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LIMITING FLOWS FOR BEAR RIVER AT BORDER GAGING STATION FOR ALLOWANCE OF UPSTREAM STORAGE

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LIMITING FLOWS FOR BEAR RIVER AT BORDER GAGING STATION FOR ALLOWANCE OF UPSTREAM STORAGE

The proposed draft of the Bear River Compact contains a provision, which in general states, new storage will be allowed above Bear Lake during the irrigation season, when the flow of Bear River at Border gaging station exceeds a certain amount and the resultant effect of such upstream storage will not be such as to reduce the flow at the Border gaging station below this amount.

The object of the limitation is to protect present direct flow irrigation rights below Bear Lake from encroachment, occasioned by the upstream diversion of natural flow water to storage. The determination of the limitation figure has been assigned by the Compact Commission to the Engineering Committee and this study has been prepared as basic information on which to make the determination.

Bear River basin covers a large area and has considerable variation in climatic and geophysical conditions. These affect the time and magnitude of runoff from different portions of the basin, and can only be expected that there will be some variation in the relation of the patterns of runoff in the portions of the basin above and below the Border gaging station. In general, the major portion of the runoff from the lower part in the basin occurs prior in time to that originating in the upper area and in many years much of the natural flow passing the Border gaging station is needed to fill natural flow rights below Bear Lake. The purpose of this study is to determine how much of the natural flow passing Border may be stored upstream without affecting downstream direct flow irrigation rights.

The basin below Border may be divided into four critical reaches, or critical places, and for each, the date determined when natural flow supplies

decrease to the point that cutting of natural flow rights become necessary. These are as follows:

1. Border to Stewart Dam section
2. Last Chance Canals
3. Riverdale and West Cache Canals
4. Cutler Dam

Border to Stewart Dam Section

The natural flow supply for canals diverting between Border and Stewart Dam is that passing the Border gaging station plus inflow from Thomas Fork. Decreed rights for canals in this reach total 618 second-feet. About seventy-five percent of this amount is derived from natural flow passing the Border gaging station. The effect of upstream storage should therefore, not result in decreasing the flow at Border during the irrigation season below about 500 second-feet.

Last Chance Canals

The natural flow supplies for the Last Chance Canal system would be practically the same as the natural flow passing the Bear River at Alexander gaging station. Decreed rights for the Last Chance Canal system total 650 second-feet, however, a review of past years of record indicate that about 450 second-feet is the maximum diverted when a plentiful supply is available. The time when cutting of rights begins can be taken as the day on which the natural flow at Alexander drops below 450 second-feet. In some years the maximum diversion by the canal system is less than 450 second-feet and a lesser amount can be used. However, as can be noted in this study, the decrease in natural flow is very pronounced and it matters little which criteria is used, as the date is seldom changed more than one day.

Riverdale and West Cache Canals

This section is not believed to be a dry spot in the river. Difficulties in connection with determination of natural flow supplies for this group of canals are many and it is believed the critical flows based on the Last Chance Canals or Cutler Dam will be of earlier dates and greater magnitude. For these reasons this section will not be investigated.

Cutler Dam

The two canals diverting at Cutler Dam will carry about 900 second-feet. The effect of upstream temporary pondage and releases from Soda, Oneida, and Cutler reservoirs makes the determination of natural flow for these canals a problem, and the following rule has been formulated as a basis for determining the date on which cutting of rights would begin.

> "Cutting of irrigation rights begin at Cutler Dam on the day that the algebraic summation of storage being released from Bear Lake, Soda, Oneida, and Cutler Reservoirs, with due allowance for time interval, becomes greater than the flow passing the Bear River at Collinston gaging station."

In some years draft on Bear Lake begins before storage water is needed for irrigation, while in other years, storage is used from the temporary pondage reservoirs for irrigation before draft begins on Bear Lake. This definition takes these operations into account, as well as upstream storage releases which are retained in downstream pondage reservoirs.

Determination of Dates When Cutting of Rights Begin

On Plates 2 and 3 for 1930 and 1947 are shown examples of computations used in determining the dates on which cutting of natural flow irrigation rights became necessary on the Last Chance Canals and the canals diverting at Cutler Dam. The tabulations are arranged to allow for time interval to the nearest day for movement of water downstream.

The Bear River at Border gaging station was not established until 1938. In order to extend the records back to 1924, the Bear River at Harer gaging station can be utilized as there is a good correlation between daily flows at this station and the station at Border. The time interval for movement of water between the two stations is about twelve hours, but for all practical purposes flows at both stations on the same day can be used. The various columns on Plates 2 and 3 are obtained from records of discharge or computed as follows:

Column 2: Bear River above Sublette Creek. Station established in 1948 and records for 1947 are estimated.

Column 4: Bear River at Border. Station established in 1938.

Column 5: Bear River at Harer.

Column 7: Rainbow Inlet Canal at head.

Column 8: Dingle Inlet Canal near Dingle.

Column 9: Bear River below Stewart Dam.

Column 10: Column 7 plus Column 8.

Column 11: Natural flow actually passing Bear Lake. Column 9 plus Column 15 minus Column 16, when Column 16 is greater than zero. Column 16 taken as zero when negative.

Column 13: Elevation of Bear Lake.

Column 14: Contents of Bear Lake.

Column 15: Bear Lake Outlet Canal near Paris.

Column 16: Bear Lake storage release. Column 15 minus Column 10. When Column 16 is minus Bear River water is being diverted to storage in Bear Lake.

Column 18: Elevation of Soda Reservoir.

Column 19: Contents of Soda Reservoir.

Column 20: Soda Reservoir release in acre-feet.

Column 21: Soda Reservoir release in second-feet.

Column 22: Summation of Columns ~~16~~ 16 and 21. This is storage water passing Bear River at Alexander gaging station. When minus, natural flow is being stored upstream.

Column 23: Natural flow passing Alexander, or which would pass the Alexander gaging station if there were no water being placed in storage upstream. Column 24 minus Column 22.

Column 24: Bear River at Alexander.

Column 25: Last Chance Canal.

Column 26: Tanner Canal.

Column 27: Bench "B" Canal.

Column 28: Total Last Chance Canal system, Column 25, plus Column 26, plus Column 27.

Column 30: Elevation of Oneida Reservoir.

Column 31: Contents of Oneida Reservoir.

Column 32: Oneida Reservoir release in acre-feet.

Column 33: Oneida Reservoir release in second-feet.

Column 36: Cutler Reservoir contents.

Column 37: Cutler Reservoir release in acre-feet.

Column 38: Cutler Reservoir release in second-feet.

Column 39: Algebraic summation of Columns 16, 21, 33, and 38.

Column 40: Bear River near Collinston.

The heavy horizontal lines extending across each plate indicate when rights are cut at Cutler Dam. The heavy horizontal lines extending about two thirds across the plates indicate when rights are cut on Last Chance Canals. The short heavy horizontal lines indicate when storage draft began on Bear Lake.

In the tabulation on Page 7 are summarized the dates that cutting of rights became necessary on the Last Chance Canals and at Cutler Dam, and also the discharges at the Harer and Border gaging stations on an earlier date corresponding to time interval for movement of water between these gaging stations and the designated places of use. It is to be noted in this tabulation that in most years the date of cutting of rights at Cutler Dam precedes that of the Last Chance Canals. Cutler Dam is therefore indicated to be the dry spot in the river.

On Plate 1 are plotted the critical flows at Harer when rights were cut at Cutler Dam and on the Last Chance Canals. The extreme range in values are well illustrated. The years of 1935 and 1941 were abnormal, as can be noted by the extreme high critical flows at Harer. In these two years, almost drought conditions existed at the beginning of the irrigation seasons. When the irrigation seasons were well along, heavy storms occurred and runoff from these storms caused high flows to occur at the Harer station after the effects of the storms had already passed in the lower basin. Because of such abnormal conditions, these two years should be excluded when studying the critical flows at Harer. No special reason for the high critical flow figure is known for 1947, but it is felt that this year should also be eliminated from consideration. Except for these erratic years, the critical flows at Harer on the basis of Cutler Dam, are fairly well grouped between 600 and 900 second-feet and on the basis of the Last Chance Canals, between 400 and 600 second-feet.

SUMMARY TABULATION OF CRITICAL FLOWS

	LAST CHANCE CANALS			CUTLER DAM			Storage Release Started at Bear Lake		
Year	Date First Nat. flow rights cut	Harer 2 days earlier c.f.s.	Border 2 days earlier c.f.s.	Date First Nat. flow rights cut	Harer 4 days earlier c.f.s.	Border 4 days earlier c.f.s.	Date	Harer 1 day earlier	Border 1 day earlier
1924	June 19	558		June 18	730		May 26	1,620	
1925	July 21	524		June 29	718		June 13	853	
1926	June 6	646		May 28	619		Apr. 30	746	
1927	July 28	356		July 9	794		July 5	746	
1928	July 18	366		June 30	626		June 27	626	
1929	July 26	412		July 5	901		July 6	772	
1930	June 28	565		June 8	970		May 22	708	
1931	-	-		-	-		-	-	
1932	July 22	530		July 19	678		July 23	472	
1933	June 29	642		June 28	790		June 28	642	
1934	-	-		-	-		-	-	
1935	June 30	644		June 26	1,270		June 24	1,000	
1936	June 26	648		June 23	758		June 22	686	
1937	June 20	530		June 22	530		June 18	582	
1938	July 23	380	268	July 15	579	451	July 13	543	405
1939	May 26	634	497	May 27	658	518	May 23	698	560
1940	-	-	-	-	-	-	-	-	-
1941	June 30	593	561	June 23	1,380	1,210	June 23	934	876
1942	June 24	515	439	June 16	812	812	June 7	824	784
1943	July 28	406	350	July 8	746	666	June 26	926	832
1944	July 17	402	348	July 3	850	824	July 9	719	614
1945	July 27	392	304	July 8	941	658	July 6	870	622
1946	June 29	442	383	June 26	572	495	June 12	820	758
1947	July 23	506	388	July 7	1,150	966	July 8	890	717
1948	July 8	508	308	July 6	538	373	June 14	1,120	768

Hydrographs of Discharge for Bear River at Harer and at Border

On Plates ~~27~~ 4 to ~~53~~ 30 are shown the hydrographs of Bear River at Harer for the years 1924 to 1950. Hydrographs of Bear River at Border are shown for the years 1938 to 1950. On each plate a heavy vertical line is drawn, indicating the date on which cutting of rights began at Cutler Dam and a small circle on the hydrographs shows discharge at Border four days earlier.

Conclusions and Recommendations

It is apparent from the computations on Plates 2 ~~to 26~~ and 3 and the summary tabulation on Page 7, that Cutler Dam is the dry spot in the lower basin. If the abnormally high Harer critical flow values for 1935, 1941, and 1947 were eliminated and an arithemtic average taken of the remaining Harer figures on Page 7, the average for 19 years would be 722 second-feet. During the period that records are available at Border, the Harer average is 712 second-feet and the Border average 600 second-feet, providing the figures for 1941 and 1947 are disregarded. If an average critical flow figure is to be used for Border, the compact provision should specify that upstream storage will be allowed only when the flow at Border is greater than 600 second-feet.

However, if the condition that downstream rights should never or rarely be violated is necessary, then a critical flow figure of about 900 second-feet at Harer must be used. The equivalent flow at Border would be about 750 second-feet. A study of the hydrographs on Plates ~~27~~ 4 to ~~51~~ 30 using a limitation of this magnitude shows that upstream storage would only have been possible in about 12 of the 25 years investigated. Such a limitation would make upstream storage unfeasible.

It should be kept in mind the critical values as determined are those which occur during the period of flow recession following high water. Prior to this recession period, considerable amounts could be stored upstream, even

thcugh the flow at Border were reduced below those indicated, without any effect on downstream natural flow rights. Upstream storage is not at all feasible unless water can be stored in practically all years except possibly in the extreme drought years.

If a definite limitation must be used at Border, it may be advisable to adopt a lower figure than indicated. This figure should not be below that necessary to supply the requirements of the canals in the Border to Stewart Dam section. About 500 second-feet is needed at Border to supply these canals, and the Harer equivalent flow is about 600 second-feet. This lower limitation will provide upstream storage in practically all years, except drought years. On Plates 28 to 53, this critical flow is indicated as a solid line for Harer and as a long dash line for Border. An examination of the hydrographs shows that in most years there will be only a few days difference in time between the ceasing of upstream storage operations if the lower critical flow value is used, than would occur if the average value based on Cutler Dam were used.

The release and use of upstream storage would begin during the period of flow recession and would result in more sustained flows at Border during the recession period. It is believed such sustained flow at Border would be quite beneficial to downstream water users and should more than compensate for any effect caused by using a lower critical flow at Border.

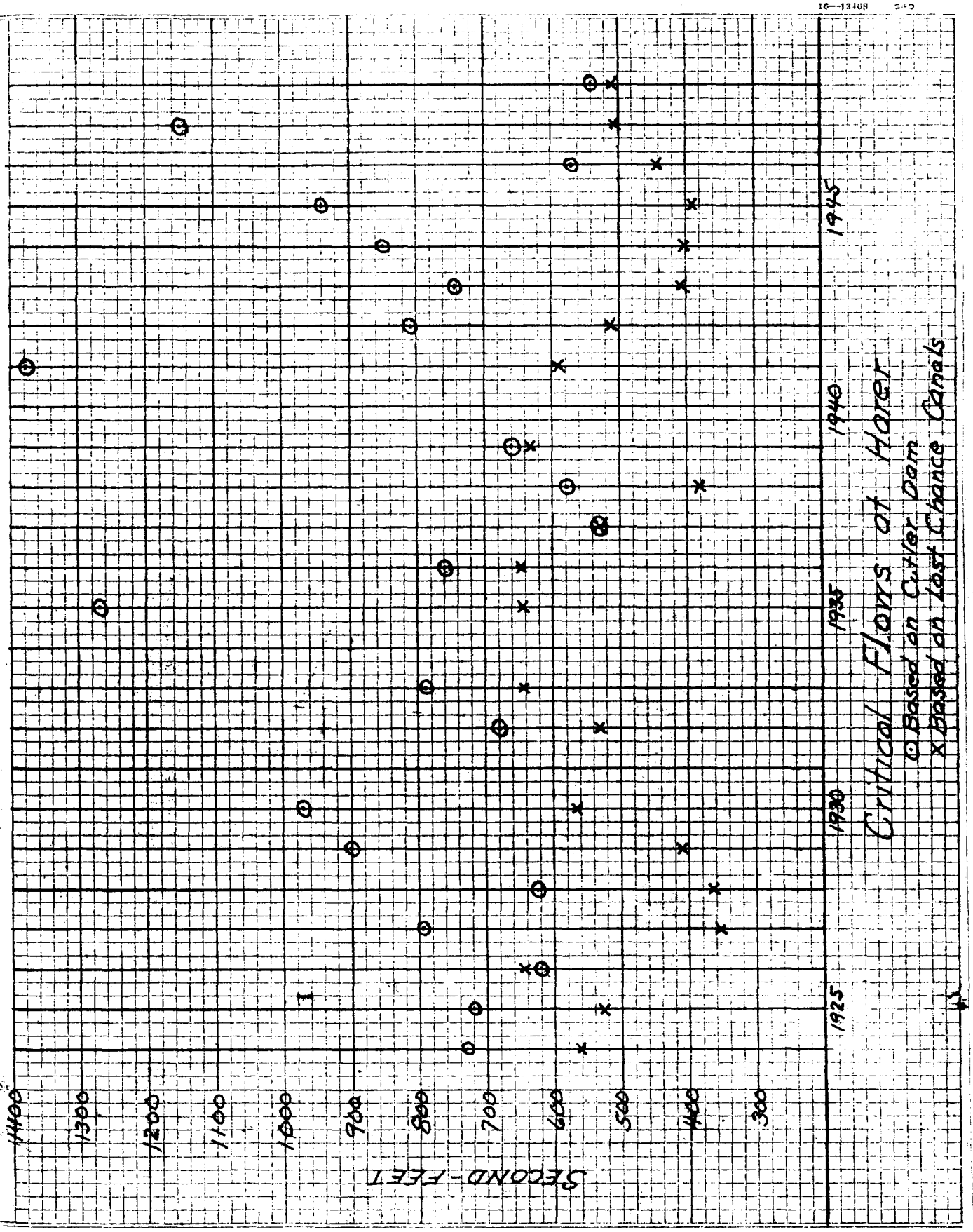
If upstream storage is to be allowed during the irrigation season, it is recommended that it be allowed to take place only when the flow at Border is greater than 500 second-feet and that the effect of upstream storage operations will not be such as to reduce the flow at Border below 500 second-feet.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES BRANCH

File Number { Washington ..... District .....

PLATE 1

16—13168



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Hatch

May 5 Count at Pass

DAILY SEGREGAT

DATE	Sublet	DATE	Border	Horer	DATE	Rainbow	Dingle	Stewart	Total Inlet Canals	Total Not. Stewart	Total Not. Pass. B.L.	BEAR LA	
												Elev.	Cont.
	S.F.		S.F.	S.F.		S.F.	S.F.	S.F.	S.F.	S.F.	S.F.	FT.	F.
1	2	3	4	5	6	7	8	9	10	11	12	13	1
May 18		May 19		799	May 20	33	10	443	43	486		15.16	826
		20		717	21	33	10	397	43	440		15.16	826
		21		708	22	33	10	396	43	439		15.16	826
		22		709	23	33	10	392	43	435		15.17	826
		23		704	24	33	2	371	35	406		15.17	826
		24		666	25	34	2	360	36	396		15.17	826
		25		637	26	35	2	330	37	367		15.17	826
		26		620	27	35	2	290	37	327		15.17	826
		27		586	28	36	2	255	38	293		15.17	826
		28		599	29	37	2	255	39	294		15.15	826
		29		637	30	38	2	265	40	305		15.15	826
		30		653	31	38	2	285	40	325		15.10	82
		31		674	June 1	39	2	367	41	408		15.09	82
		June 1		739	2	40	2	436	42	478		15.09	82
		2		849	3	41	2	489	43	532		15.10	82
		3		934	4	41	2	534	43	577		15.12	83
		4		970	5	42	2	556	44	600		15.10	82
		5		962	6	43	2	510	45	555		15.10	82
		6		849	7	43	2	450	45	495		15.10	82
		7		778	8	45	2	402	47	449		15.10	82
		8		730	9	48	2	361	50	411		15.10	82
		9		708	10	50	2	328	52	380		15.10	82
		10		704	11	52	2	280	54	334		15.09	82
		11		726	12	55	2	270	55	327		15.06	82
		12		770	13	57	2	353	59	412		15.04	82
		13		890	14	57	2	406	59	465		15.02	82
		14		849	15	56	2	400	58	458		14.99	82
		15		836	16	55	2	394	57	451		14.97	81
		16		818	17	54	2	397	56	453		14.95	81
		17		818	18	54	2	400	56	456		14.93	81
		18		814	19	53	2	396	55	451		14.92	81
		19		787	20	52	2	365	54	419		14.90	81
		20		726	21	51	2	332	53	385		14.90	81
		21		679	22	50	2	295	52	347		14.87	81
		22		645	23	48	2	275	50	325		14.84	81
		23		641	24	47	2	270	49	319		14.85	81
		24		632	25	46	2	250	48	298		14.82	80
		25		611	26	45	2	240	47	287		14.79	80
		26		565	27	44	2	220	46	266		14.77	80
		27		536	28	44	2	210	46	256		14.73	80
		28		516	29	43	2	200	45	245		14.70	80
		29		500	30	42	2	190	44	234		14.67	79
		30		488	July 1	41	2	180	43	223		14.62	79
		July 1		468	2	41	2	170	43	213		14.59	79
		2		432	3	40	2	155	42	197		14.55	79
		3		436	4	40	2	132	42	173		14.52	78
		4		400	5	40	2	122	42	164		14.49	78
		5		376	6	33	2	152	35	187		14.46	78

EGREGATION OF FLOW

Total Nat. Pass. B.L.	BEAR LAKE		Outlet Canal	B.L. Stor. Rel.	DATE	SODA RESERVOIR				BEAR R. AT ALEXANDER			LAST CHA. CANAL SYS.		
	Elev.	Contents				Elev.	Cont.	Rel.	Rel.	Stor.	Nat.	Total	L.Chan	Tann.	"B"
S.F.	FT.	A.F.	S.F.	S.F.		F.T.	A.F.	A.F.	S.F.	S.F.	S.F.	S.F.	S.F.	S.F.	S.F.
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
						17.90	8740								
	15.16	828,700	5	-38	May 21	16.60	8380	360	180	142	820	962	355	10	101
	15.16	828,700	35	-8	22	16.45	8240	140	70	68	724	786	360	12	94
	15.16	828,700	154	111	23	16.80	8560	-320	-160	-49	784	735	360	13	96
	15.17	828,800	245	202	24	17.50	9220	-660	-330	-178	772	644	360	4	8[illegible]
	15.17	828,800	237	202	25	18.15	9840	-620	-310	-108	726	618	360	0	8[illegible]
	15.17	828,800	193	157	26	18.15	9840	0	0	157	738	895	360		87
	15.17	828,800	152	115	27	18.05	9740	100	50	165	689	854	360		90
	15.17	828,800	151	114	28	17.85	9560	180	90	209	615	824	360		9[illegible]
	15.17	828,800	195	157	29	17.65	9170	380	190	347	515	862	360		7[illegible]
	15.15	828,700	334	295	30	17.50	9120	50	25	320	489	809	360		88
	15.15	828,700	389	349	31	17.30	9020	100	50	399	480	879	360		86
	15.10	827,700	519	479	June 1	18.05	9790	-770	-385	94	504	598	360		78
	15.09	827,000	578	537	2	18.56	10250	-460	-230	307	487	794	360		87
	15.09	827,000	421	379	3	18.90	10600	-360	-175	204	683	887	360		97
	15.10	827,700	318	275	4	19.15	10750	-150	-75	200	712	912	360		88
	15.12	836,700	291	248	5	19.[illegible]	10970	-220	-110	138	732	870	360		85
	15.10	827,700	238	194	6	19.[illegible]	11290	-320	-160	-34	727	771	360		91
	15.10	827,700	190	145	7	19.[illegible]	11550	-260	-130	15	691	706	360		92
	15.10	827,700	121	76	8	19.[illegible]	11660	-110	-55	21	664	686	359		85
	15.10	827,700	102	55	9	19.[illegible]	11230	430	215	328	584	904	321		83
	15.10	827,700	148	103	10	19.[illegible]	10860	370	185	403	502	895	369		94
	15.10	827,700	287	236	11	18.[illegible]	10600	260	130	365	540	895	368		90
	15.09	827,000	314	260	12	18.[illegible]	10300	300	150	410	503	945	367		96
	15.06	825,000	419	362	13	18.[illegible]	10140	160	80	442	434	895	363		95
	15.04	823,700	563	504	14	18.[illegible]	10350	-210	-105	398	481	870	361		86
	15.02	822,800	508	448	15	19.[illegible]	10860	-510	-255	189	496	685	353		94
	14.99	820,300	442	384	16	19.[illegible]	10970	-110	-55	329	503	832	358		99
	14.97	819,000	448	386	17	19.[illegible]	10860	110	55	440	464	904	363		101
	14.95	817,600	464	408	18	19.[illegible]	10810	50	25	433	462	895	362		90
	14.93	816,300	536	480	19	19.[illegible]	10860	-50	-25	455	524	979	365		88
	14.92	816,600	654	599	20	19.[illegible]	11130	-270	-135	464	473	937	360		90
	14.90	814,300	698	592	21	19.[illegible]	11290	-160	-80	514	414	928	358		90
	14.90	814,300	456	408	22	19.[illegible]	11610	-320	-160	243	536	779	351		90
	14.87	812,300	402	350	23	19.[illegible]	11390	220	110	460	477	937	358		90
	14.84	810,300	536	486	24	19.[illegible]	11230	160	80	566	396	962	358		90
	14.83	809,600	599	550	25	19.[illegible]	11230	0	0	550	404	954	354		90
	14.82	808,900	602	554	26	19.[illegible]	11230	0	0	554	466	1,020	354		90
	14.79	806,900	593	546	27	19.[illegible]	11070	160	80	626	434	1,060	360		88
	14.77	805,600	575	529	28	19.[illegible]	10810	260	130	659	361	1,020	364		92
	14.74	802,900	572	526	29	19.[illegible]	10970	-160	-80	446	340	786	354		86
	14.70	800,900	581	536	30	19.[illegible]	10650	320	160	696	344	1,040	351		84
	14.67	798,900	651	607	July 1	19.[illegible]	10300	350	175	782	338	1,120	354		80
	14.62	795,500	814	771	2	19.[illegible]	9940	360	180	951	249	1,200	348		76
	14.59	793,500	839	786	3	19.[illegible]	9640	300	150	936	214	1,150	351		52
	14.55	790,800	906	864	4	18.35	10040	-400	-200	664	190	854	339		11
	14.52	788,800	926	884	5	18.10	9790	250	125	1019	171	1,190	349		9
	14.49	786,800	922	880	6	17.70	9400	390	195	1075	185	1,260	351		7
	14.46	784,800	929	887	7	17.50	9240	160	80	984	176	1,160	321	0	7

1930 PLATE 2

AST CHANCE NAL SYSTEM			DATE	ONEIDA RES.				DATE	CUTLER RES.				Σ Stor. Alex To Cutler	BEAR RIV. Collinston
m Tonn.	"B"	Total	.	Elev.	Cont.	Rel.	Rel.		Elev.	Cont.	Rel.	Rel.		
S.F.	S.F.	S.F.		F.T.	A.F.	A.F.	S.F.		F.T.	A.F.	A.F.	S.F.	S.F.	S.F.
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
				50.2	10580					12460				
10	101	456	May 22	50.7	10830	-250	-125	May 23		13550	-1090	-545	-528	1260
12	94	466	23	50.5	10730	100	50	24		12460	1090	545	157	1667
13	96	469	24	49.6	10230	500	250	25		11410	1050	525	726	1100
4	89	453	25	48.5	9740	490	245	26		10400	1010	505	622	594
0	82	442	26	49.3	10130	-390	-195	27		9440	960	480	177	93
	87	447	27	49.8	10380	-250	-125	28		15850	-6410	-3205	-3173	94
	90	450	28	49.6	10280	100	50	29		11410	4440	2220	2435	90
	93	453	29	49.7	10330	-50	-25	30		11930	-520	-260	-76	82
	77	437	30	49.9	10430	-100	-50	31		12460	-530	-265	32	292
	88	448	31	50.4	10680	-250	-125	June 1		13550	-1090	-545	-350	611
	86	446	Jun. 1	50.4	10680	0	0	2		13550	0	0	399	279
	78	438	2	49.8	10380	300	150	3		13550	0	0	244	517
	87	447	3	50.7	10830	-450	-225	4		13000	550	275	357	133
	97	457	4	50.4	10680	150	75	5		13550	-550	-275	4	378
	88	448	5	50.4	10680	0	0	6		13550	0	0	200	614
	85	445	6	50.4	10680	0	0	7		12460	1090	545	283	905
	91	451	7	49.9	10430	250	125	8		11410	1050	525	684	316
	92	452	8	48.6	9790	640	320	9		11410	0	0	335	125
	85	444	9	49.3	10130	-340	-170	10		11410	0	0	-149	119
	83	454	10	49.8	10380	-250	-125	11		10900	510	255	450	89
	94	463	11	50.2	10580	-200	-100	12		10400	500	250	453	23
	90	458	12	49.6	10280	300	150	13		10400	0	0	515	24
	96	463	13	49.9	10430	-150	-75	14		10400	0	0	335	26
	95	458	14	48.8	9880	550	225	15		10400	0	0	667	28
	86	447	15	48.3	9640	240	120	16		10400	0	0	519	29
	94	437	16	49.2	10080	-340	-170	17		9440	960	480	499	30
	99	457	17	48.6	9790	290	145	18		8560	80	40	514	59
	101	464	18	47.9	9450	340	170	19		7750	810	405	1015	30
	90	452	19	47.7	9360	90	45	20		8150	-400	-200	278	28
	88	453	20	47.5	9270	90	45	21		8560	-410	-205	205	50
	90	450	21	47.5	9270	0	0	22		8150	410	205	669	29
	90	448	22	47.9	9450	-180	-90	23		7750	400	200	624	26
	90	441	23	48.4	9740	-290	-145	24		7010	740	370	468	48
	90	448	24	47.8	9410	330	165	25		6340	670	335	960	28
	90	448	25	47.0	9040	370	185	26		7010	-670	-335	416	28
	90	444	26	46.6	8860	180	90	27		7010	0	0	640	28
	90	444	27	46.7	8900	-40	-20	28		7010	0	0	534	50
	88	448	28	46.2	8680	220	110	29		6340	670	335	1071	29
	92	456	29	45.3	8280	400	200	30		7010	-670	-335	524	28
	86	440	30	44.9	8110	170	85	July 1		6340	670	335	866	50
	84	435	Jul. 1	44.7	8020	90	45	2		5710	630	315	1056	28
	80	434	2	43.9	7680	340	170	3		6340	-630	-315	637	26
	76	424	3	43.9	7680	0	0	4		6340	0	0	951	26
	52	406	4	44.3	7850	-170	-85	5		7010	-670	-335	516	50
	11	350	5	44.5	7940	-90	-45	6		6340	670	335	934	28
	9	358	6	44.5	7940	0	0	7		6020	320	160	1179	26
	7	358	7	45.2	8240	700	350	8		5710	310	155	1580	48
0	7	328	8	46.2	8680	-440	-220	9		5710	0	0	764	28

DAILY SEGREGAT

DATE	Sublet.	DATE	Border	Harer	DATE	Rainbow	Dingle	Stewart	Total Inlet Canals	Total Not. Stewart	Total Not. Pass. B.L.	BEAR LA	
												Elev.	Conte
	S.F.		S.F.	S.F.		S.F.	S.F.	S.F.	S.F.	S.F.	S.F.	FT.	A
1	2	3	4	5	6	7	8	9	10	11	12	13	1
Jun. 27		Jun. 28	1720	1940	Jun. 29	1490	4	25	1494	1519	722		1,25
28		29	1490	1820	30	1360	5	24	1365	1389	718		1,25
29		30	1260	1580	Jul. 1	1200	5	19	1205	1224	719		1,25
30	700	Jul. 1	1120	1360	2	1060	5	17	1065	1082	714		1,25
Jul. 1	650	2	1020	1240	3	980	4	15	984	999	712		1,25
2	580	3	966	1150	4	941	3	14	944	958	696		1,25
3	550	4	915	1100	5	889	3	14	892	906	694		1,25
4	520	5	852	1030	6	845	2	13	843	860	704		1,25
5	480	6	771	956	7	817	1	12	818	830	788		1,25
6	460	7	717	890	8	759	1	11	760	771	771		1,25
7	430	8	678	810	9	680	1	11	681	692	692		1,25
8	400	9	665	797	10	635	1	10	636	646	646		1,25
9	360	10	652	784	11	608	1	9	609	618	618		1,25
10	320	11	606	733	12	558	1	9	559	668	668		1,25
11	300	12	556	671	13	509	1	8	510	518	518		1,24
12	320	13	523	639	14	497	1	7	498	505	505		1,2
13	390	14	523	623	15	468	1	7	469	476	476		1,2
14	320	15	504	607	16	421	1	7	422	429	429		1,2
15	300	16	475	575	17	409	1	7	410	417	417		1,2
16	266	17	451	544	18	391	1	7	392	399	399		1,2
17	230	18	426	537	19	360	1	7	368	370	390		1,2
18	210	19	410	521	20	341	1	7	342	349	349		1,2
19	230	20	406	504	21	341	10	6	357	363	363		1,2
20	220	21	388	504	22	333	25	6	358	364	364		1,2
21	200	22	364	480	23	338	18	7	356	357	357		1,2
22	180	23	356	467	24	271	11	20	341	411	411		1,2
23	170	24	325	418	25	87	10	223	97	320	320		1,2
24	160	25	306	407	26	41	10	272	51	328	328		1,2
25	150	26	299	390	27	215	9	109	224	381	331		1,2
26	140	27	285	377	28	207	8	102	215	317	317		1,2
27	130	28	276	367	29	196	7	100	203	303	303		1,2
28	120	29	265	354	30	154	8	95	162	257	257		1,2
29	105	30	240	340	31	220	10	108	230	338	338		
30	100	31	253	337	Aug 1								
31	100	Aug 1			2								

SEGREGATION OF FLOW 1947

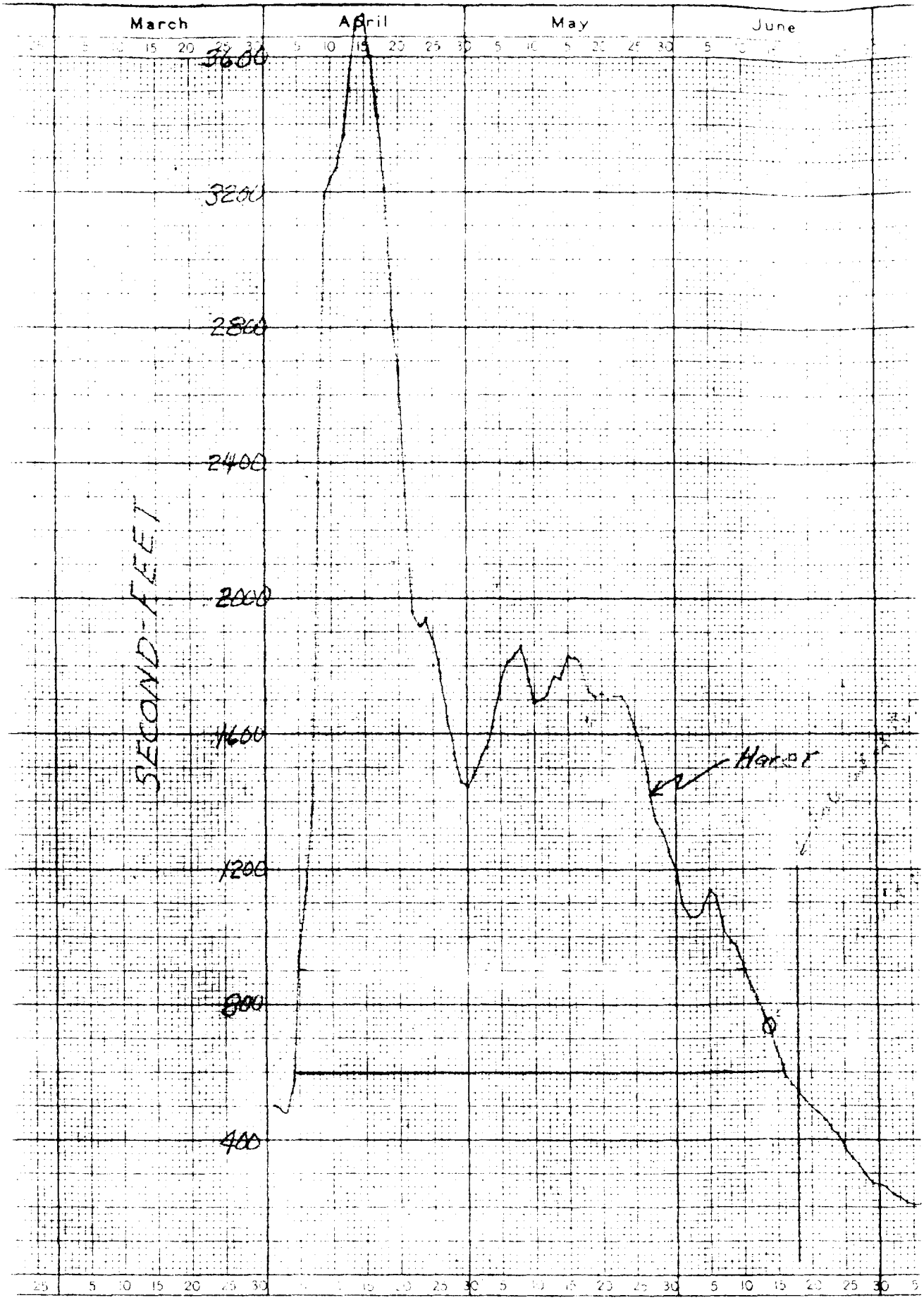
Total Nat. Stewart	Total Nat. Pass. B.L.	BEAR LAKE		Outlet Canal	B.L. Stor. Rel.	DATE	SODA RESERVOIR				BEAR R. AT ALEXANDER			LAST CANAL	
		Elev.	Contents				Elev.	Cont.	Rel.	Rel.	Stor.	Nat.	Total	L.Chan	Ton
S.F.	S.F.	F.T.	A.F.	S.F.	S.F.		F.T.	A.F.	A.F.	S.F.	S.F.	S.F.	S.F.	S.F.	S.
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	2
						29		10,590							
1519	722		1,251,000	697	-797	June 30		10,560	30	15	-782	1942	1160		
1389	718		1,252,000	694	-671	July 1		10,330	230	115	-556	1796	1240	306	
1224	719		1,252,000	740	-505	2		10,110	220	110	-395	1645	1250	307	
1082	714		1,253,000	697	-368	3		9,890	220	110	-258	1508	1250	307	
999	712		1,254,600	697	-287	4		10,670	-780	-390	-677	1379	702	293	
958	696		1,254,000	682	-262	5		10,880	-210	-105	-367	1307	940	302	
906	694		1,254,000	680	-212	6		11,360	-480	-240	-452	1225	773	308	
860	704		1,254,000	691	-156	7		11,000	360	180	-24	1226	1250	307	
830	788		1,254,000	772	-47	8		10,580	420	210	163	1207	1270	308	
771	771		1,254,000	884	124	9		10,380	200	100	224	1046	1270	308	
692	692		1,254,000	872	191	10		10,050	330	165	356	954	1310	310	
646	646		1,254,000	894	258	11		9,640	410	205	463	837	1300	308	
618	618		1,252,000	922	313	12		9,320	320	160	473	797	1270	308	
668	668		1,251,000	922	363	13		9,280	40	20	383	737	1120	305	
518	518		1,249,000	915	405	14		8,780	500	250	655	695	1350	303	
505	505		1,248,000	992	494	15		8,320	460	230	724	636	1360	302	
476	476		1,247,000	1190	701	16		8,140	180	90	791	549	1340	300	
429	429		1,246,000	1360	936	17		8,320	-180	-90	846	494	1340	307	
417	417		1,244,000	1420	1010	18		8,520	-200	-100	910	480	1390	303	
399	399		1,241,000	1360	978	19		8,560	-40	-20	958	472	1430	302	
370	370		1,239,000	1270	907	20		8,710	-150	-75	832	448	1280	305	
349	349		1,237,000	1240	898	21		8,550	160	80	818	582	1400	302	
363	363		1,236,000	1270	913	22		8,370	180	90	823	627	1450	301	
364	364		1,235,000	1360	1002	23		8,240	130	65	1147	313	1480	288	
357	357		1,233,000	1400	1050	24		8,260	-20	-10	1040	390	1430	263	
411	411		1,231,000	1370	1029	25		8,360	-100	-50	929	481	1410	252	
320	320		1,299,000	1340	1243	26		8,550	-190	-95	1148	252	1400	249	
328	328		1,264,000	1340	1289	27		9,050	-500	-250	1039	221	1260	252	
331	331		1,222,000	1310	1086	28		9,200	-150	-75	1011	289	1400	251	
317	317		1,218,000	1350	1135	29		9,220	-20	-10	1115	345	1460	245	
303	303		1,215,100	1380	1177	30		9,300	-80	-40	1137	313	1450	247	
257	257		1,213,000	1360	1198	31		9,400	-100	-50	1148	302	1450	227	
338	338					Aug. 1									
						2									
						3									

1947 PLATE 3

LAST CHANCE CANAL SYSTEM.				DATE	ONEIDA RES.				DATE	CUTLER RES.				Σ Stor. Alex To Cutler	BEAR RIV. Collinston
Chan.	Tonn.	"B"	Total		Elev.	Cont.	Rel.	Rel.		Elev.	Cont.	Rel.	Rel.		
S.F.	S.F.	S.F.	S.F.		F.T.	A.F.	A.F.	S.F.		F.T.	A.F.	A.F.	S.F.	S.F.	S.F.
25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
				30		9450			1		9650				
				Jul. 1		8770	-680	-340	Jul. 2		8990	660	330	-792	352
306	0	132	438	2		7940	830	415	3		8550	440	220	79	426
307	0	130	437	3		6860	1080	540	4		10090	-1440	-770	-625	24
307	0	130	437	4		8590	-1730	-865	5		11410	-1320	-660	-1783	32
293	0	130	423	5		9270	-680	-340	6		10090	1320	660	-357	24
302	0	130	432	6		10080	-810	-405	7		7450	2640	1320	548	298
308	0	130	438	7		8820	1260	630	8		4930	2520	1260	1438	528
307	0	133	440	8		8720	100	50	9		5370	-440	-220	-146	107
308	0	130	438	9		9360	-640	-320	10		5370	0	0	-157	257
308	0	131	439	10		8950	410	205	11		3700	1670	835	1244	429
310	0	130	440	11		8460	490	245	12		4630	-630	-315	286	43
308	0	131	439	12		9640	-1180	-590	13		5220	-590	-295	-422	70
308	0	131	439	13		9640	0	0	14		3920	1300	650	1123	257
305	0	130	435	14		9180	460	230	15		3580	340	170	783	335
303	0	134	437	15		8950	230	215	16		3920	-340	-170	700	235
302	0	132	434	16		8590	360	180	17		4780	-860	-430	474	222
300	0	135	435	17		8240	350	175	18		5220	-440	-220	746	360
307	0	133	440	18		7720	520	260	19		6710	-1490	-745	361	34
303	0	132	435	19		8240	-520	-260	20		8110	-2400	-1200	-550	33
302	0	131	433	20		9740	-1500	-750	21		7890	220	110	318	290
305	0	132	437	21		8900	840	420	22		7230	660	330	1582	368
302	0	132	434	22		8680	220	110	23		7890	660	330	1258	157
301	0	134	435	23		9000	-320	-160	24		9430	-1540	-770	-107	27
288	0	132	420	24		9930	-930	-465	25		9870	-440	-220	262	231
263	0	131	394	25		10030	-100	-50	26		10530	-660	-330	660	51
252	0	134	386	26		9640	390	195	27		11410	-880	-440	684	71
249	0	131	380	27		10280	-640	-320	28		11980	-570	-285	543	341
252	0	134	386	28		9690	590	295	29		11410	570	285	1619	483
251	0	137	388	29		9000	690	345	30		11410	0	0	1356	539
245	0	128	373	30		8020	980	490	31		11980	-570	-285	1320	461
247	0	129	376	31		7340	680	340	Aug. 1						
227	0	110	337	Aug. 1					2						
				2					3						
				3					4						
				4					5						

URCES BRANCH)

HYDROGRAPH FOR BEAR RIVER AT



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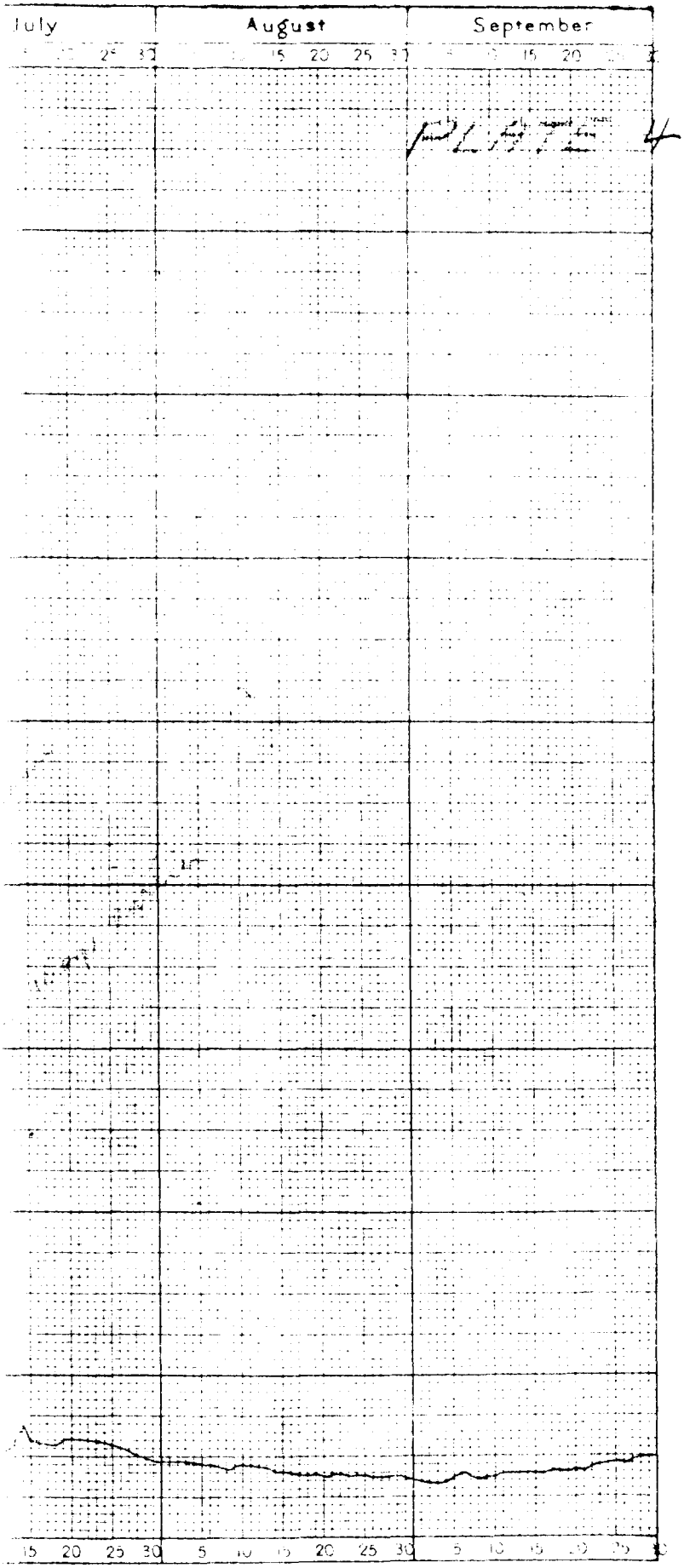

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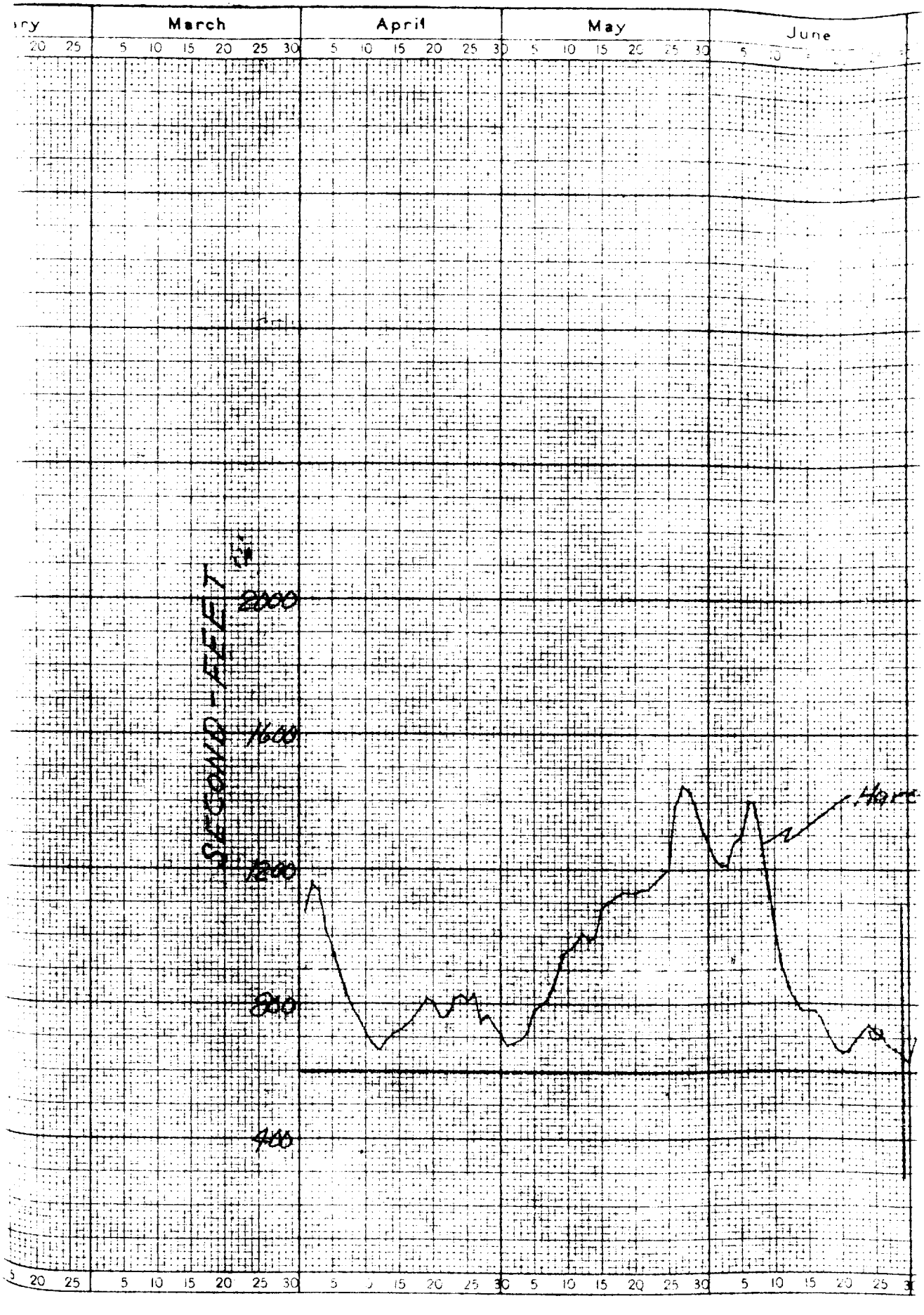

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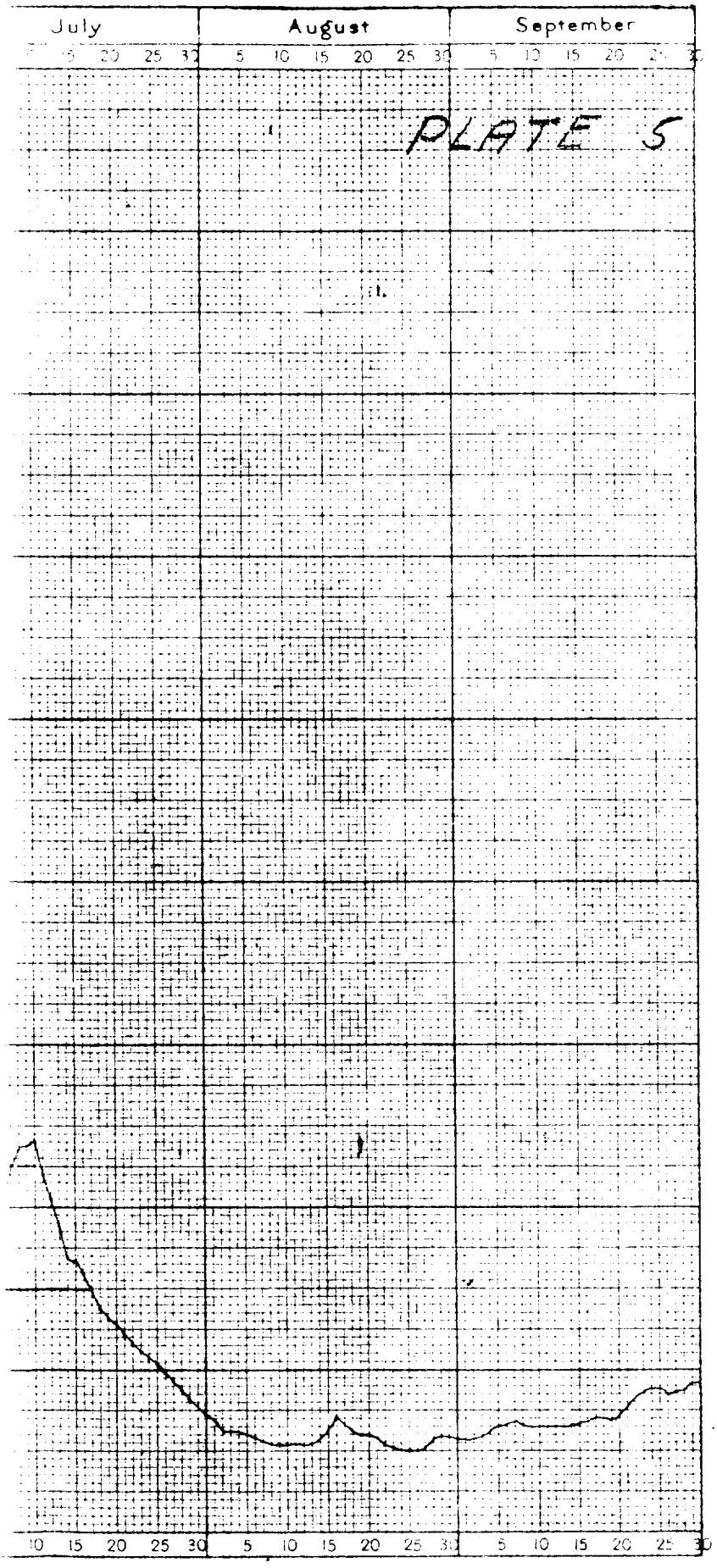

RESOURCES BRANCH

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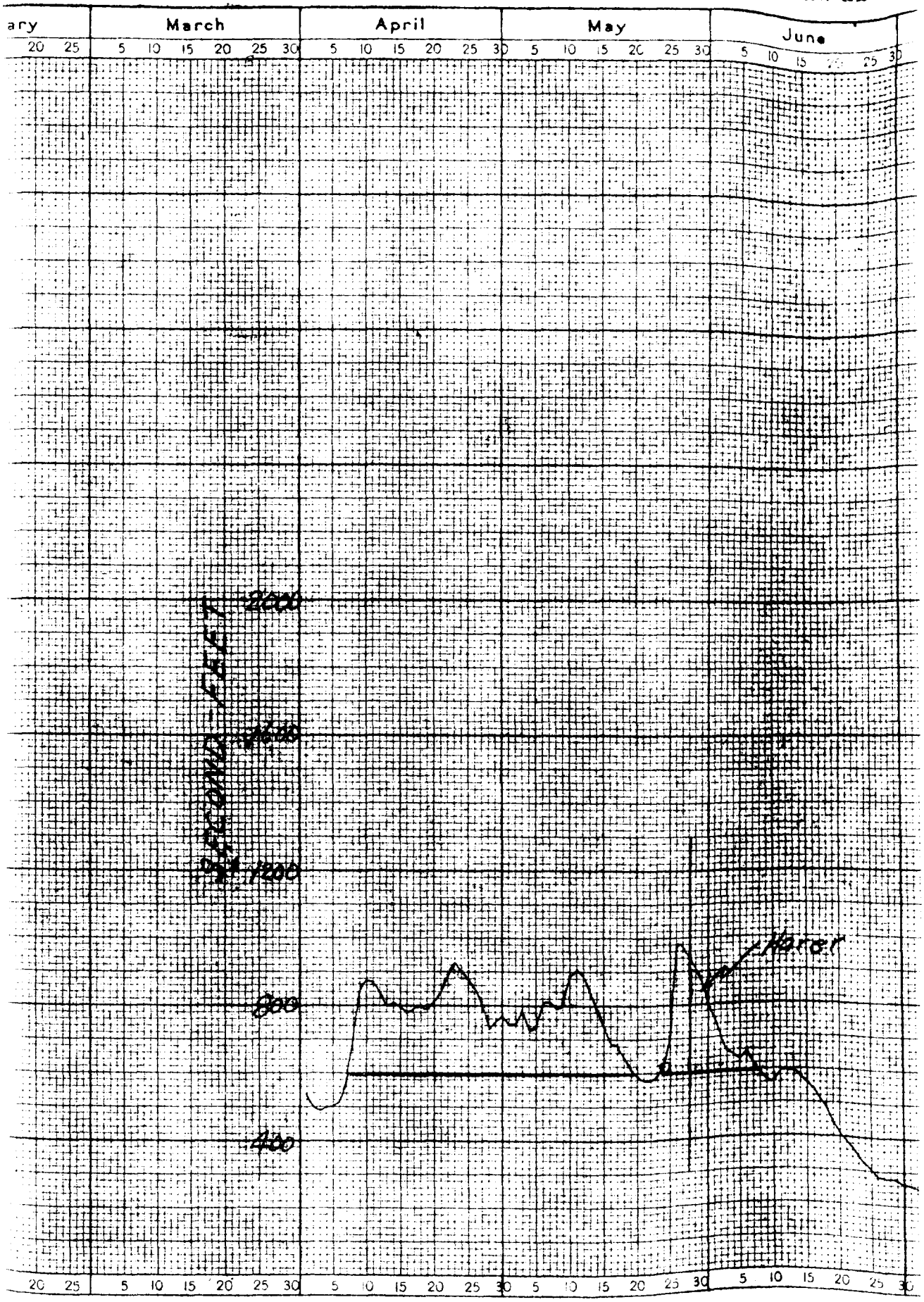

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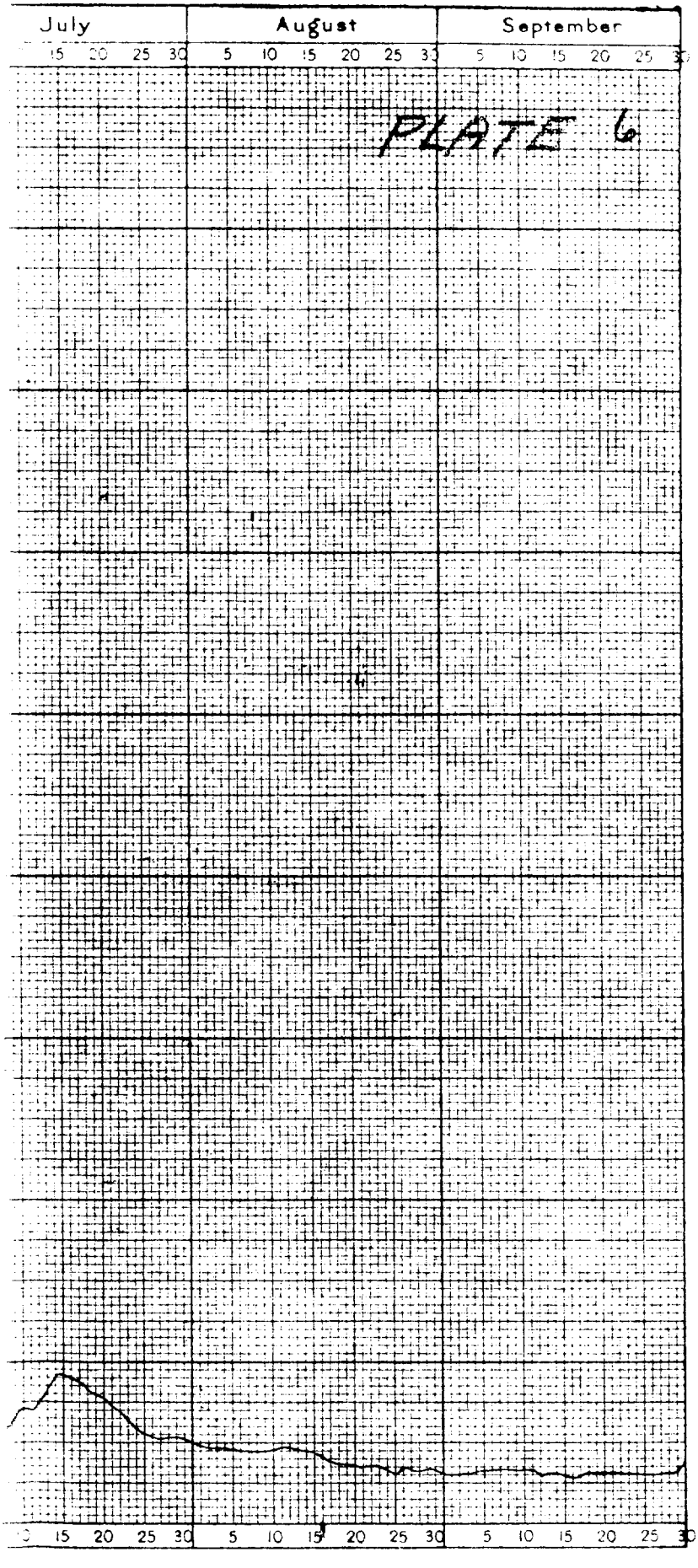

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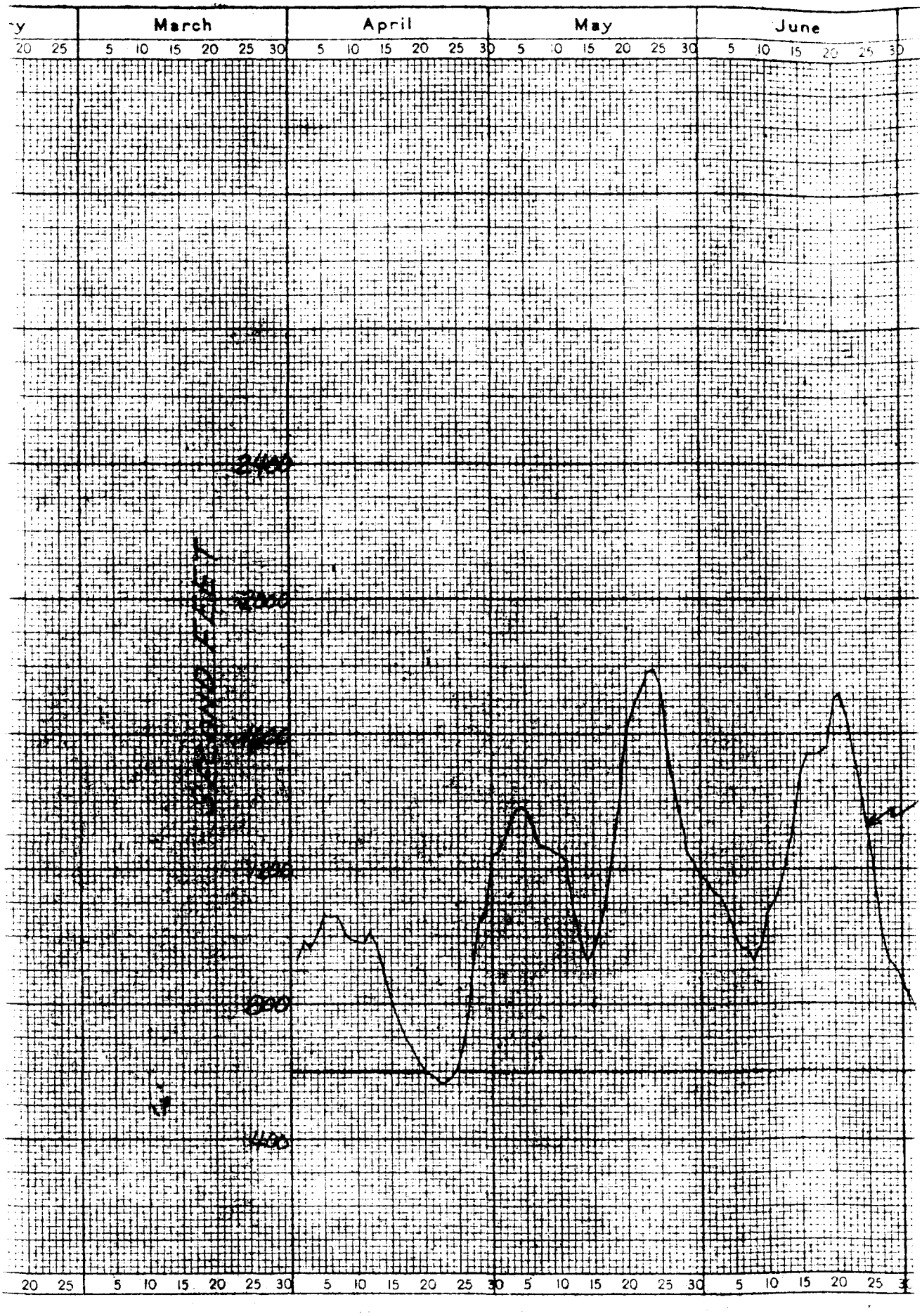

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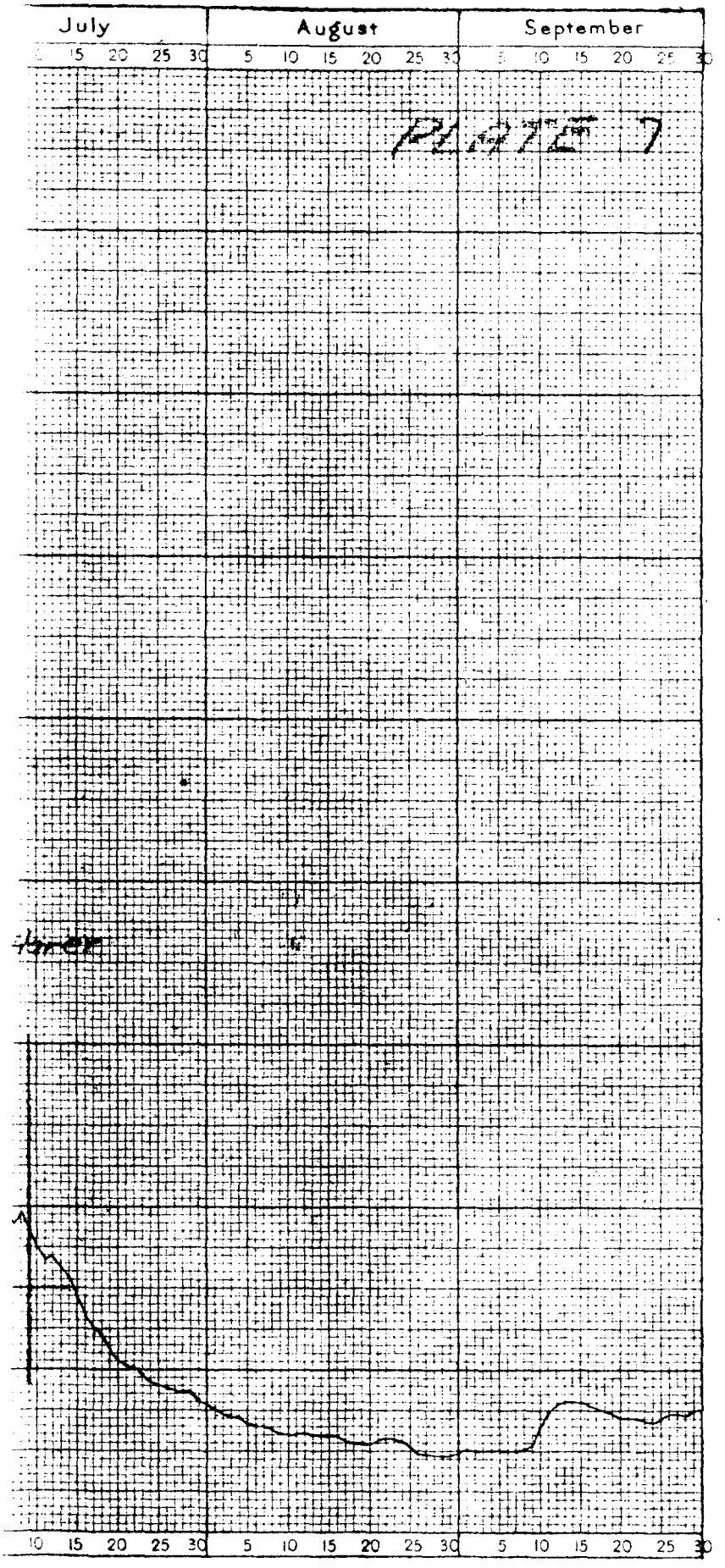

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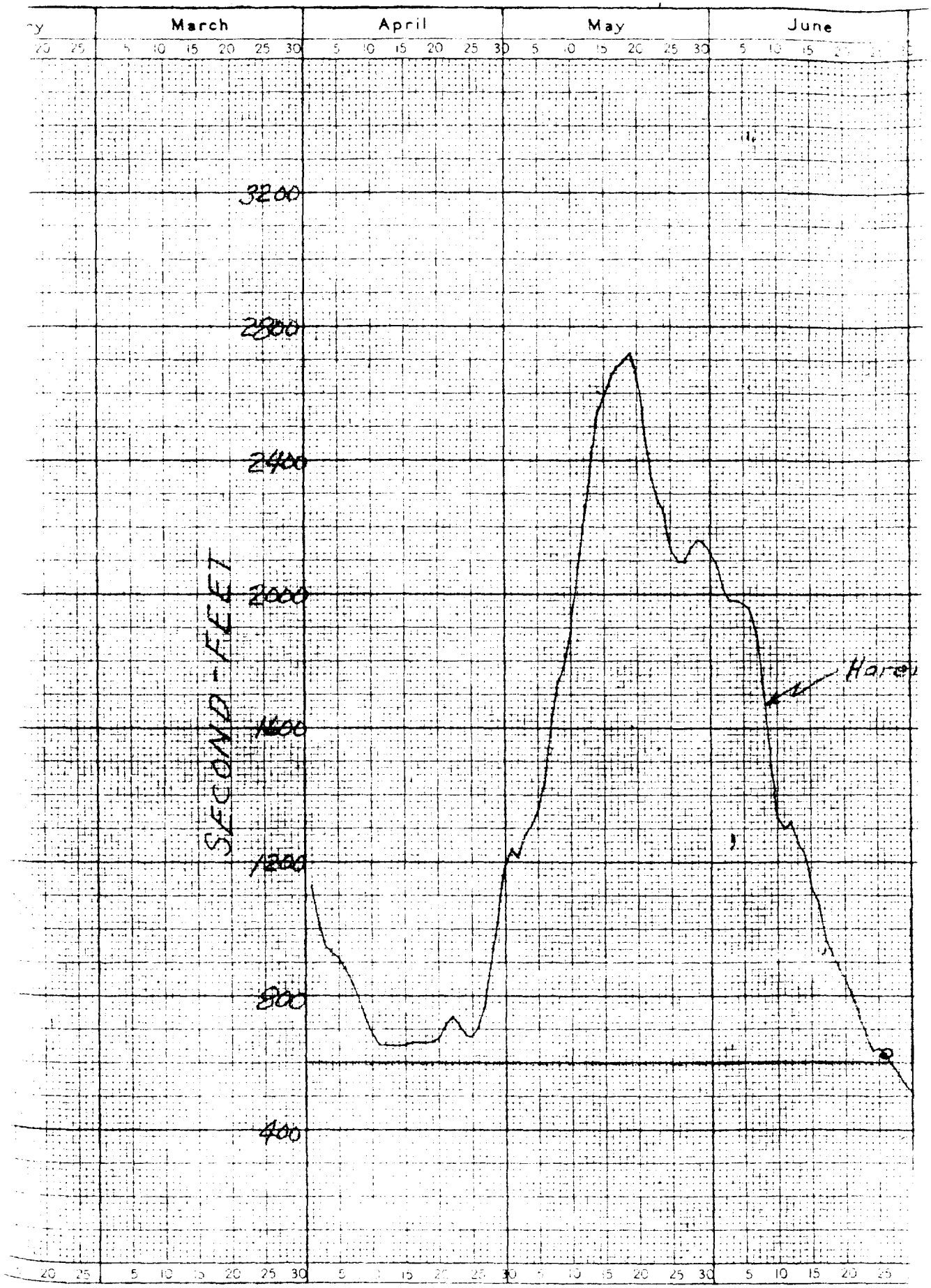
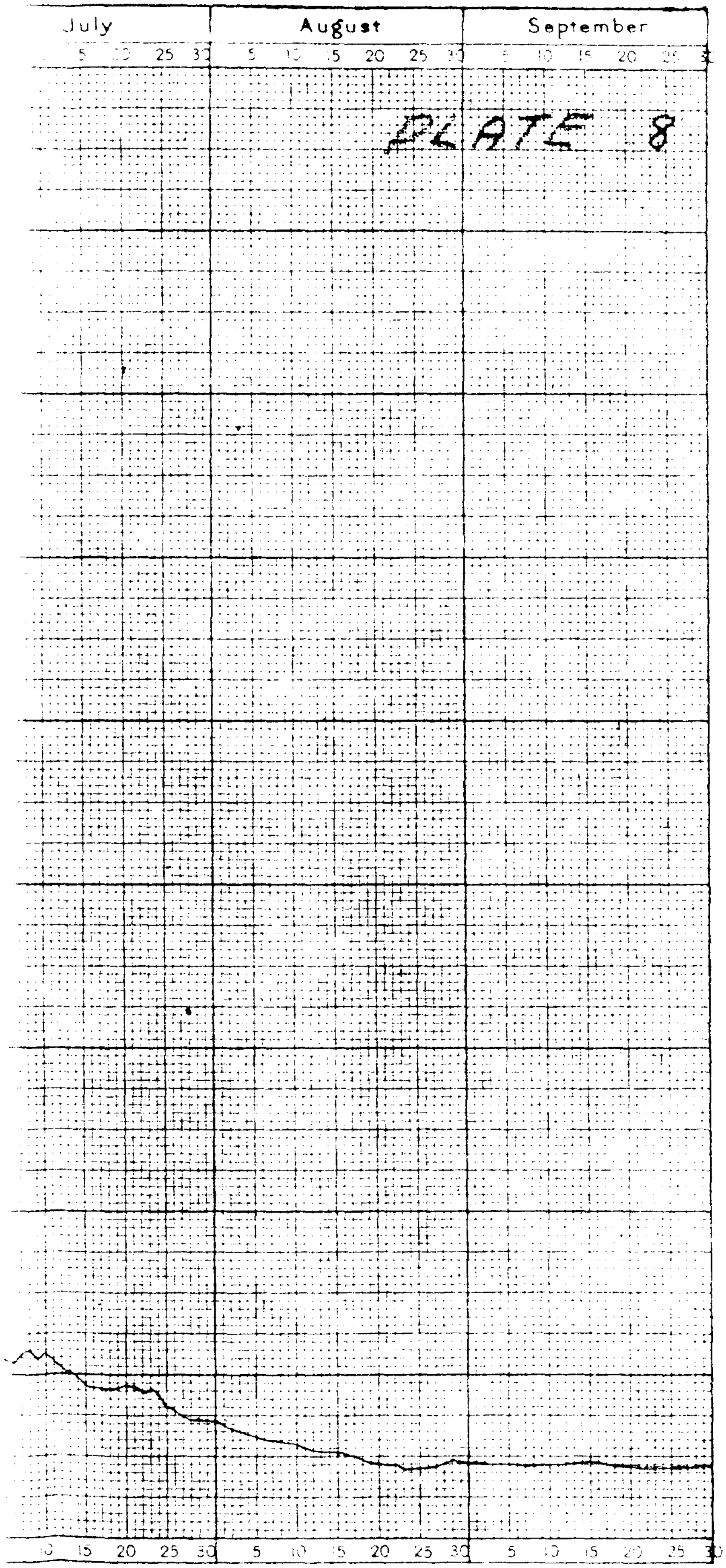


ER - 1928 File No. Washington / Field

PLATE 8



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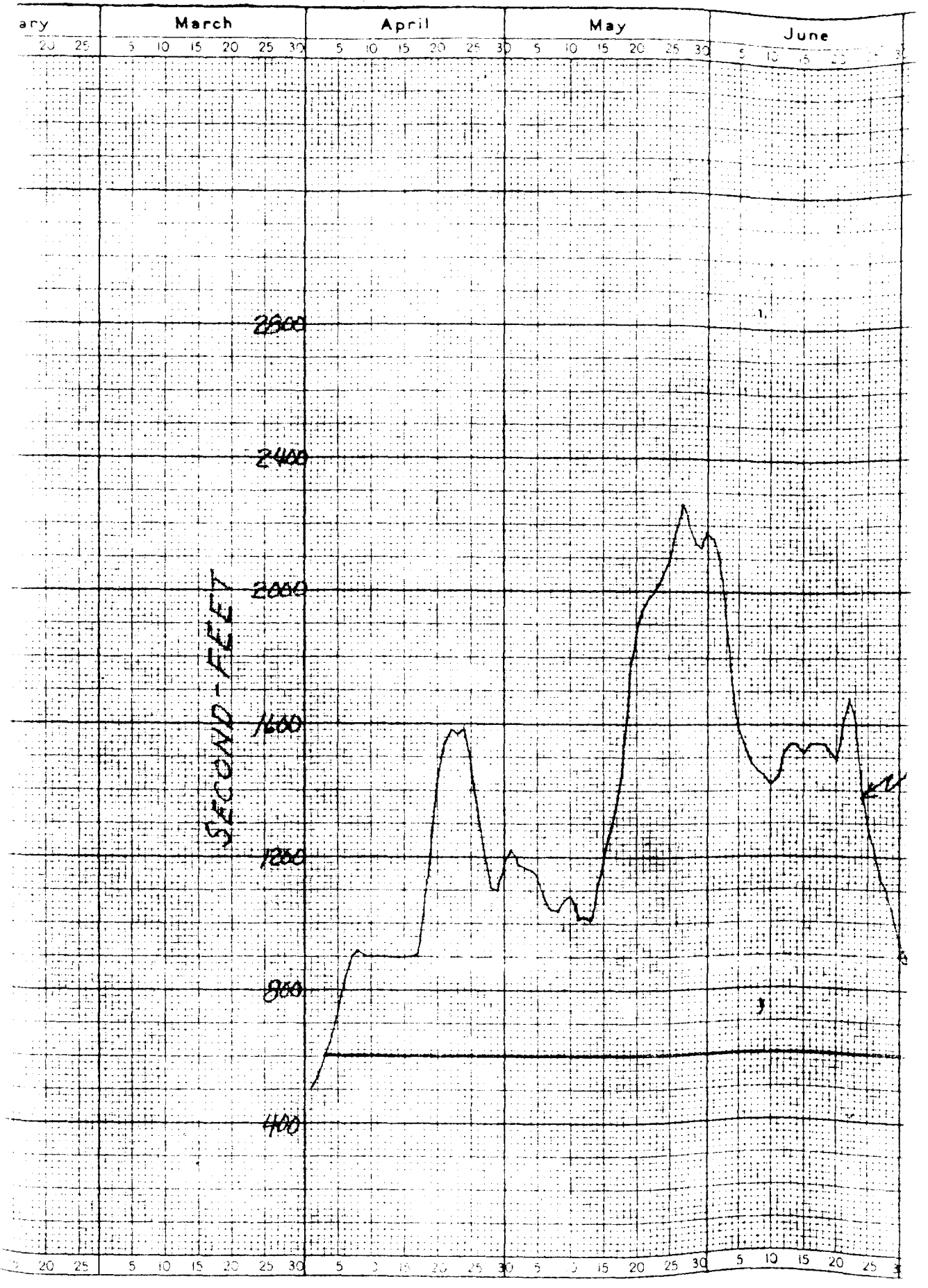
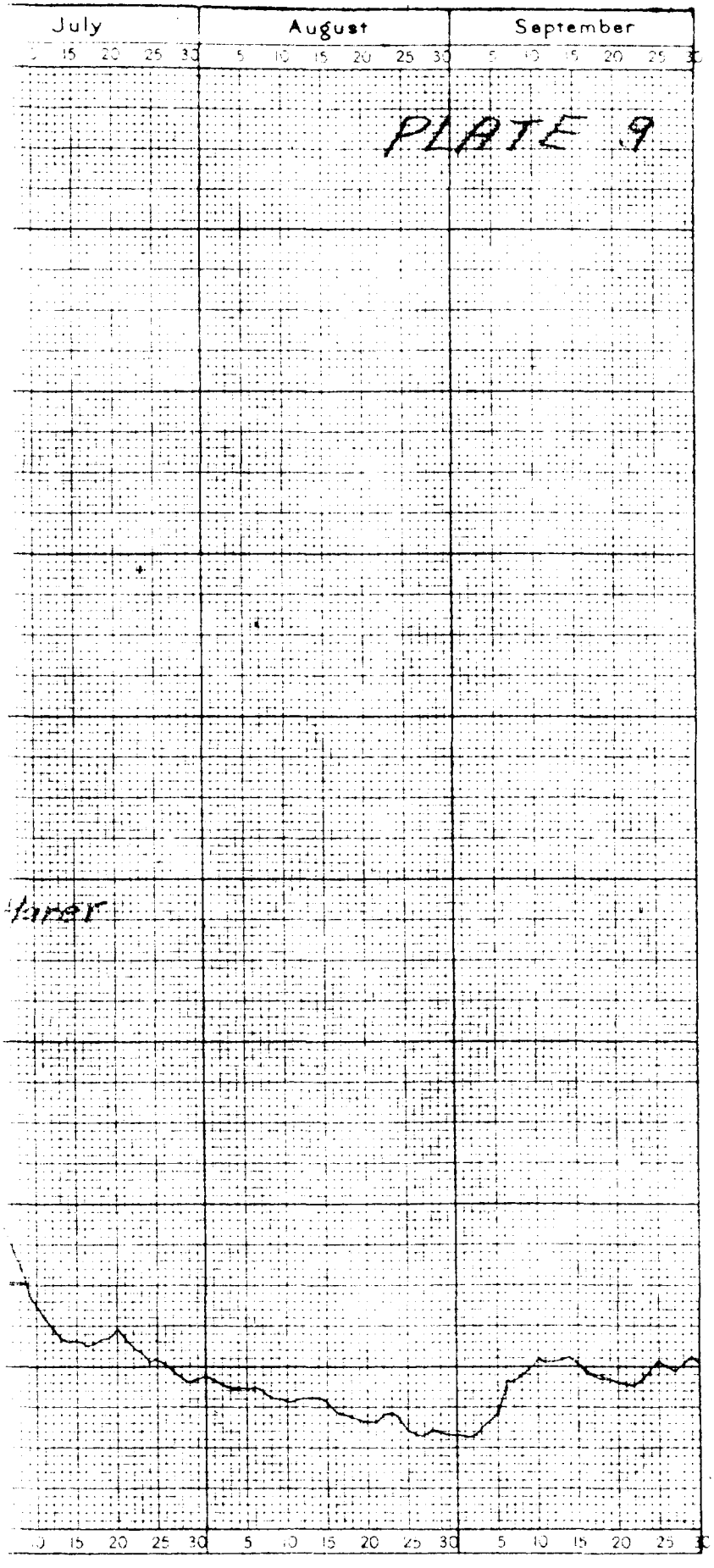


RSA - 1921

File No. Washington / Field



ES BRANCH)

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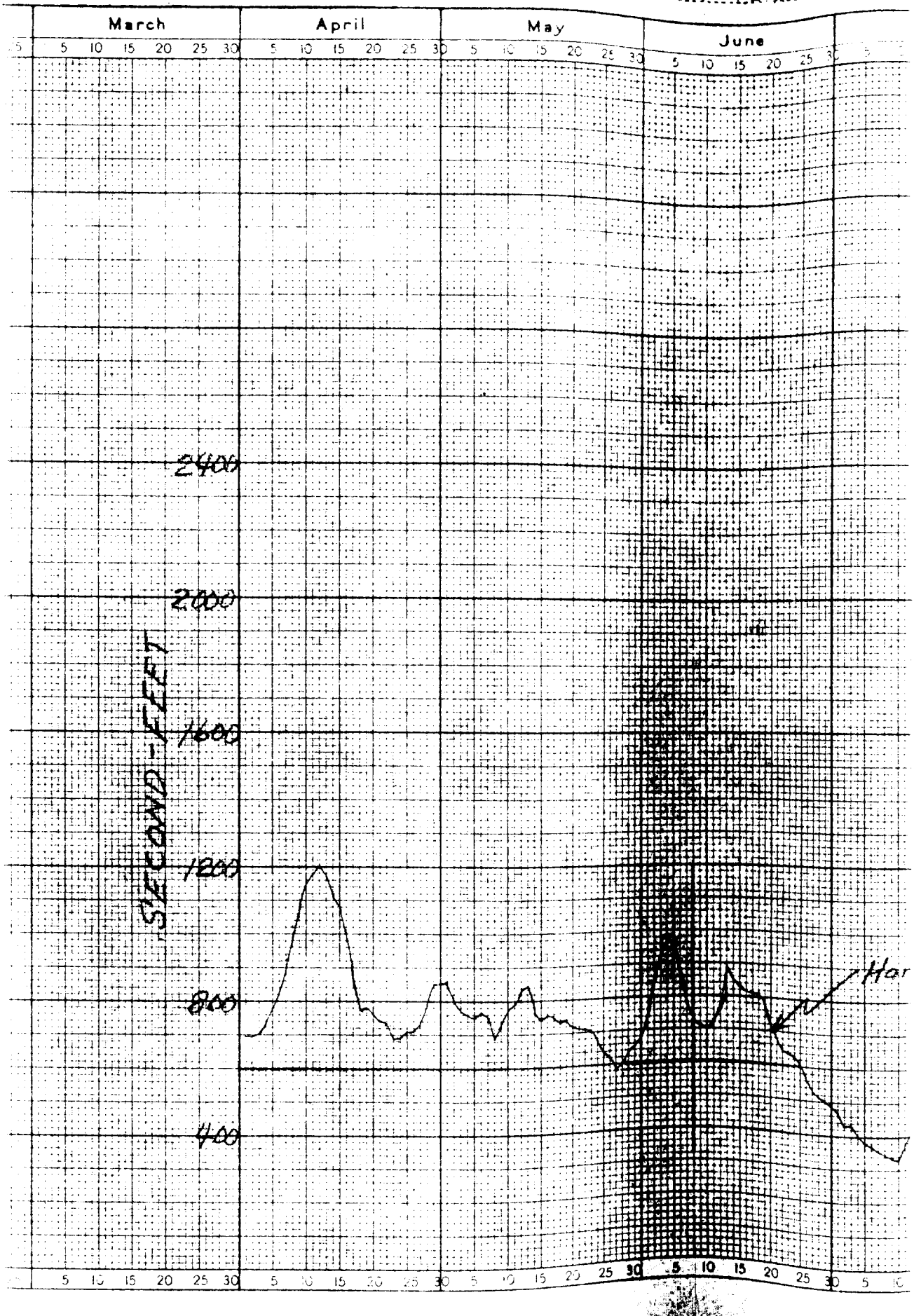
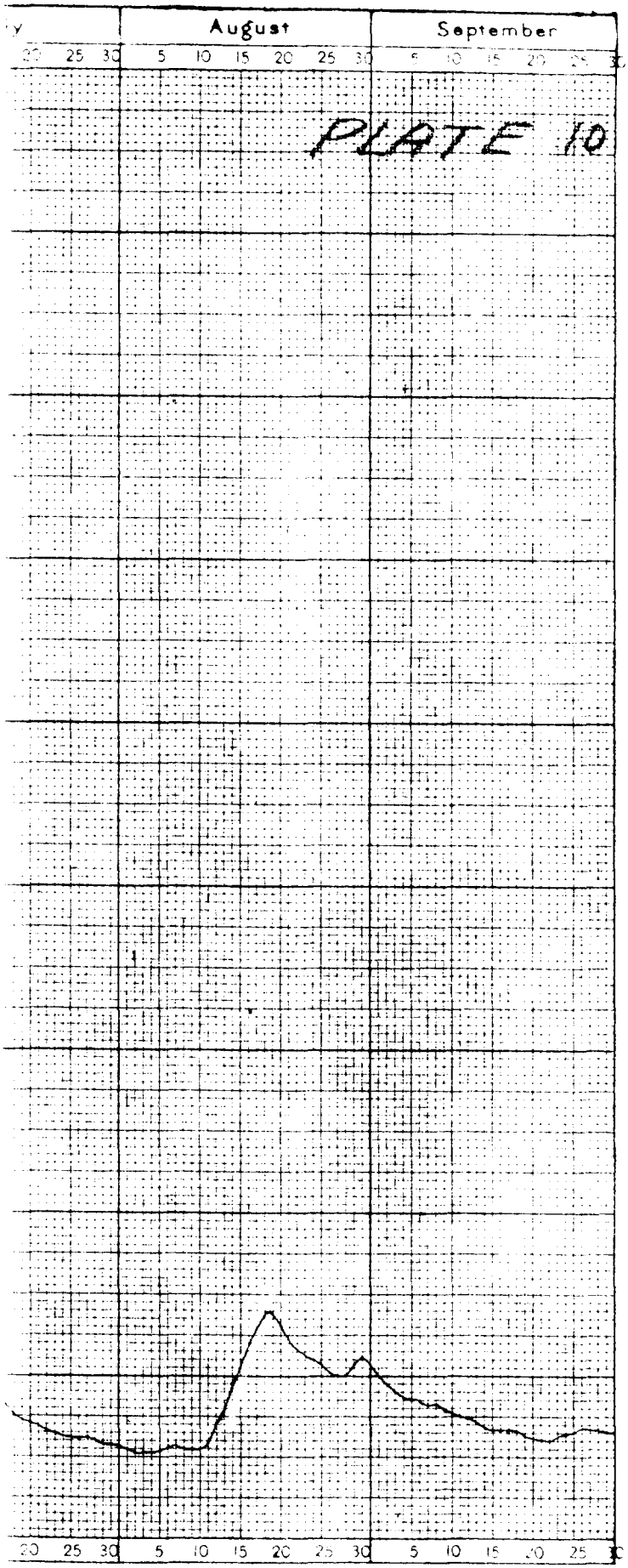


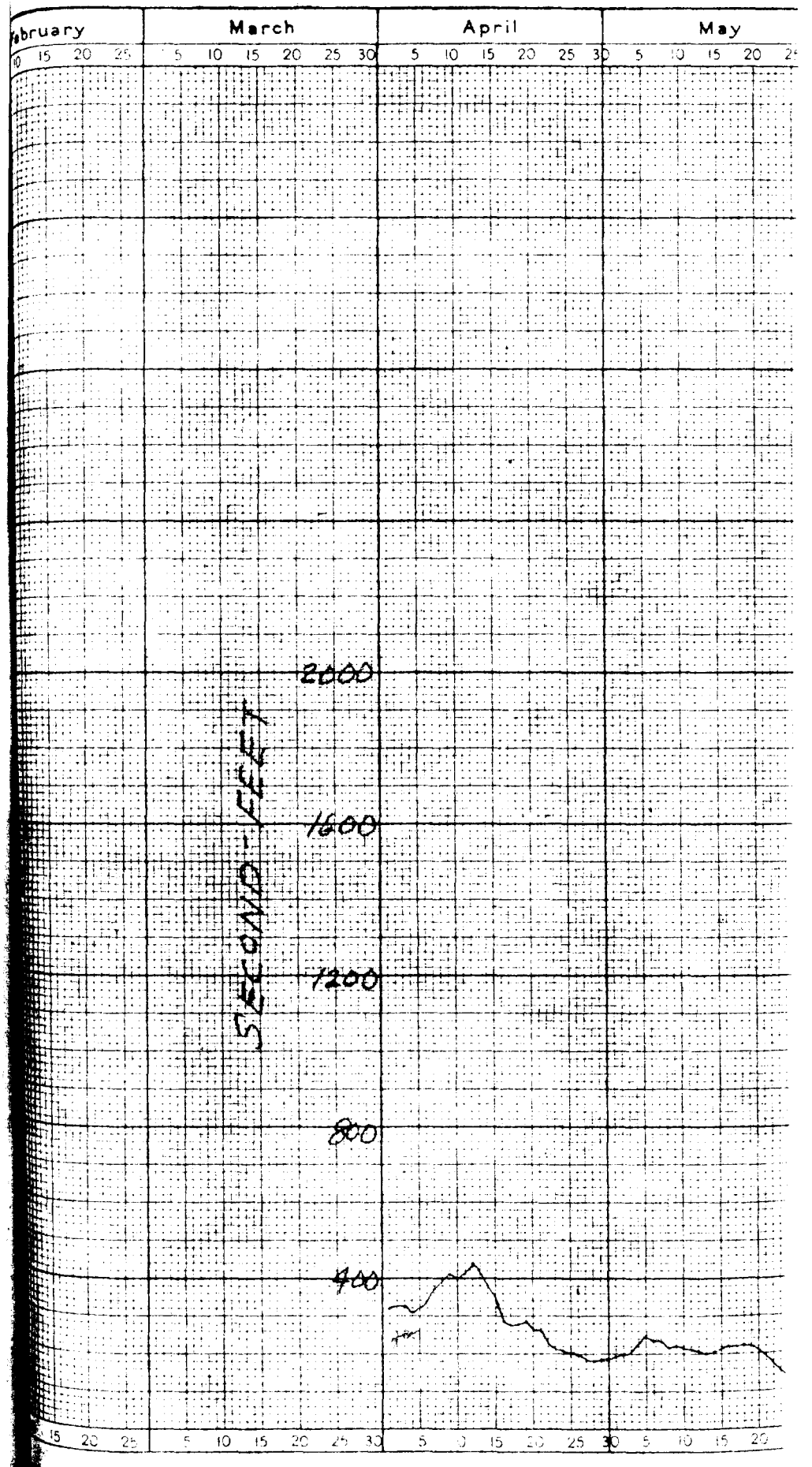
P-1230

File No. / Washington / Field



ATER RESOURCES BRANCH)

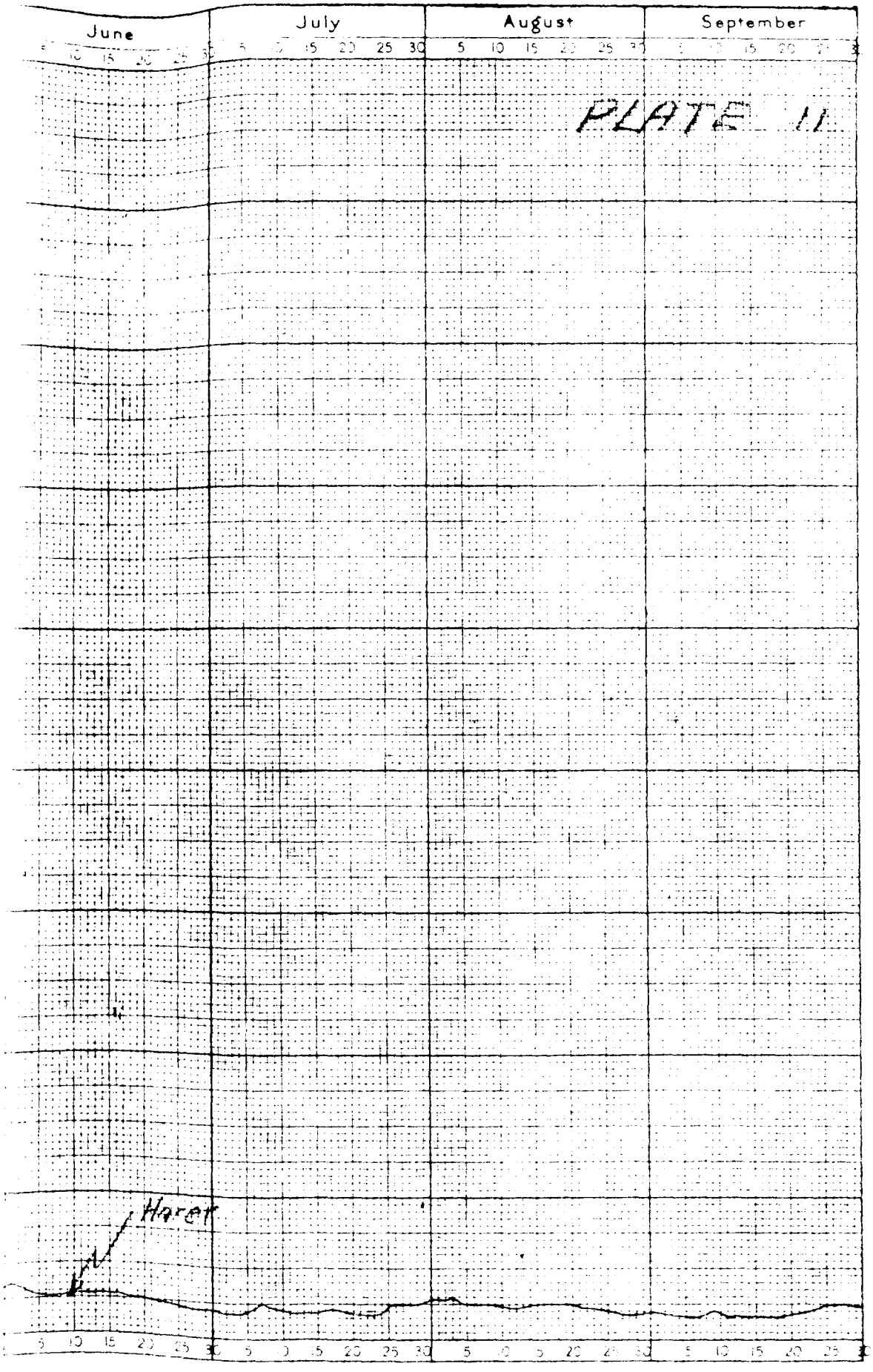
HYDROGRAPH FOR BEAR R.



ER AT HARER - 1931

File No. (Washington)

Field



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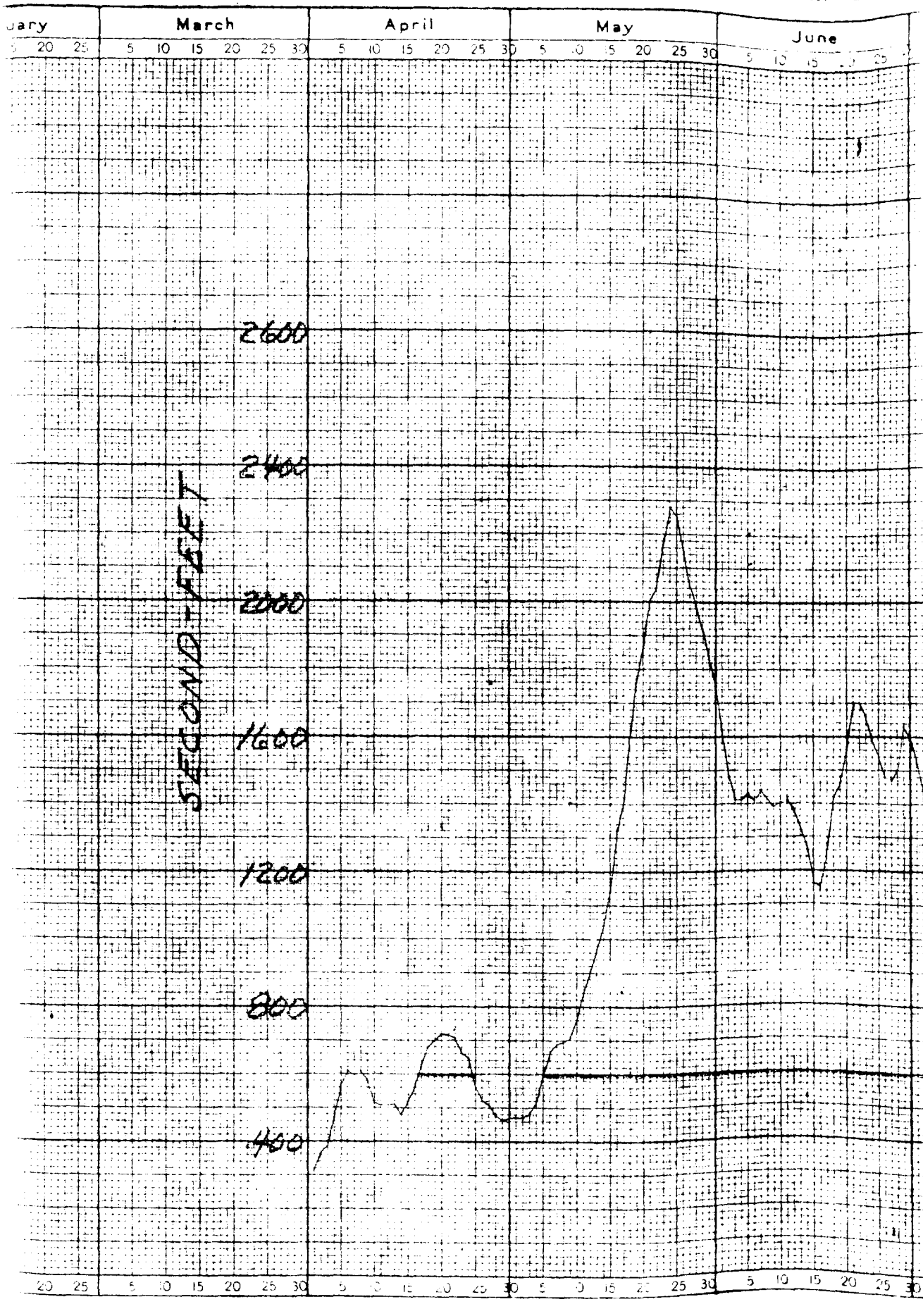
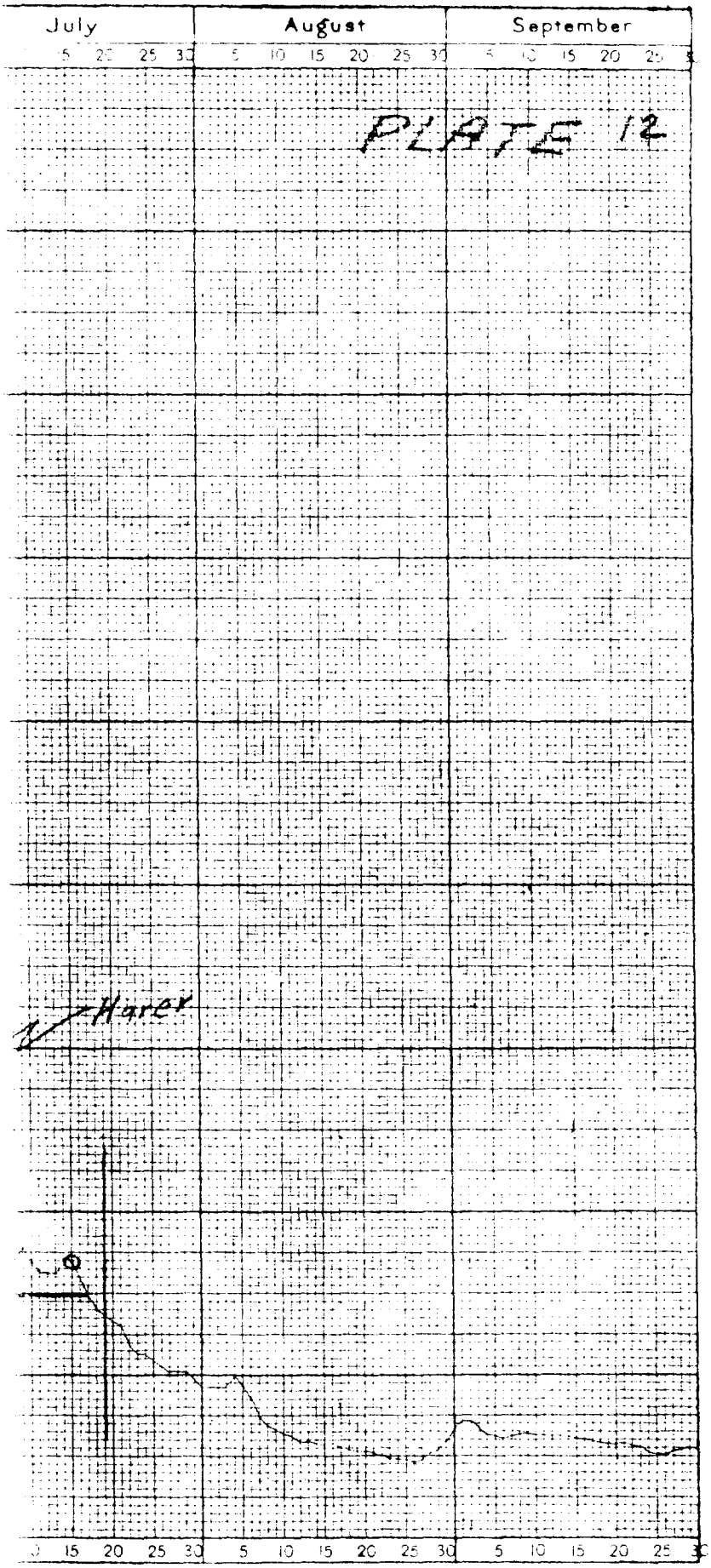
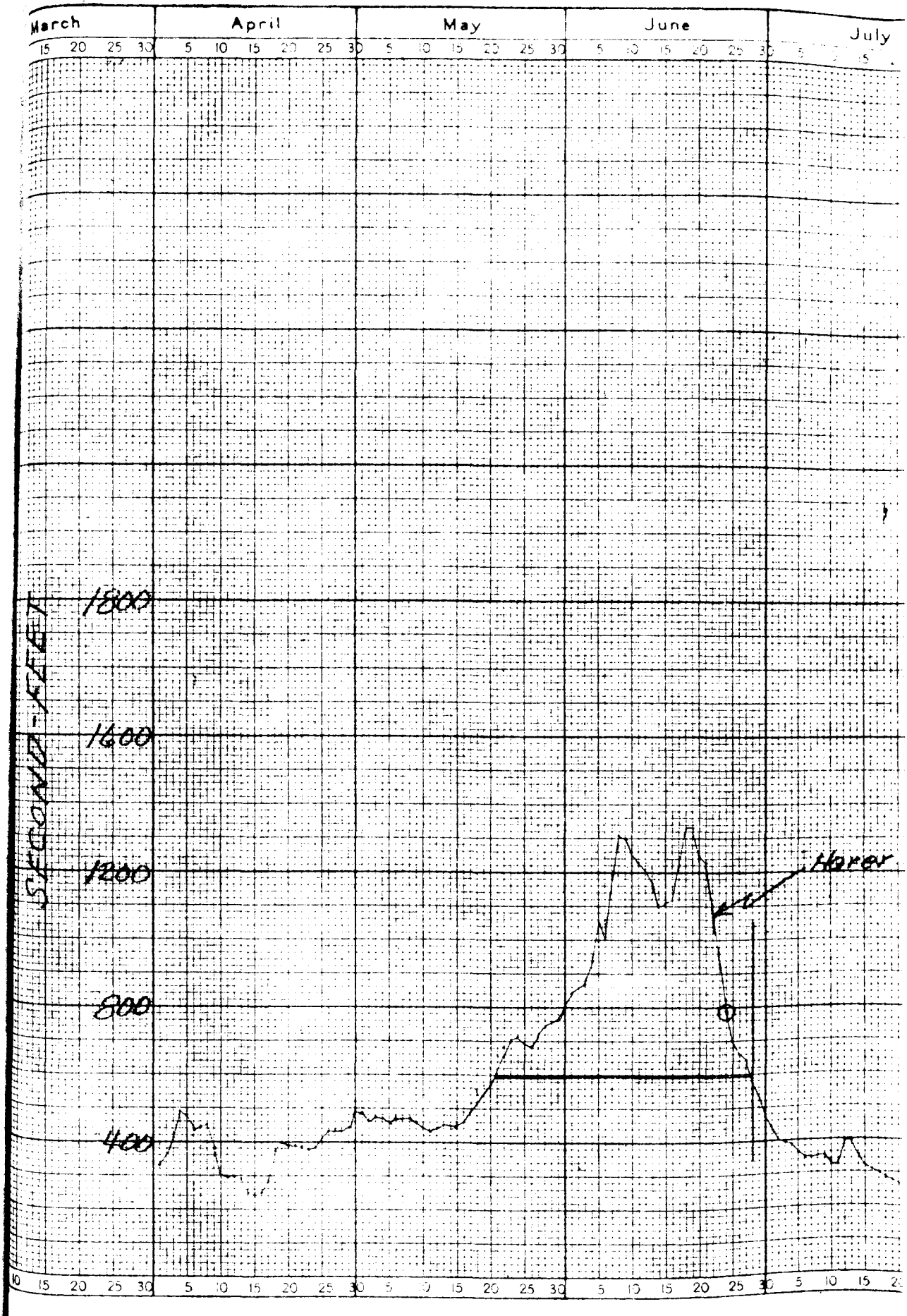


ARER 1952 File No. Washington / Field



HYDROGRAPH FOR BEAR RIVER AT [illegible]



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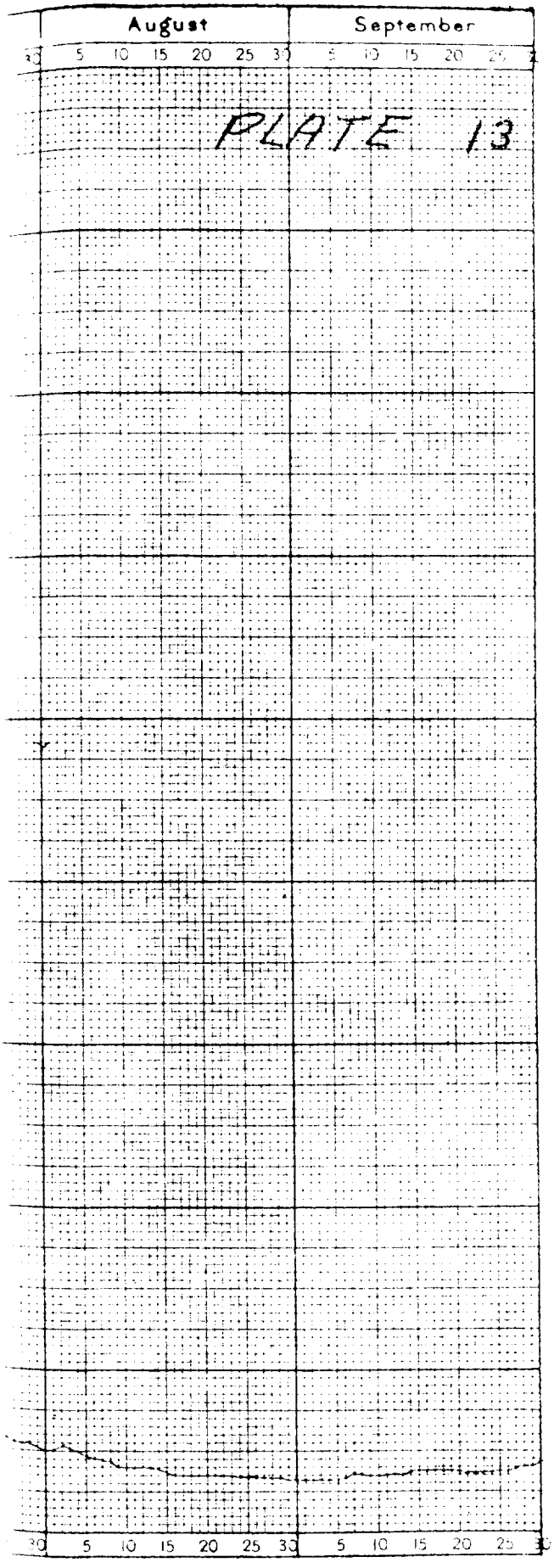
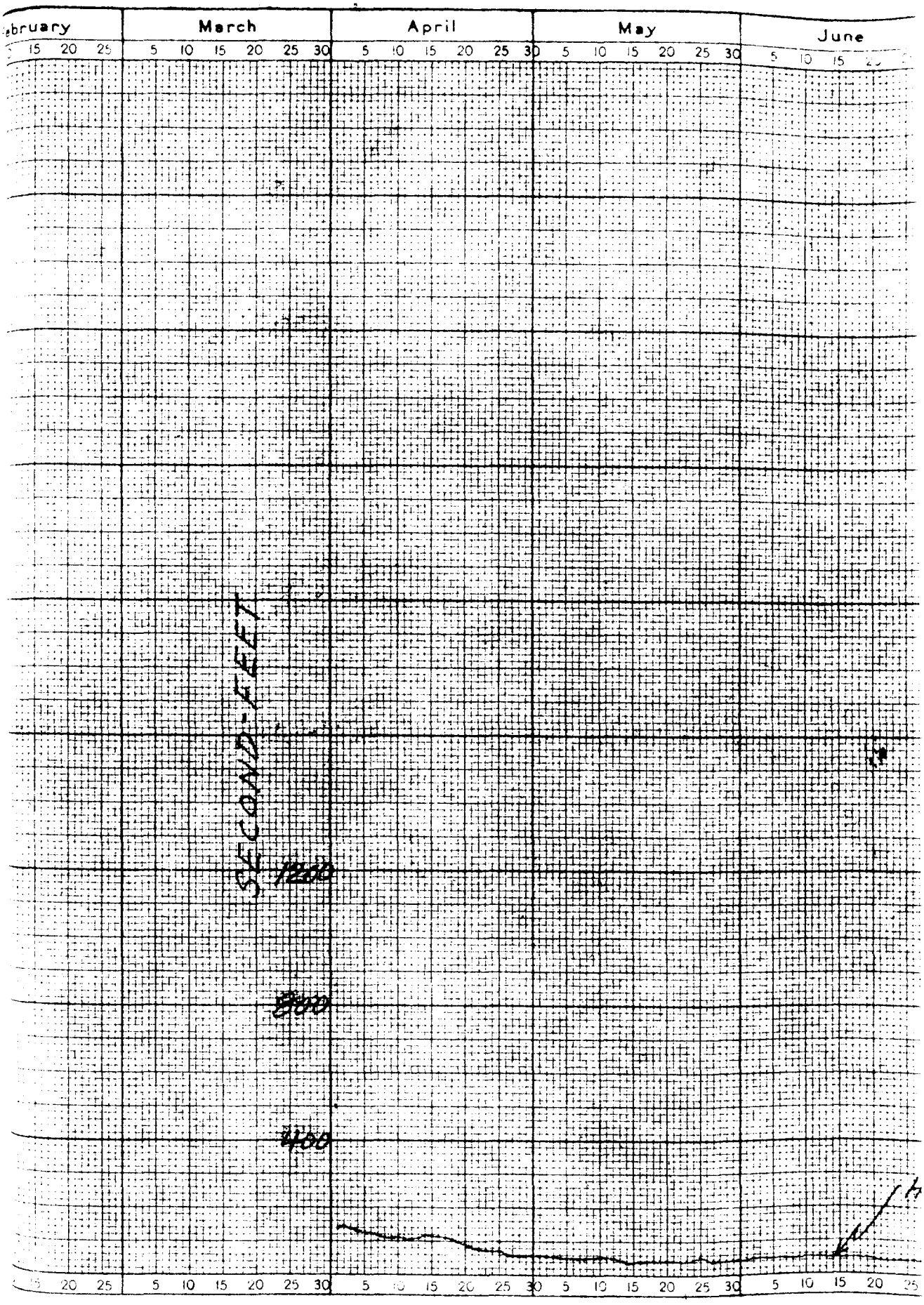


(ATER RESOURCES BRANCH)

HYDROGRAPH FOR BEAR RIVER AT

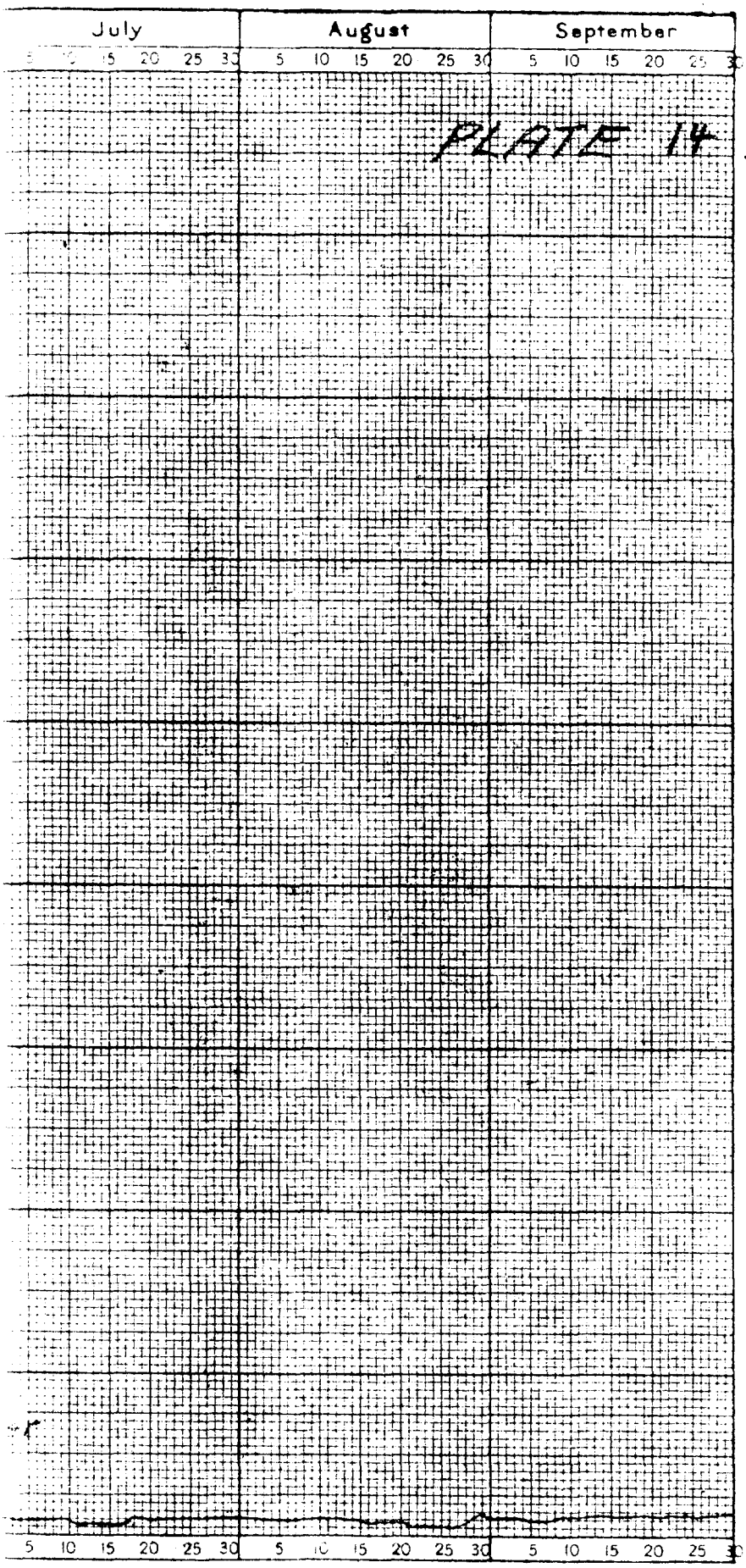


APER -1934

File No.

Washington

Field



ER RESOURCES BRANCH)

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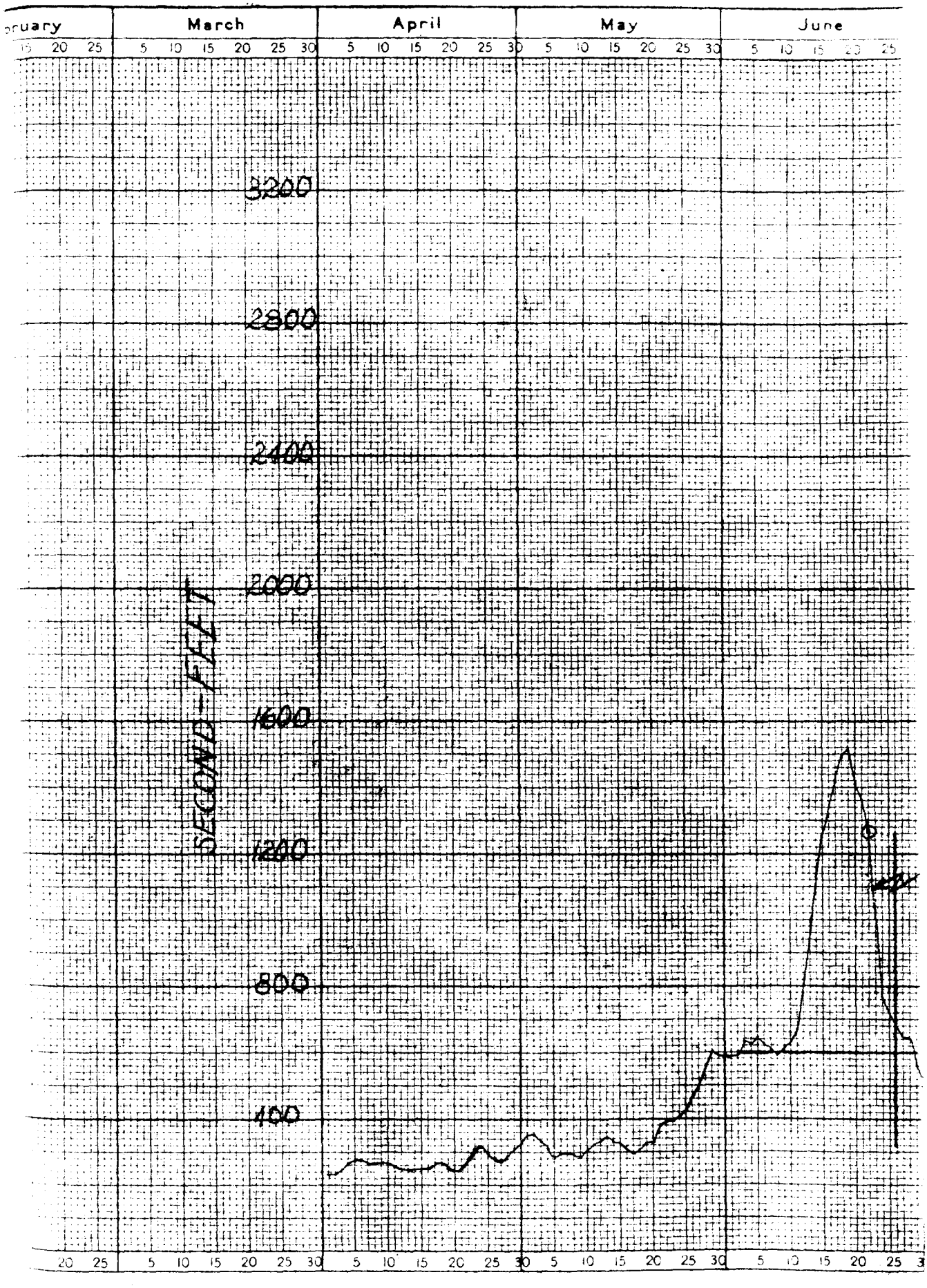

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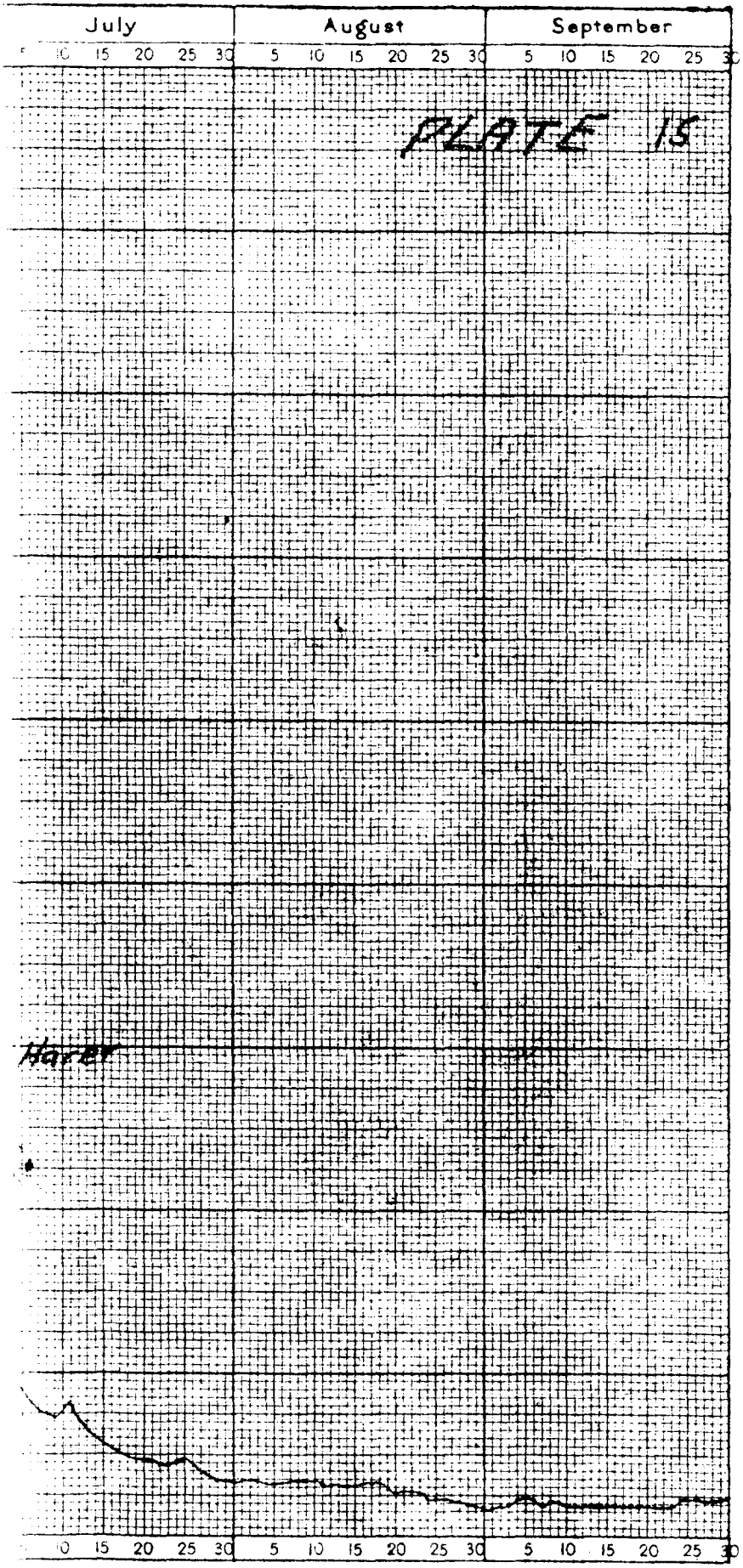

RESOURCES BRANCH)

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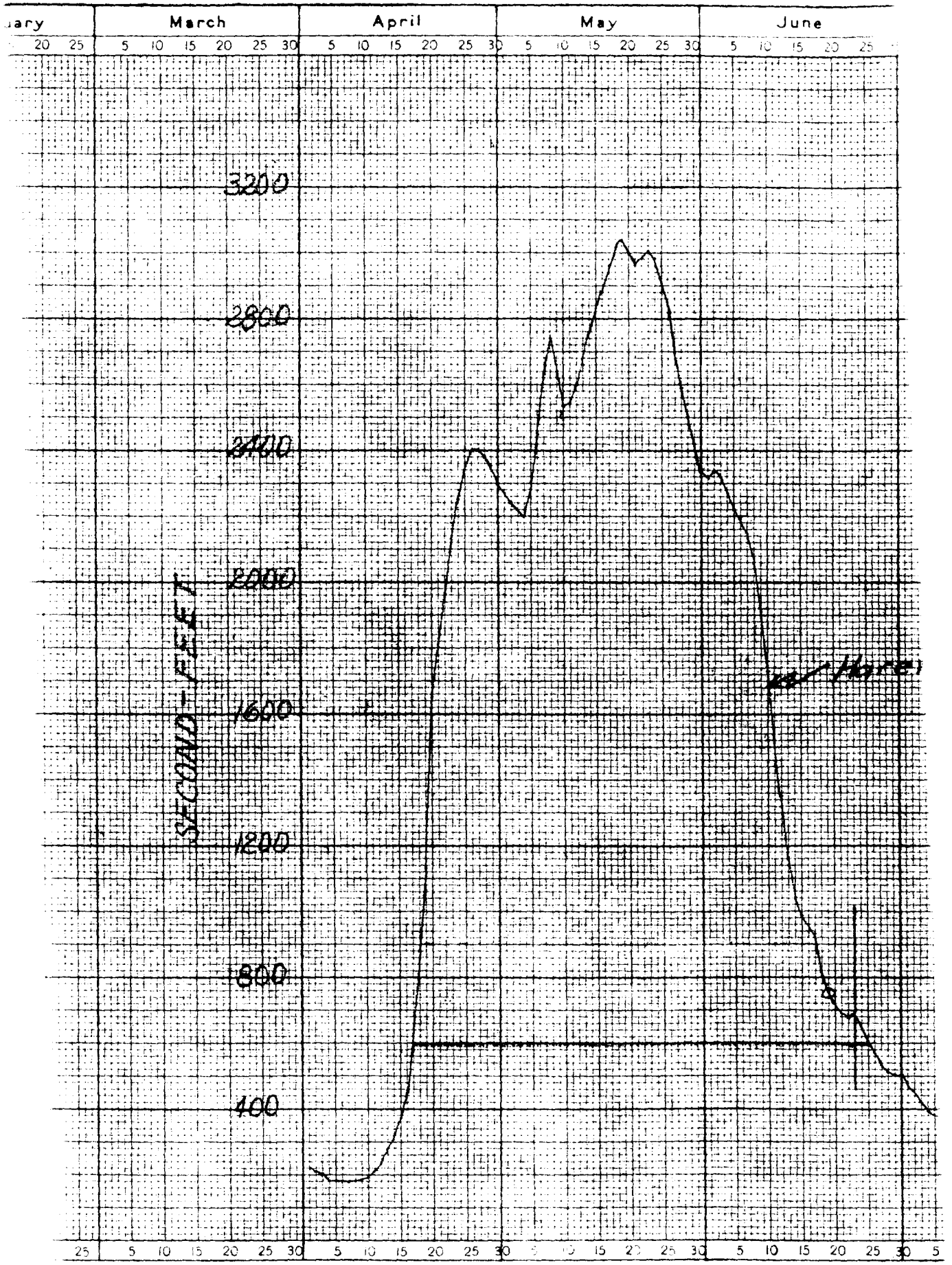

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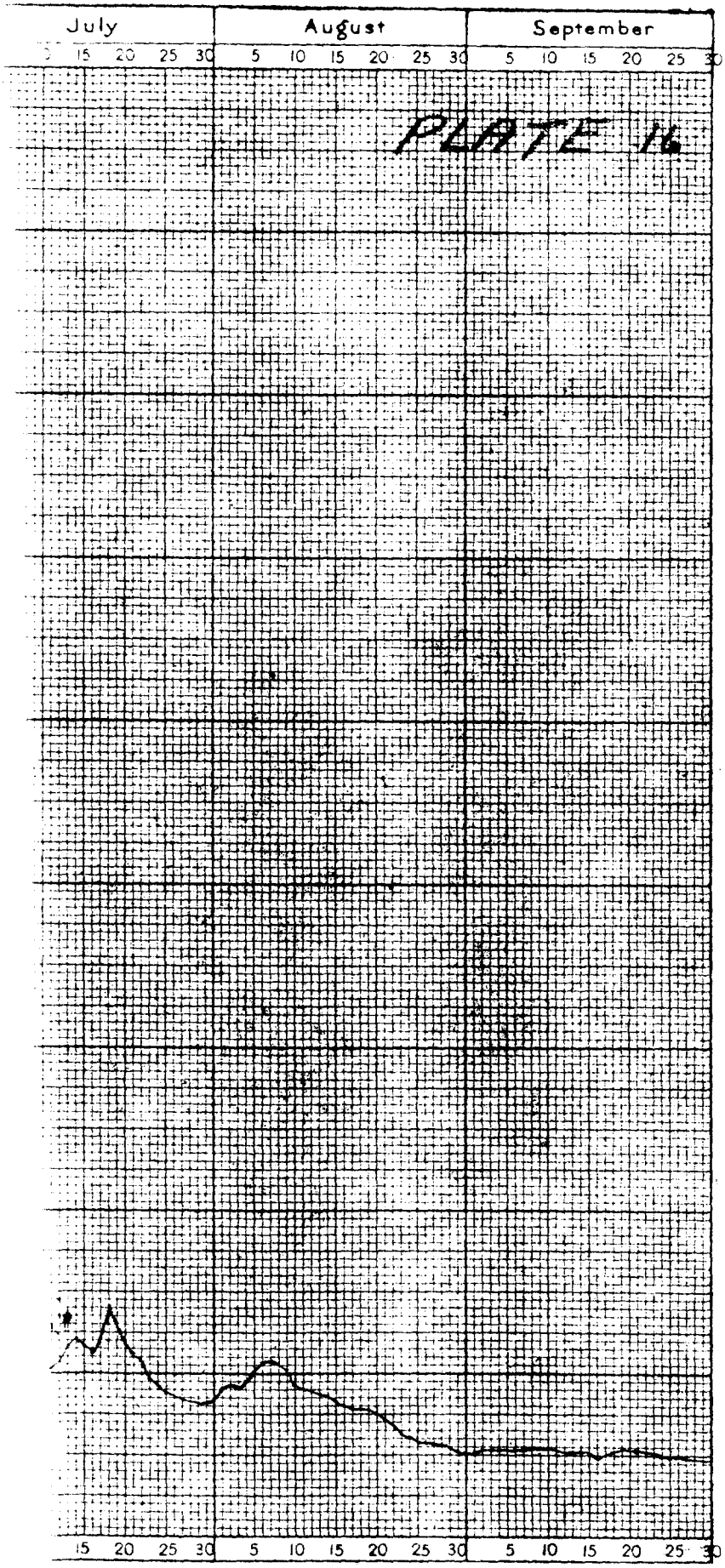
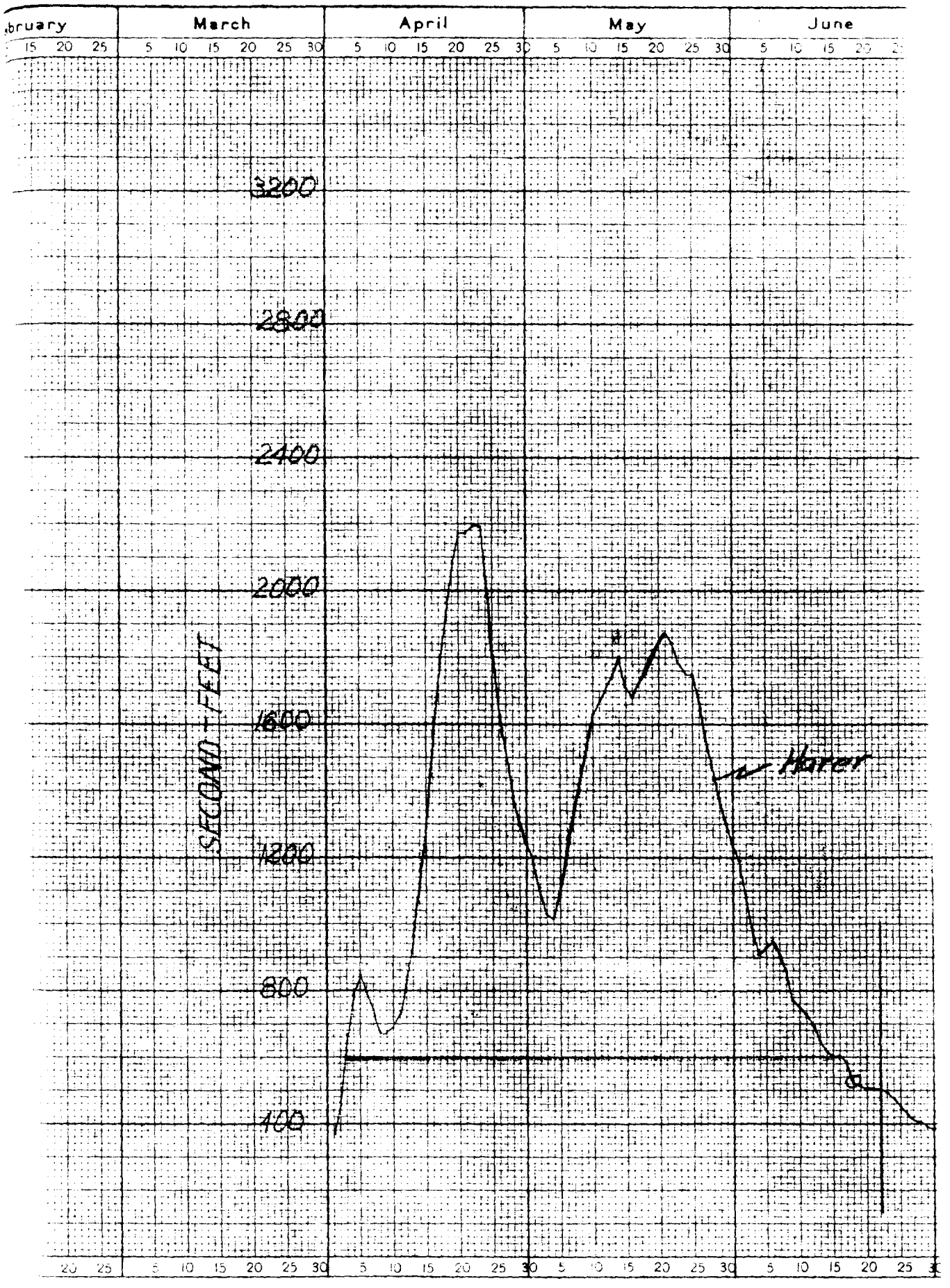


ATER RESOURCES BRANCH)

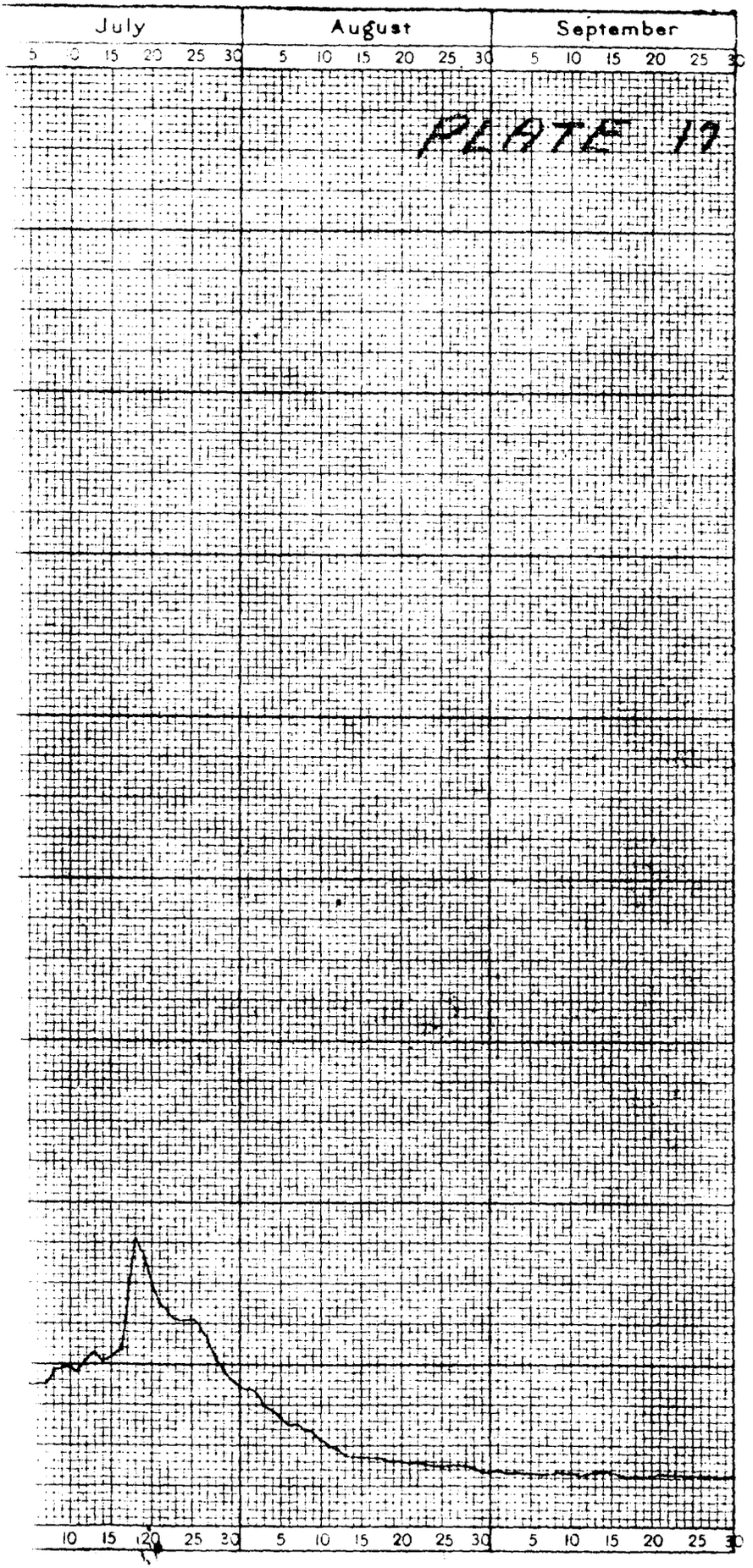
HYDROGRAPH FOR BEAR RIVER AT HARE



1937

File No. Washington

Field



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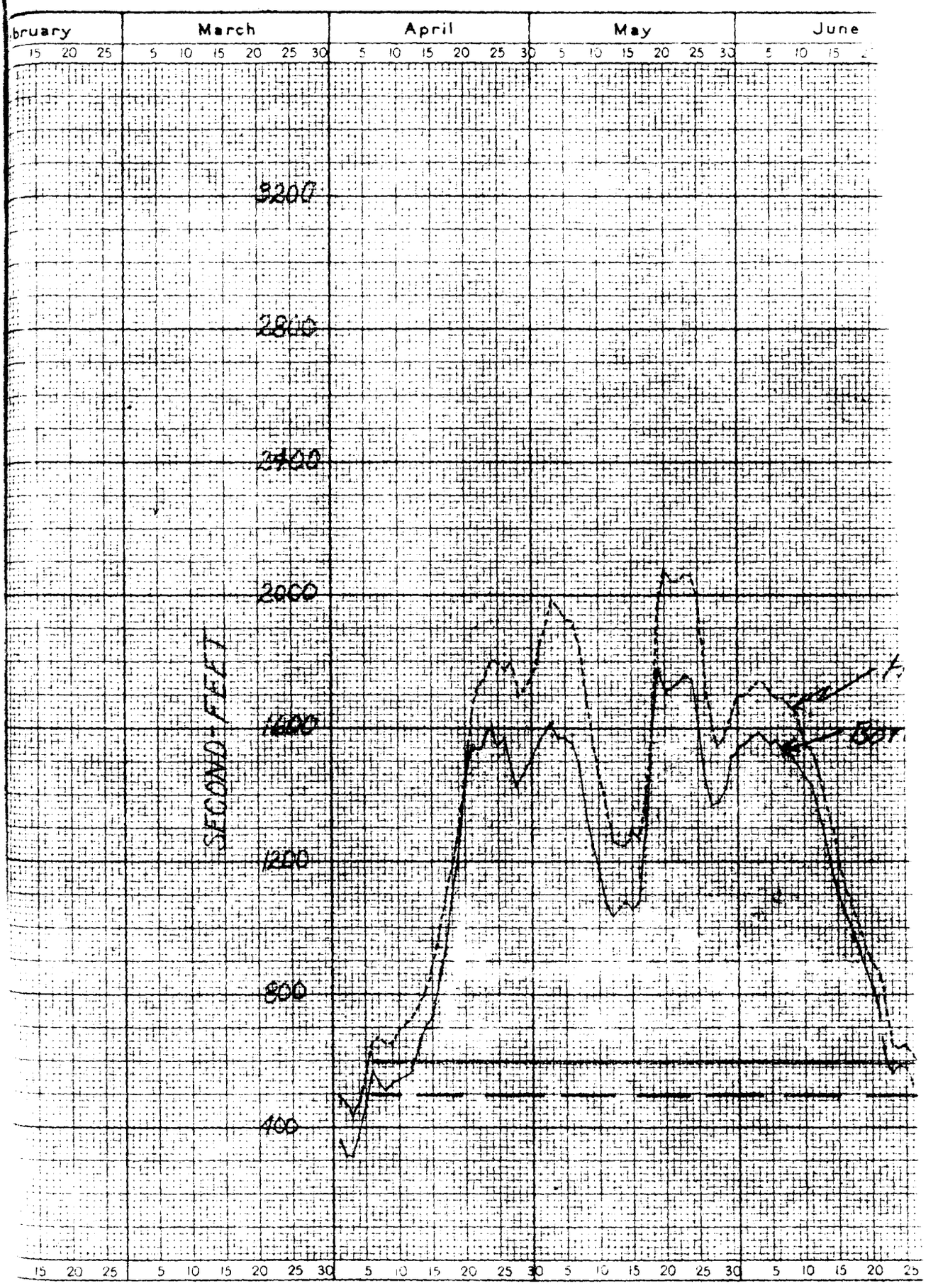
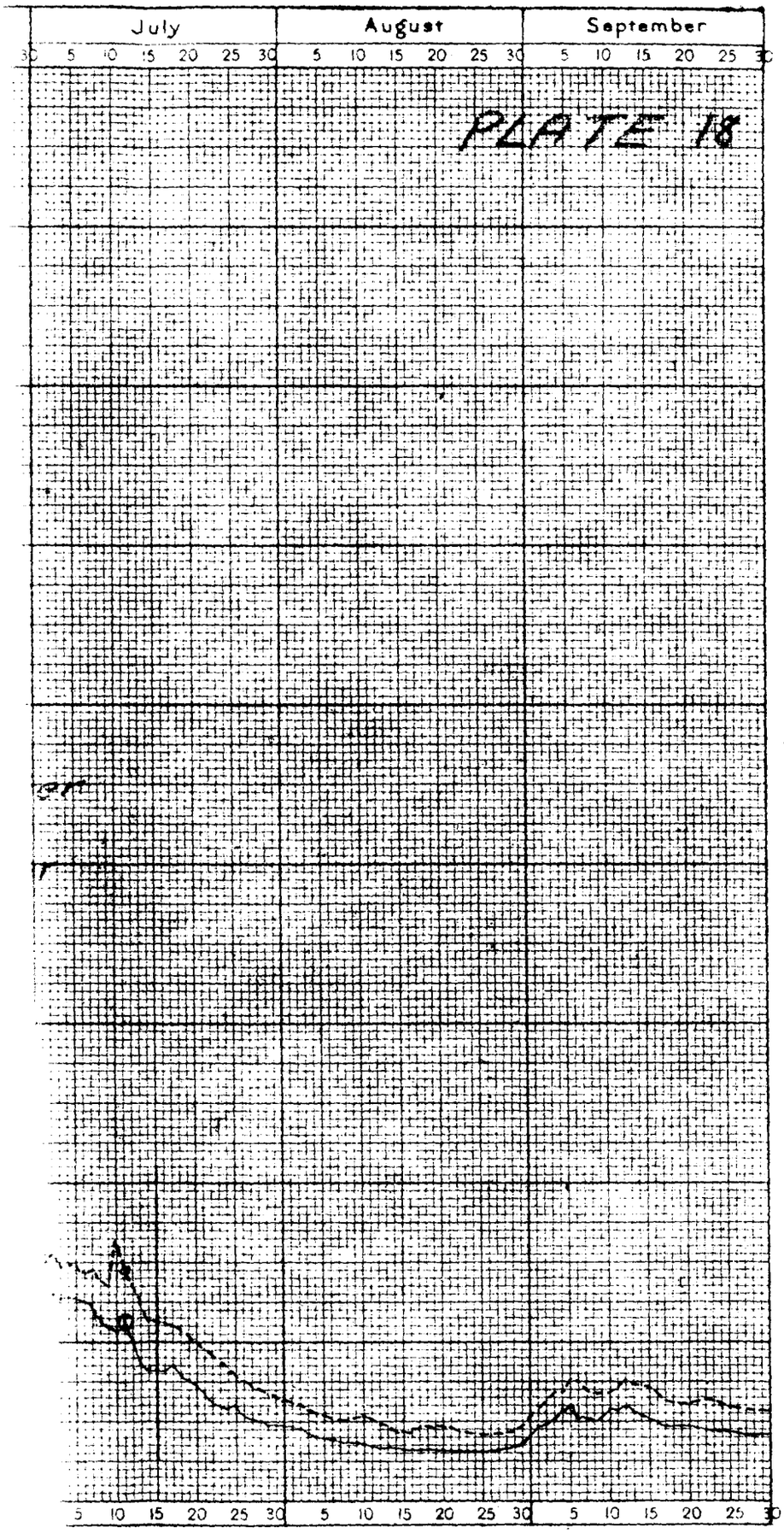
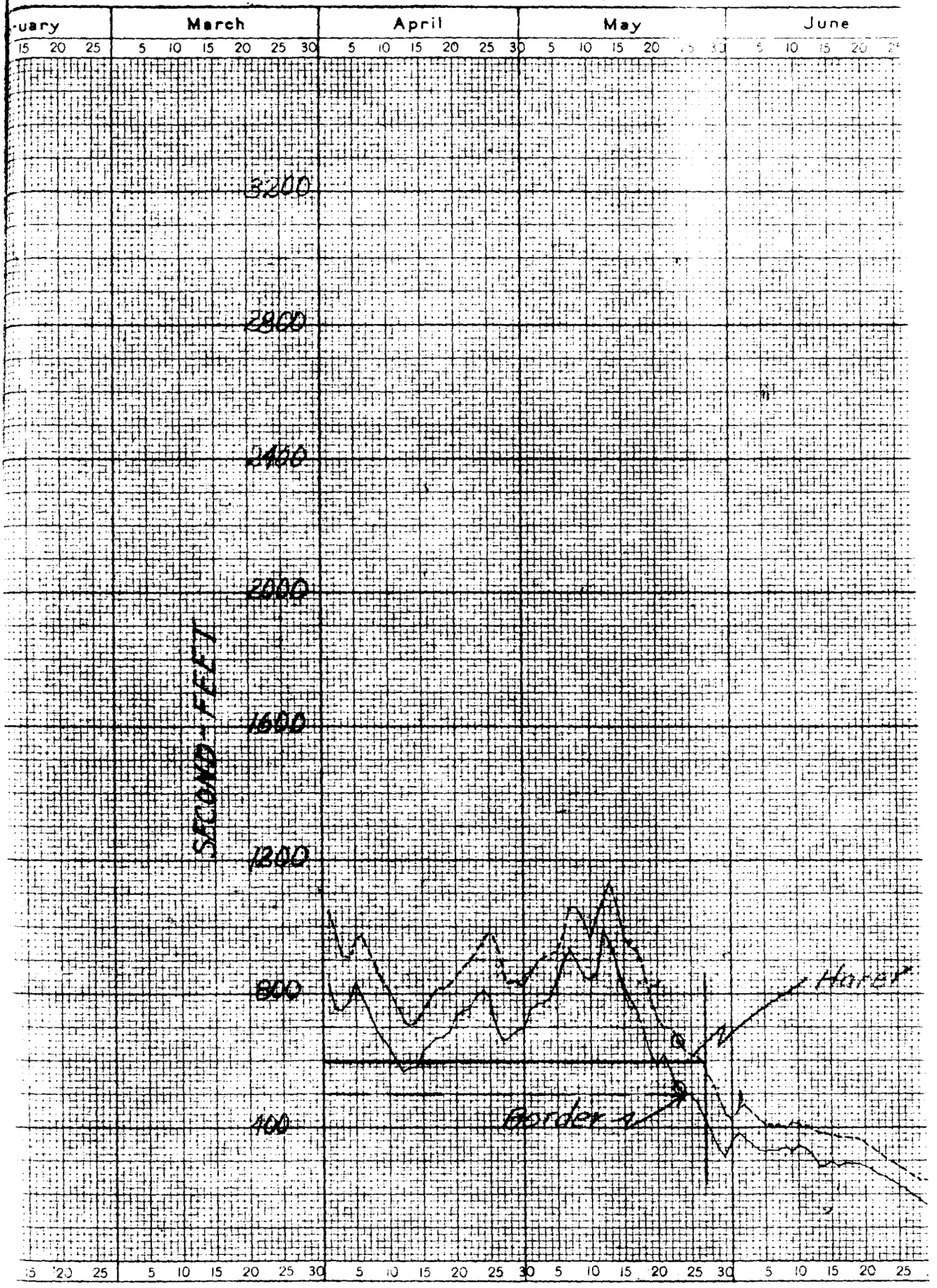


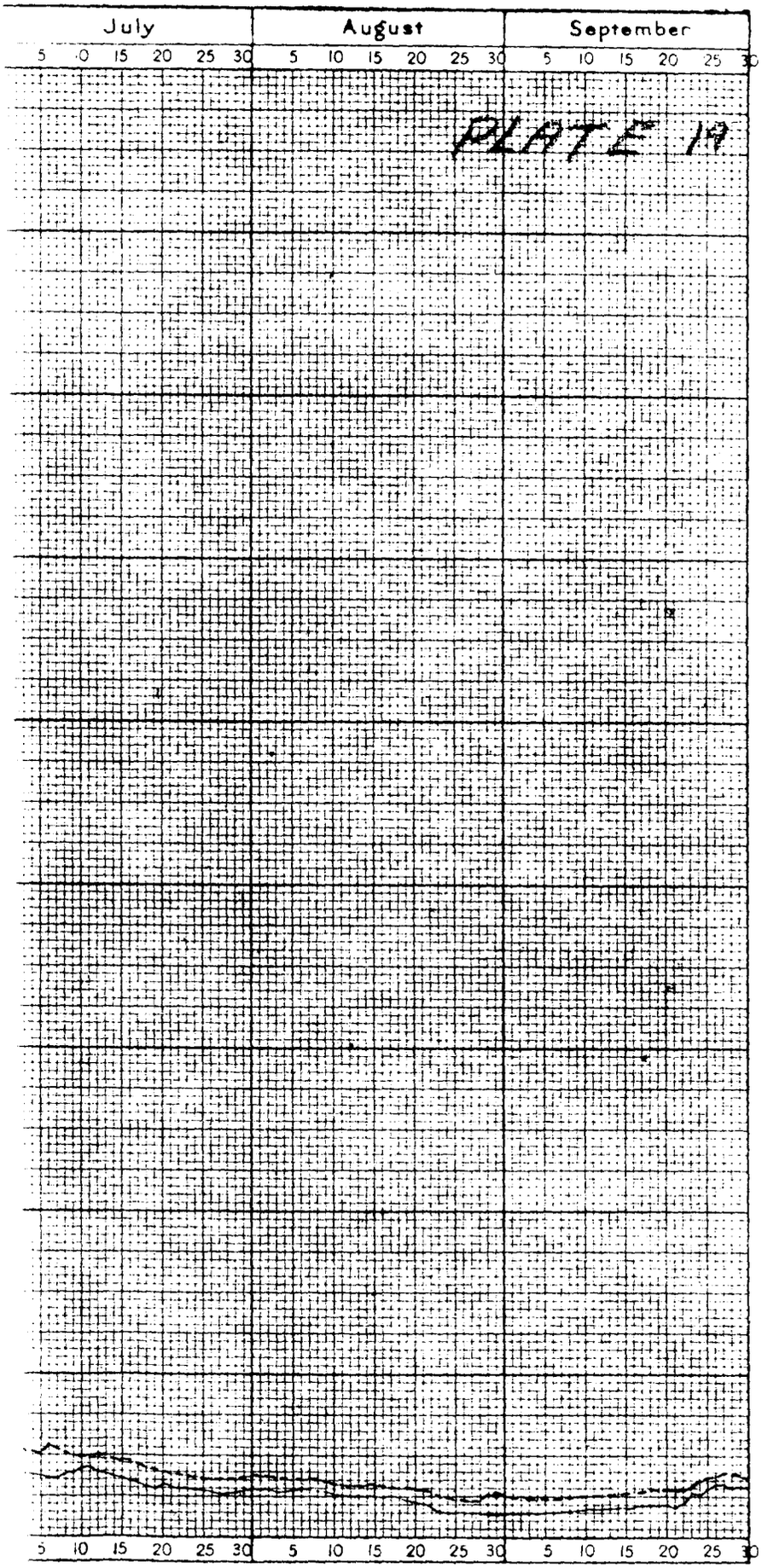
Rand BORDER - 1938 File No. Washington Field



(R RESOURCES BRANCH) HYDROGRAPH FOR BEAR RIVER AT H



PER and BORDER - 1939 File No. Washington Field



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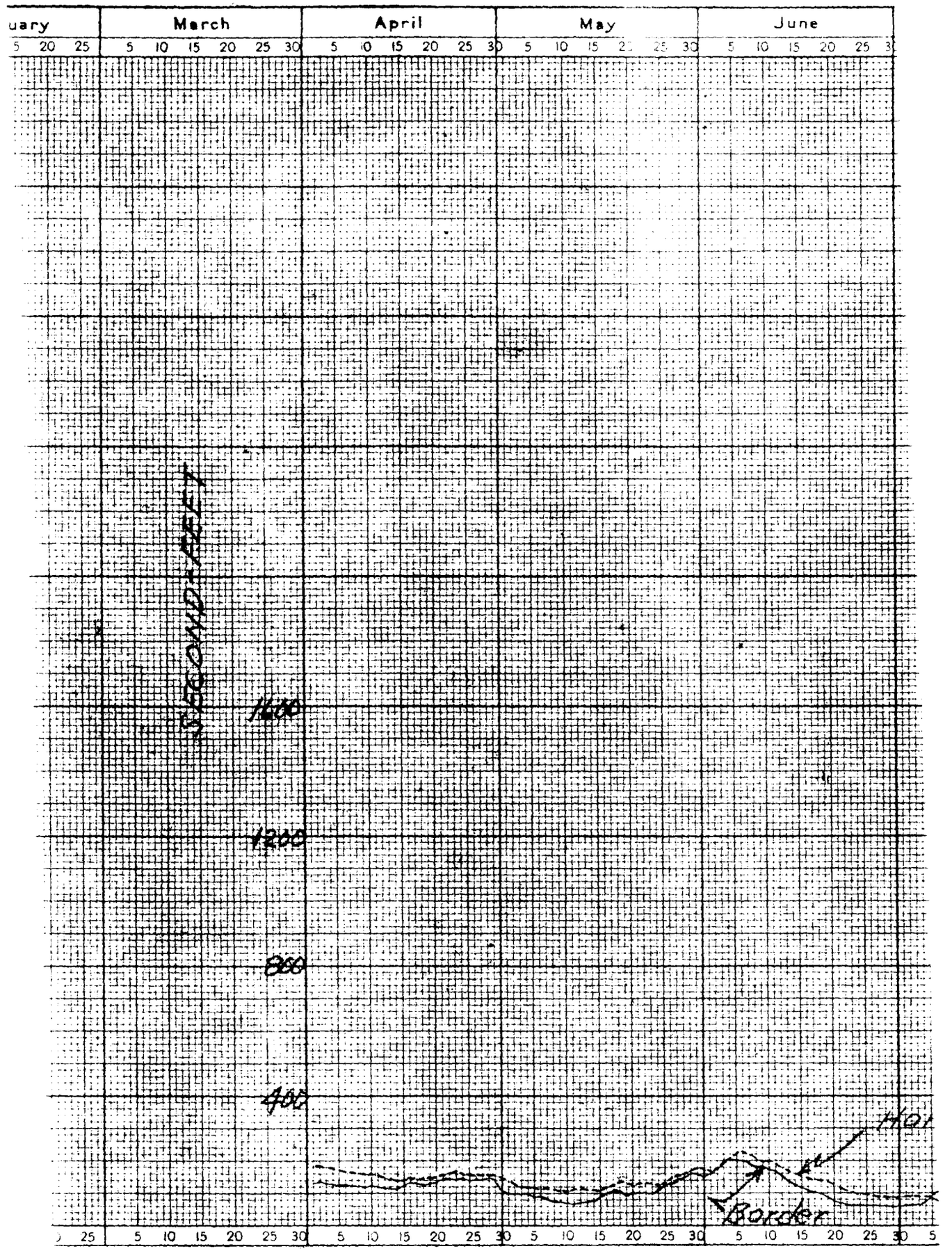
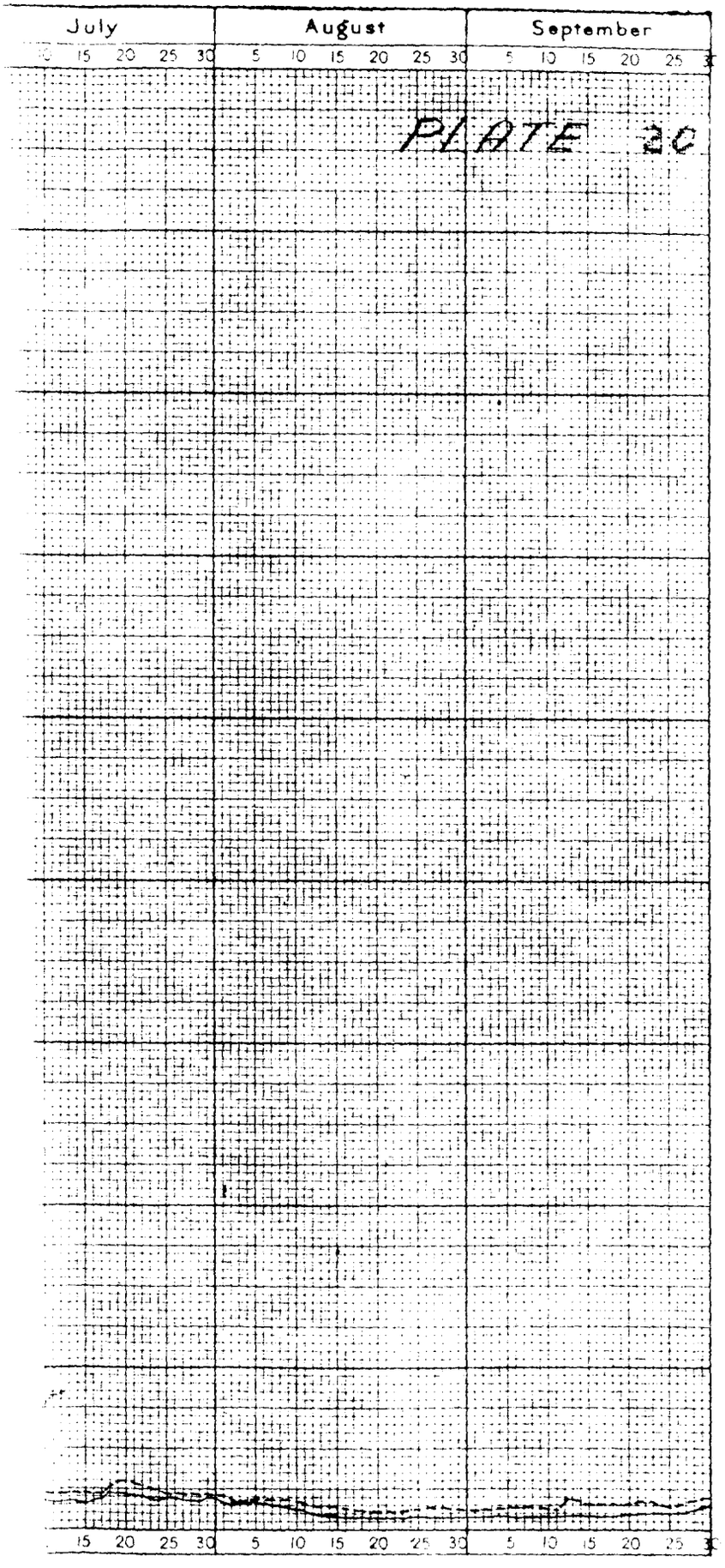
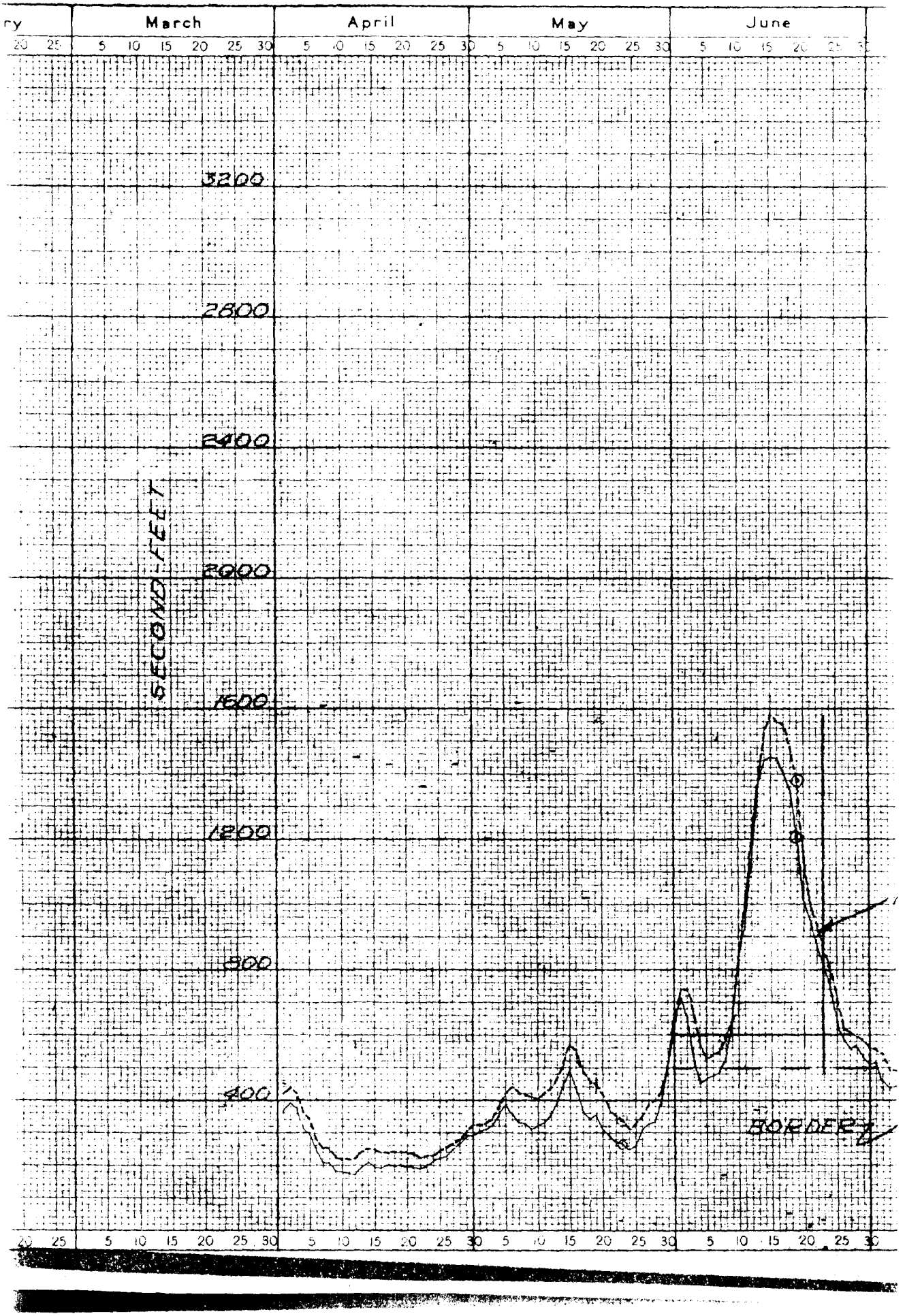
HYDROGRAPH FOR BEAR RIVER AT HARE



AND BORDER-1940 File No. Washington Field



(SOURCES BRANCH) HYDROGRAPH FOR BEAR RIVER at HARER



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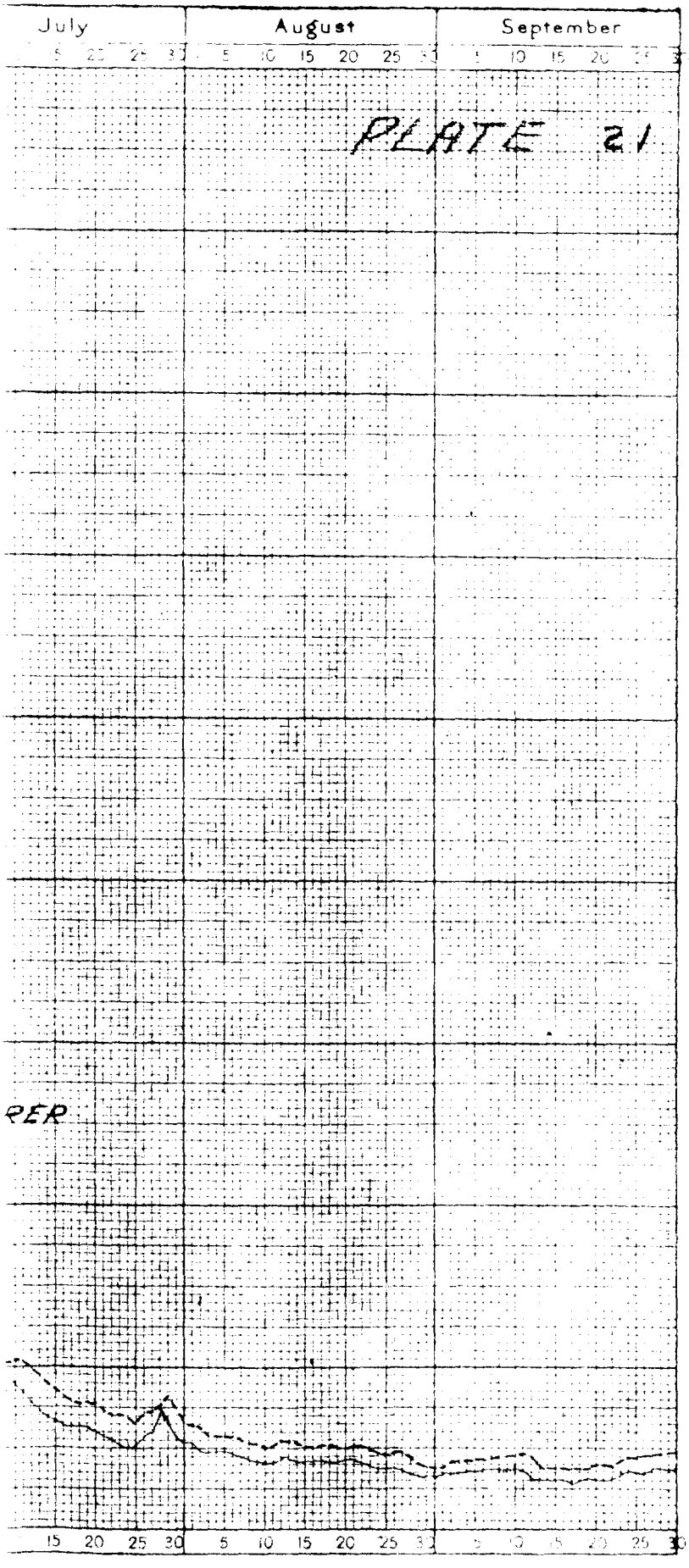
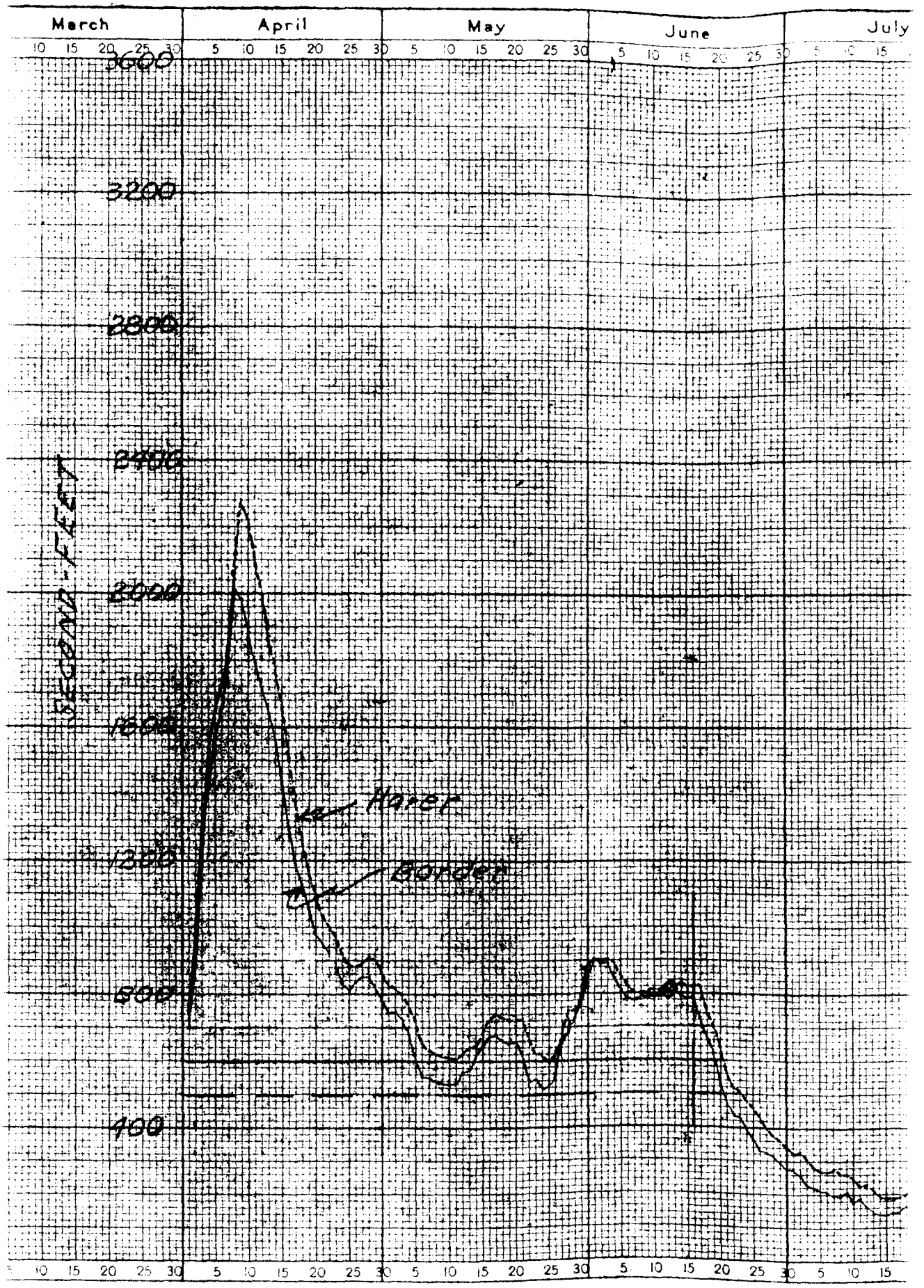


HYDROGRAPH FOR Bear RIVER AT HARER AND E



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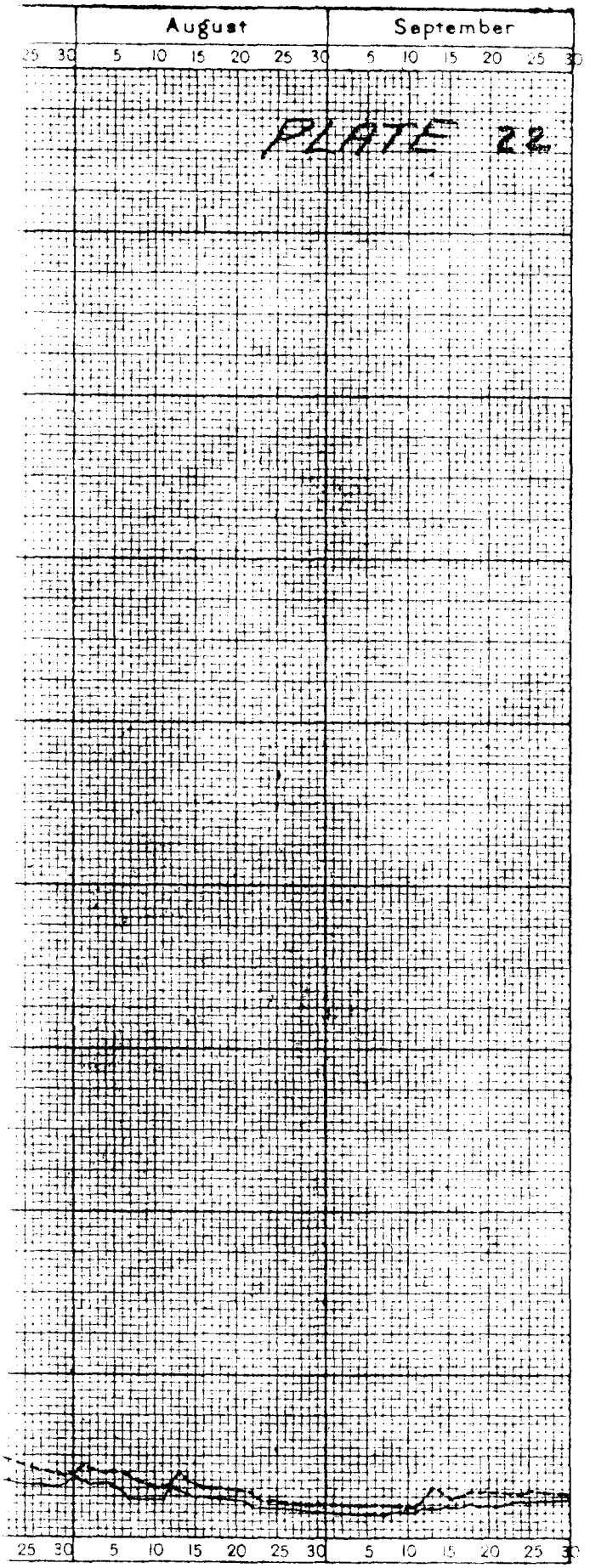
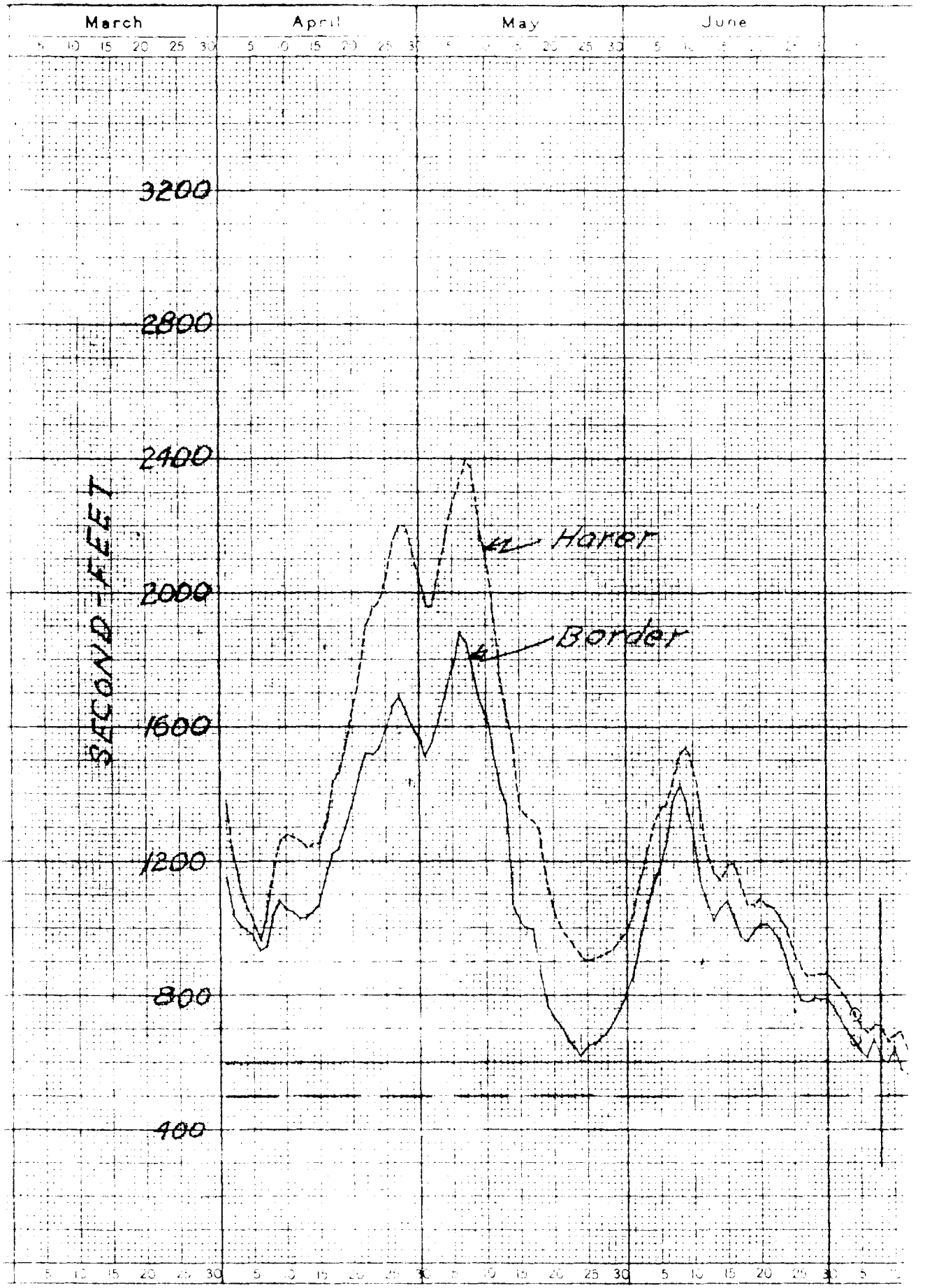


BRANCH HYDROGRAPH FOR BEAR RIVER AT HORER AND



ORDER 1943

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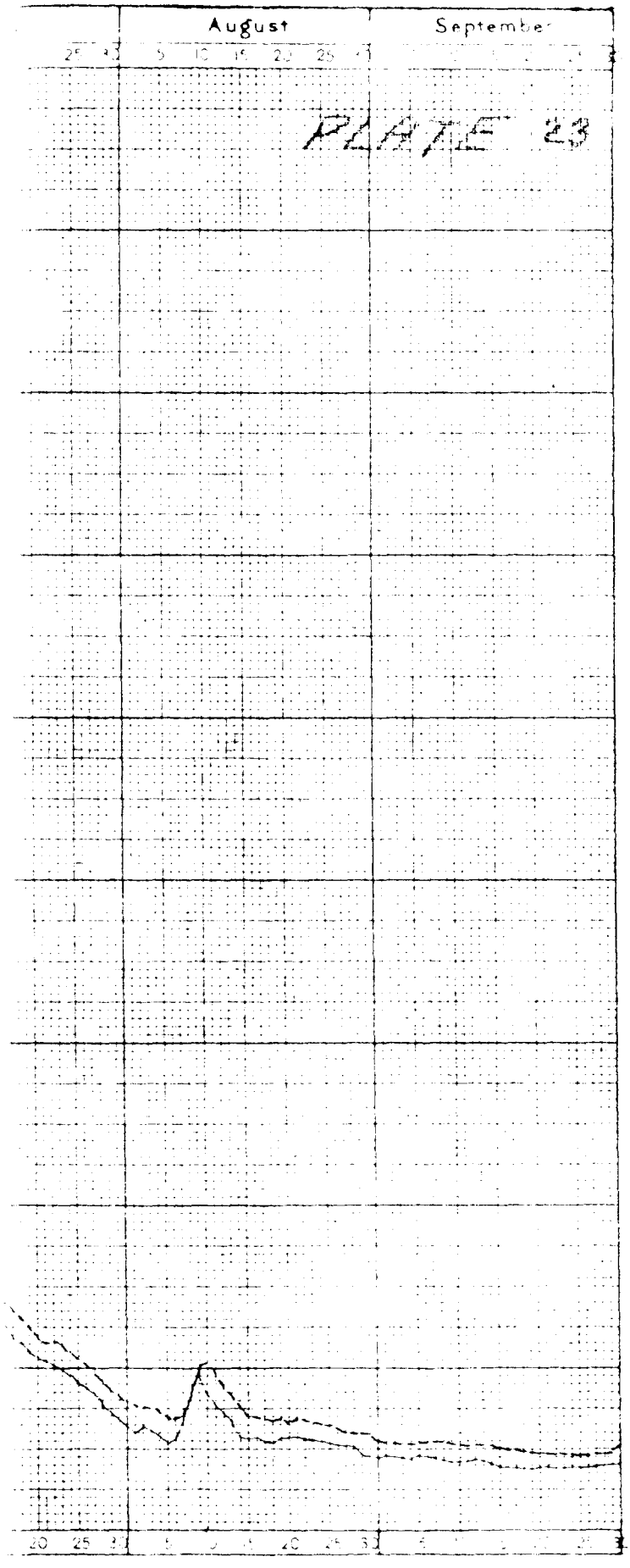

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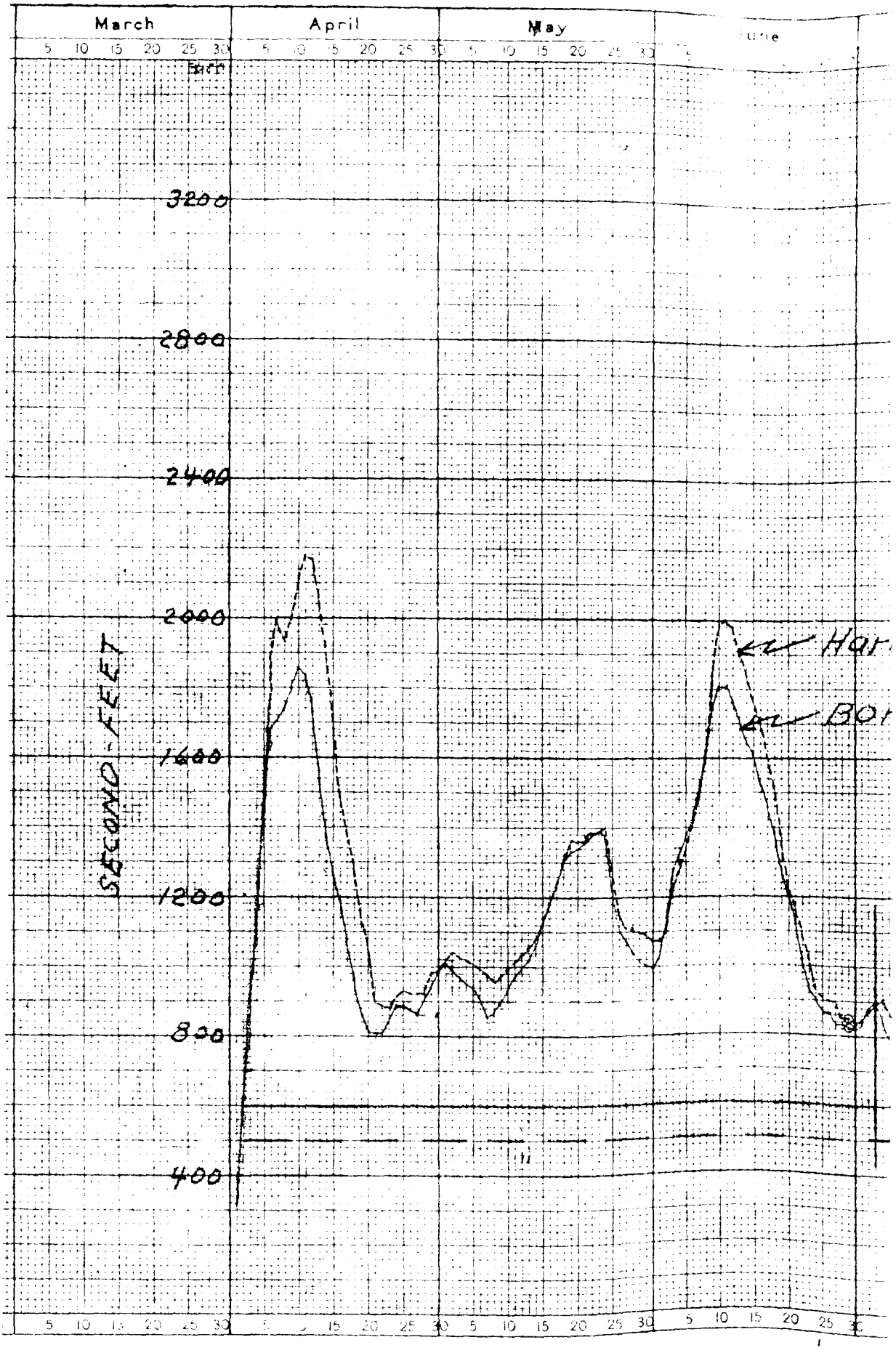

ND BORDER 1944 Washington
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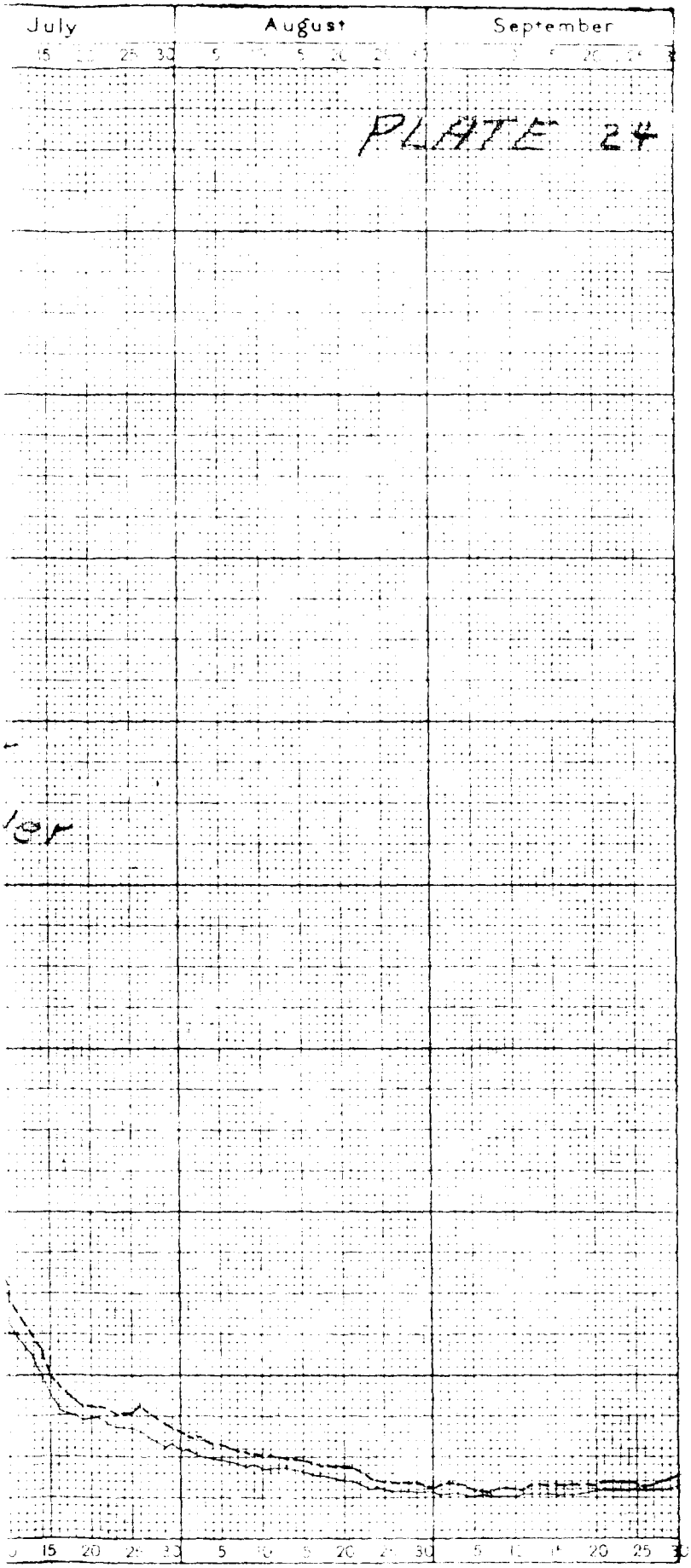

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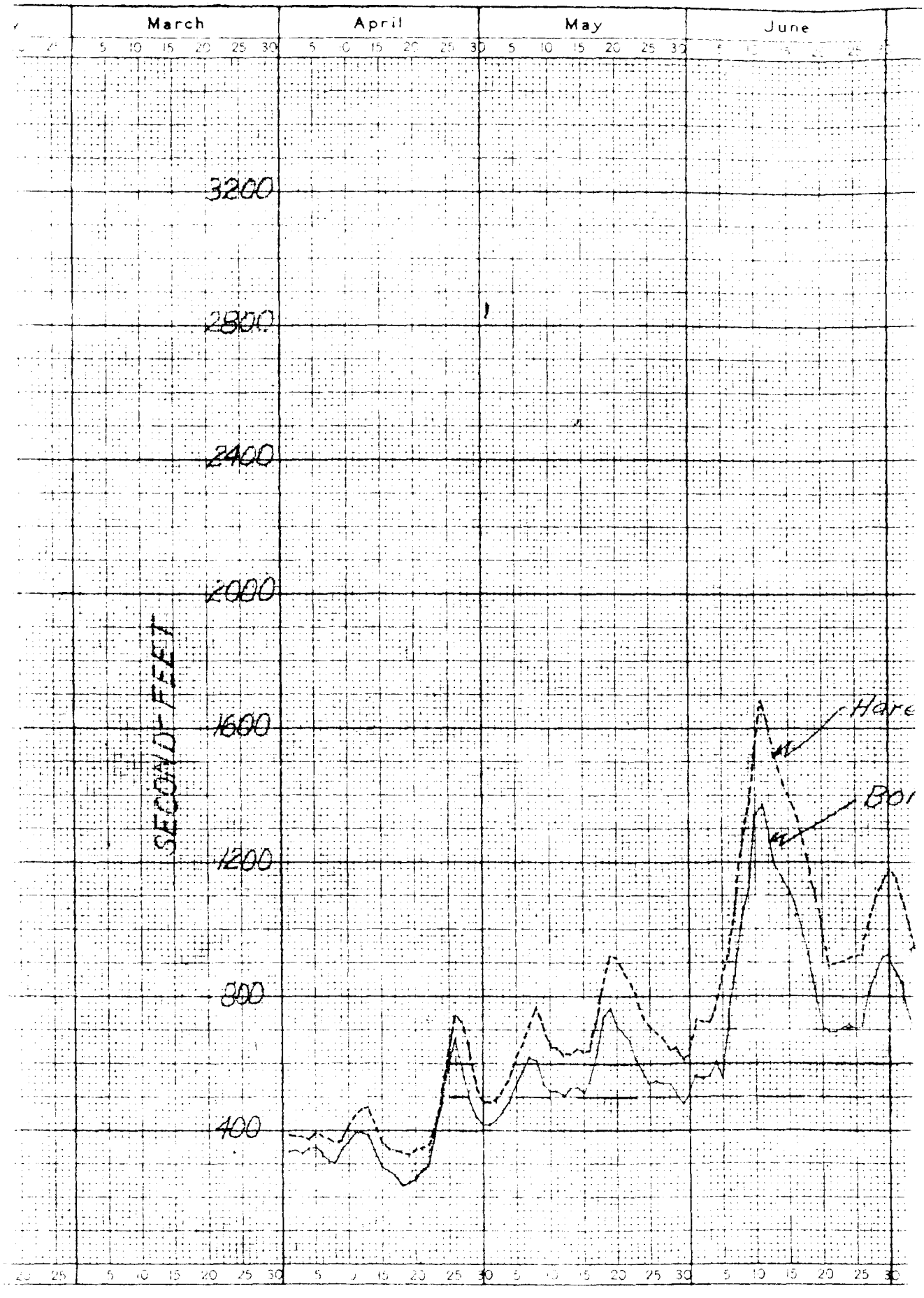
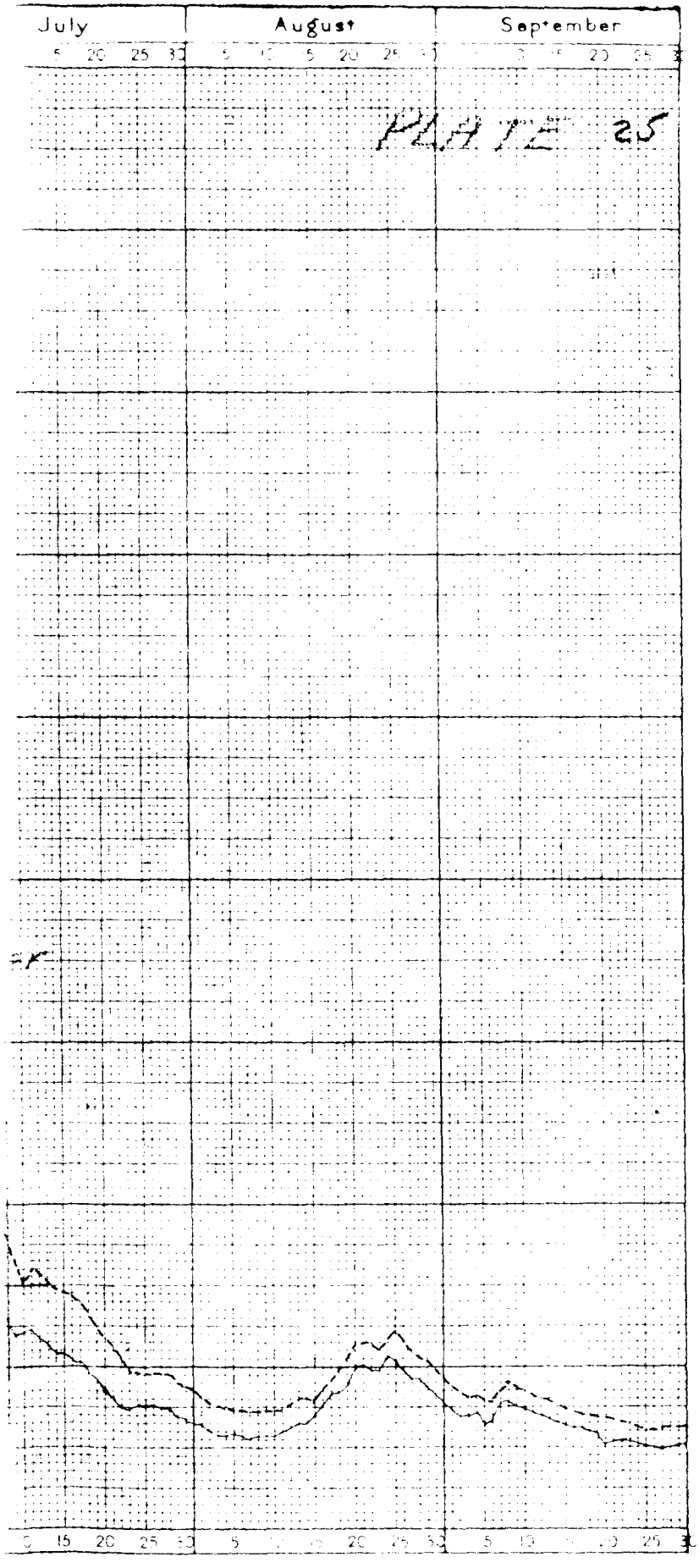
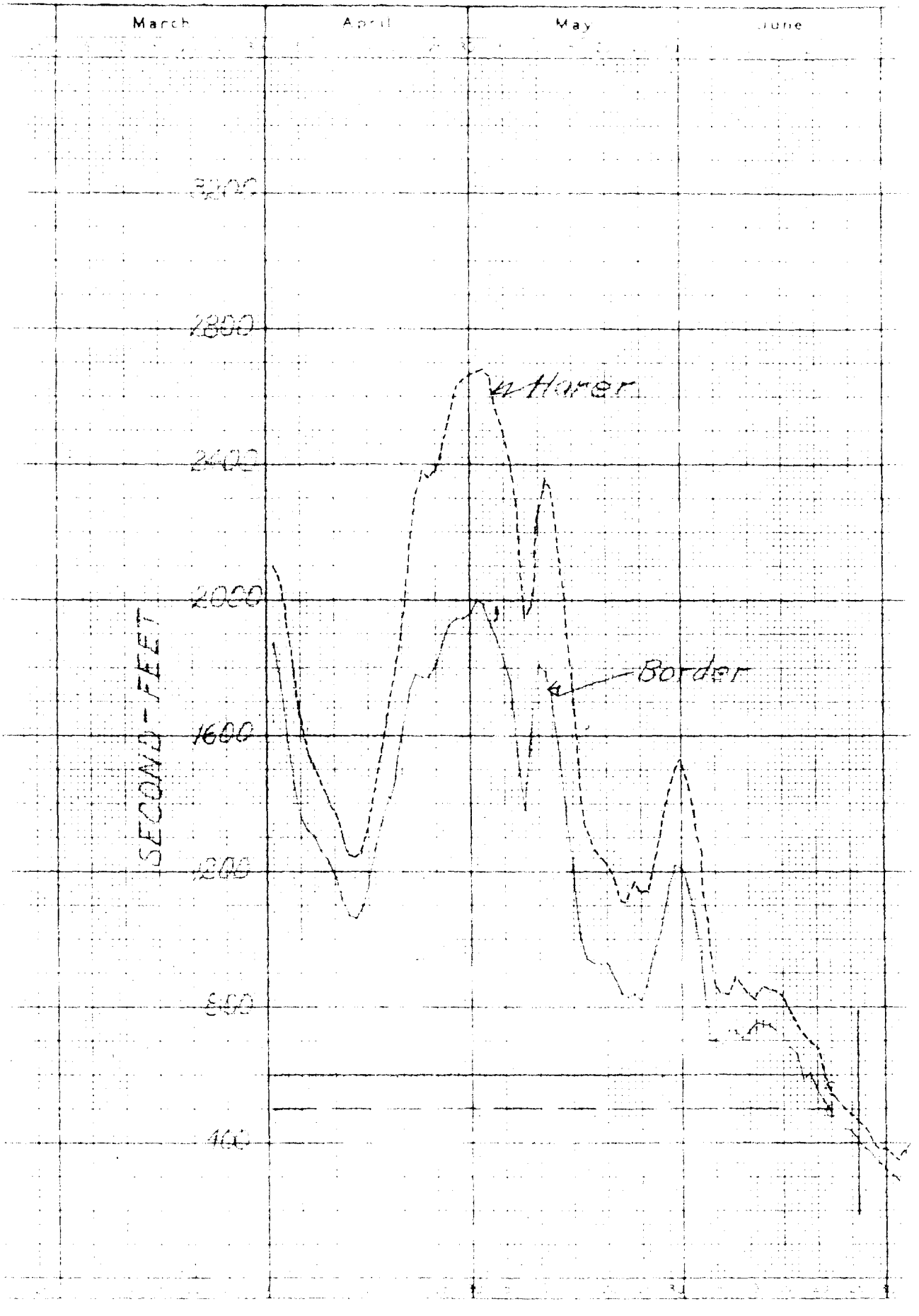
HYDROGRAPH FOR BEAR RIVER AT HARER



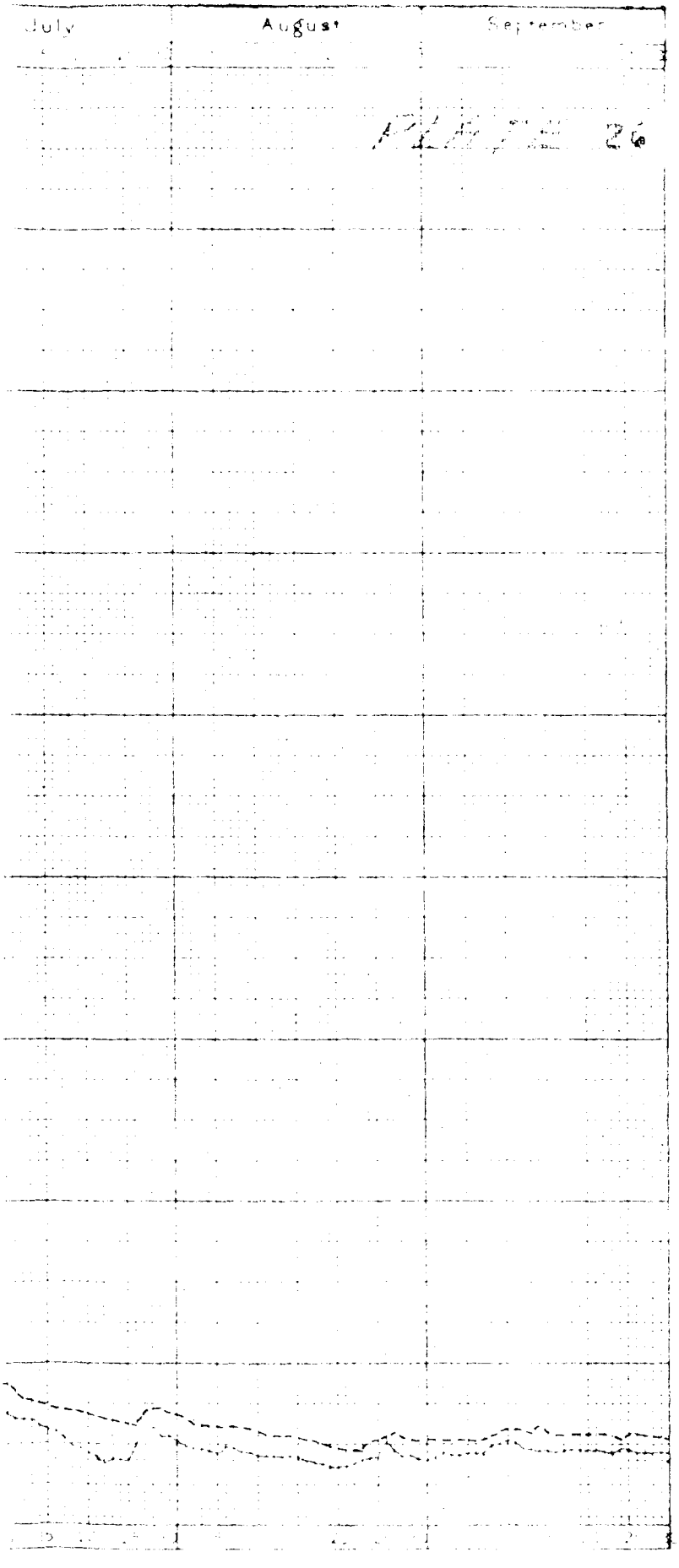
D BORDER 1945 File No. Washington Field



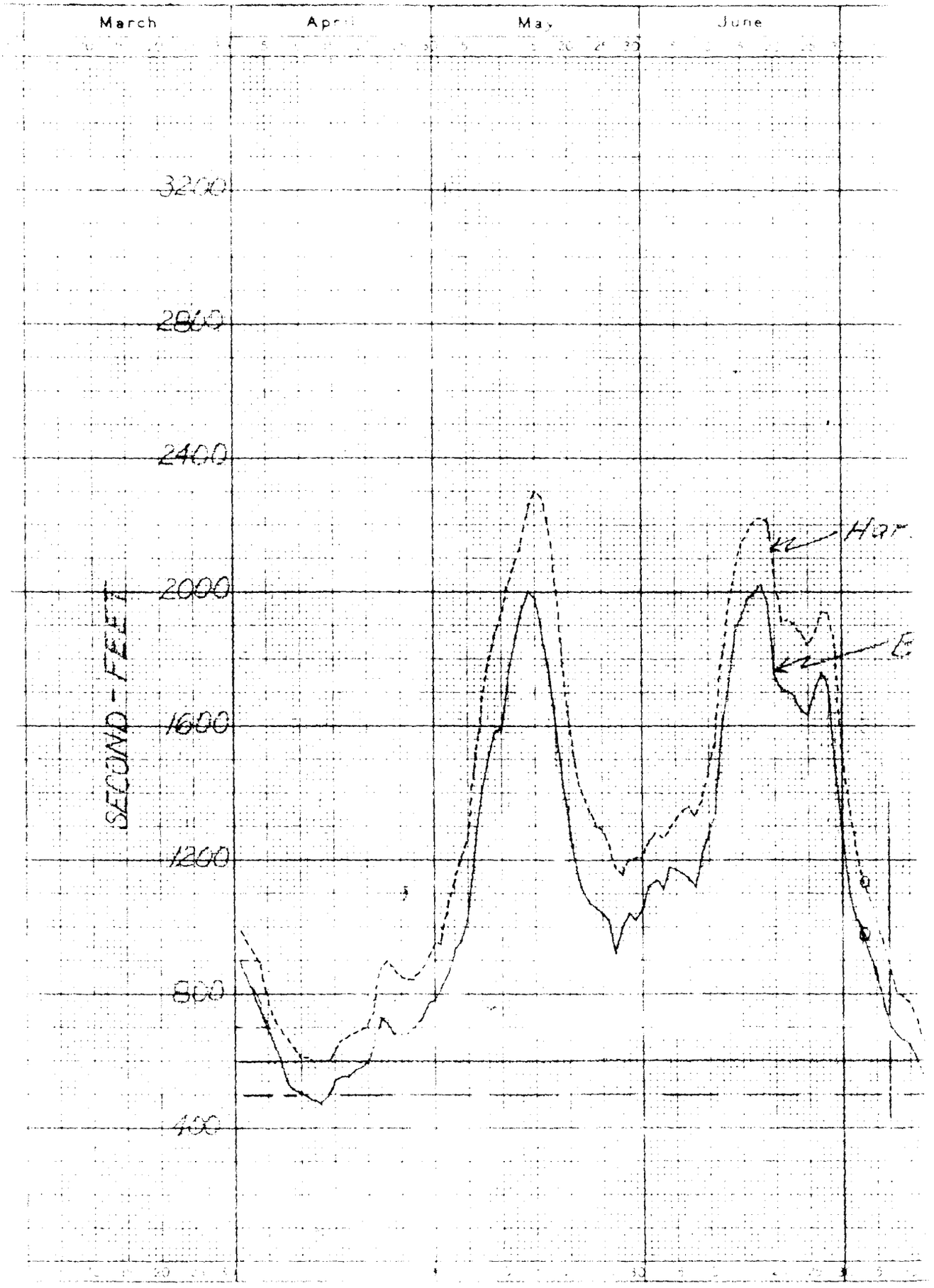
...ES BRANCH HYDROGRAPH FOR BEAR RIVER AT HARER A...

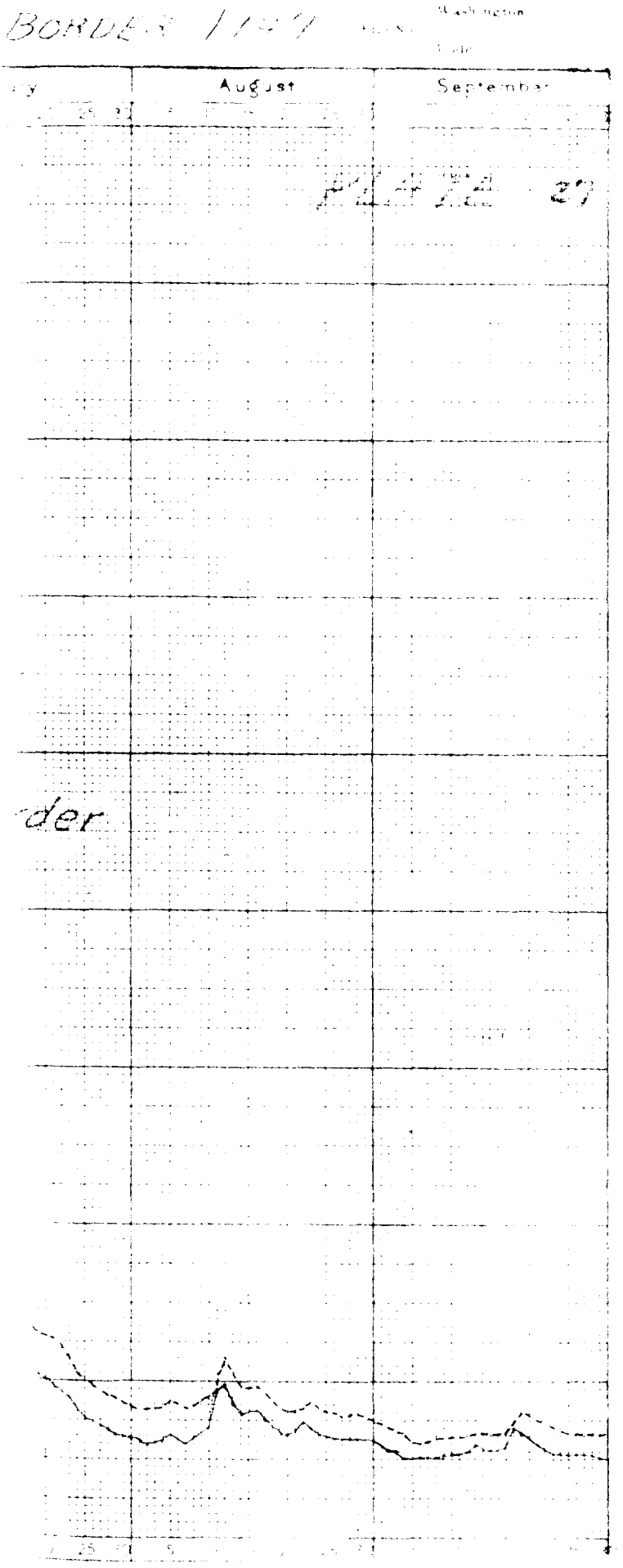


BORDER 1946



HYDROGRAPH OF BEAR RIVER AT HARER A

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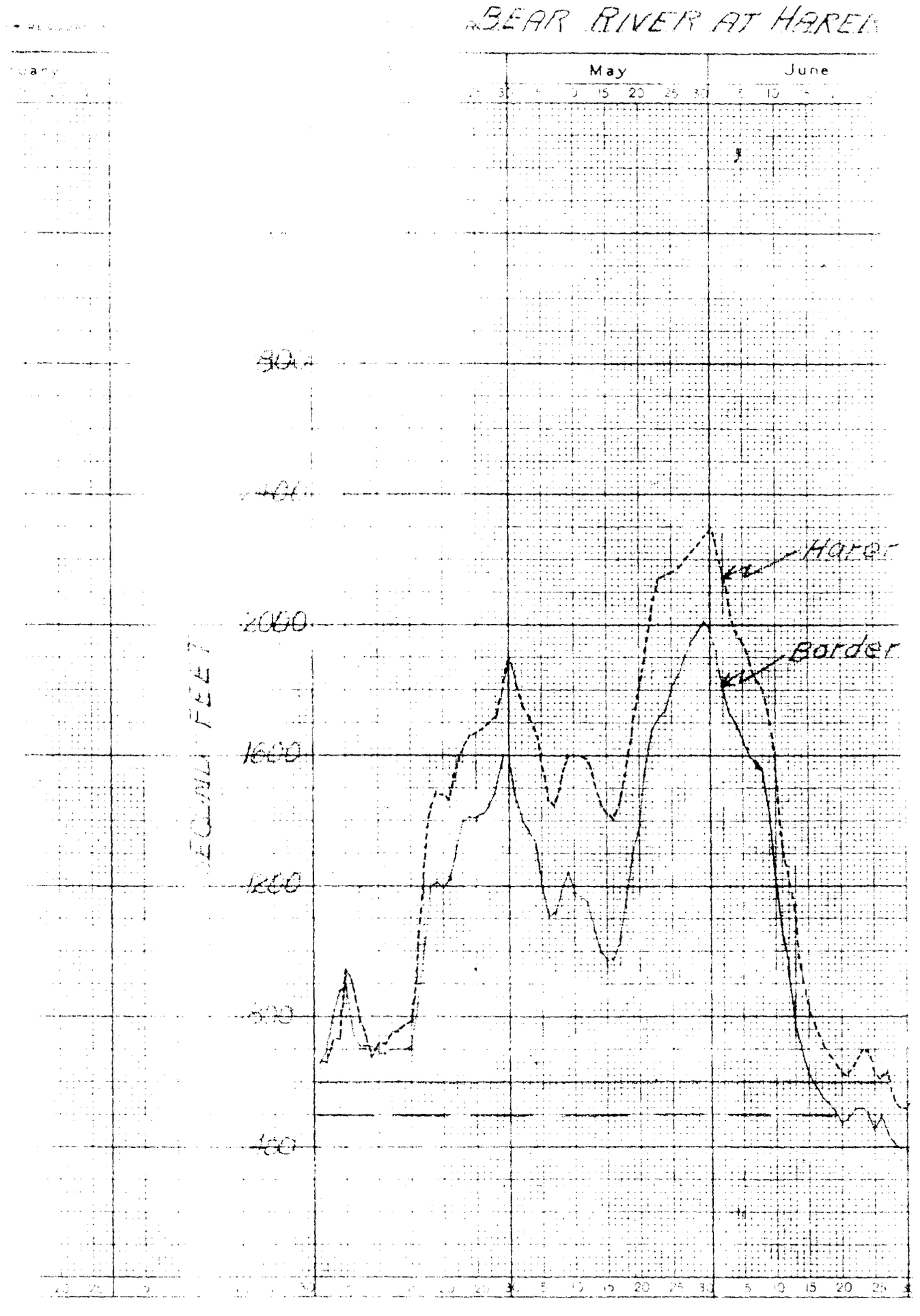
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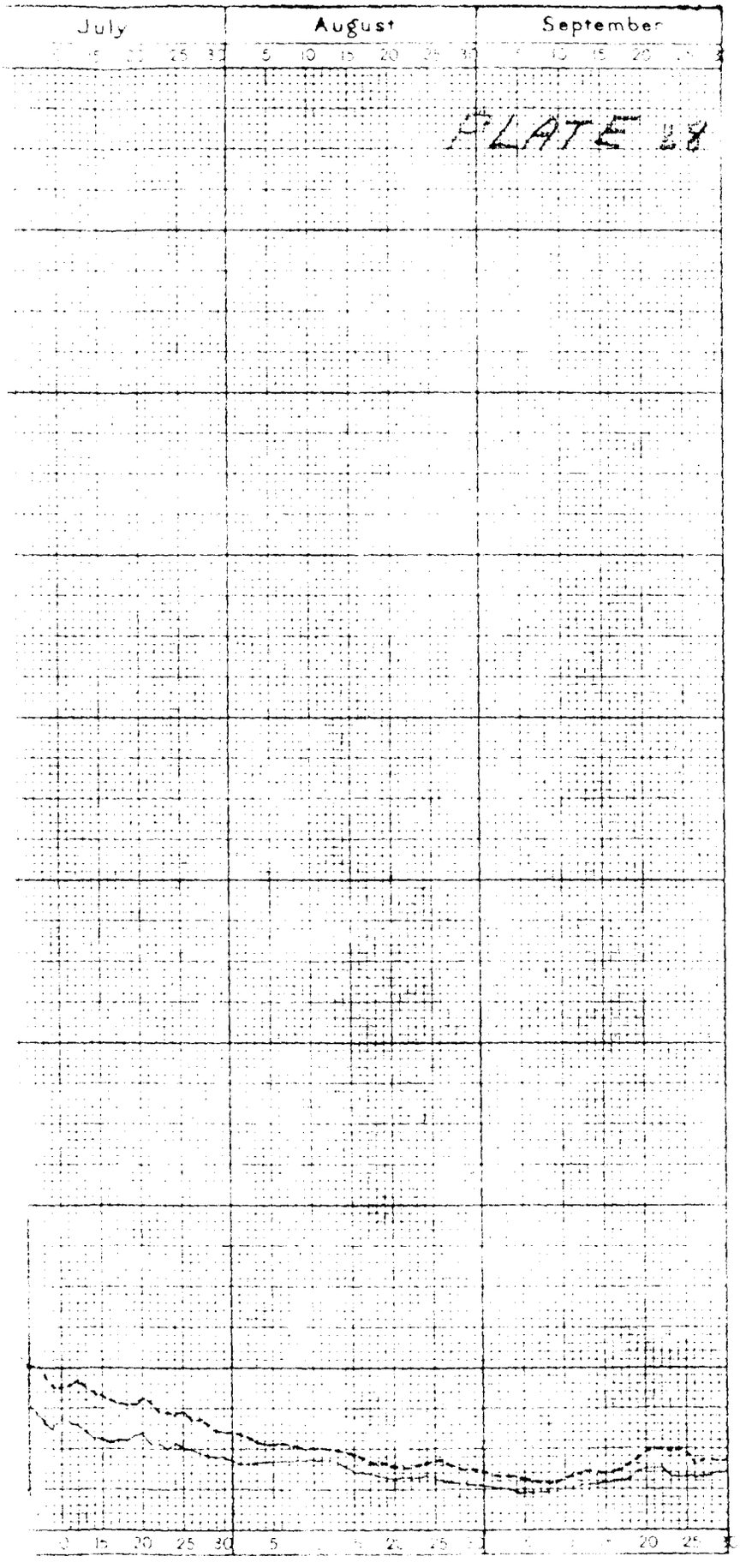
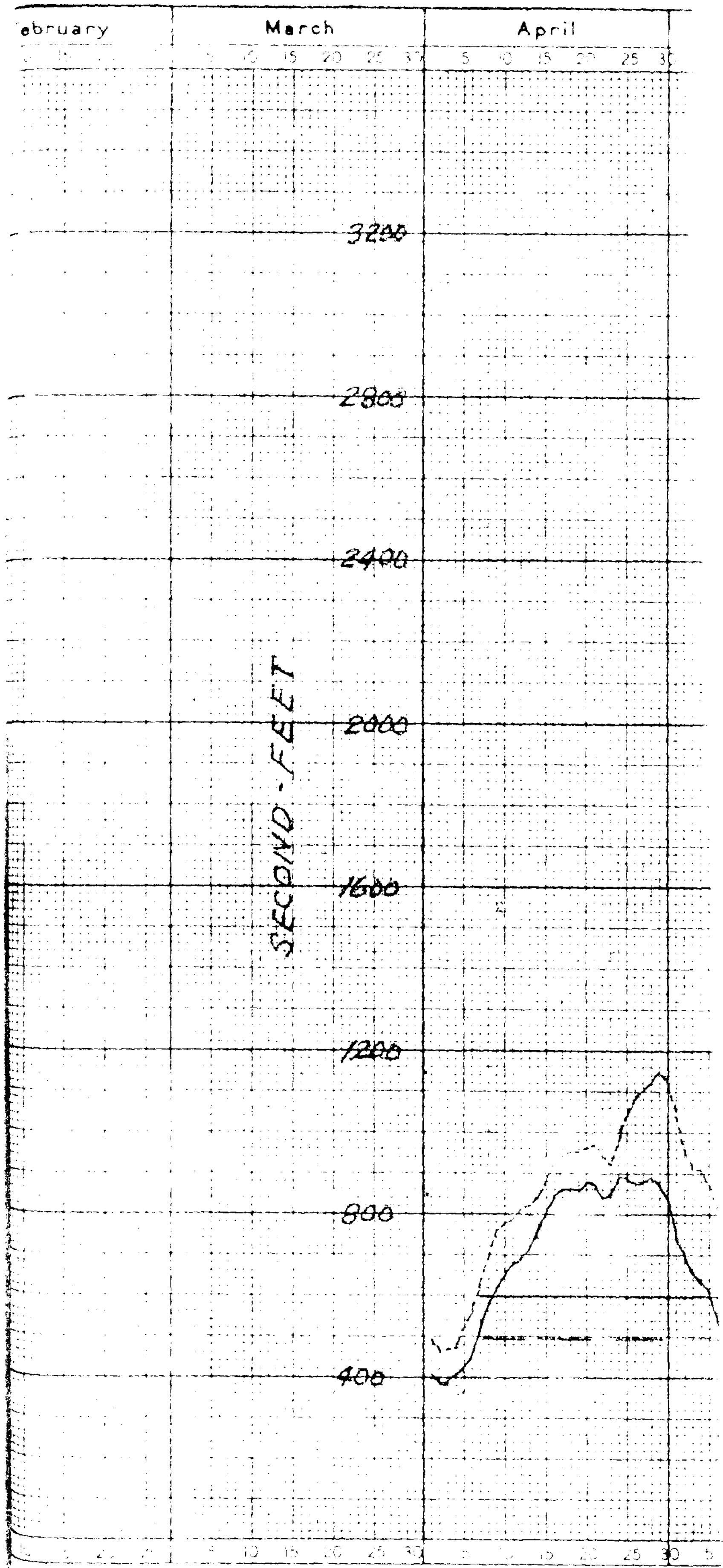
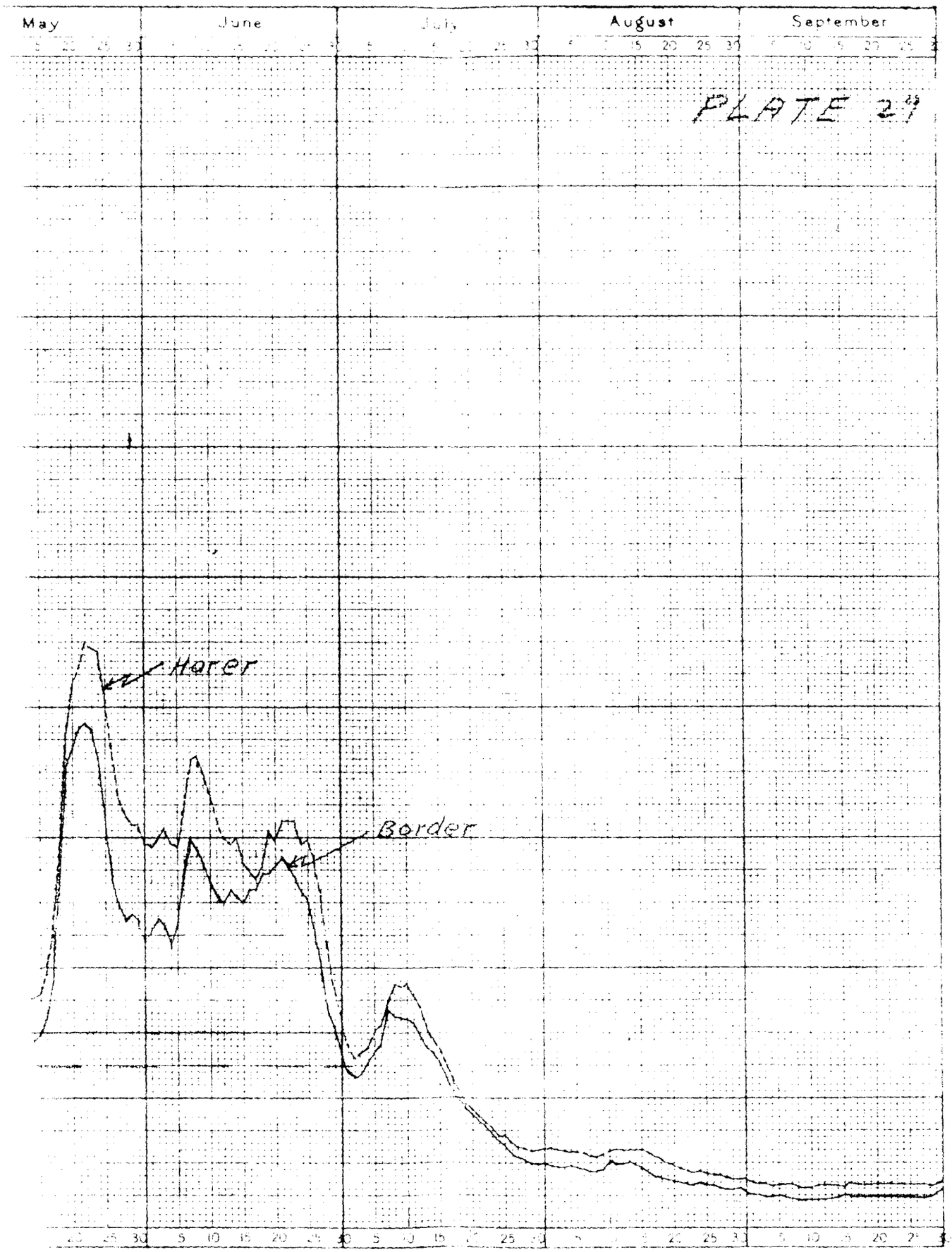
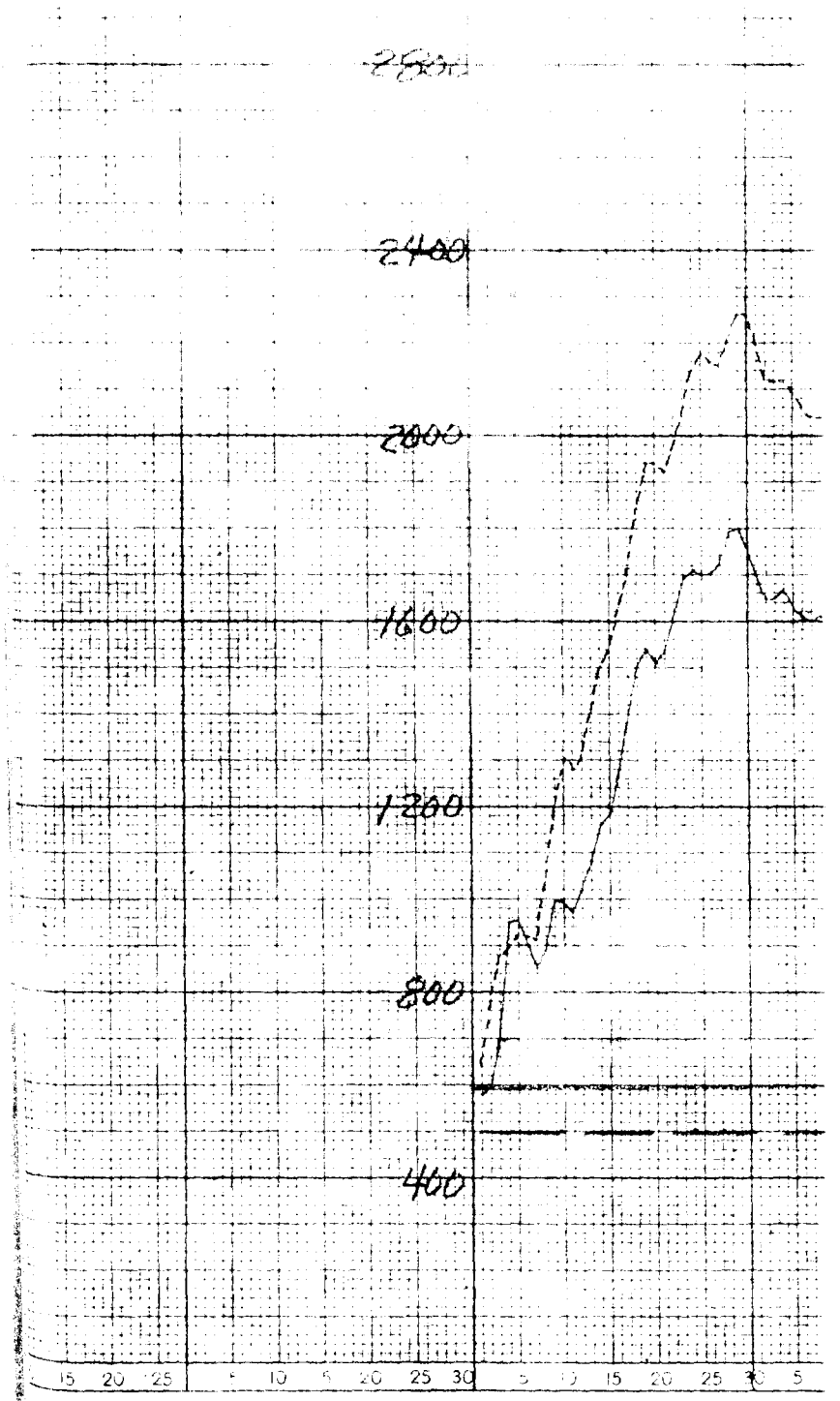


(ATER RESOURCES BRANCH) HYDROGRAPH FOR B...



RIVER AT HARER AND BORDER 1947 File No. Washington Field

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RIVER AT HARER AND BORDER - 1950 File No. Washington Field