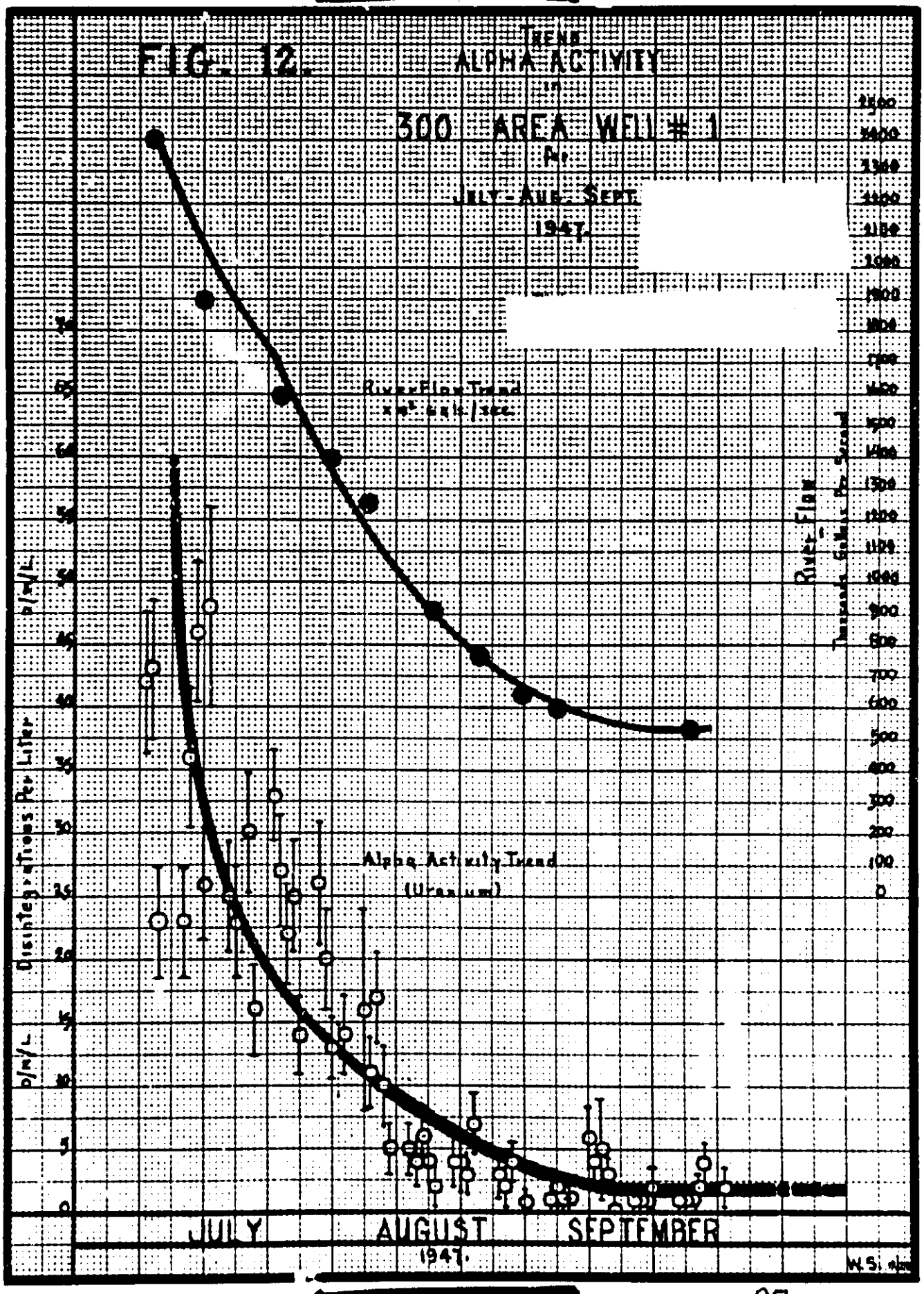
CONTAMINATION FOUND AT 50' ALTITUDES ON HANFORD MAP
(NORTHWEST SIDE OF YAKIMA RIVER)

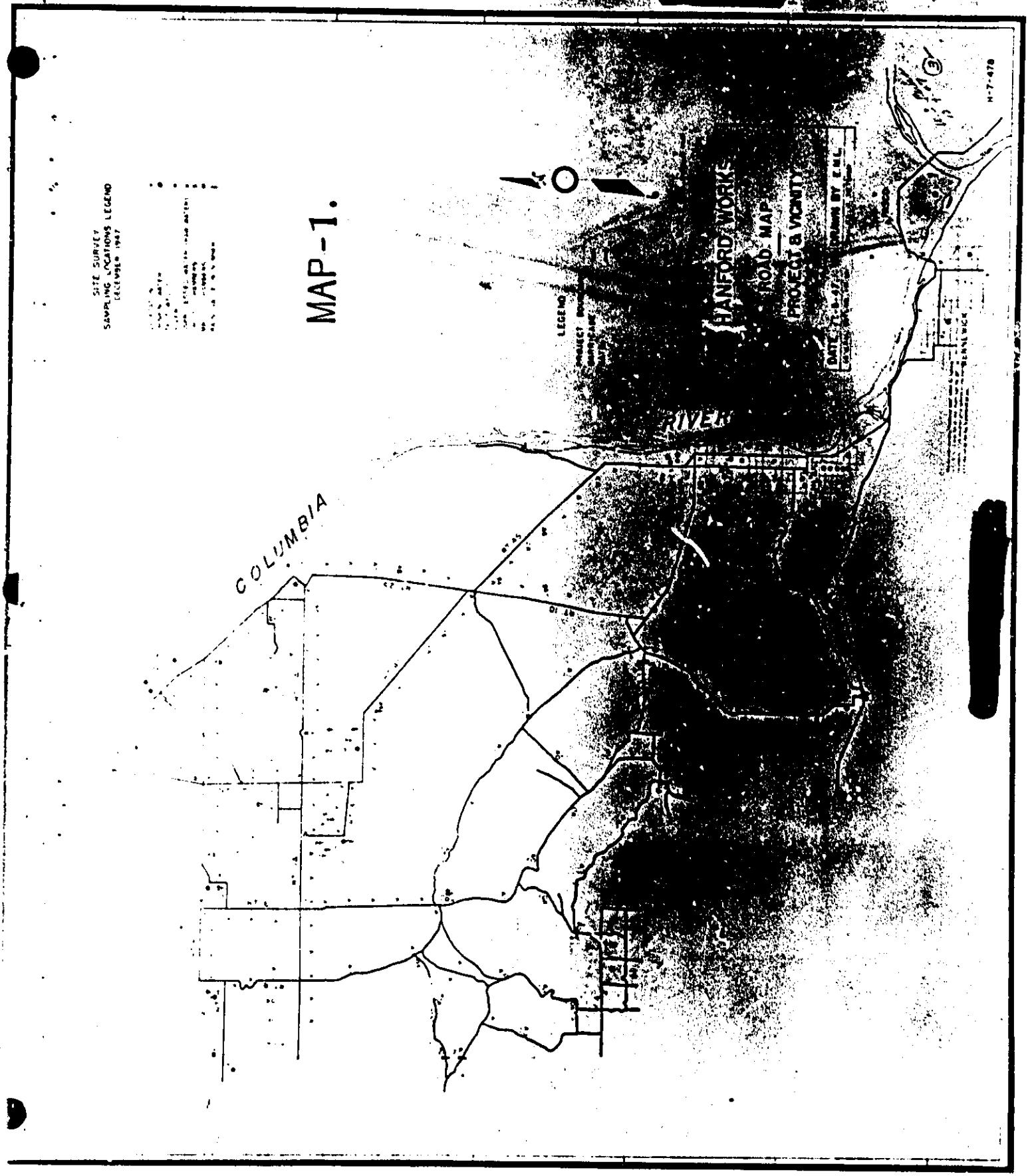
ELEVATION

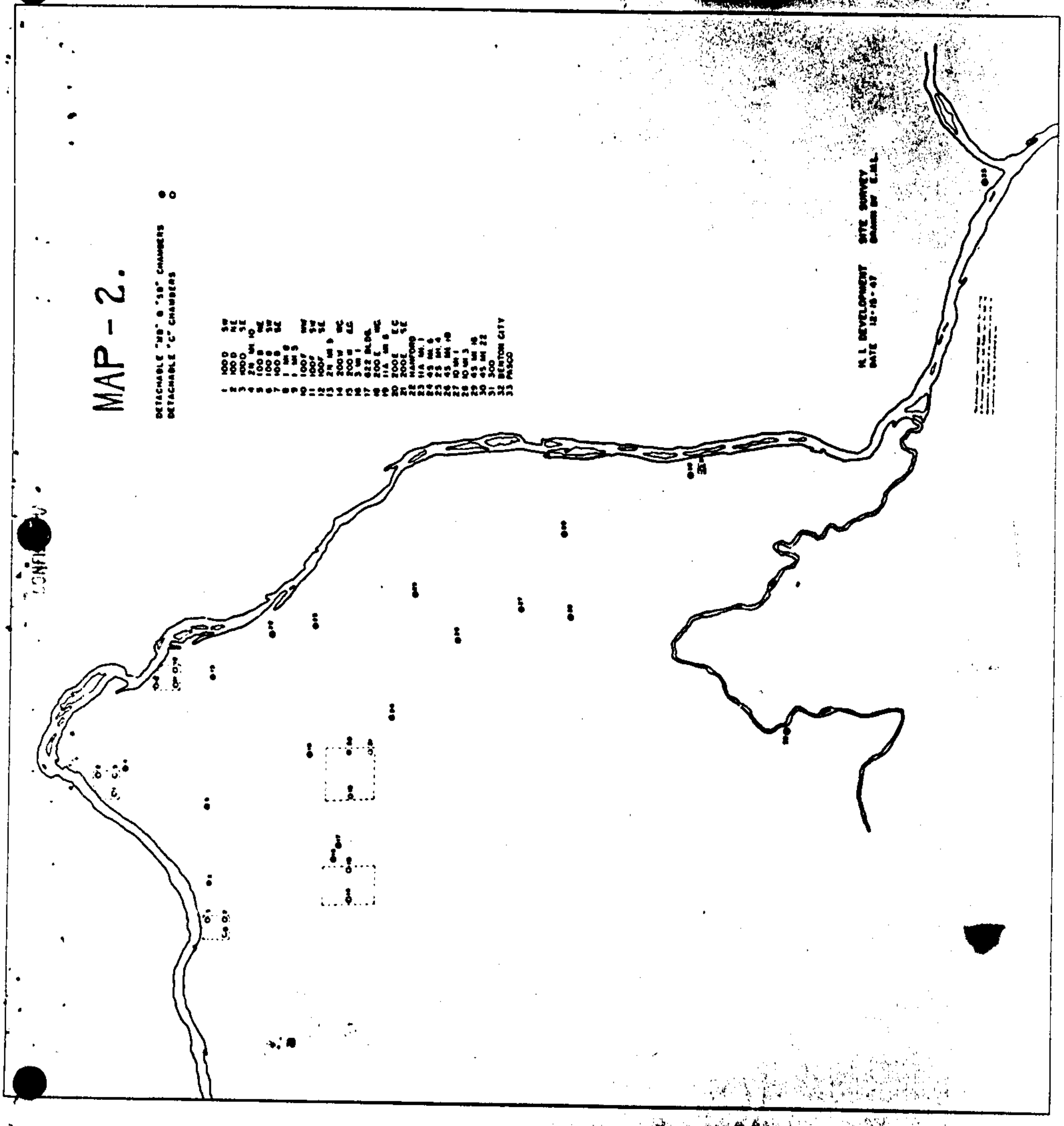
Feet

3400
3300
3200
3100
3000
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
Feet

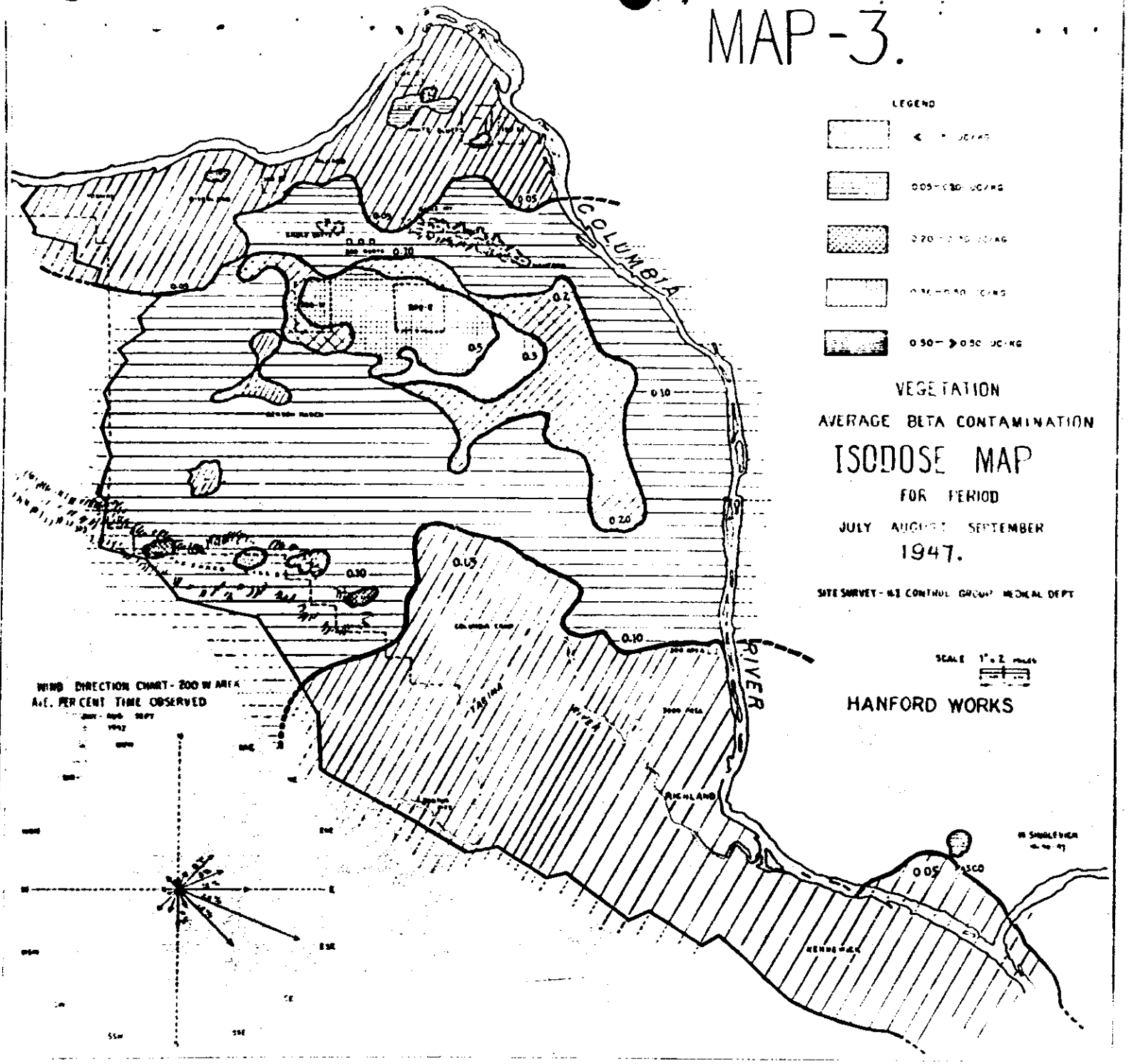
[redacted]




MAP-1.
HANFORD WORKS
AOLD MAP
PROJECT & VICINITY
COLUMBIA
RIVER
SITE SURVEY
SAMPLING LOCATIONS LEGEND


MAP - 2.
DETACHABLE "C" CHAMBERS
BENTON CITY
PASCO

MAP-3.



UNCLASSIFIED

30

HW-8549

30