Mayfield 1985 a)

Los Alamos

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memorandum

TO: Miguel Salazar, HSE-7, MS K592 DATE: March 27, 1985

THRU: Thomas C. Gunderson, HSE-8 Group Leader, MS K490 MAIL STOP/TELEPHONE: K490/7-0819

FROM: Don L. Mayfield, HSE-8 DLM SYMBOL: HSE8-85-271

SUBJECT: ENVIRONMENTAL SAMPLING RESULTS FOR AREA U

SUMMARY

Traces of enriched U, $^{239,240}Pu$, ^{227}Ac daughters, and ^{3}H are associated with external penetrating radiation levels that range up to 10 times background on the absorption bed surfaces. These radiation levels will not deliver a significant dose to remedial action workers. Radionuclide concentrations in a few soil samples range high enough to indicate remedial action (Ref. 1), although most sample results are too low to warrant it. Samples within the fence were not taken deeper than 30 cm, but contaminants should be expected in the underlying tuff and throughout the absorption materials, i.e., from the bed surface to more than 120 cm deep. The ^{3}H concentrations from nearby observation holes are high enough to suggest that other contaminants may have been moved downward into the tuff under the influence of waste water.

I. EXTERNAL PENETRATING RADIATION

Figures 1 and 2 show the distribution of external penetrating radiation at Area U. The highest measurements are over a tar puddle in the east absorption bed. Next highest is a spot in the west absorption bed. These were observed in 1980.

II. PHOSWICH MEASUREMENTS

Phoswich measurements in 1980 consisted of scanning the surface with a wide energy window (10 kev - 250 kev) in a ratemeter mode (counts per minute). Those measurements were similar in magnitude to those made in 1980 (Figure 3). Phoswich measurements in 1984 were done with a narrow window (10 kev - 26 kev) in a scaler mode (200 sec integrated count) on grid intersections (Figure 4).

Received by ER-RPF
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III. SOIL SAMPLING

A. Tritium

Figures 5, 6, 7, and 13 and Tables 2, 3 and 4 show the tritium sampling results. There are areas of above background (up to about 10 times background) tritium concentrations.

B. Uranium

Figures 8, 9, and 10 and Tables 2 and 3 indicate elevated U concentrations. The highest U concentration sampled to date occurs in the 1-10 cm depth of the grid intersection on the south edge of the west absorption bed. At 750 ug/g, it is roughly 200 times natural background. If it is highly enriched in ^{235}U, the health implications are somewhat more severe. These results warrant radiological protection for remedial action workers. The vertical distribution of U at the test holes is consistent with local background levels. This shows that no appreciable U has been transported laterally with water percolating down from the absorption bed. Higher concentrations should be expected at the bottom of the absorption bed.

C. Other Radionuclides

The 1980 sampling results show low level Pu contamination on the west absorption bed and ^{227}Ac daughters in the tar on the east absorption bed. Higher concentrations should be expected at the bottom of the absorption bed.

DLM:mm

Attachments: a/s

REFERENCES

1. "Radiological Guidelines for Application to DOE's Formerly Utilized Sites Remedial Action Program," US DOE Publication ORO-831, U.S. Department of Energy Oak Ridge Operations (March 1983).

2. Nyhan, Jack; et al, "Distribution of Radionuclides and Water In Bandelier Tuff Beneath a Former Los Alamos Liquid Waste Disposal Site After 33 Years," Los Alamos National Laboratory report LA-10159-LLWM (July 1984).

TABLE 1

EXTERNAL PENETRATING RADIATION

AT THE AREA U FENCE (mRem)

1982			1983			1984		
QUARTER	STATION	DOSE (mRem) X ± S[1]	QUARTER	STATION	DOSE (mRem) X ± S[1]	QUARTER	STATION	DOSE (mRem) X ± S[1]
4	U1	35.8 ± 2.2	1	U1	35.7 ± 2.3	1	U1	33.6 ± 2.6
	U2	32.3 ± 2.2		U2	34.6 ± 2.3		U2	34.4 ± 2.6
			2	U1	36.6 ± 2.3	2	U1	43.3 ± 1.8
				U2	35.1 ± 2.3		U2	36.2 ± 1.8
			3	U1	24.4 ± 2.8	3	U1	30.6 ± 2.2
				U2	28.2 ± 2.8		U2	38.0 ± 2.2
			4	U1	44.0 ± 2.7	4	U1	44.0 ± 2.7
				U2	39.9 ± 2.7		U2	39.9 ± 2.7

1. Analytical Error at 68.3% confidence

STATISTICAL SUMMARY

	RANGE	X ± 25	N
U1	24.4 to 44.4	36.4 ± 13.2	9
U2	28.2 to 39.9	35.4 ± 7.5	9

TAB 2

SELECTED RADIONUCLIDE ANALYSES FOR 1980 SOIL AND VEGETATION SAMPLES

I. SOIL

FENCED						BEYOND FENCE					
LOCATION	DEPTH (CM)	^{3}H (nCi/ℓ[1])	TOTAL U (μg/g[2])	$^{239,240}Pu$ (pCi/g[2])	GAMMA SPECTRA	LOCATION	DEPTH (CM)	^{3}H (nCi/ℓ[1])	TOTAL U (μg/g[2])	$^{239,240}Pu$ (pCi/g[2])	GAMMA SPECTRA
U-1	0-1	2.7±0.4	26.1±2.6	tracer swamped	Total U is highly enriched with ^{235}U	U-3	0-1	10.6±0.5	4.7±0.5	1.6±0.0	Normal
	10-1	3.9±0.4	25.6±2.6	17.5±0.3			1-10	6.5±0.5	4.4±0.5	2.5±0.1	Normal
	10-30	3.8±0.4	10.9±1.1	2.2±0.0			10-30	5.4±0.5	4.5±0.5	2.0±0.1	Normal
U-2	0-1	37.2±0.8	7.0±0.7	2.4±0.1	^{227}Ac daughters in great abundance						
	1-10	11.8±0.5	6.3±0.6	2.2±0.1							
	10-30	27.3±0.7	4.3±0.5	0.1±0.0							

II. VEGETATION

FENCED						BEYOND FENCE					
LOCATION	SPECIES	^{3}H (nCi/ℓ[3])		$^{239,240}Pu$ (pCi/g[4])		LOCATION	SPECIES	^{3}H (nCi/ℓ[3])		$^{239,240}Pu$ (pCi/g[4])	
U-1	Salix sp. (willow)	7.2±0.4		0.8±0.1		U-3	Guttierezia s. (snakeweed)	3.3±0.3		0.2±0.0	
U-2	Pinus pon. (Ponderosa)	5.8±0.3		0.6±0.0			Bromus tec. (downy chess)	-0.8±0.3		2.3±0.1	
	Bromus tec. (downychess)	-9.8±1.3		1.1±0.1			Artemesia car. (wormwood)	3.0±0.3		1.8±0.0	

1. liter of soil moisture
2. gram of soil
3. liter of tissue moisture
4. gram of ash

TABLE 3

SELECTED RADIONUCLIDE STATISTICS FOR 1984

SOIL AND VEGETATION SAMPLES

I. SOIL

		FENCED			BEYOND FENCE		
	Depth (cm)	0-1	1-10	10-30	0-1	1-10	10-30
^3H	Range	7.3 to 25.0	10.0 to 11.0	4.8 to 6.0	1.7 to 290.0	3.2 to 5.7	3.3 to 6.0
(n Ci/ℓ)	$\bar{X} \pm 2S$	14.4 ± 18.7	10.5 ± 1.4	5.4 ± 1.7	36.3 ± 190.5	4.5 ± 2.2	4.5 ± 1.9
	N	3	2	2	9	7	7
E U	Range	3.3 to 141.0	4.0 to 750.0	3.0 to 182.0	2.9 to 21.6	3.5 to 6.1	3.3 to 13.0
(μg/g)	$\bar{X} \pm 2S$	17.1. ± 78.7	252.7 ± 861.3	63.4 ± 205.4	6.3 ± 11.9	4.2 ± 1.6	4.9 ± 6.6
	N	12	3	3	9	8	8

II. VEGETATION

		FENCED			Beyond Fence			
	Category	Fungi	Forb	Shrub	Grass	Forb	Shrub	Tree
^3H	Range	9.0 to 11.0	5.9 to 7.5	2.9 to 3.9	4.9 to 5.13	5.0 to 6.6	3.1 to 6.0	5.5 to 6.1
(nCi/ℓ)	$\bar{X} \pm 2S$	10.0 ± 1.0	6.7 ± 0.8	3.4 ± 0.5	5.6 ± 0.7	5.7 ± 1.6	4.4 ± 2.5	5.8 ± 0.8
	N	1	1	1	1	4	5	2
E U	Range	265.0 to 335.0	1.5 to 1.7	34.0 to 46.0	0.9 to 1.1	2.1 to 3.2	0.6 to 3.8	1.8 to 2.0
(μg/g) ash	$\bar{X} \pm 2S$	300.0 ± 35.0	1.6 ± 0.1	40.0 ± 6.0	1.0 ± 0.1	2.5 ± 0.1	2.0 ± 2.4	1.9 ± 0.3
	N	1	1	1	1	4	5	2

TABLE 4

VERTICAL DISTRIBUTION OF SELECTED

RADIONUCLIDES IN TEST HOLES NORTH OF AREA U

(1973)

DEPTH (M)	TEST HOLE U-E			DEPTH (M)	TEST HOLE U-W		
	^{3}H (nCi/ℓ)	Total U (μg/g)	^{137}Cs (pCi/g)		^{3}H (nCi/ℓ)	Total U (μCi/g)	^{137}Cs (pCi/g)
0 - 0.9	19.0 ± 2.0	3.79 ± 0.18	0.18 ± 0.07	0 - 0.9	7.8 ± 0.8	4.75 ± 0.18	0.16 ± 0.07
0.9- 1.5	11.7 ± 1.2	3.76 ± 0.18	0.10 ± 0.04	0.9 - 2.4	9.2 ± 1.0	3.88 ± 0.18	0.01 ± 0.04
1.5- 2.4	10.1 ± 1.0	3.46 ± 0.18	0.09 ± 0.04	2.4 - 4.0	39.0 ± 4.0	3.70 ± 0.18	0.02 ± 0.07
2.4- 4.0	13.5 ± 1.4	3.75 ± 0.18	0.03 ± 0.03	4.0 - 5.5	9.0 ± 0.9	3.80 ± 0.18	0.07 ± 0.03
4.0- 5.5	10.2 ± 1.0	3.49 ± 0.18	0.08 ± 0.04	5.5 - 7.0	9.3 ± 1.0	3.63 ± 0.18	0.06 ± 0.05
5.5- 7.0	17.7 ± 1.8	3.65 ± 0.18	0.06 ± 0.05	7.0 - 8.5	8.3 ± 0.9	3.27 ± 0.18	0.10 ± 0.05
7.0- 8.5	11.1 ± 1.1	3.19 ± 0.18	0.04 ± 0.07	8.5 -10.1	9.6 ± 1.0	3.70 ± 0.18	0.02 ± 0.04
8.5-10.1	18.1 ± 1.8	3.09 ± 0.18	0.02 ± 0.03	10.1 -11.6	9.3 ± 1.0	3.52 ± 0.18	0.06 ± 0.03
10.1-11.6	31.0 ± 3.0	3.75 ± 0.18	0.06 ± 0.03	11.6 -13.1	7.1 ± 0.7	3.51 ± 0.18	0.08 ± 0.04
11.6-13.1	47.0 ± 5.0	3.41 ± 0.18	0.06 ± 0.03	13.1 -14.6	8.9 ± 0.9	3.55 ± 0.18	0.16 ± 0.06
13.1-14.6	66.0 ± 7.0	3.67 ± 0.18	0.08 ± 0.04	14.6 -16.2	11.4 ± 1.2	3.51 ± 0.18	0.04 ± 0.03
14.6-16.2	78.0 ± 8.0	3.48 ± 0.18	0.09 ± 0.05	16.2 -17.6	8.9 ± 0.9	3.11 ± 0.18	0.04 ± 0.03

SEE Fig. 13 FOR locations

LEGEND

- SCALE: 1" = 32.3'
- CONTOURS OF ELEVATION IN FEET:
  - —— 7118 ——
  - ---- 7116 ----
- DOSE RATE IN μR/hr (Based on scintillator response for photons from 60 to 2000 Kev):
  - ← 25 — 40 →
- LOCAL BACKGROUND AT AREA U WAS 25 to 30 μR/hr

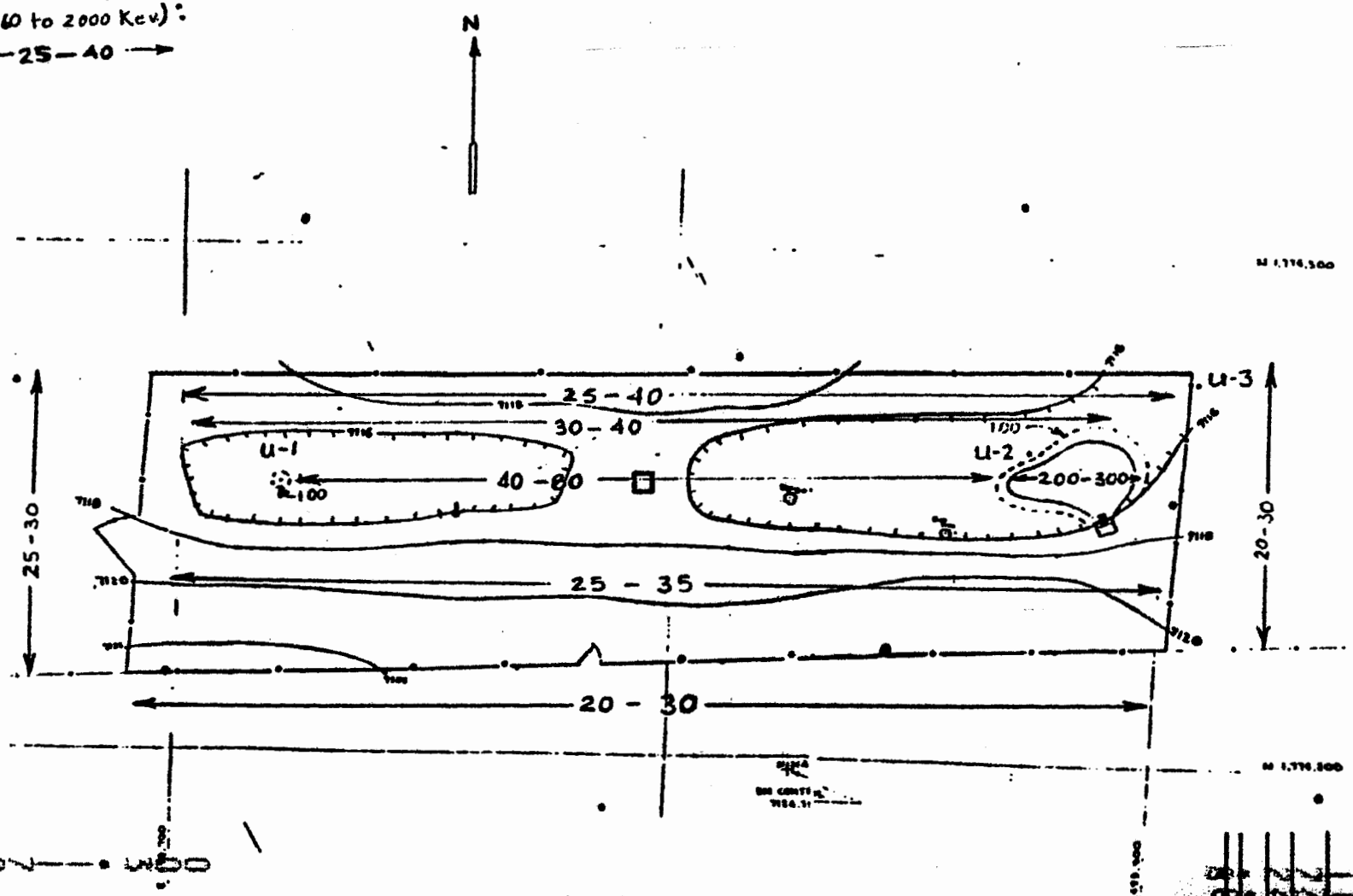


Fig. 1: 1980 [illegible] Major Survey

LEGEND

- SCALE: 1" = 32.3
- CONTOURS OF ELEVATION IN FEET

—7118—

QUALITY CONTROL

ROOM 114, TA-50 (BKG) 8 μCi ^{137}Cs

8-15-84	4.1 μR/hr	82 μR/hr
9-19-84	2.1 μR/hr	102 μR/hr

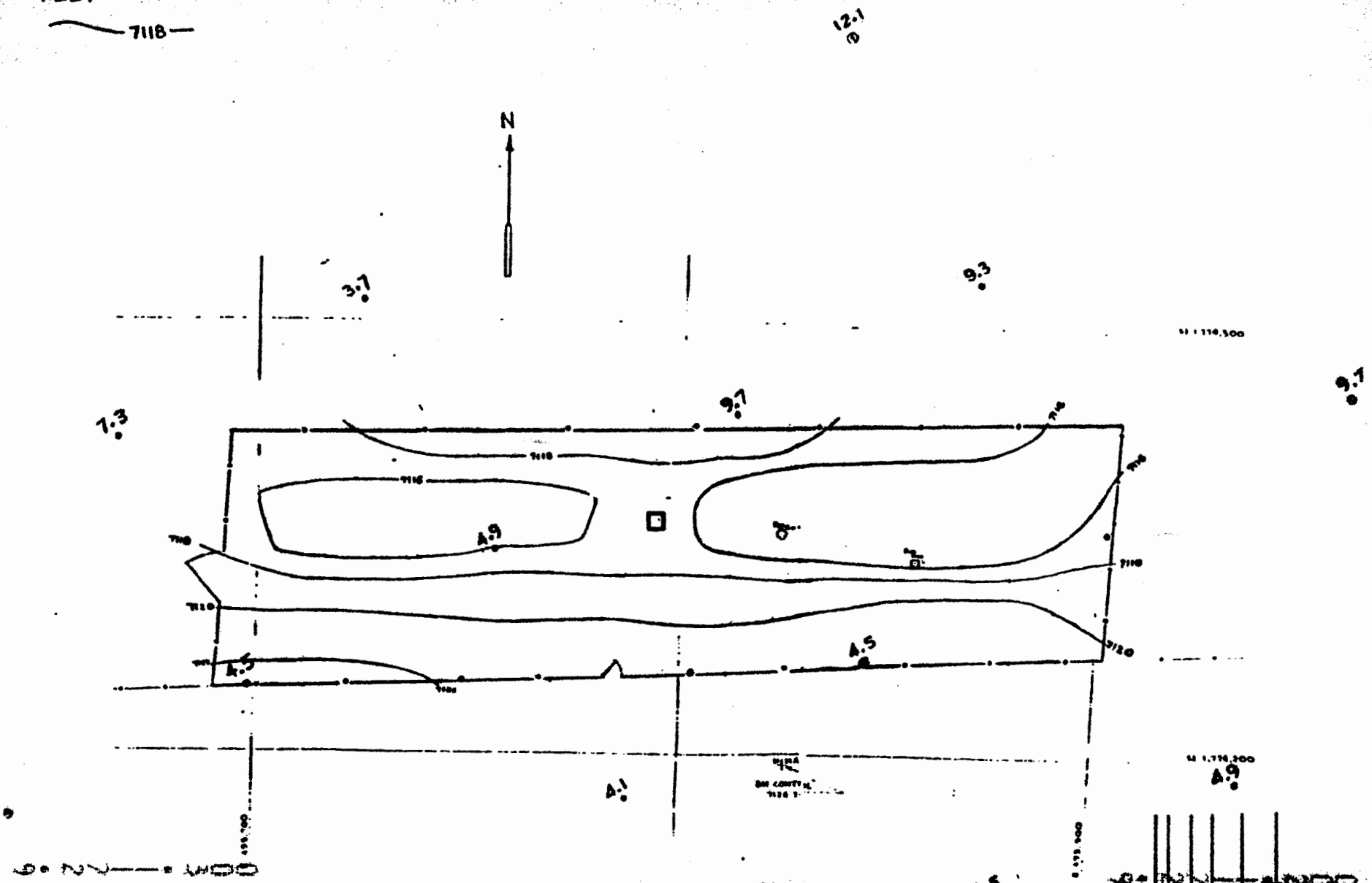


Fig. 2 1981 High Pressure Ion Chamber Survey

LEGEND

- SCALE: 1" = 32.3'
- contours of elevation in feet
- count rate ←1.5 - 2 K→ in counts per minute. (Based on scintillator response for photon energies from 10 to 250 Kev)
- local background at Area U was 0.9 - 2 K cpm
- contours of count rate
- ---- ← 10K

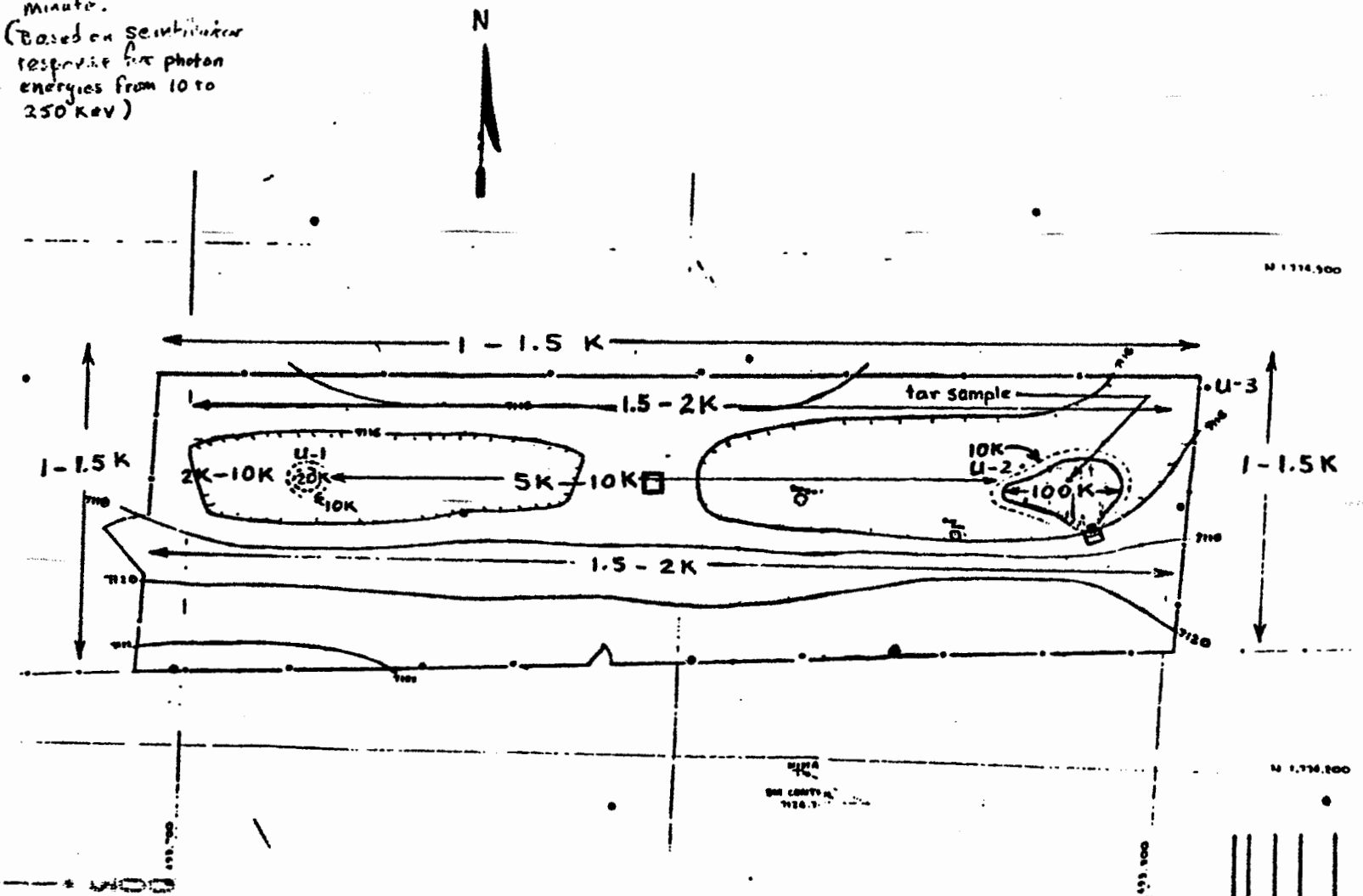


Fig.3 1980 Phosphorich Survey

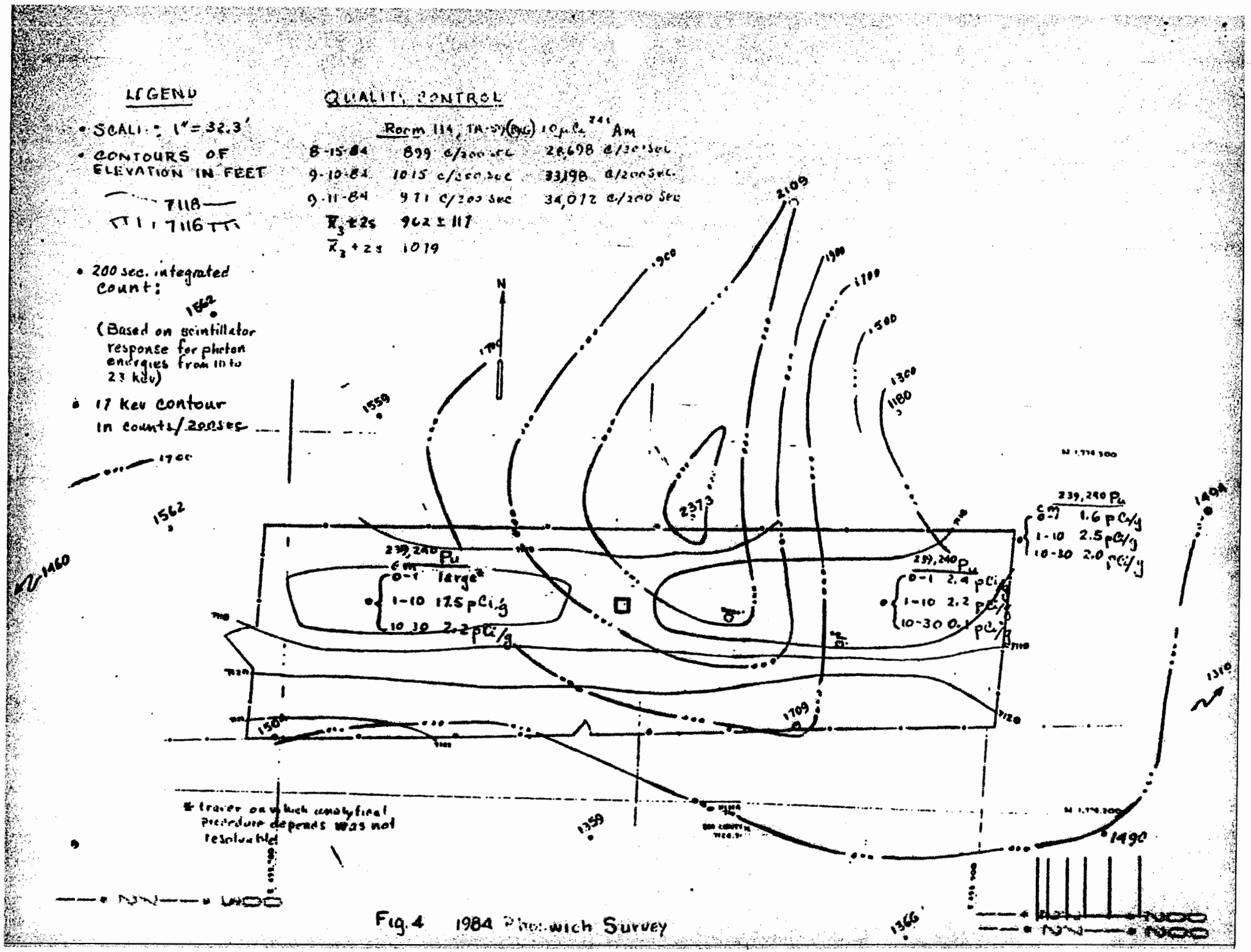


Fig. 4 1984 Pinedwich Survey

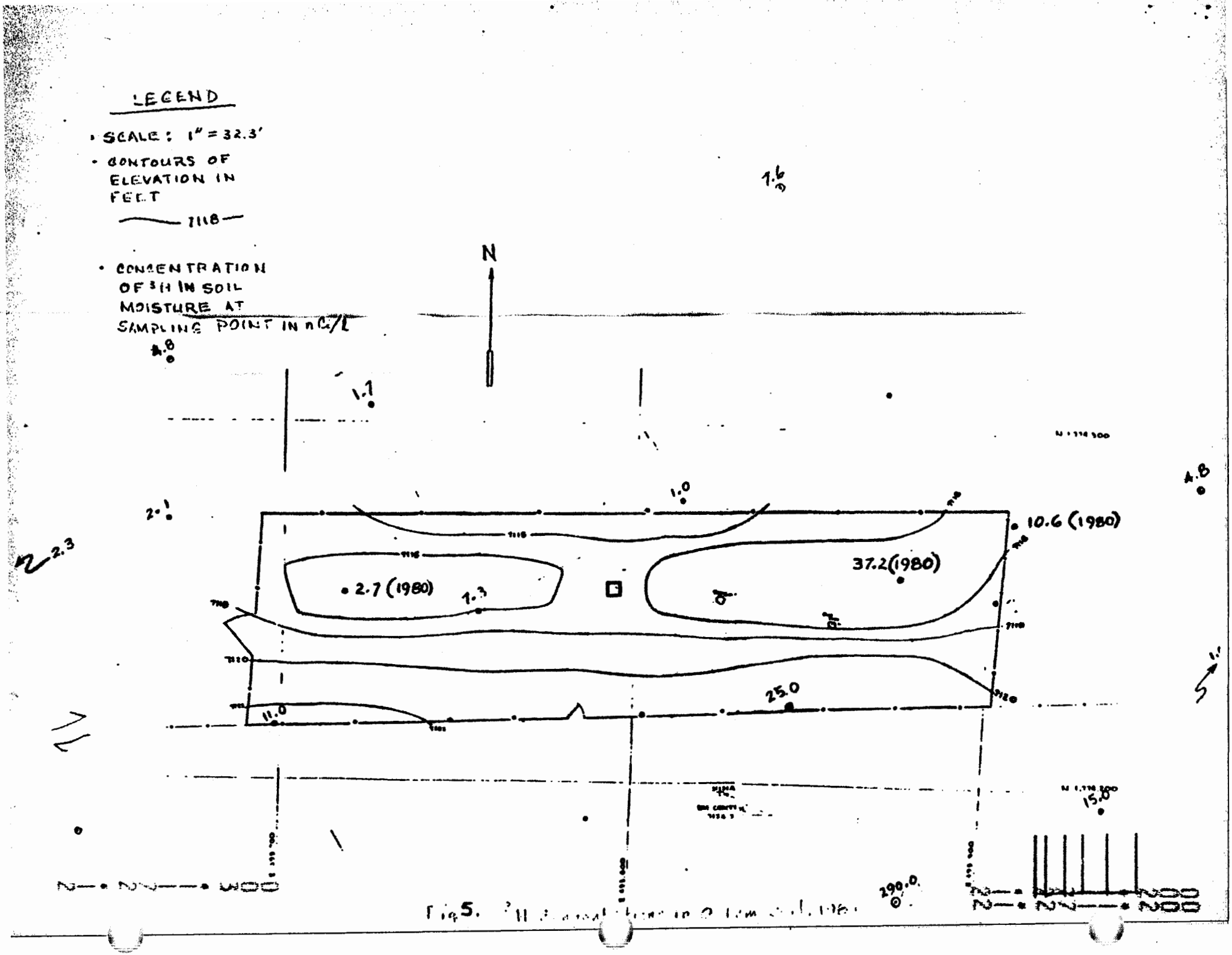

LEGEND
• SCALE: 1" = 32.3'
• CONTOURS OF ELEVATION IN FEET
7118
• CONCENTRATION OF ³H IN SOIL MOISTURE AT SAMPLING POINT IN nCi/L
N
7.6
4.8
1.7
2.1
2.3
1.0
4.8
10.6 (1980)
37.2(1980)
2.7 (1980)
7.3
25.0
11.0
15.0
290.0

Fig 5. ³H [illegible]

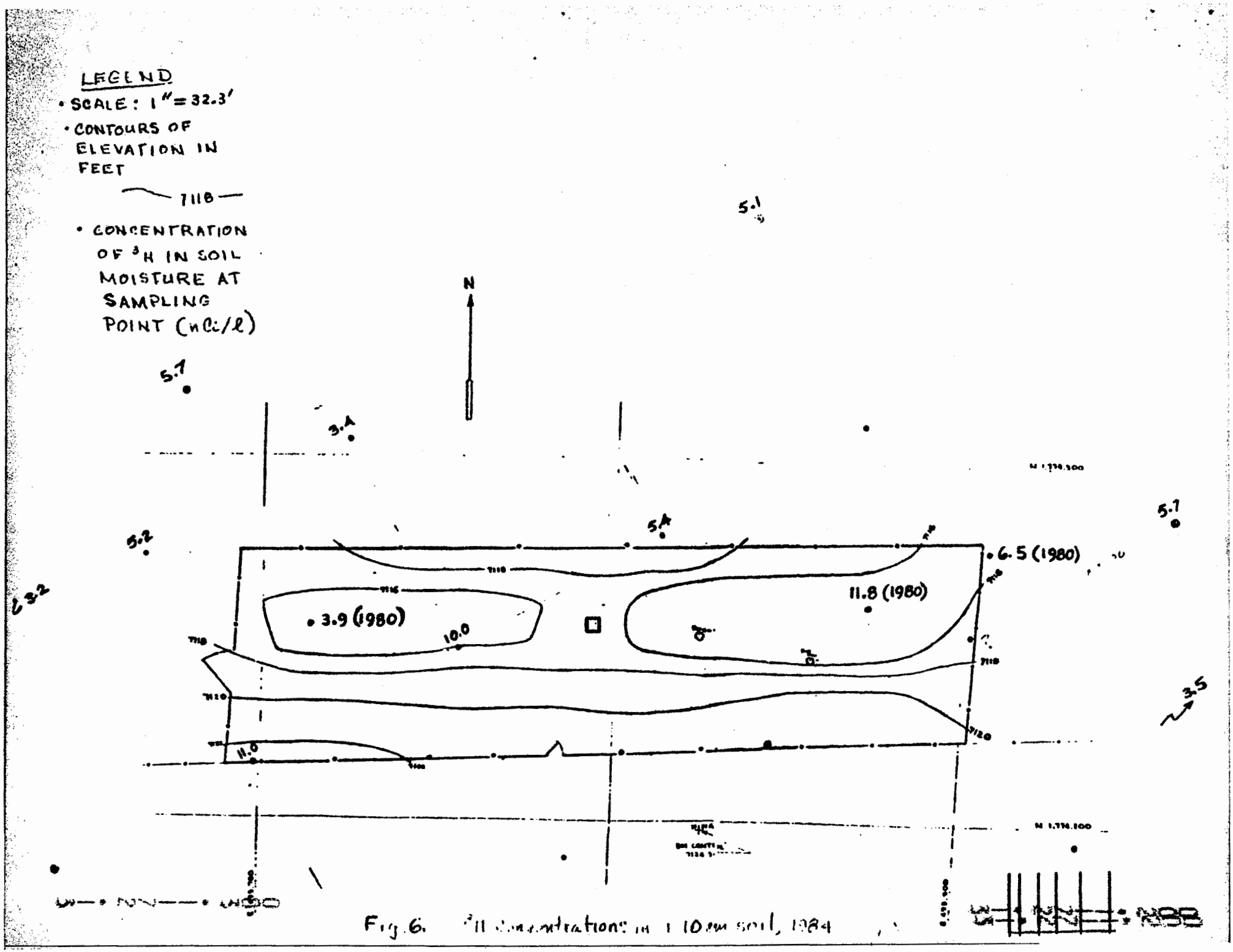


Fig. 6. ³H Concentrations in 1-10 cm soil, 1984

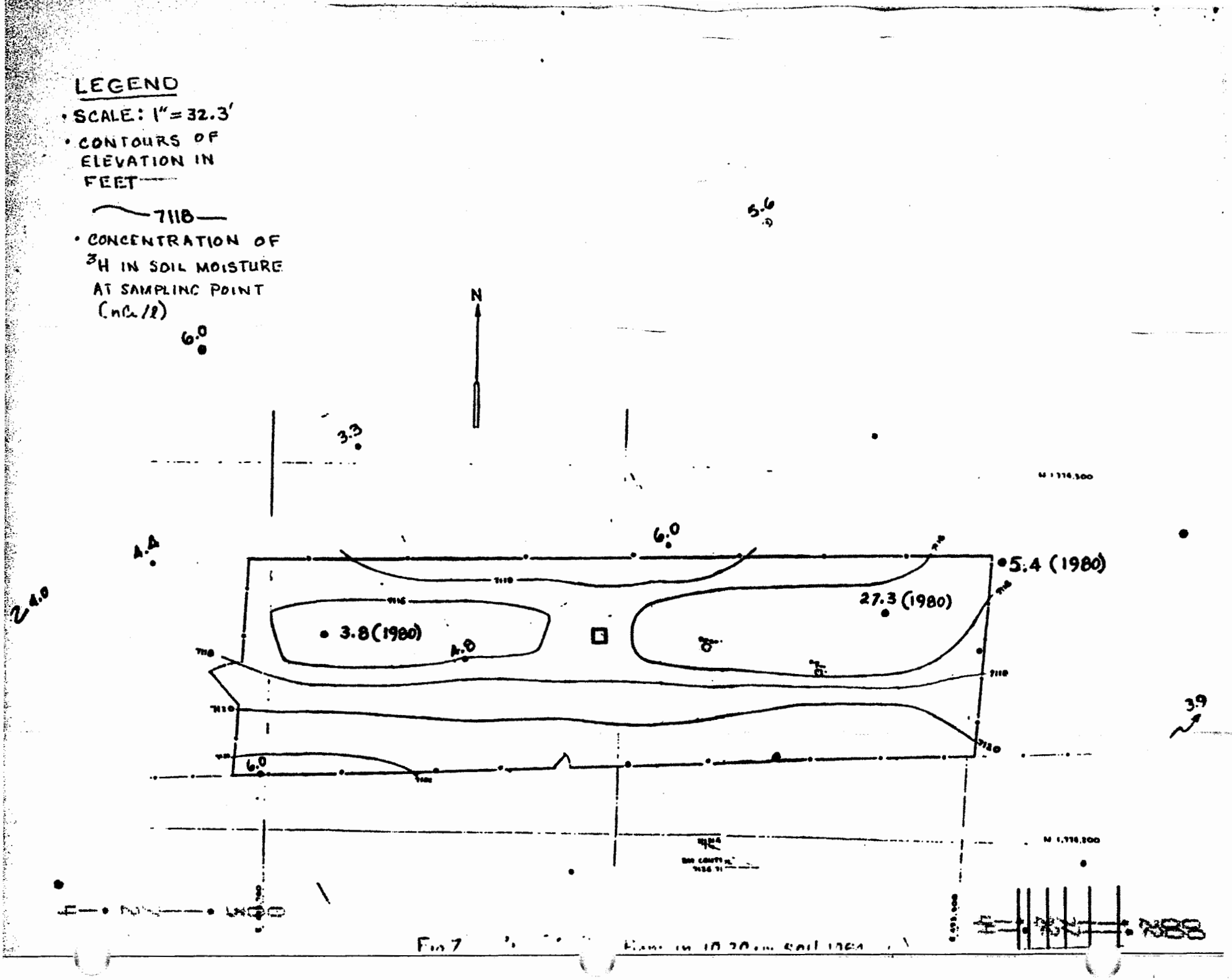

LEGEND
• SCALE: 1" = 32.3'
• CONTOURS OF ELEVATION IN FEET
7118
• CONCENTRATION OF ^3H IN SOIL MOISTURE AT SAMPLING POINT (nCi/l)
N
5.6
6.0
3.3
4.4
6.0
5.4 (1980)
27.3 (1980)
3.8 (1980)
4.0
4.0
6.0
3.9

Fig 7

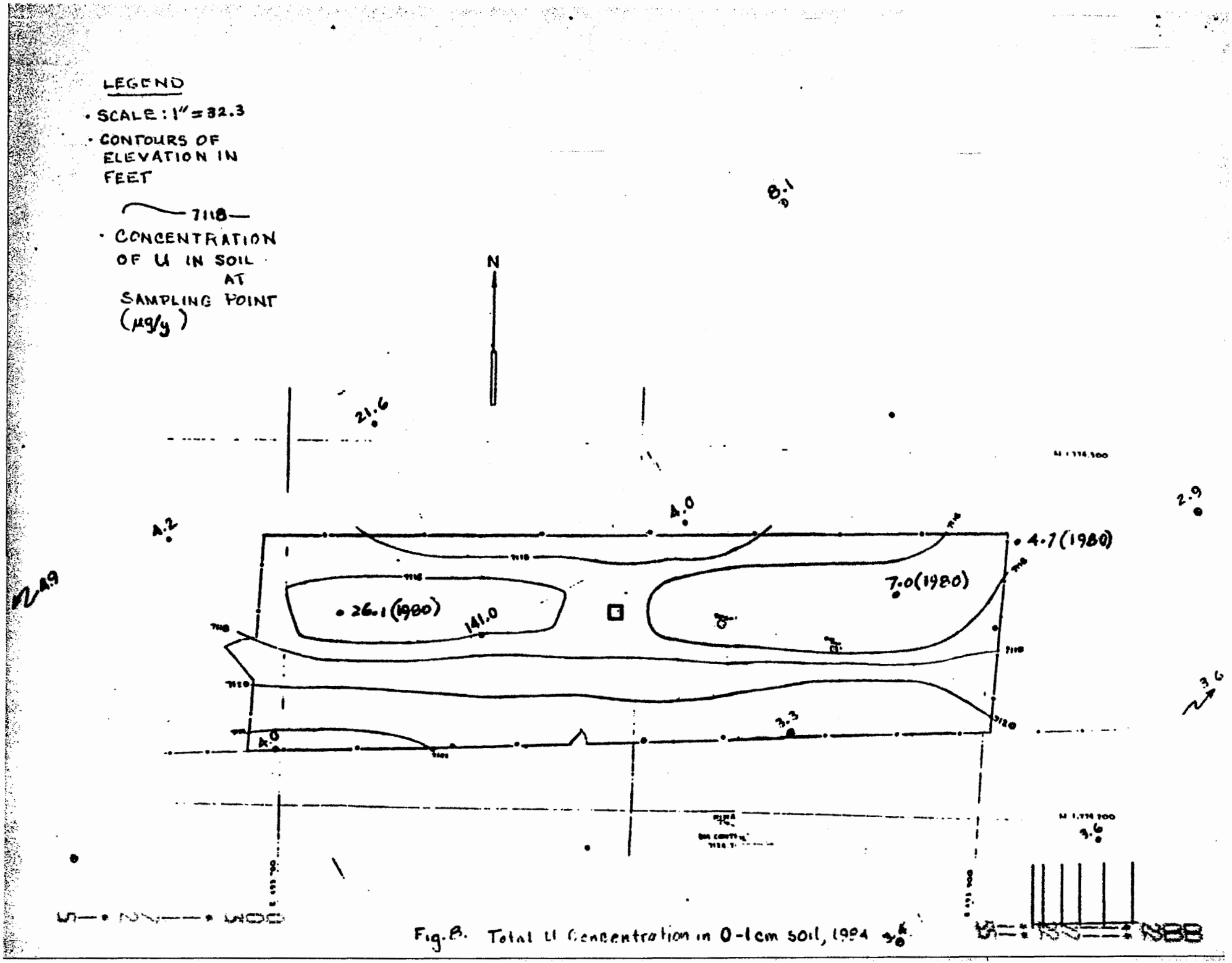


Fig. B. Total U Concentration in 0-1cm soil, 1994

LEGEND

- SCALE: 1" = 32.3'
- CONTOURS OF ELEVATION IN FEET
- 7118 — CONCENTRATION OF U IN SOIL AT SAMPLING POINT (μg/g)

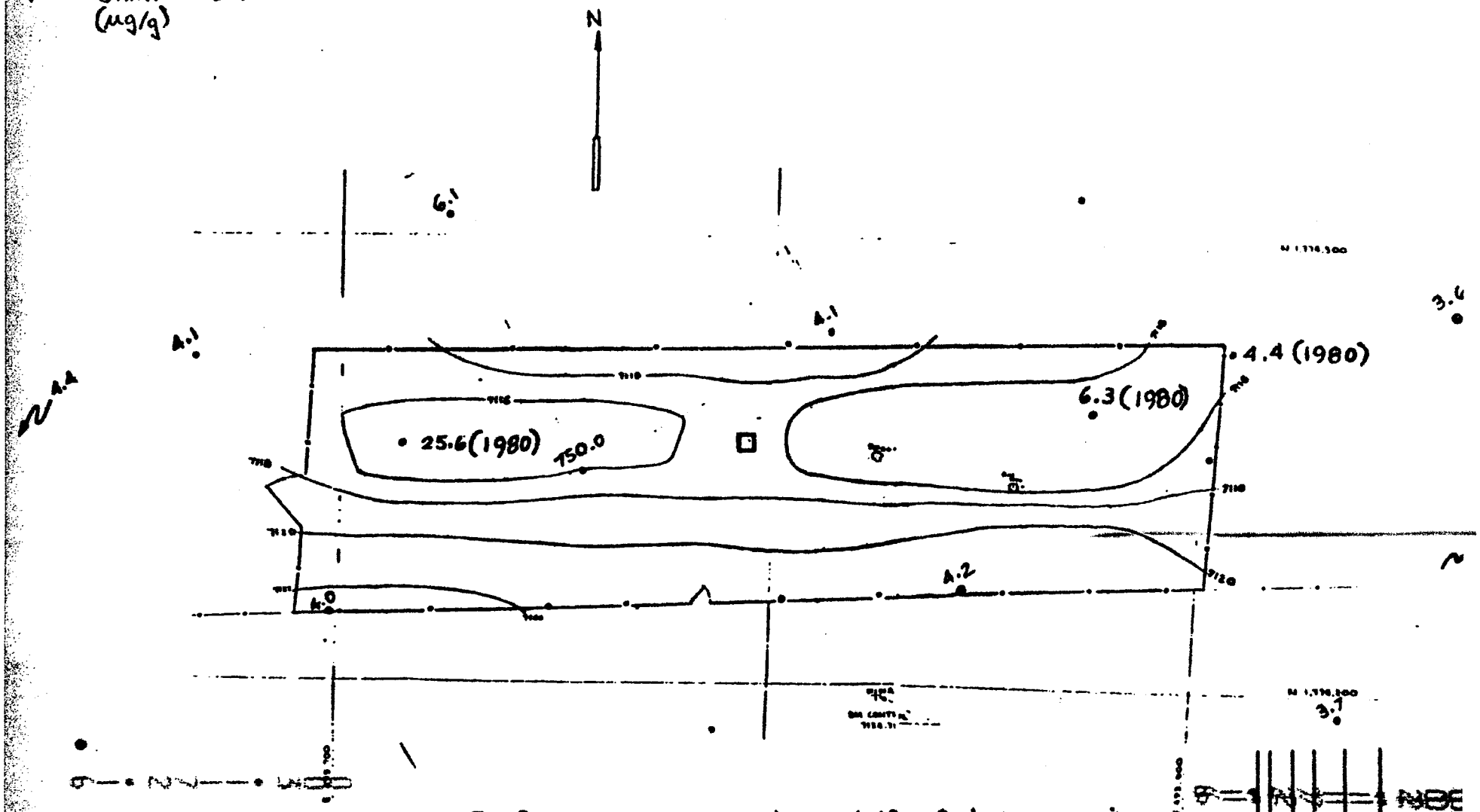


Fig. 9. [illegible] Concentration in 1-10 cm Soil, 1984

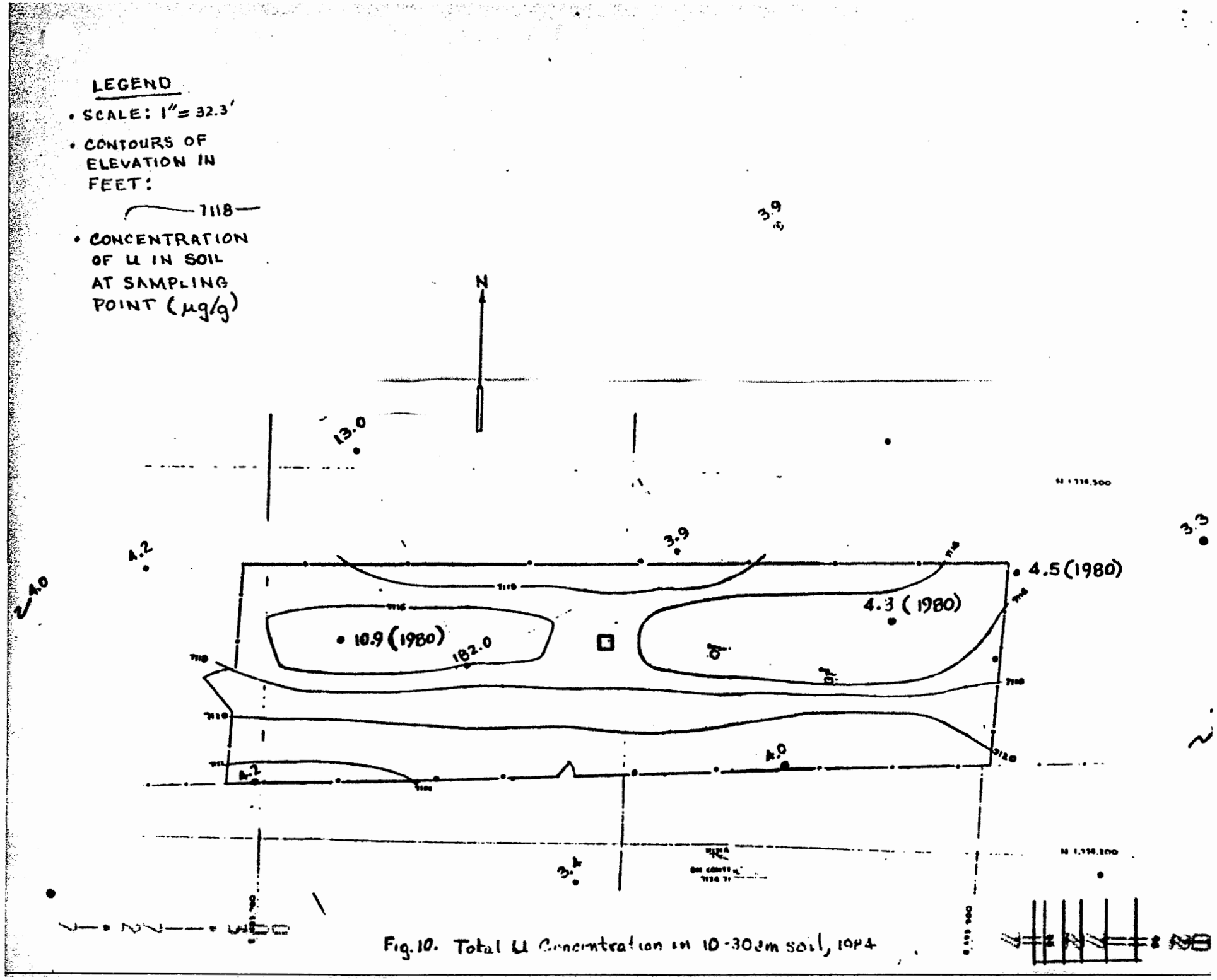


Fig. 10. Total U Concentration in 10-30cm soil, 1984

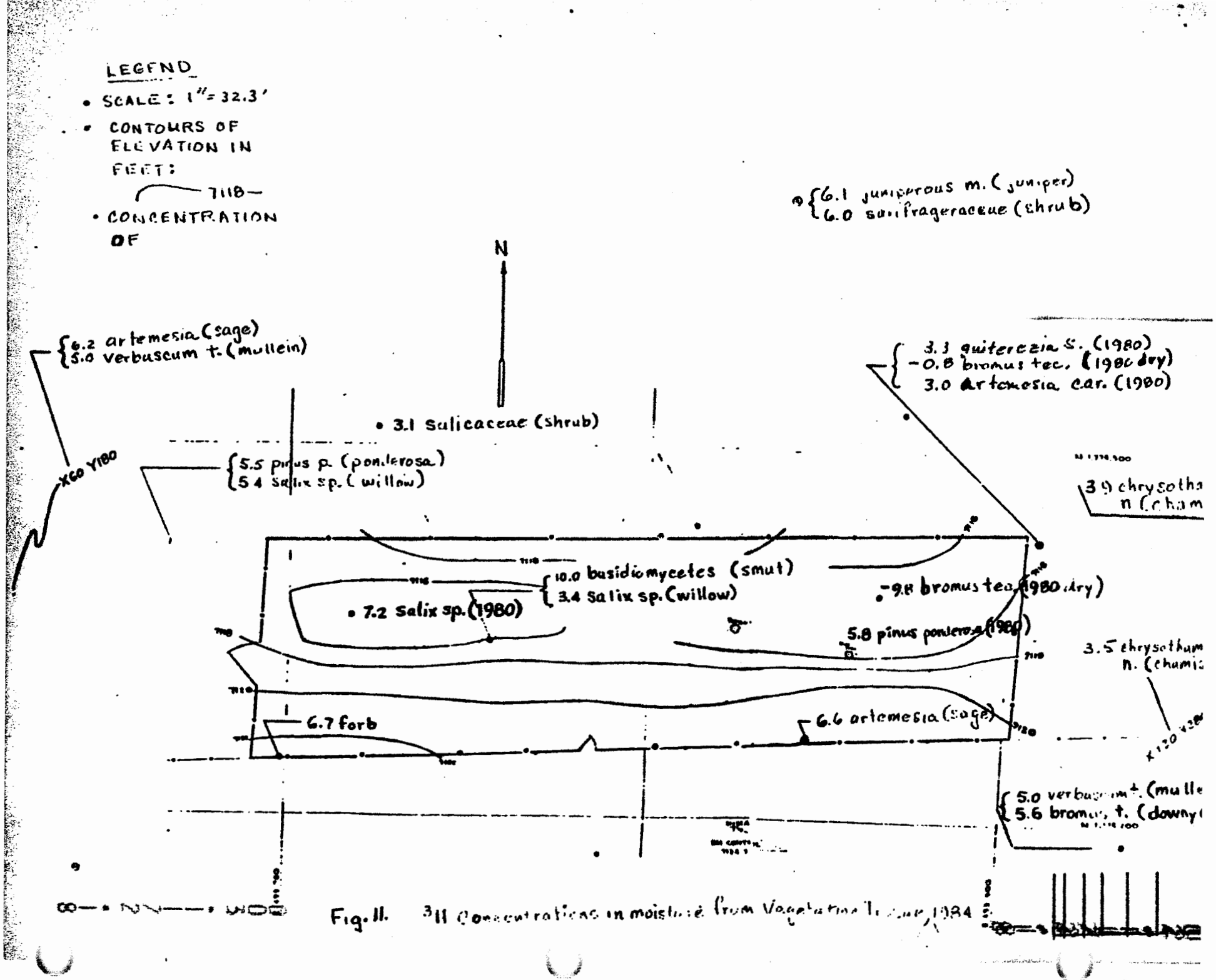


Fig. 11. ^{3}H Concentrations in moisture from Vegetation Tissue, 1984

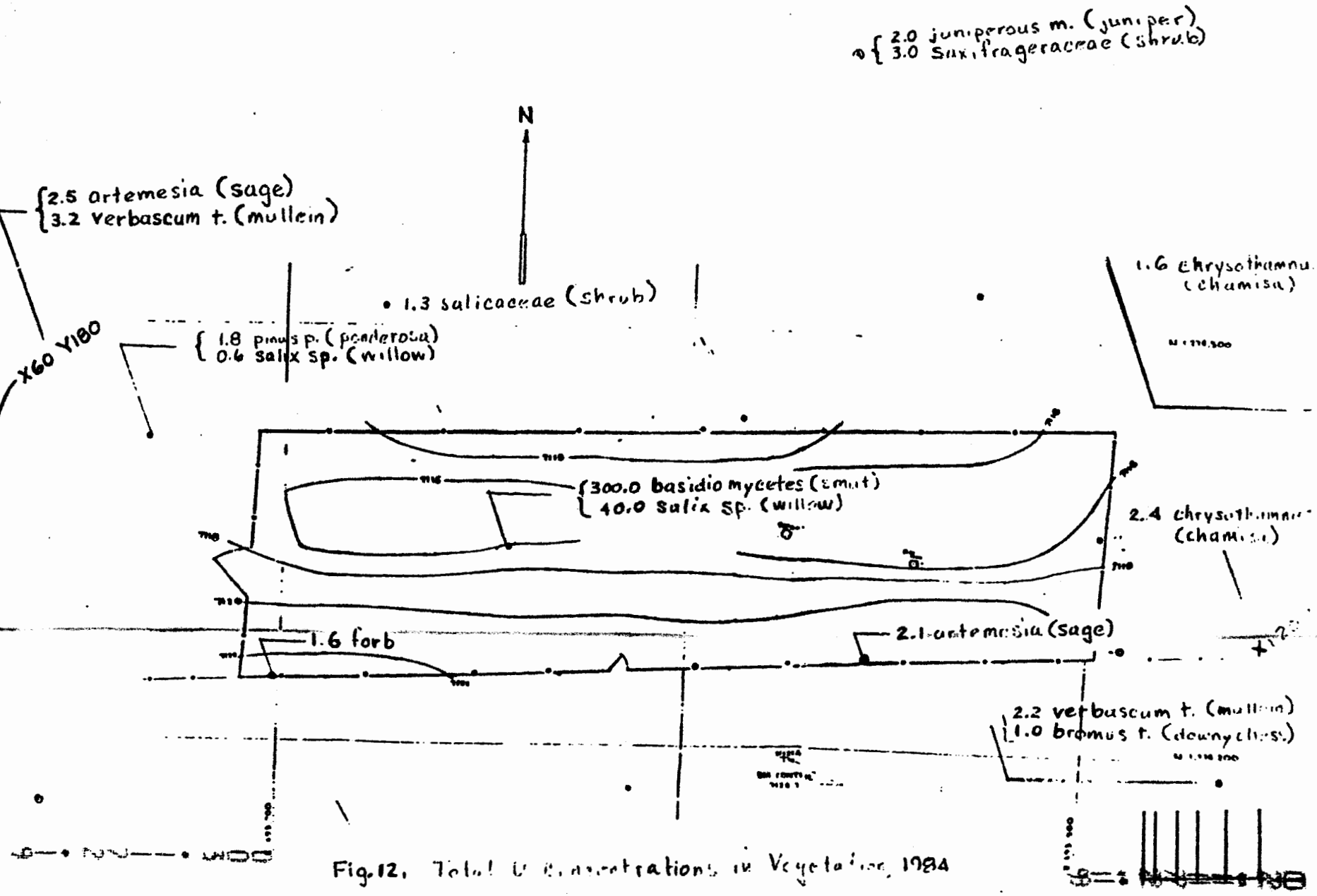


Fig. 12. Total U Concentrations in Vegetation, 1984

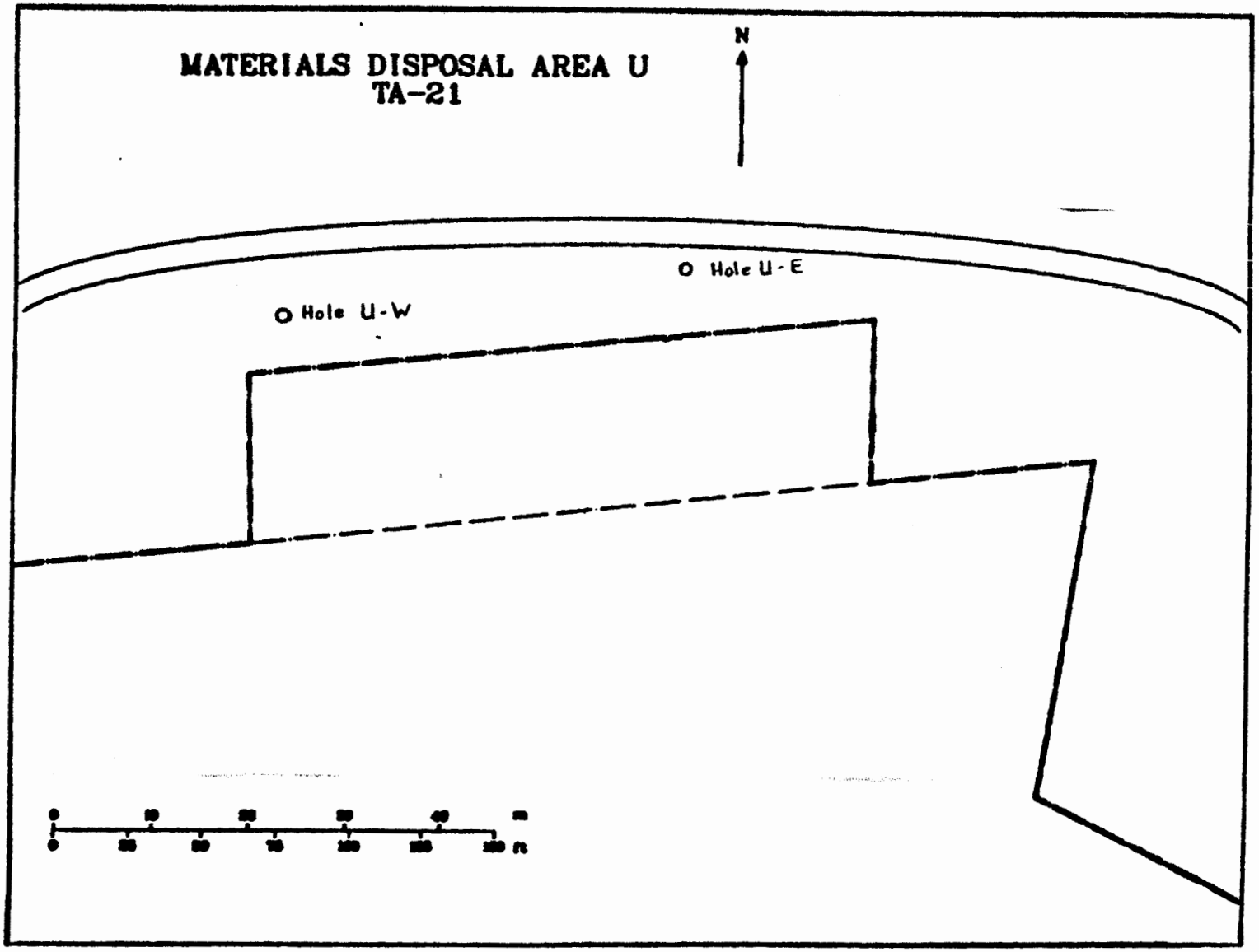
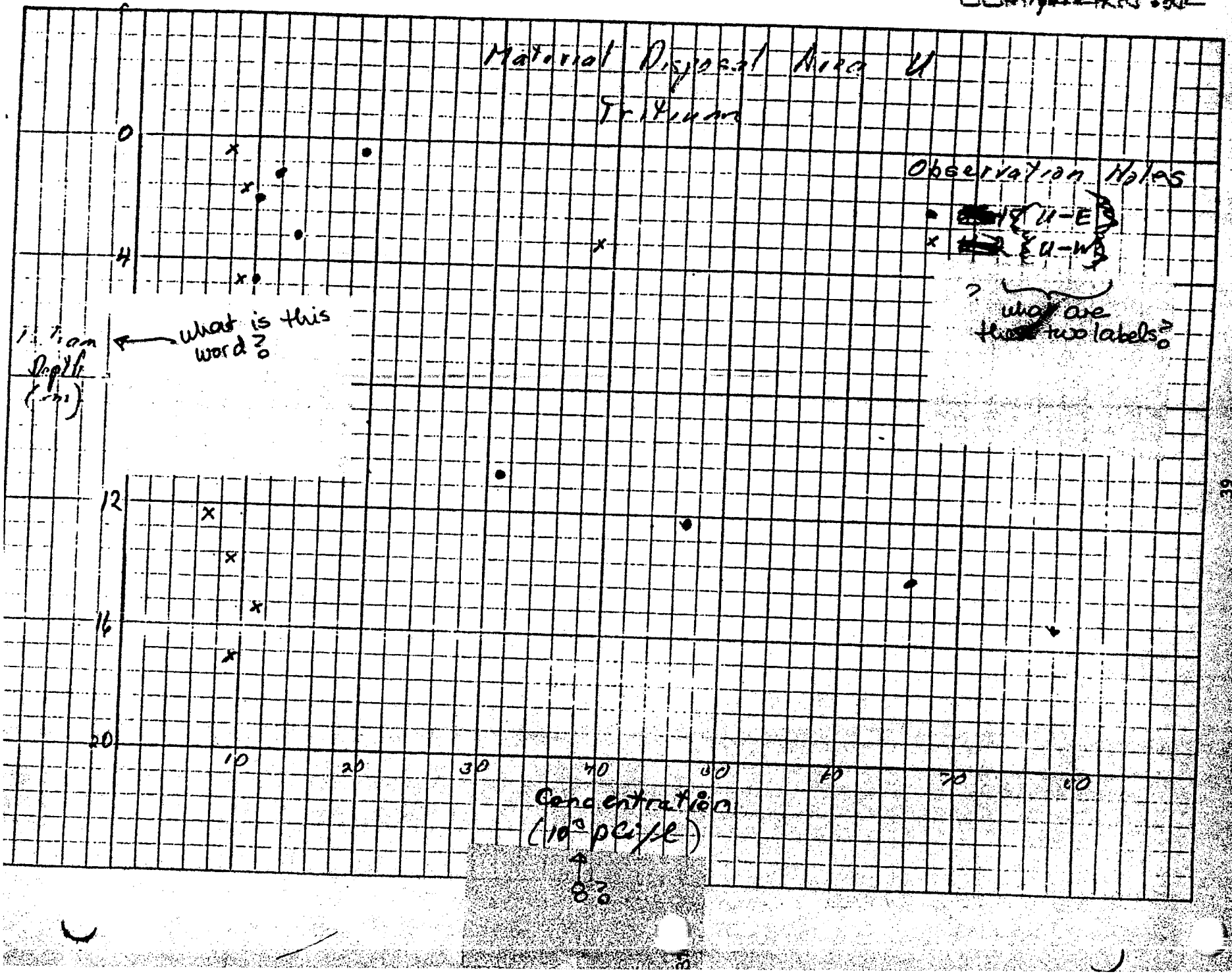


Fig. 13 . Location of Observation Holes at Area U

Figure 4



Material Disposal Area U
Tritium
Observation Holes
• {U-E}
x {U-W}
? what are these two labels?
Tritium Depth (m)
what is this word?
0
4
12
16
20
10
20
30
40
50
60
70
80
Concentration (10^3 pCi/l)
8?