

OPEN FILE 84-12

ESTIMATED OIL AND GAS RESERVES FOR MOFFAT COUNTY, COLORADO

Compiled by
A. H. Scanlon

Funded by the Department of Local Affairs--
Division of Commerce and Development



Colorado Geological Survey
Department of Natural Resources
State of Colorado
Denver, Colorado
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Acknowledgments

I would like to thank the staff of the Colorado Oil & Gas Conservation Commission (C.O.G.C.C.) who provided considerable assistance during the course of this compilation, and the staff of the Colorado Geological Survey, who assisted in the manuscript preparation.

However, I assume full responsibility for any errors or omissions in these tabulations. Users of this OPEN-FILE REPORT could provide a significant service if they would inform the Colorado Geological Survey of any misinformation or omissions.

This project was completed by the staff of the Colorado Geological Survey as part of a grant from the Department of Local Affairs - Division of Commerce and Development.

A. H. Scanlon
Senior Geologist

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ESTIMATED OIL AND GAS RESERVES FOR MOFFAT COUNTY, COLORADO

Introduction

This report is the tenth* in a series of oil and gas reserve investigations undertaken for those counties in which oil and/or gas is currently being produced.

This study involves Moffat County, located in the northwestern corner of Colorado, partially with the Sand Wash Basin. Moffat County covers 4,761 square miles. In this county, oil and/or gas are produced from, in descending order of age, the Wasatch Sandstone, Ft. Union Sandstone, Lance Sandstone, Lewis Shale, Mesaverde Sandstone, Niobrara Limestone, Frontier Sandstone, Mancos Shale, Dakota Sandstone, Morrison Sandstone, Curtis Sandstone, Entrada Sandstone, Sundance Sandstone, Nugget Sandstone, Shinarump Conglomerate and Weber Sandstone.

There are 28 fields considered active producers as of September 30, 1983. Of these, 11 are classified as oil fields (based on cumulative gas-oil ratio (GOR) of <15:1), and 17 are classified as gas fields (based on cumulative GOR >15:1).

Three of the 28 oil fields are currently undergoing secondary recovery by injected fluids. These projects are listed in Table I, which includes the amount of injected fluid for 1982 and the cumulative amount injected through 1982.

* Refer to:

- OPEN-FILE REPORT 84-3: Estimated Oil and Gas Reserves for Washington County, Colorado;
- OPEN-FILE REPORT 84-4: Estimated Oil and Gas Reserves for Rio Blanco County, Colorado.
- OPEN-FILE REPORT 84-6: Estimated Oil and Gas Reserves for Adams County, Colorado;
- OPEN-FILE REPORT 84-7: Estimated Oil and Gas Reserves for Weld County, Colorado;
- OPEN-FILE REPORT 84-8: Estimated Oil and Gas Reserves for Arapahoe County, Colorado;
- OPEN-FILE REPORT 84-9: Estimated Oil and Gas Reserves for Baca County, Colorado.
- OPEN-FILE REPORT 84-10: Estimated Oil and Gas Reserves for Cheyenne County, Colorado.
- OPEN-FILE REPORT 84-11: Estimated Oil and Gas Reserves for Garfield County, Colorado; and
- OPEN-FILE REPORT 84-12: Estimated Oil and Gas Reserves for La Plata County, Colorado.

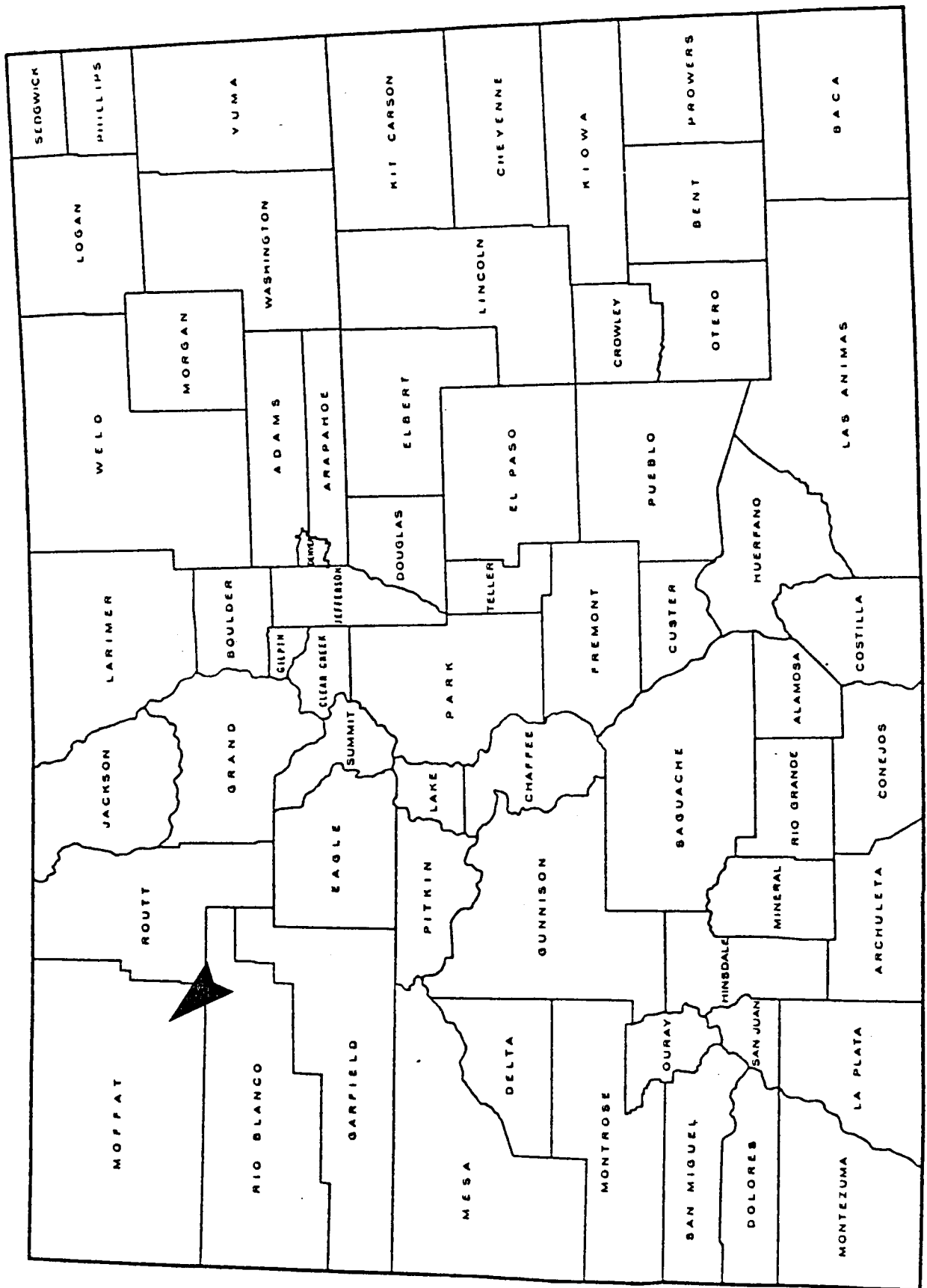


Figure 1. County Location Map

TABLE I

Summary of Secondary Recovery Projects
by Injected Fluids
for Moffat County

Field Name/ Horizon	Operator	Initial Inj. Date	Injected Water (bbls) 1982	Cumulative through 1982
Danforth Hills/ Morrison	Texaco	3-16-62	1,882,840	5,090,730
Danforth Hills/ Sundance	Texaco	6-13-63		16,724,440
Moffat-Dakota	Texaco	11-29-63	66,954	5,209,932
Powder Wash/ Wasatch	Mountain Fuel Supply	5-29-68	410	1,491,707

Method of Approach

Production decline curves are plotted for each currently producing horizon within each field, hereafter referred to as a field-horizon. There are 42 production decline curves plotted, one for each field-horizon. Production data were obtained from the C.O.G.C.C. annual production books. These books contain records of yearly production data, dating back to 1952. All production decline curves are plotted as rate (annual production in barrels of oil or MCF of gas) versus time (in years). The rate scale was adjusted to accommodate each field-horizon.

Oil Reserve Calculations

There are 21 oil field-horizons. Production histories have allowed for decline rates to be calculated for 20 of these. The remaining field-horizon, Maudlin gulch-Weber, has been shut-in for 17 of the past 18 years, therefore, no reserve calculations could be made. For the previously mentioned 20 fields, decline rates were determined based on actual past production and recorded, see Table II. These decline rates were then applied to the equation:

$$R_r = \frac{q_1 - q_f}{-\ln(1-dy)}$$

where: R_r = remaining reserves
 q_1 = current annual production
 q_f = final economic production rate
 (see note below.)
 $-\ln$ = negative natural log
 dy = yearly decline rate (in percent)

The ultimate recoverable was then determined by adding the estimated reserves to the cumulative production. These values are listed in Table II.

Note: the final economic production rate used was one barrel of oil per day per well, for one year; therefore 365 barrels, multiplied by the number of wells needed to keep field production economic. In most cases this was one well. The number of wells used was determined at the discretion of the author.

For associated gas production, estimated reserves were calculated in the same manner as that described in the Gas Reserve Calculations section.

No adjustments were necessary for the three fields undergoing water injection. They have all had a substantial amount of time to level off since injection began, therefore not affecting the current decline rates calculated.

Gas Reserve Calculations

There are 21 gas field-horizons. Production histories have allowed for decline rates to be calculated for 19 of these. The remaining 2 field-horizons have not produced for a long enough time (less than 3 years) to determine a reliable decline rate. Decline rates were determined for the previously mentioned 19 field-horizons (see Table II) and applied to the equation:

$$S = \frac{a(1-r^n)}{1-r}$$

Where: S = gas reserves

a = current annual gas production

r = (1-dy) where dy = annual decline rate

n = number of years -- 20 years was used
in all cases except where noted in
the remarks column of Table II.

Results can be found in Table II.

For the associated oil production, where this production was significant, the same method to determine estimated oil reserves was used, as discussed in the previous section. Whether oil production was considered significant or not was determined by the author. In all cases, if oil production indicated any kind of trend, reserves were calculated. A few cases arose where oil production, though a trend was indicated, did not exceed the economic limit (as discussed previously) of one barrel of oil per day per year, and therefore no reserve estimate was calculated, or an economic limit of zero was used.

Results

The following figures are for those field-horizons for which reserves could be calculated. Estimated oil reserves for Moffat County totaled 6,258,073 barrels. Estimated gas reserves for Moffat County totaled 221,910,846 MCF. Note that the gas reserve calculations are based on a 20-year projection, therefore they do not account for gas production after the year 2002.

These figures also do not account for production increases due to secondary and/or tertiary recovery not already in progress, or account for undiscovered reserves, nor do they reflect changes in economics or demand.

In nine to ten years, roughly half of the estimated oil reserves in Moffat County will have been produced. Roughly one half of the estimated gas reserves for the next 20-year period are expected to be produced in seven to eight years.

In this county there are two classes of field-horizons: I) those with a long enough production history to calculate reserves with confidence, and II) those new field-horizons with essentially no production history, or for other reasons, reserves cannot be calculated.

To be able to calculate total county oil and gas reserves, it was necessary to apply the overall decline rates (6.85 percent per year for oil and 6.3 percent per year for gas) obtained from class I field-horizons to the current production from Class II field-horizons.

Using this approach on current production from Class II field-horizons (11,994 Bbls. of oil and 120,178 MCF of gas) additional reserves of 158,739 Bbls. of oil and 1,388,457 MCF of gas were obtained. This gives total county reserves (Class I and II) of 6,416,812 Bbls. of oil and 223,299,303 MCF of gas.

To insure that the reserve figures calculated for Class II are reasonable using this method, a comparison was made between the sources (producing horizons) of the Class I and Class II field-horizons. It was determined that there were no significant differences in the sources of production for the two groups. Therefore, it is concluded that the overall decline rates can be applied with confidence.

LIST OF ABBREVIATIONS USED IN TABLE OF RESERVE DATA

'a'	annual gas production
ABD.	abandoned
Approx.	approximate, approximately
Avg.	average, averaged
Bbls.	barrels
B.W.E.	Bottom Water Encroachment
calc.	calculate, calculated
Co.(s)	county (counties)
cond.	condensate
ck.	Creek
Cum.	cumulative
Dak.	Dakota Sandstone
Deplet.	Depletion
dy	annual decline rate
Econ.	Economic
Est.	Estimated
Exp.	Expansion
g	gas
Gas Exp.	Gas Expansion
G.C.E.	Gas Cap Expansion
G.E.	Gas Expansion
GOR	Gas-Oil Ratio
Inc.	Increase, increasing, increased
Inj.	Injection, injected
Lmtd.	Limited
MCF	Thousand cubic feet
Miss.	Mississippian
Mos.	Months
Mtn.	Mountain
N	North
N.P.	New Production or less than five years production, therefore, no reliable annual decline rate could be calculated to apply to the equations to calculate reserves.
No.	number, numbers, North
o	oil
P and A	Plug (ged) and Abandon (ed)
Poss.	Possible
Prod.	Production, produced
Proj.	Projection, projected
q	current annual production of oil
qf	final economic production of oil
react.	reactivated
Rr	Remaining reserves-oil
S	Remaining reserves-gas
S.G.D.	Solution Gas Drive
S.I.(SI)	Shut-in
So	South
W	West
W.D.	Water Drive
Yr or Yrs	Year or years

TABLE I
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RESERVE DATA FOR MOFFAT COUNTY

FIELD NAME/ PRODUCING HORIZON	LOCATION	DATE OF DISCOVERY	TYPE OF DRIVE	Dy	CUMULATIVE PRODUCTION 12/31/82		ESTIMATED RESERVES		ULTIMATE RECOVERABLE		REMARKS
					OIL (Bbls.) () Condensate (Bbls.)	GAS (MCF)	OIL (Bbls.) () Condensate (Bbls.)	GAS (MCF)	OIL (Bbls.) () Condensate (Bbls.)	GAS (MCF)	
1. Big Hole/ Lewis	10N-94W	1973	Depletion	13.0 -0 7.1 -g	(22,721)	3,247,189	(8,559)	3,455,467	(31,280)	6,702,656	Econ. Limit = 3 wells.
2. Big Gulch/Mesa- verde-Frontier	7N-93W	1964			(4,182)	3,055,670		178,198	(4,182)	3,233,868	
3. Black Mountain/ Lewis	10N-90W	1981		14.2 -g	187 (9)	47,940					N.P.
4. Blue Gravel/ Lewis	9N-91W	1969	W. D. & Gas Exp.	8.4 -g	(767)	3,533,977		2,129,901	(767)	5,663,878	
5. Buck Peak/ Mancos	6N-90W	1957		14.2 -0 12.7 -g	1,643,231	1,865,521	99,540	66,843	1,742,771	1,932,364	
6. Buck Peak/ Niobrara	6N-90W	1972		8.4 -0 9.8 -g	1,947,742	2,244,737	939,686	1,900,767	2,887,428	4,145,504	
7. Craig Dome/ Frontier	6N-91W	1932			(466)	1,505,389					SI 1982, 1983
8. Craig North/ Lewis	8N-90W	1967	Gas Exp.	10.8 -0 6.3 -g	3,779 (21,145)	11,624,520	12,451	12,133,559	16,230 (21,145)	23,758,079	
9. Danforth Hills/ Morrison	5N-95W	1954		5.8 -0 9.1 -g	1,058,453	145,173	109,941	20,458	1,168,394	165,631	
10. Danforth Hills/ Shinarump	5N-95W	1979		31.2 -0 31.2 -g	42,282	6,760	22,029	3,889	64,311	10,649	
11. Danforth Hills/ Sundance	5N-95W	1958		13.6 -0 15.0 -g	1,711,555	37,150	95,996	2,249	1,807,551	39,399	
12. Danforth Hills/ Weber	5N-95W	1960		7.1 -0 25.0 -g	408,366	8,575	354,993	1,902	763,359	10,477	
13. Danforth Hills North/Morrison	5N-95W	1958		3.9 -0 4.2 -g	375,629	116,983	130,088	24,139	505,717	141,122	
14. Elk Springs/ Weber	5N-98W	1926		10.9 -0	541,179	13,030	61,788		602,967	+13,030	
15. Great Divide/ Middle Lewis	9N-93W	1978	Gas Exp. & W. D.	24.2 -0 6.7 -g	(13,705)	1,903,823	(4,674)	3,577,067	(18,379)	5,480,890	
16. Hiawatha/ Entrada-Nugget	12N- 100W	1926		14.0 -g		1,603,643		3,252,345		4,855,988	
17. Hiawatha/ Fort Union	12N- 100W	1926		10.0 -0 4.5 -g	76,560 (91,102)	18,047,141	20,064	9,689,212	96,624 (91,102)	27,736,353	
18. Hiawatha/ Wasatch	12N- 100W	1926		3.5 -0 2.4 -g	3,543,960 (59,135)	94,903,539	554,661	22,302,515	4,089,621 (59,135)	117,206,054	Econ. Limit = 4 wells
19. Hiawatha West/Fort Union- Lewis-Lance-Mesa- verde-Wasatch	12N-100 & 101W	1958		5.4 -011 5.1 -g	11,022	131,942,856 (199,706)	58,779	41,067,895	69,801 (199,706)	41,067,895	
20. Horse Gulch/ Shinarump	5N-91W	1980		41.5 -0	11,184		5,383		16,567		Used Actual 1983 Prod. thru 9/83 rather than 1982 Prod.
21. Iles/Curtis	4N-92W	1963		5.5 -0	63,271		20,240		83,511		

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MOFFAT COUNTY

FIELD NAME/ PRODUCING HORIZON	LOCATION	DATE OF DISCOVERY	TYPE OF DRIVE	Dy	CUMULATIVE PRODUCTION 12/31/82		ESTIMATED RESERVES		ULTIMATE RECOVERABLE		REMARKS
					OIL (Bbls.) (Condensate Bbls.)	GAS MCF	OIL (Bbls.) (Condensate Bbls.)	GAS (MCF)	OIL (Bbls.) (Condensate Bbls.)	GAS (MCF)	
22.11es/ Morris	4N-92W	1924		12.4 -0	1,335,001	55,186	1,246		1,336,247	+55,186	Econ.Limit= 0 wells.
23.11es/ Sundance	4N-92W	1954		3.5 -0 18.7 -g	16,897,438	1,989,510	1,299,233	26,018	18,196,671	2,015,528	Econ.Limit= 2 wells. N.P.
24.11es/ Mesaverde	12N-99W	1981			21,301						
25.11es/ Lower Mesaverde	8N-92&93W	1972		15.6 -g	(25)	5,862,354		1,588,026	(25)	7,450,380	
26.11es/ Dakota	4N-95W	1966	W. D.	10.4 -0 8.4 -g	4,332,728	908,561	276,438	152,217	4,609,166	1,060,778	
27.11es/ Morrison-Sundance	4N-95W	1947	W. D.	5.9 -0 6.7 -g	2,511,920	353,712	403,028	8,757	2,914,948	362,469	
28.11es/ Weber	4N-95W	1957			11,753						N.P. oil Prod. '57-'62, 1983 - Gas Prod. '63-'64.
29.11es/ rump-Dakota- Sundance	5N-91W	1924		4.5 -0 5.9 -g	8,359,787	82,886	163,149	4,468	8,522,936	87,354	
30.11es/ Niobrara	5N-91W	1962		4.1 -0	96,390	14,031	25,320		121,710	+14,031	
31.11es/ Lewis	12N-92W	1966		8.7 -0 11.1 -g	4,494 (1,385)	6,618,424	417	697,539	4,911 (1,385)	7,315,963	
32.11es/ Fort Union	11&12N - 97W	1931		7.5 -0 6.2 -g	855,089 (814,573)	109,275,286	1,261,070	86,277,863	2,116,159 (814,573)	195,553,149	Econ.Limit= 16 wells.
33.11es/ Wasatch	11&12N-97W	1931		8.8 -0 8.5 -g	4,505,145 (409,566)	83,770,820	149,715	9,937,196	4,654,860 (+409,566)	93,708,016	Econ.Limit= 4 wells.
34.11es/ Nugget	11N-100W	1977			(110)	2,994,521		2,223,653	(+110)	5,218,174	
35.11es/ Ft. Union	12N-101W	1953		12.5 -g	517 (2,143)	277,259					
36.11es/ Mesaverde	12N-101W	1954		6.8 -0 6.1 -g	2,928 (248,694)	61,707,153	25,020	19,239,973	27,948 (248,694)	80,947,126	Econ.Limit= 3 wells.
37.11es/ Shinarump	4N-95W	1964		15.9 -0	177,723	19	45,453		223,176	+19	
38.11es/ (Marapos)/Weber	3N-91W	1955		4.8 -g	753,686	6,420,032		153,254	+753,686	6,573,286	
39.11es/ Niobrara	4N-90W	1964		9.8 -0 9.4 -g	424,127	22,662	101,085	111,482	525,212	134,144	
40.11es/ al/Lance-Lewis	12N-92W	1967		36.0 -g	210	3,230,830		862,980	+210	4,093,810	
41.11es/ Dakota	4N-98W	1960		16.6 -g	274,405	12,781,989		805,010	+274,405	13,586,999	Used 1983 Prod. thru 9/83 for 'a'.
42.11es/ Weber	4N-98W	1979		24.0 -0 11.0 -g	31,345	6,407	8,027	16,004	39,372	22,411	

COUNTY TOTAL OF ESTIMATED RESERVES

6,258,073 Bbls.
221,910,846 MCF

Reference List

Colorado Oil and Gas Conservation Commission Production Records and Injected Fluids - Water and/or Gas-File.

Crouch, M.C., III, editor, 1982 Oil and Gas Fields of Colorado, Nebraska and Adjacent Areas: Rocky Mountain Association of Geologists, vols. I and II, 791 pp.

Haun, J.D., Cardwell, A.L., Herrod, W.H. and Cronoble, J.M., 1976. Oil and Gas Reserves of Colorado in Colorado School of Mines Research Institute, Mineral Industries Bulletin, v. 19, #5.

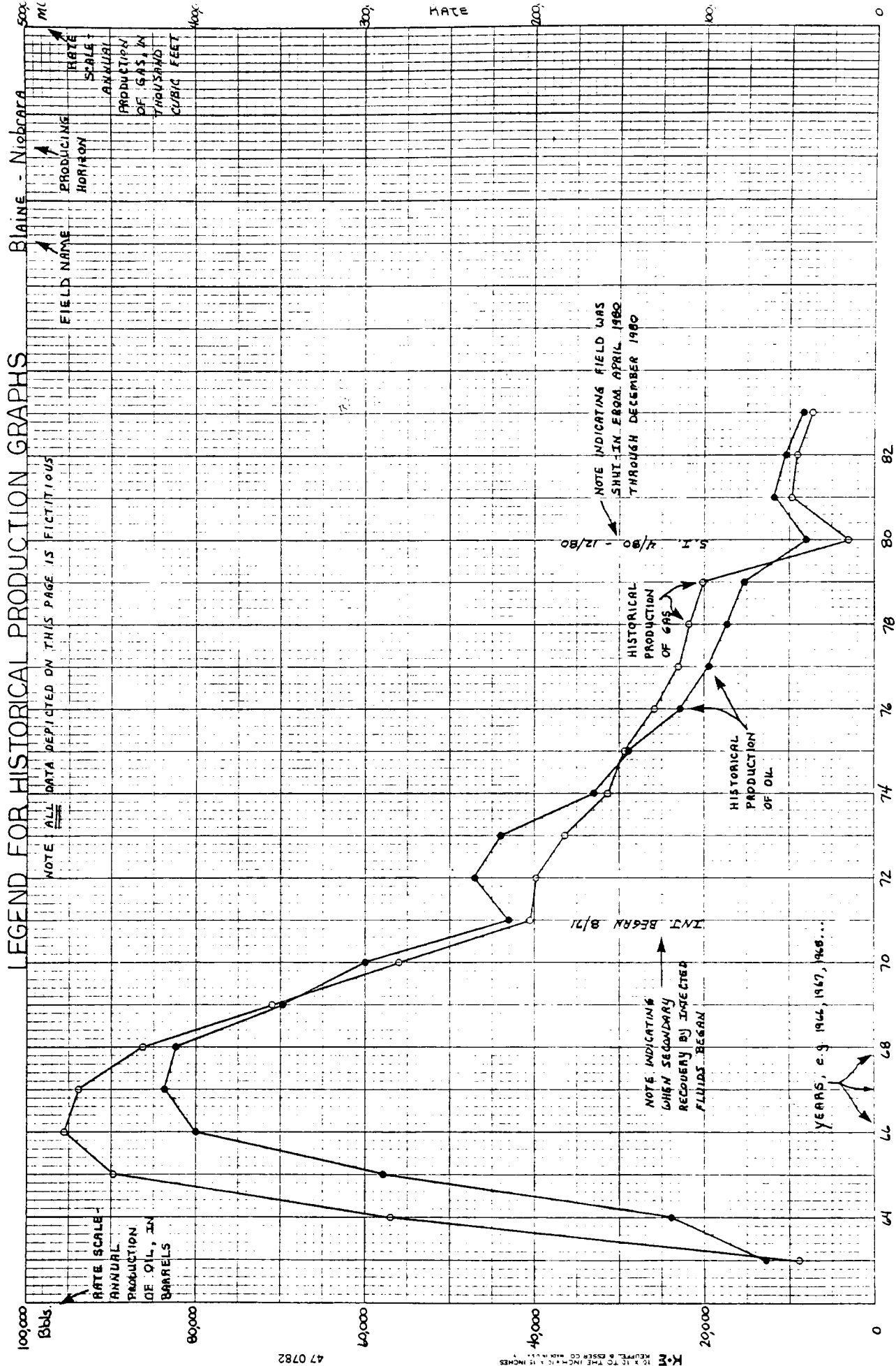
Parker, J.M., editor, 1961 Oil and Gas Field volume: Colorado-Nebraska: Rocky Mountain Association of Geologists, 389 pp.

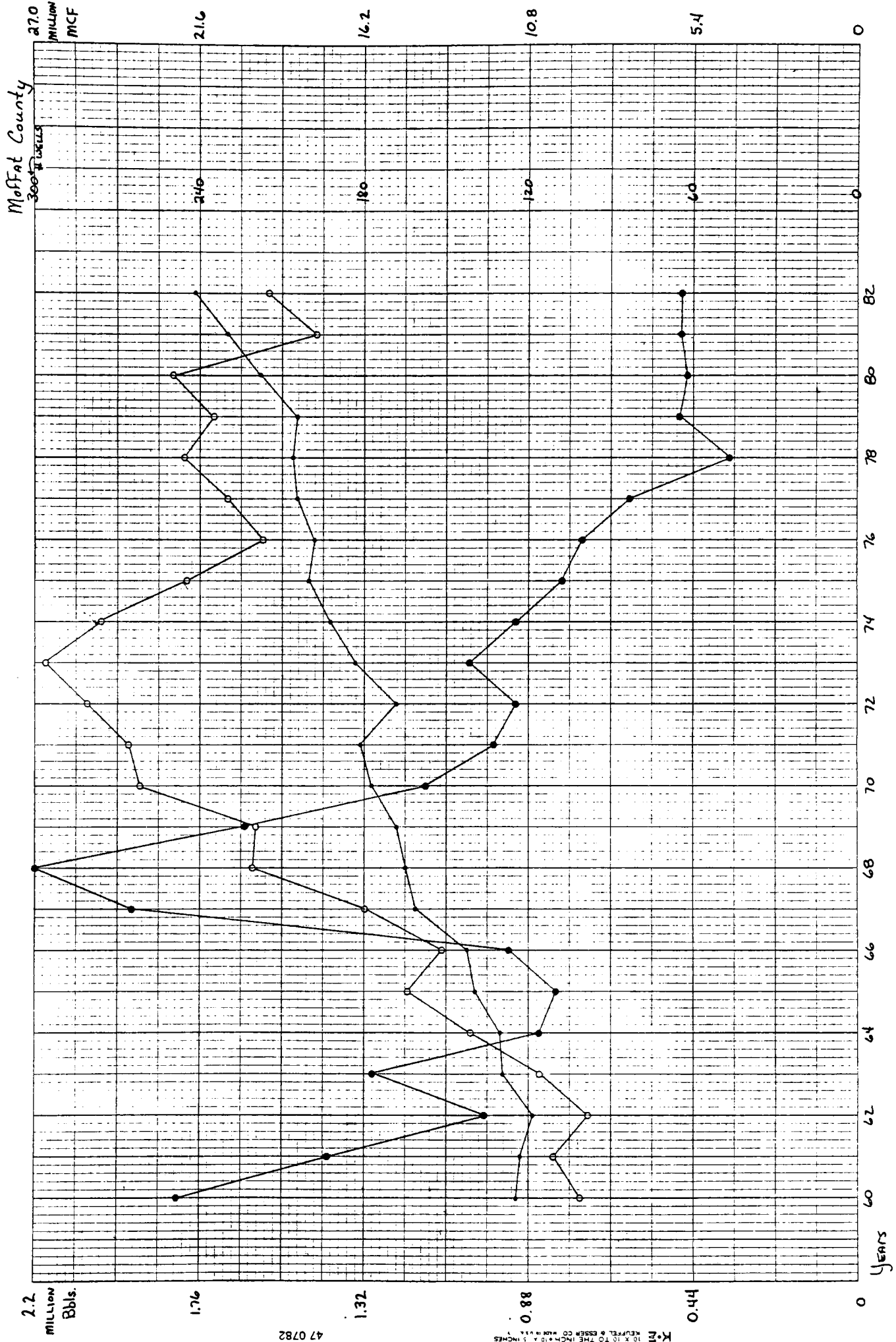
Appendix I

Historical production decline curve graphs for Moffat County. These graphs are presented in alphabetical order by Field name and then by producing horizons within each field.

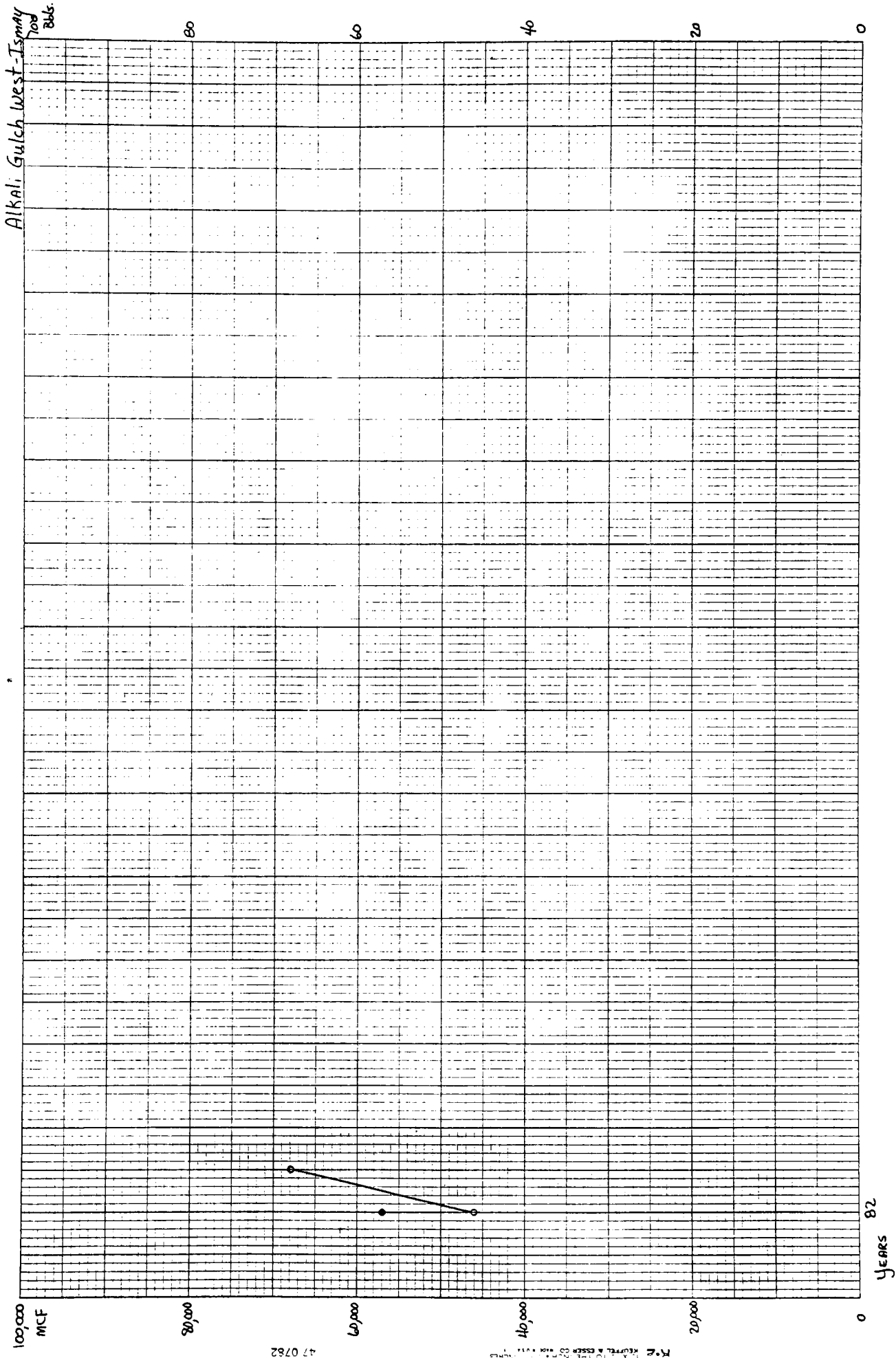
Note that only those fields actively producing as of 9-30-83 are included. Abandoned fields or field-horizons are not included.

LEGEND FOR HISTORICAL PRODUCTION GRAPHS





Alkali Gulch West-Tsmay
Bbls.



0009
P.L.s.

0008
h.

0007
e

0007
e

0007
e

0

Years

74

76

78

80

82

50000
MCF

40000

30000

20000

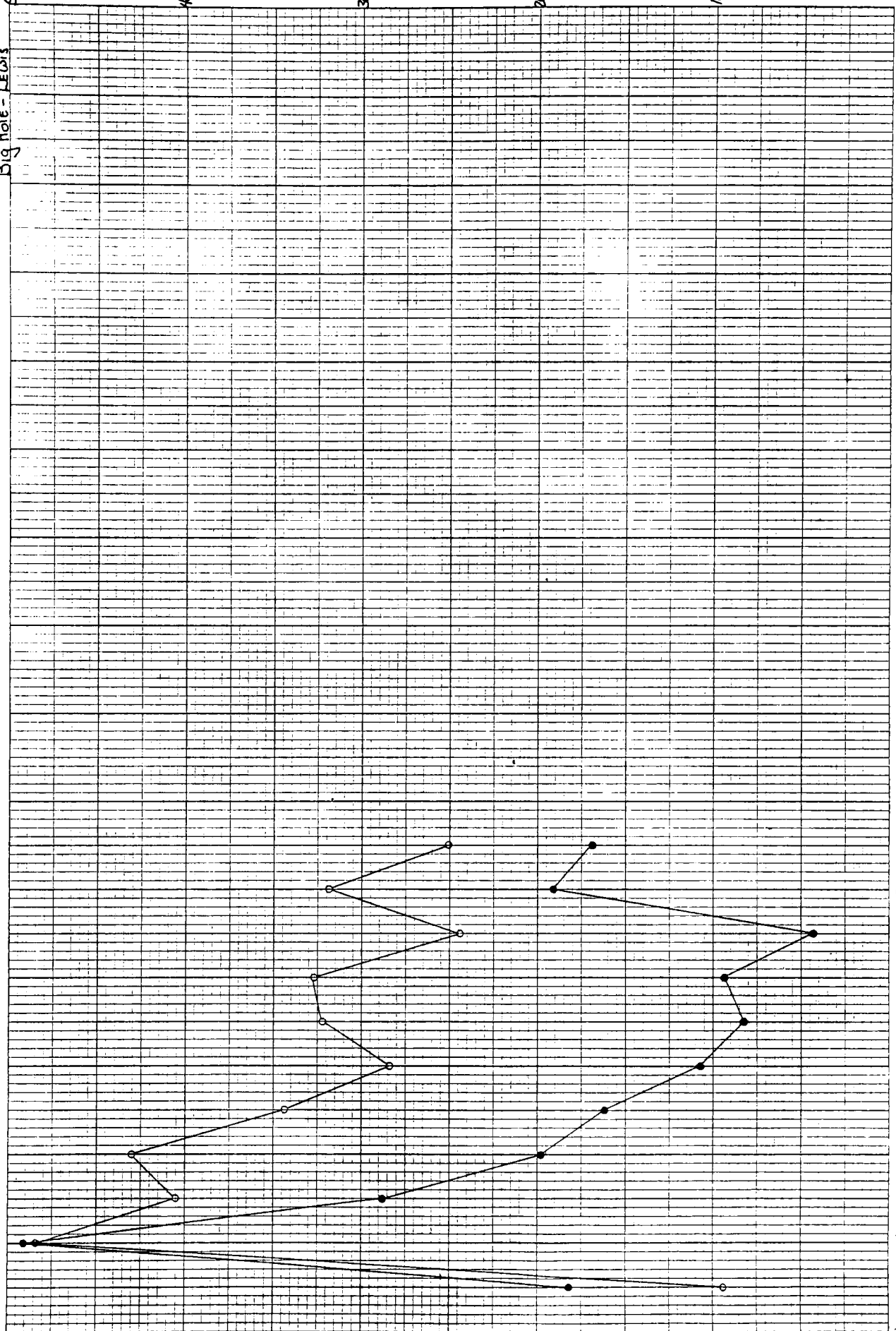
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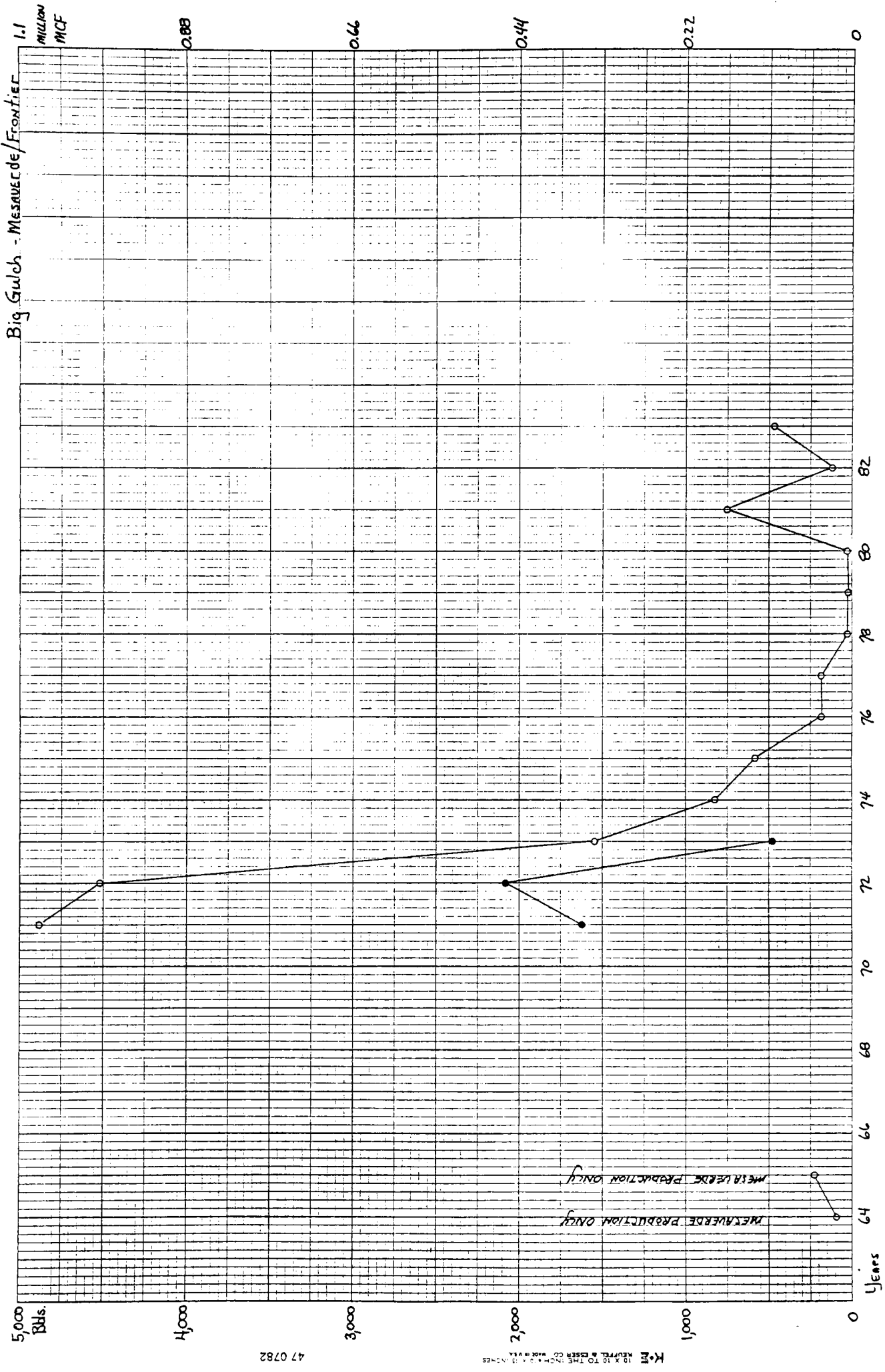
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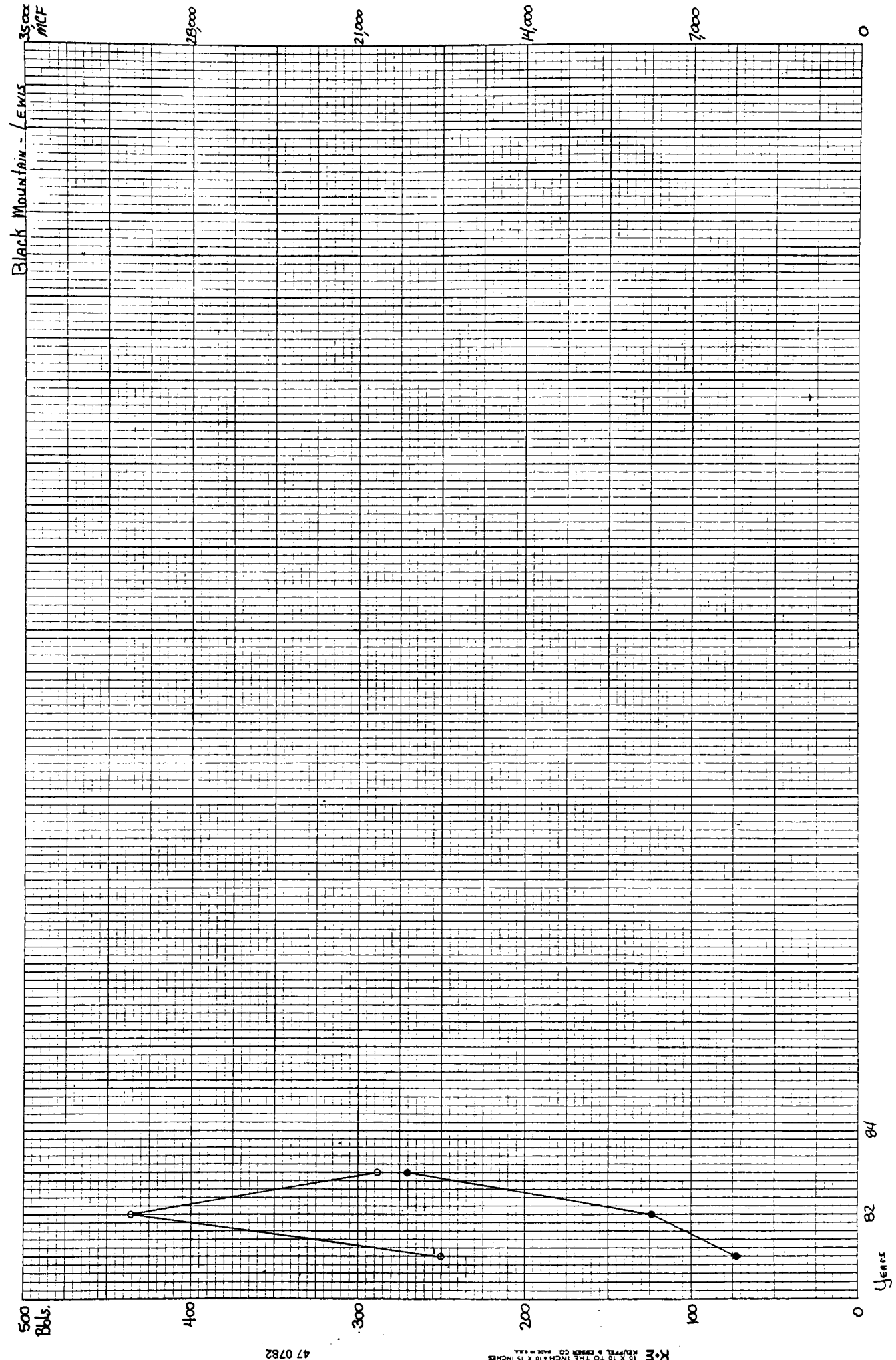
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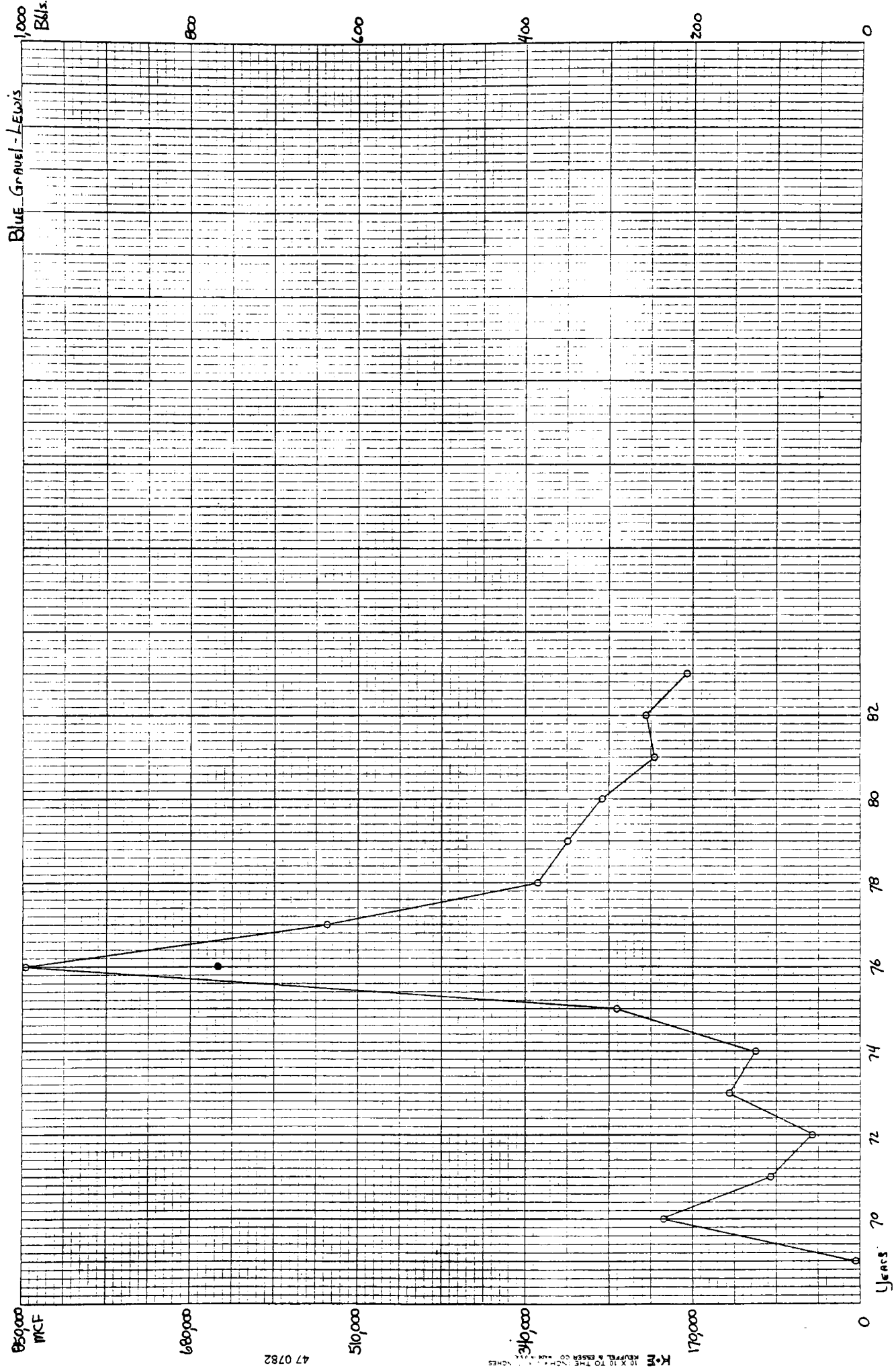
47 0782

K-E
10 X 10 TO THE INCH * 1.5 INCHES
KUPPER & ESSER CO. MADE IN U.S.A.









47 0782

K-21
10 X 10 TO THE INCH
KEUFFEL & ESSER CO. MADE IN U.S.A.

WCF
000000

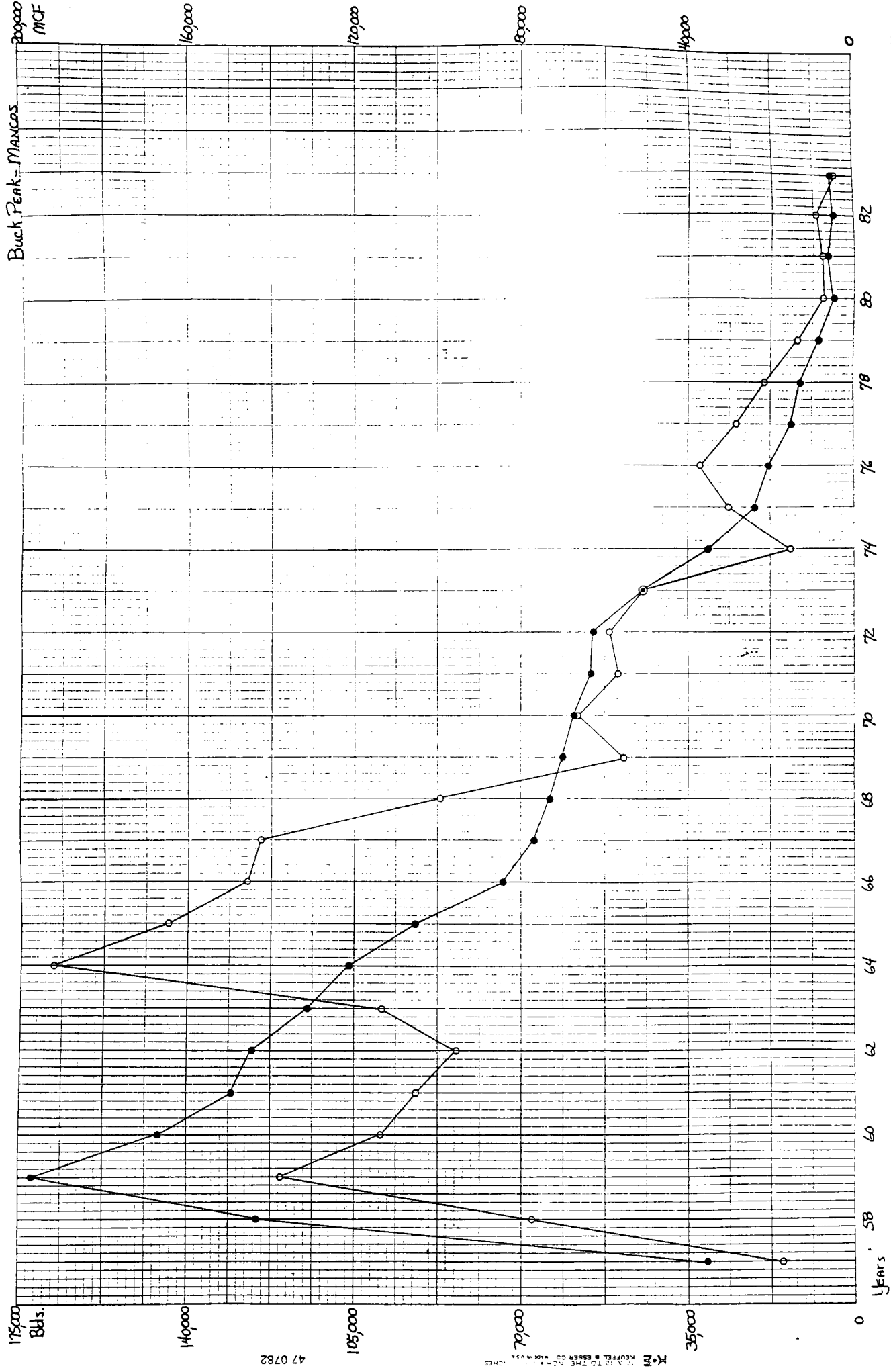
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47 0782

K. E. KUPFER & SONS CO. MADE IN U.S.A.

415,000
Bids

332,000

249,000

166,000

83,000

47 0782

K-E
10 X 10 TO THE NORTH
KEUFFEL & ESSER CO. NEW YORK, N.Y.

Buck Peak-Niagara
MCF

350,000

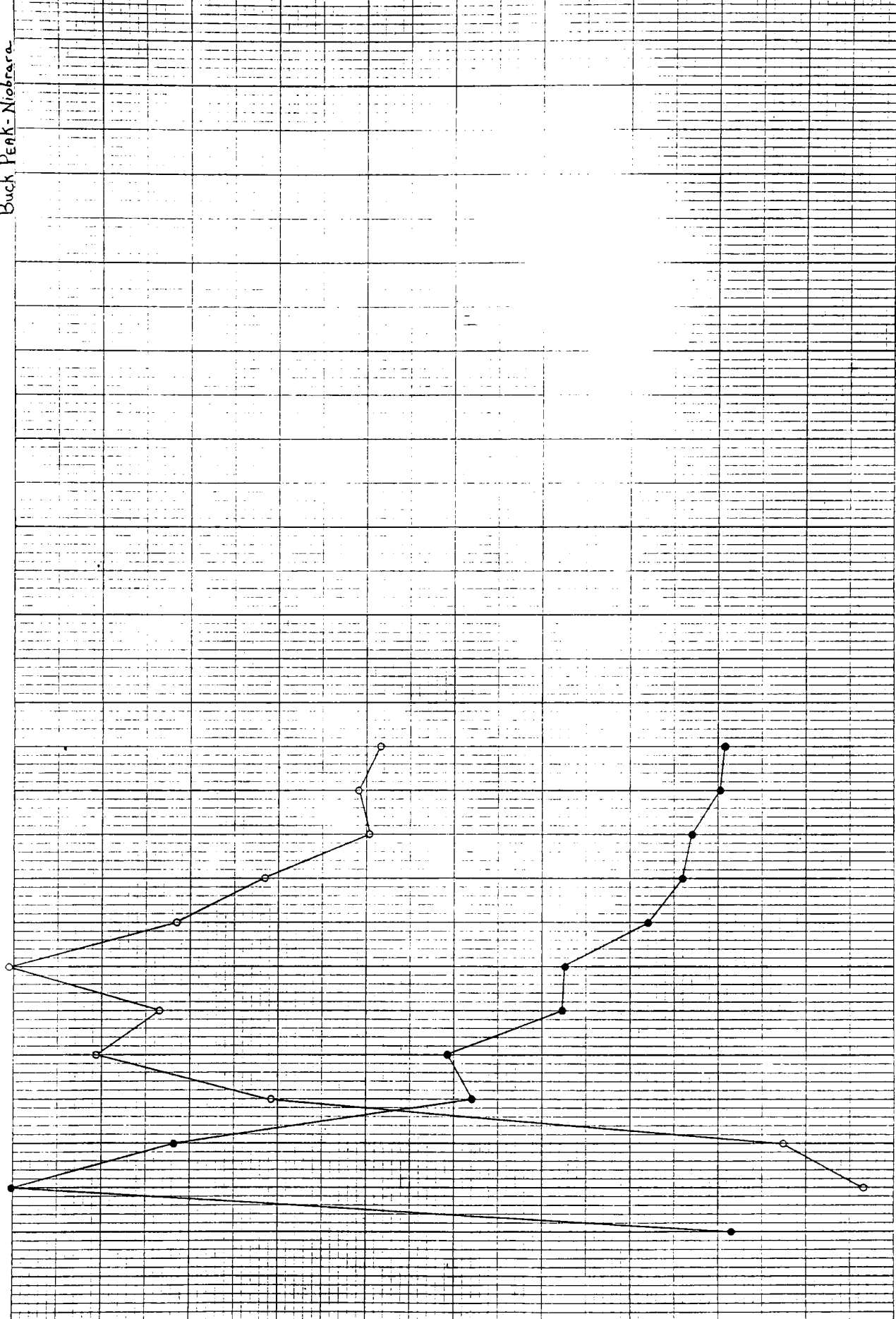
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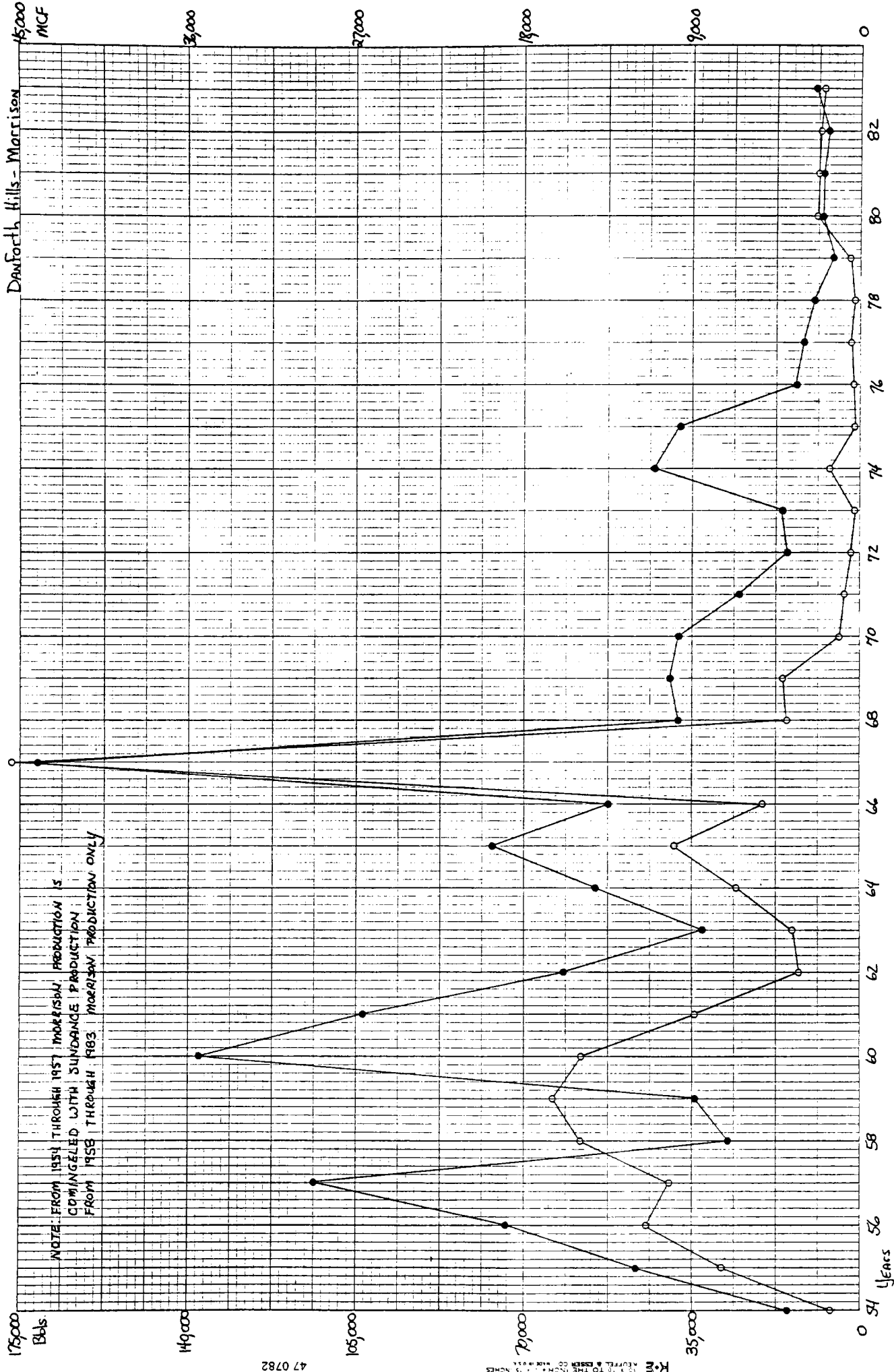
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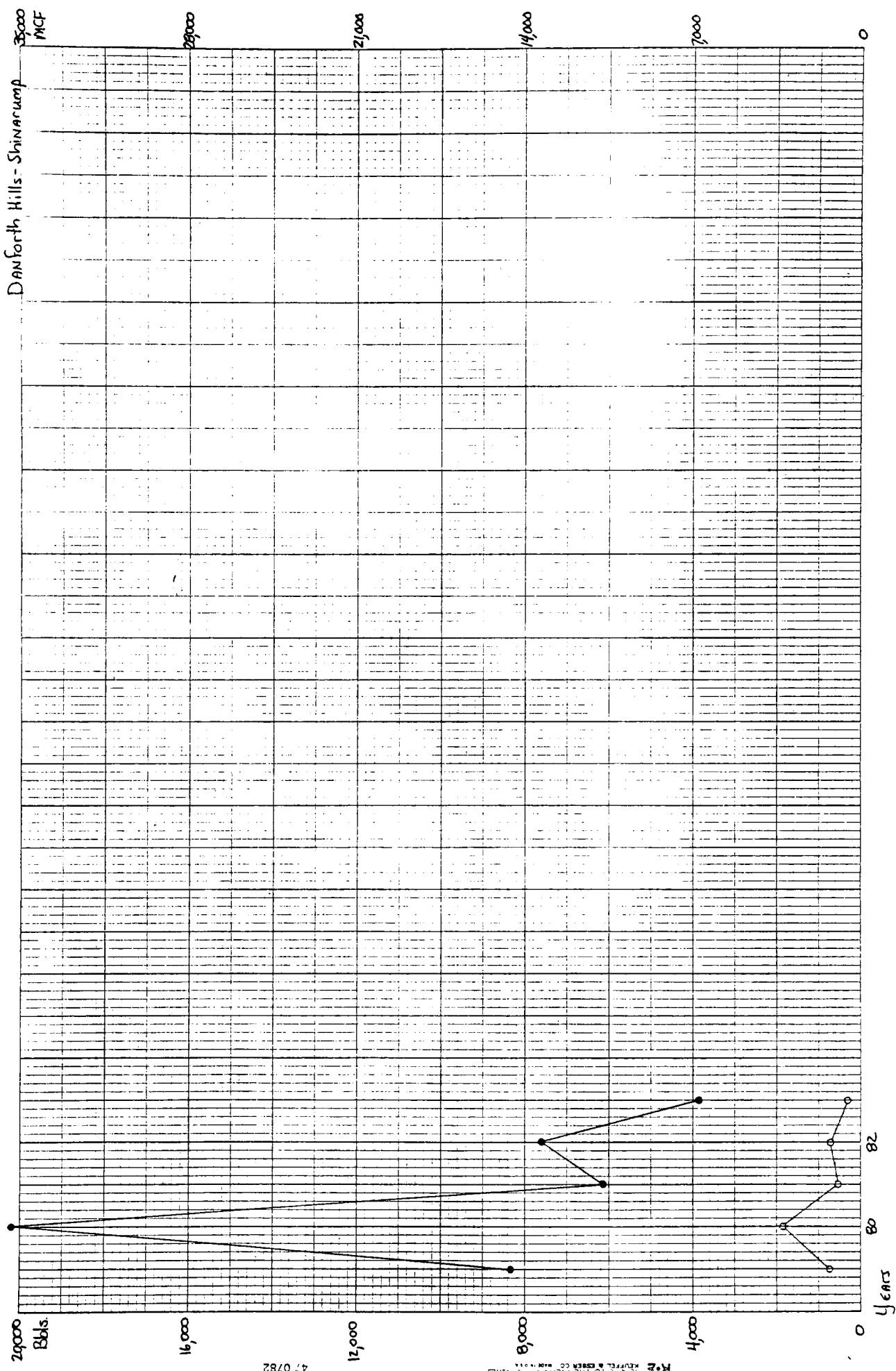
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70,000

Years
72 74 76 78 80 82





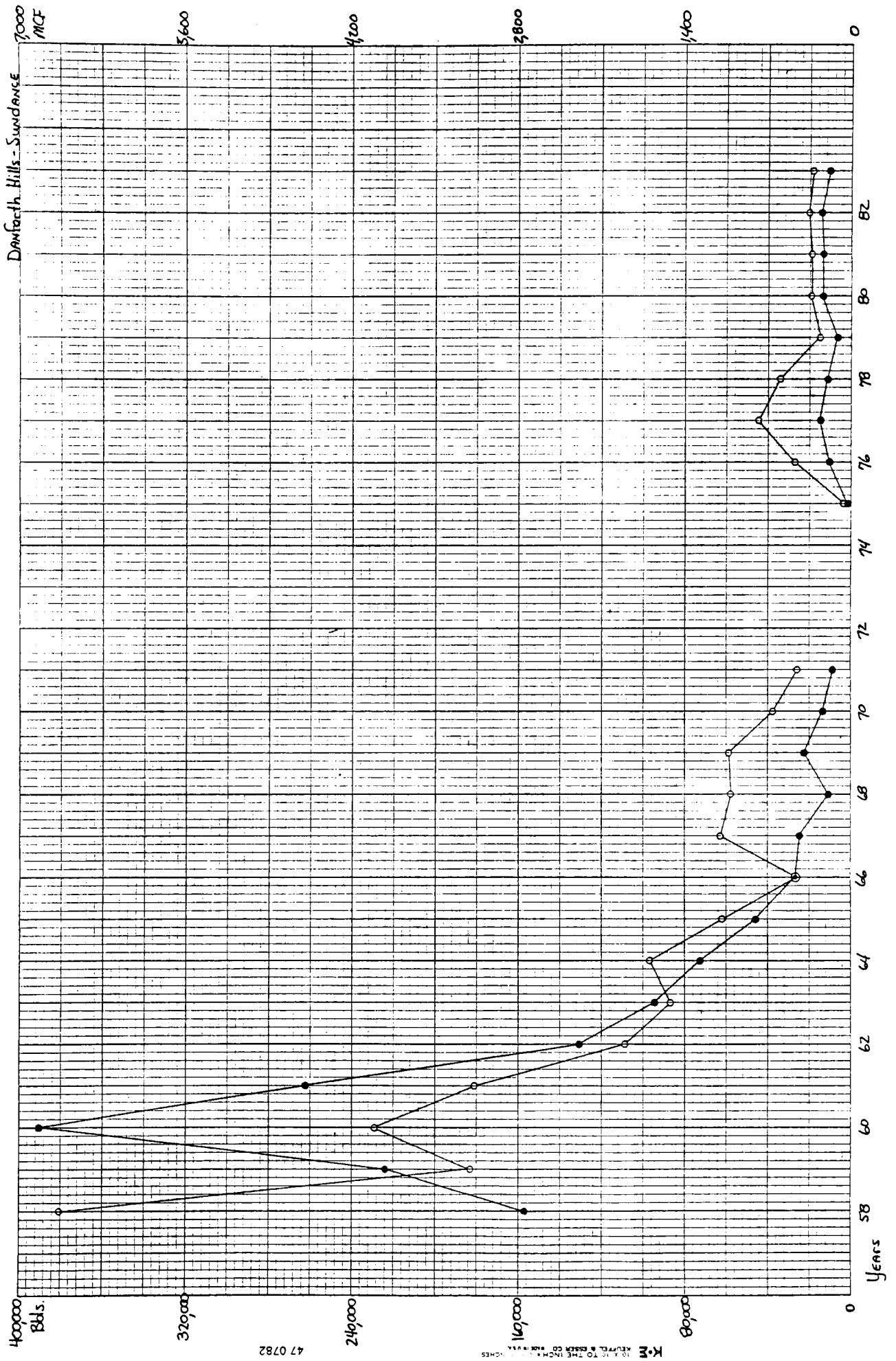


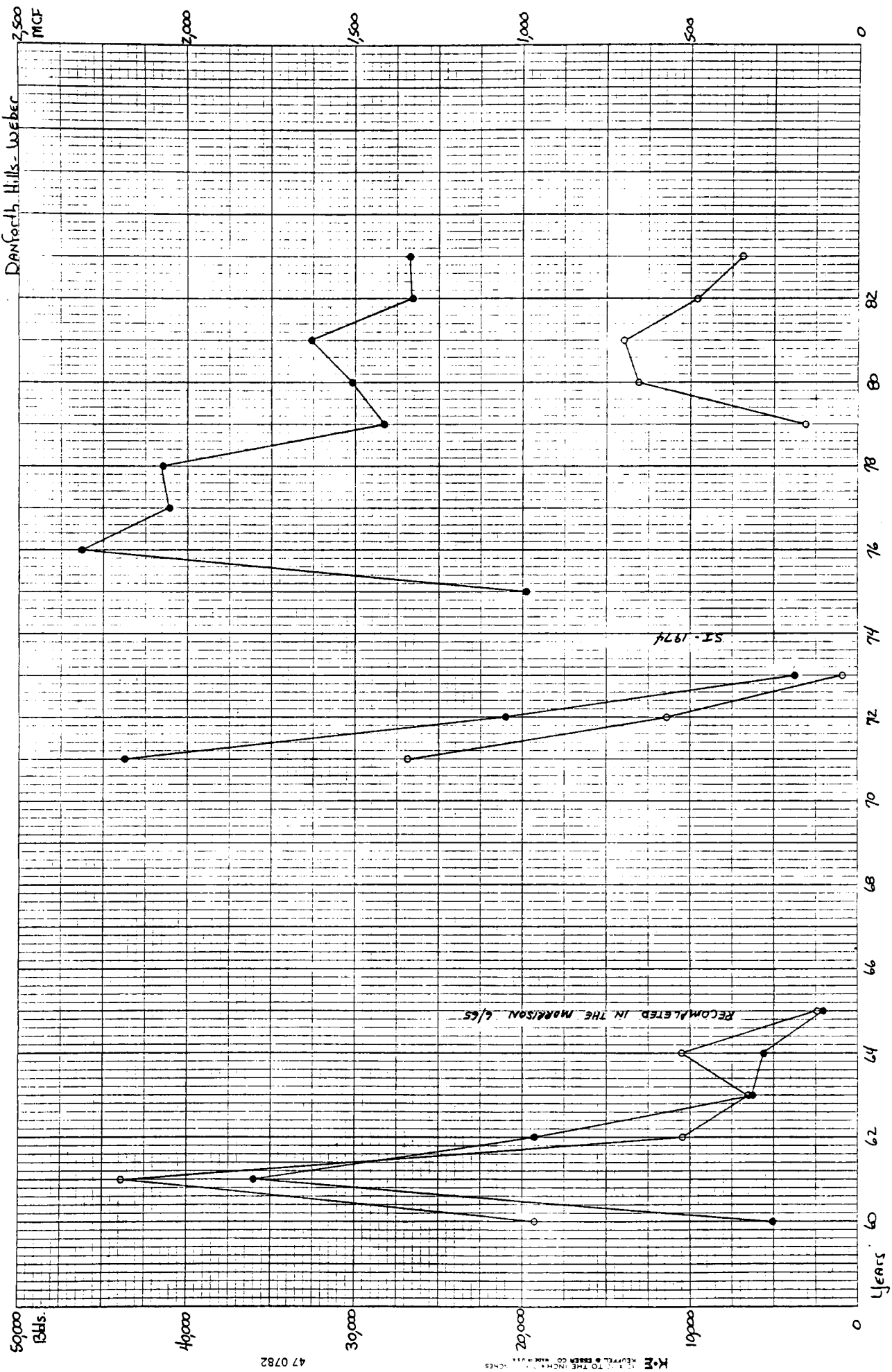
Danforth Hills - Shinarump

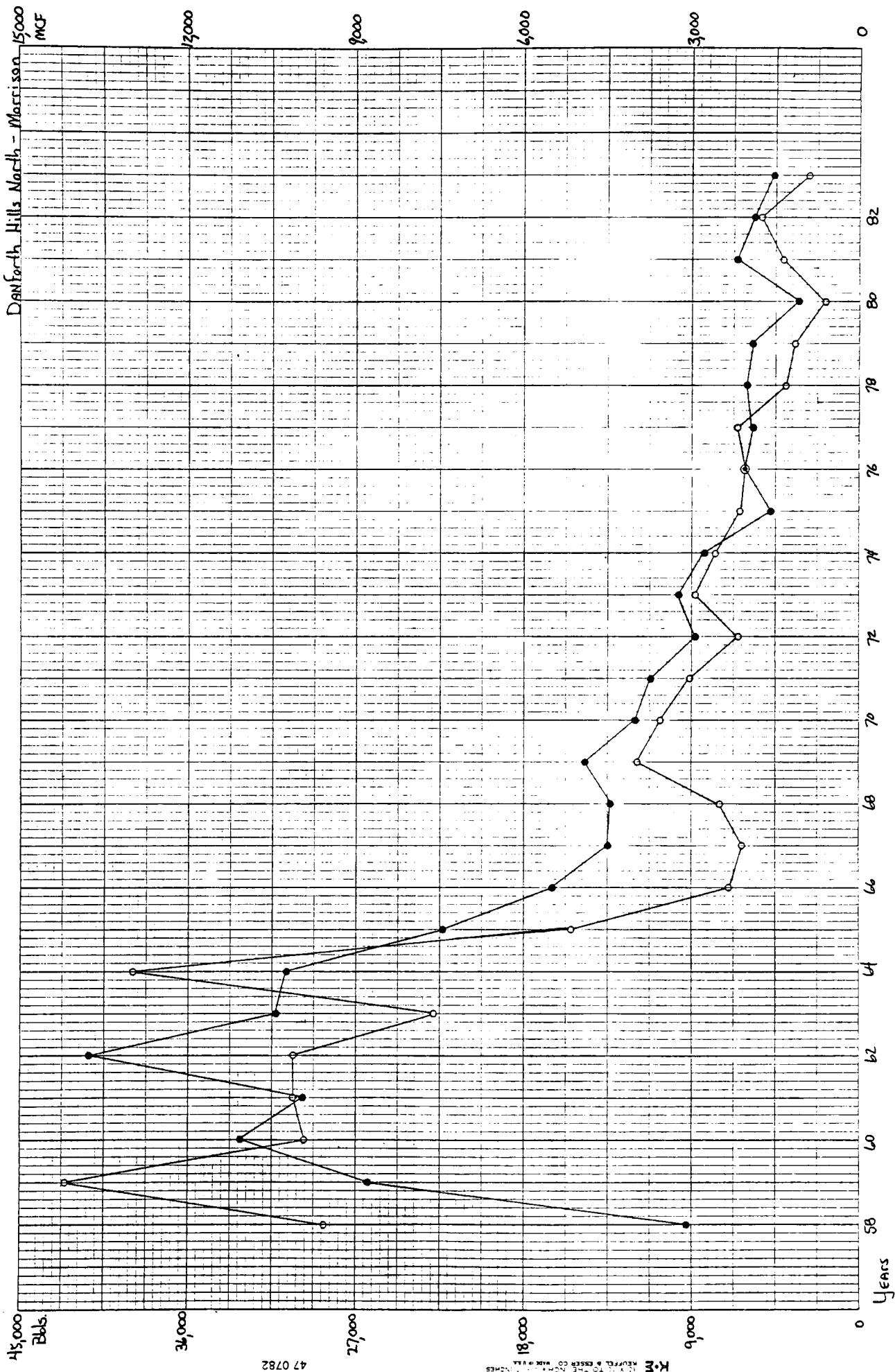
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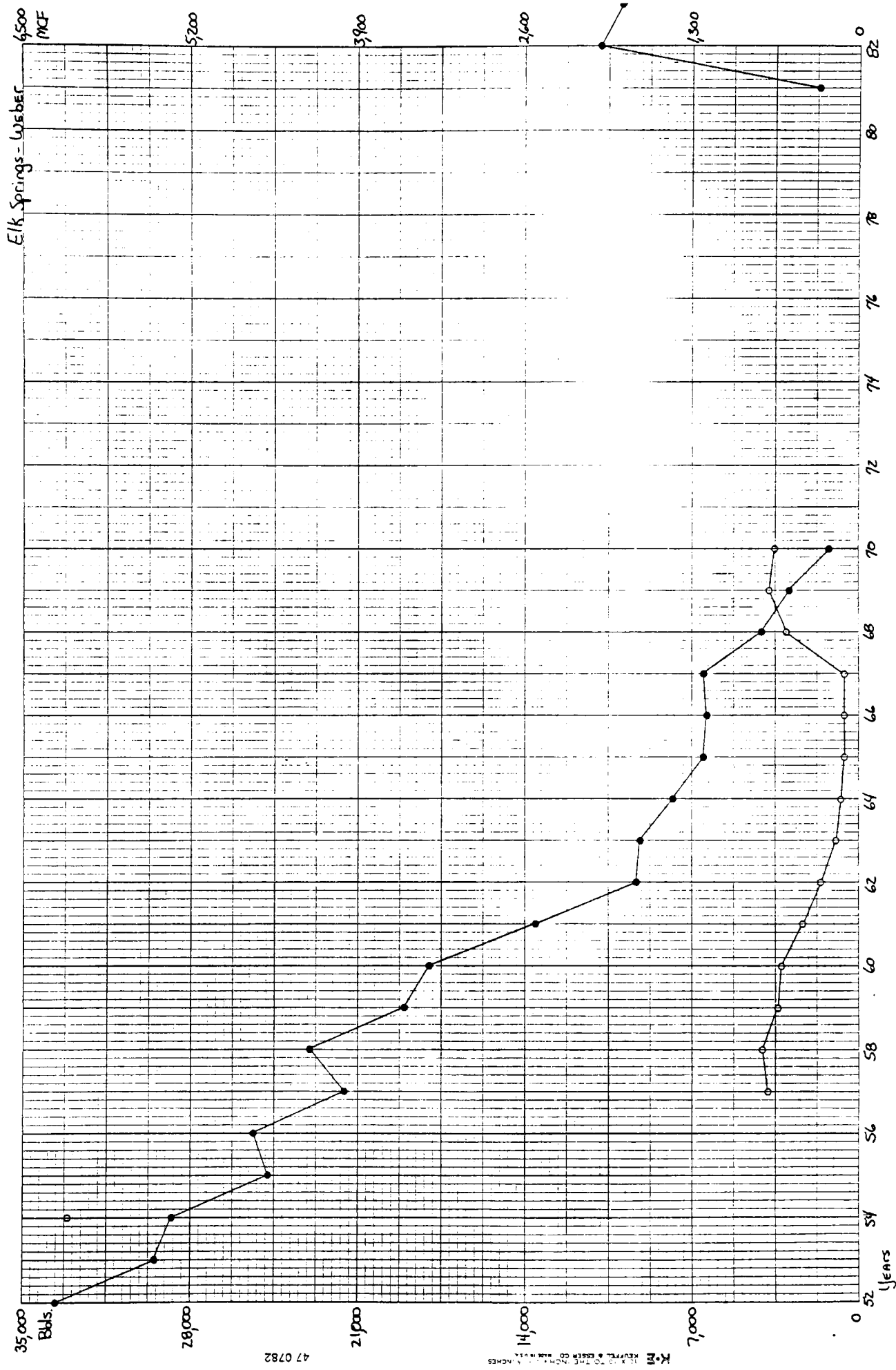
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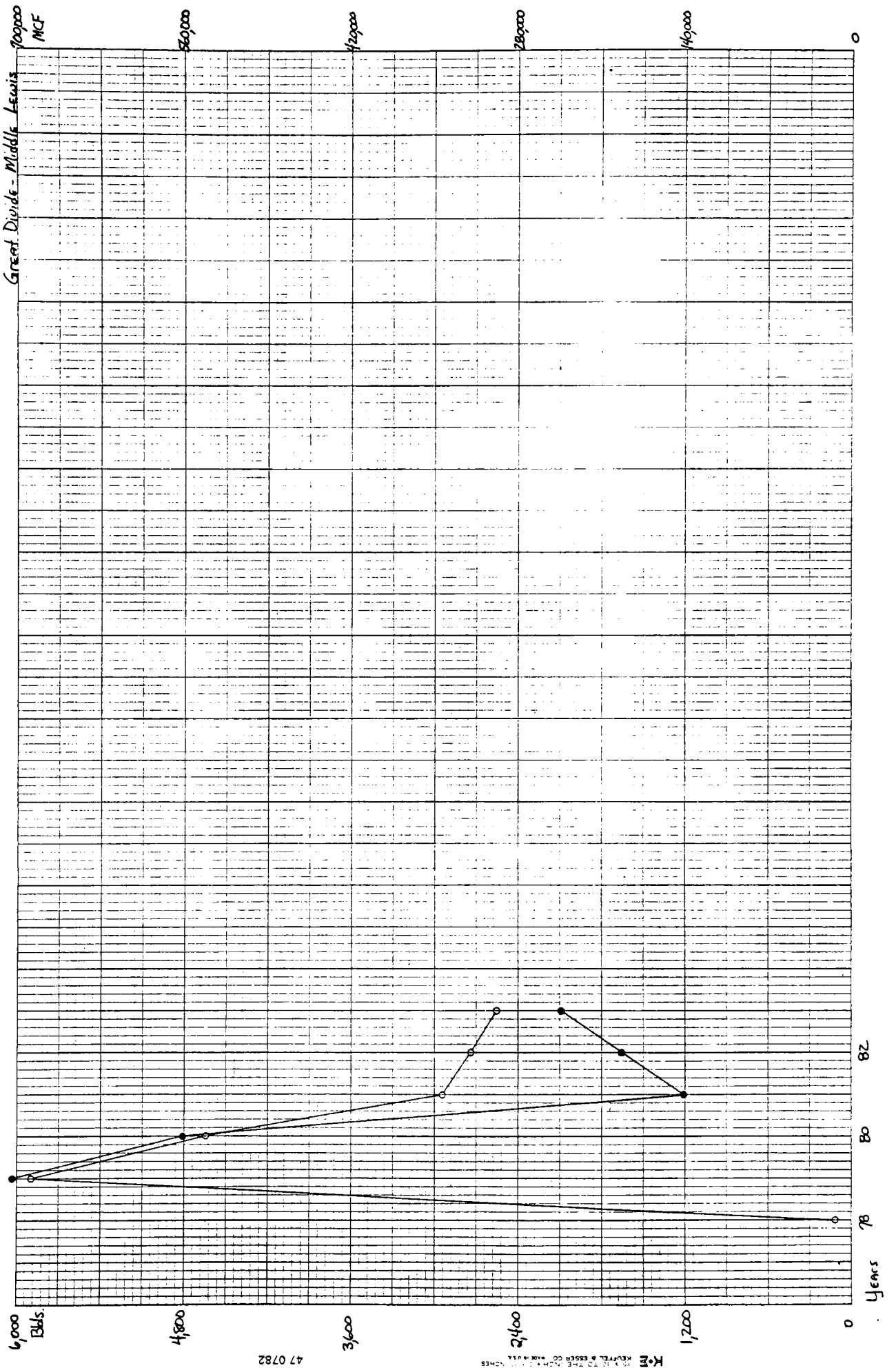
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KELFEL & CO. INC.
1000 N. 10TH ST. SALT LAKE CITY, UT 84143

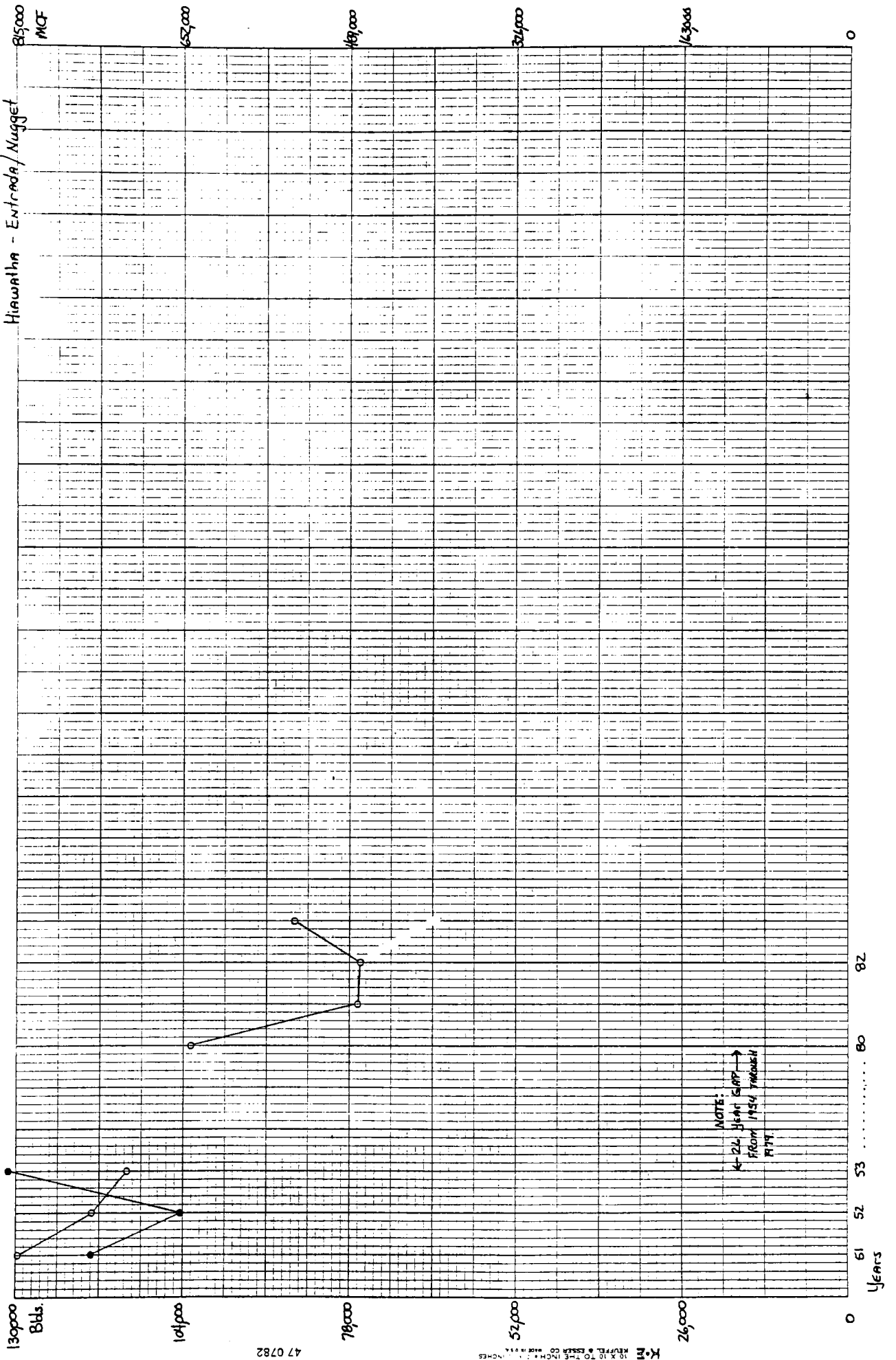


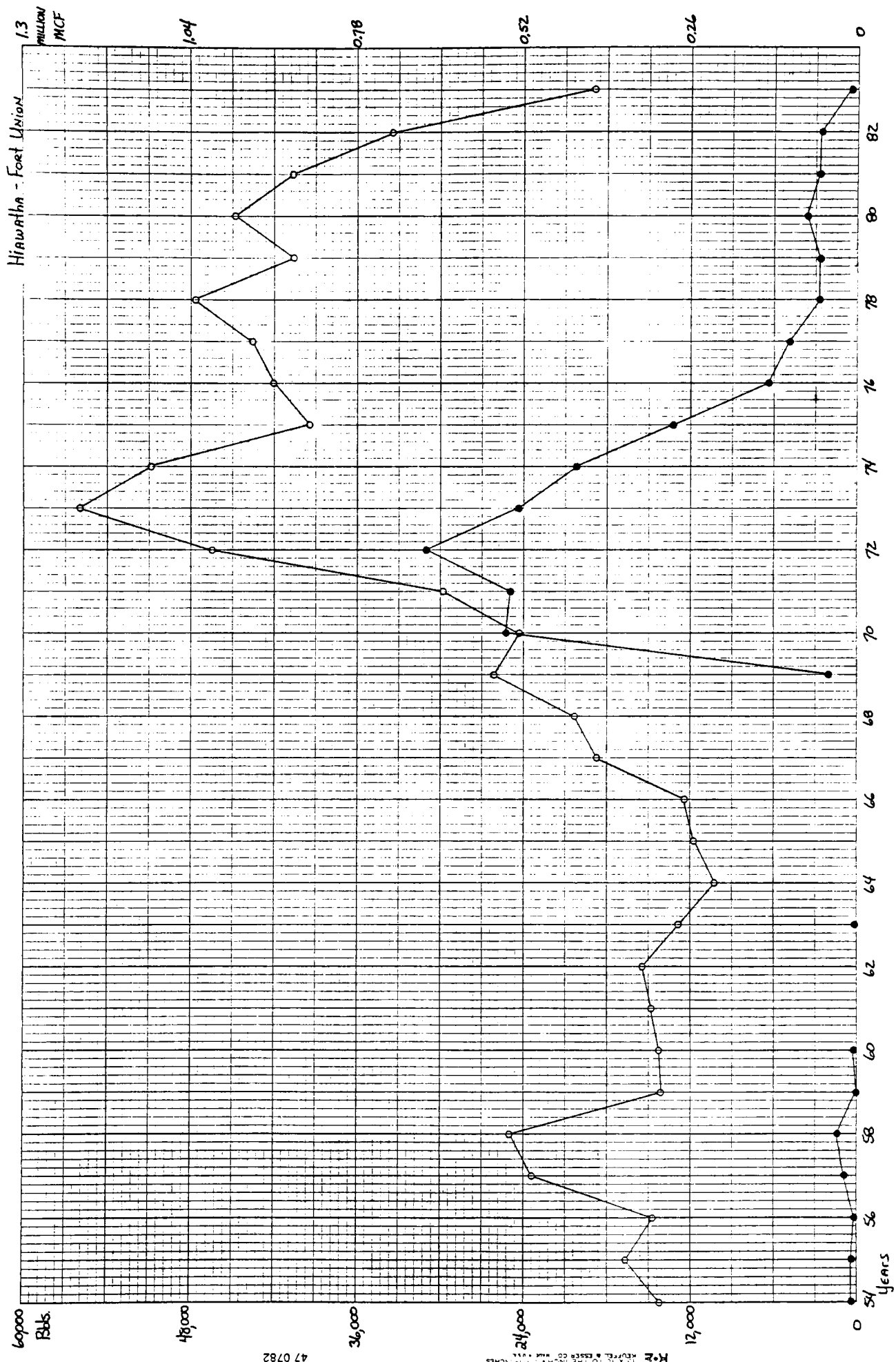


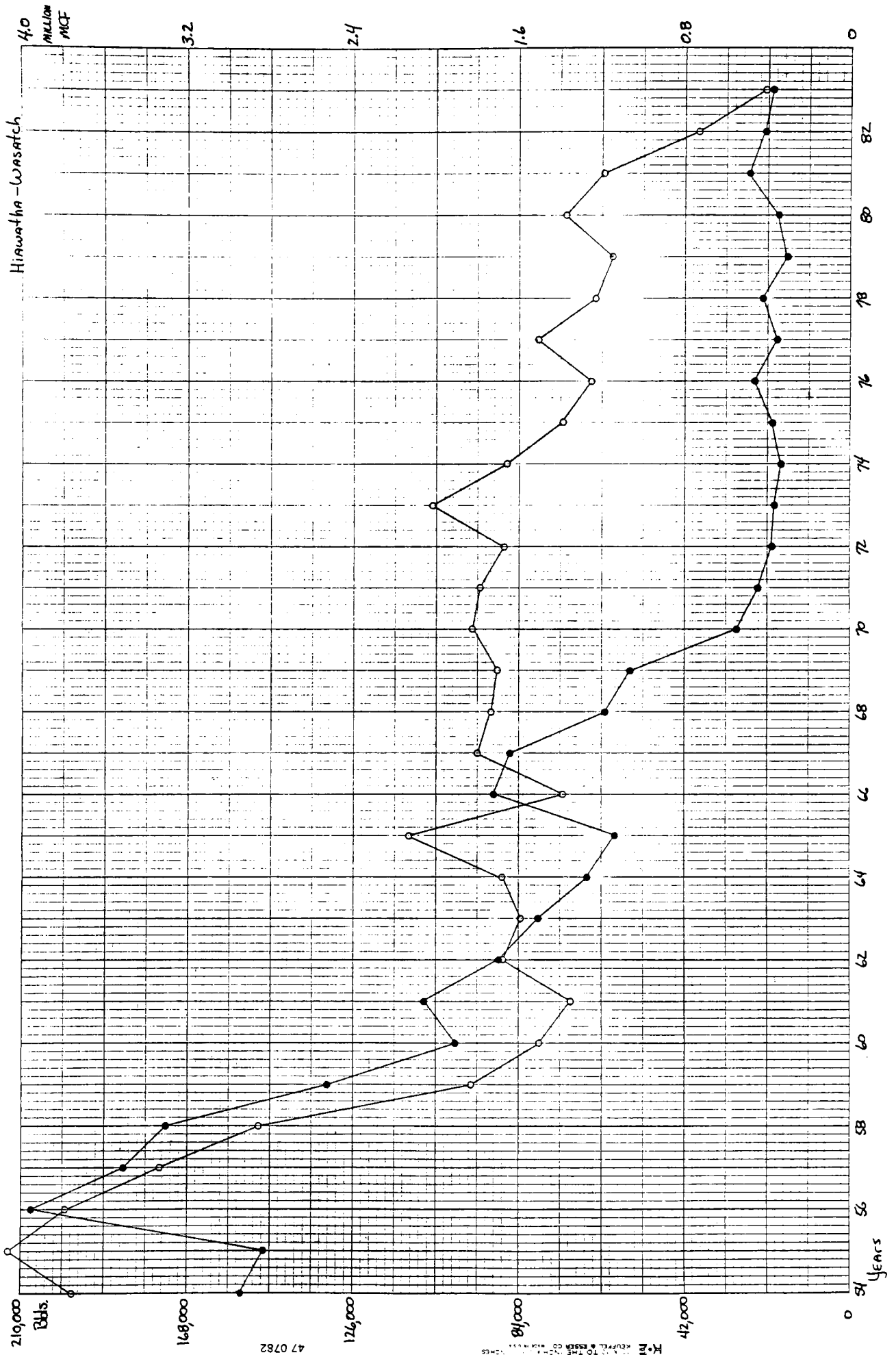


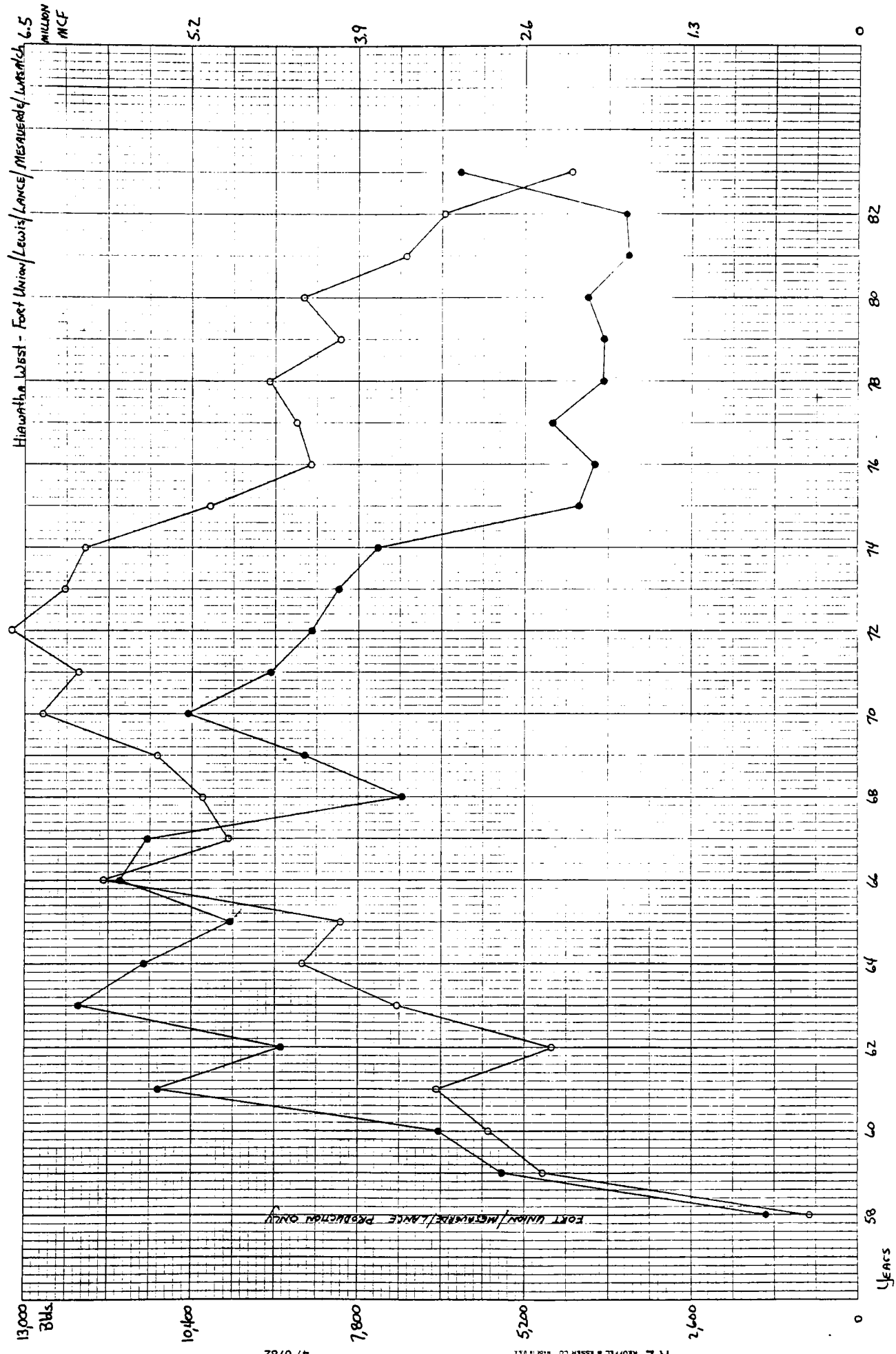








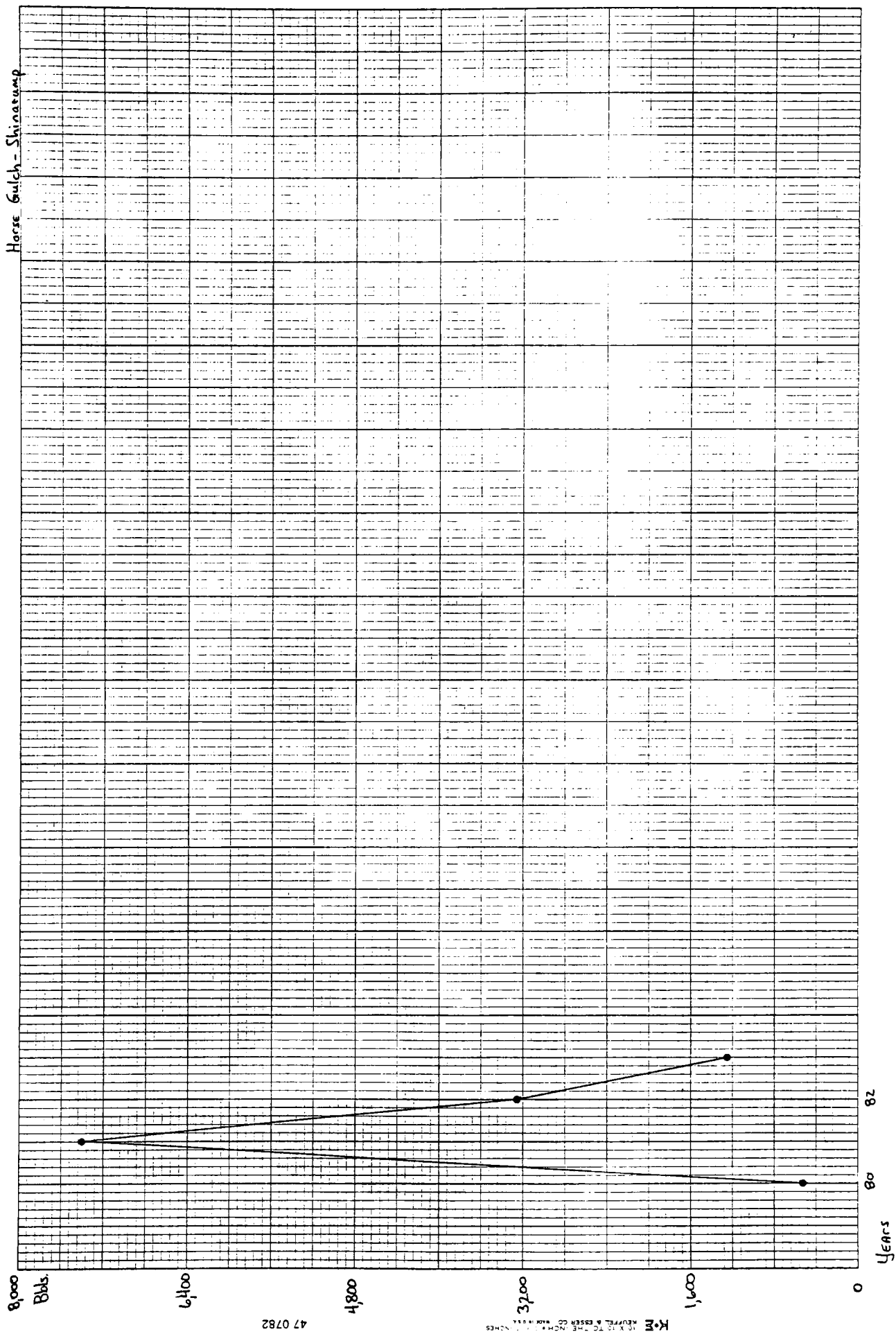




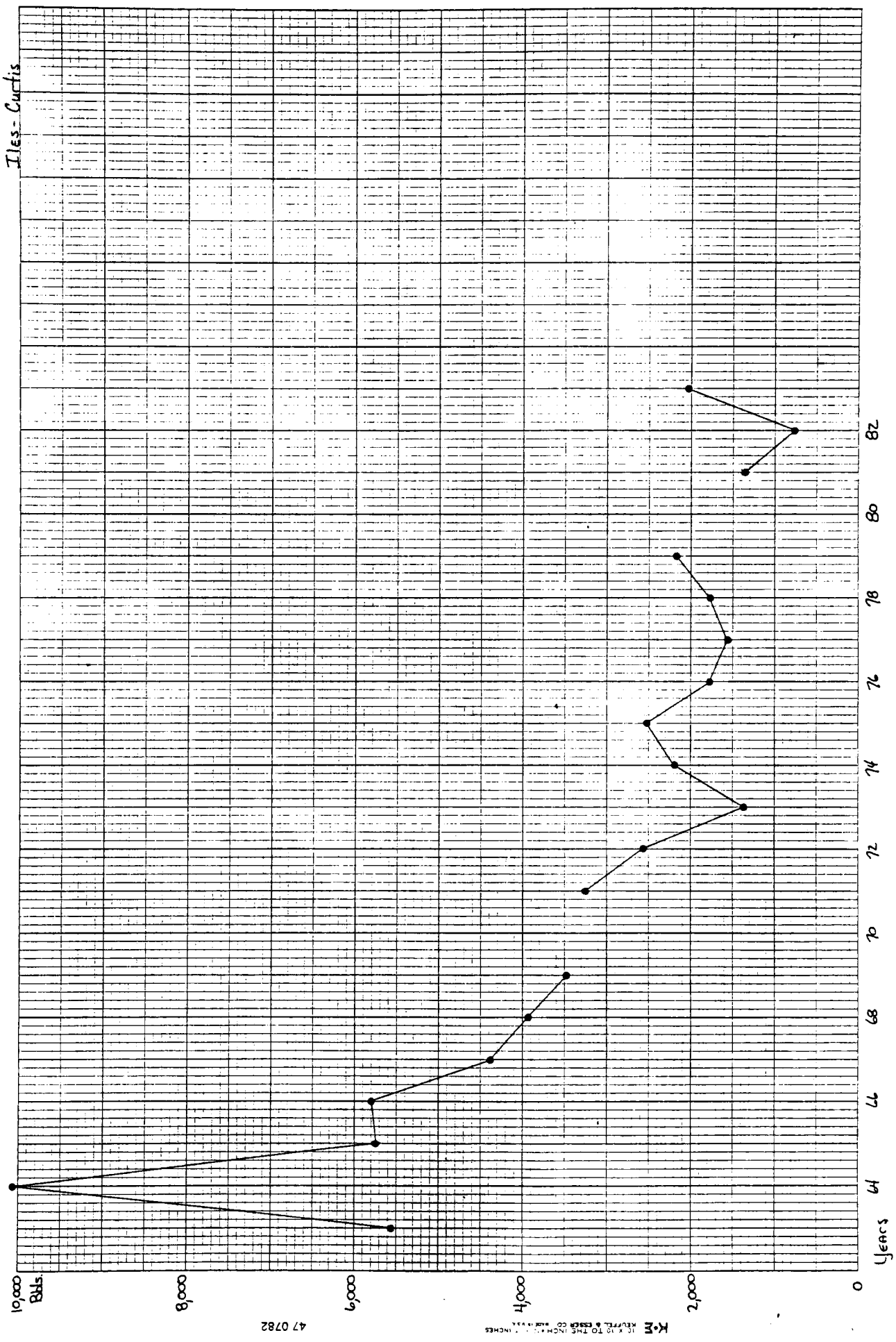
47 0782

K-E
10 X 10 TO THE INCH
REVISED & ESSER CO. MADE IN U.S.A.

Horse Gulch - Shinatump

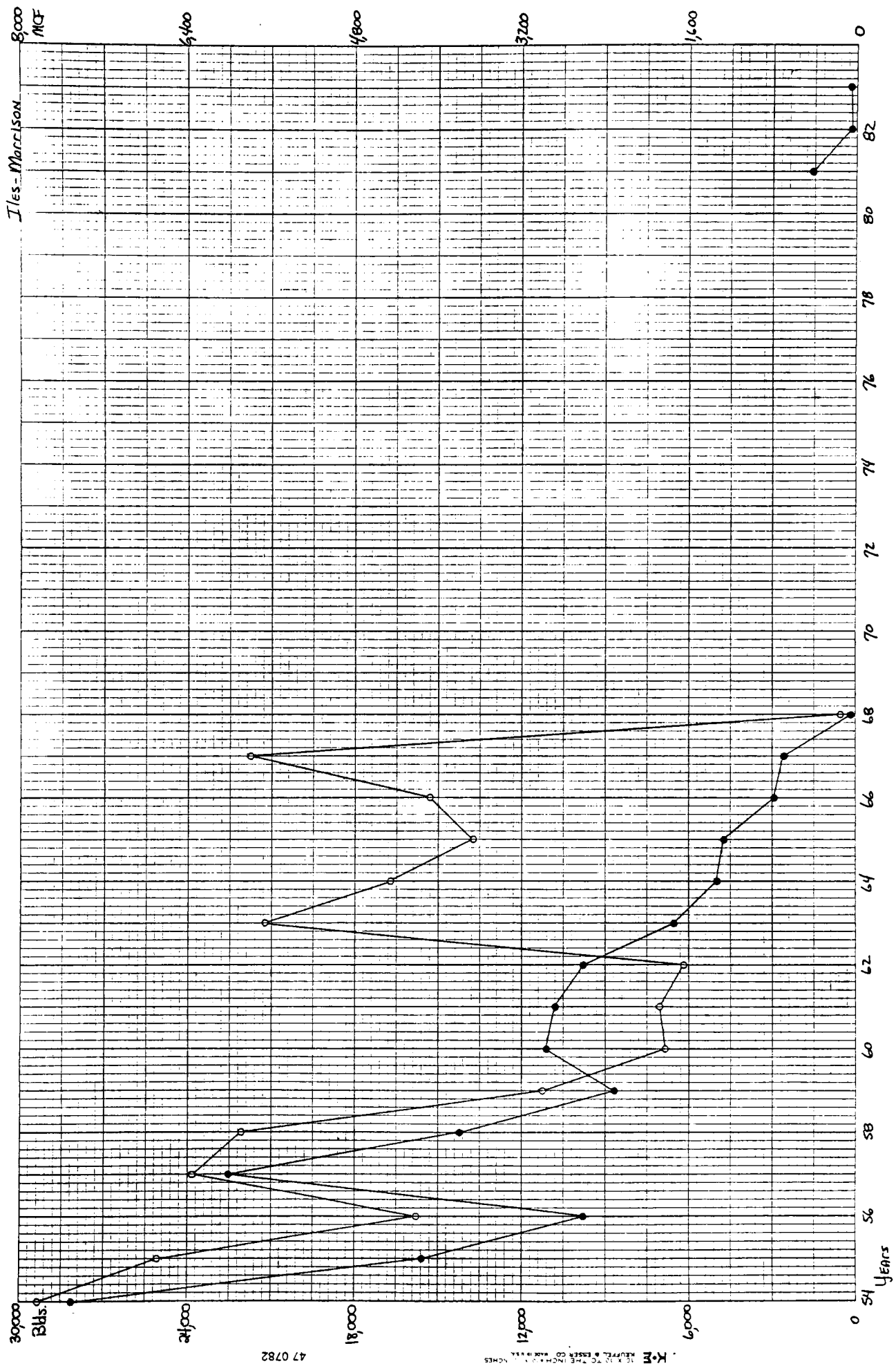


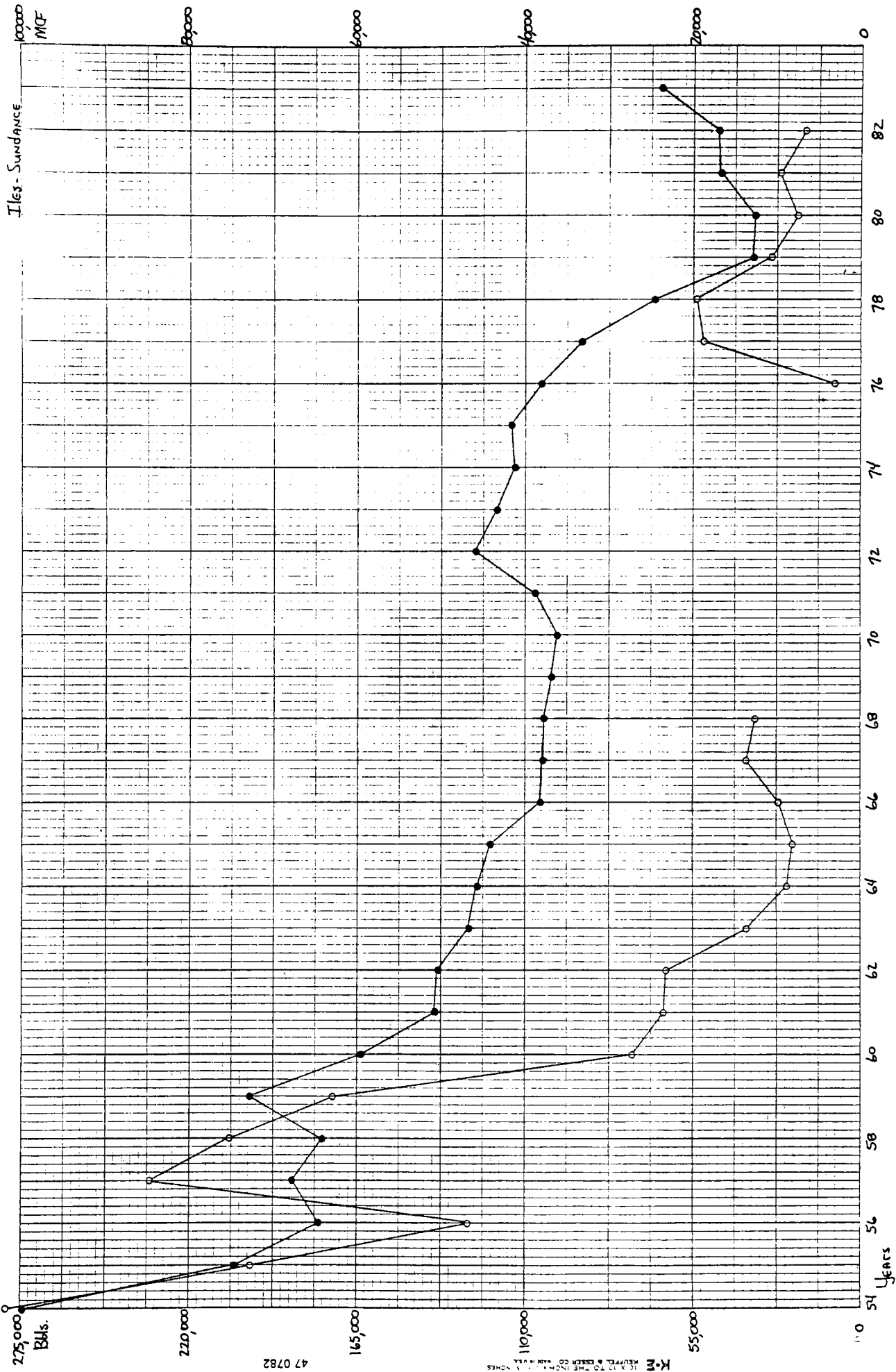
Iles - Curtis



47 0782

K.M
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KUPPEL & BUSH CO. MADE IN U.S.A.

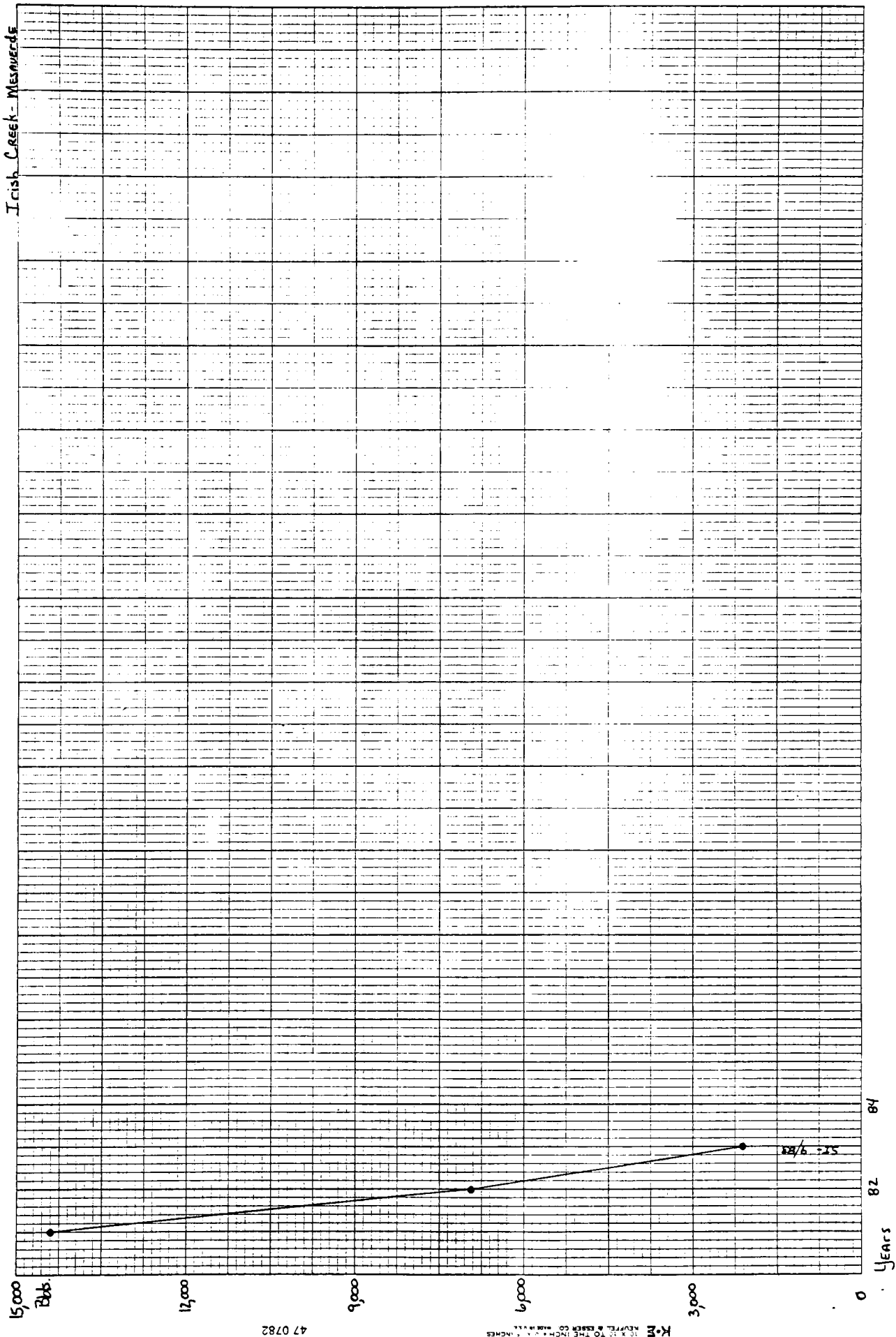




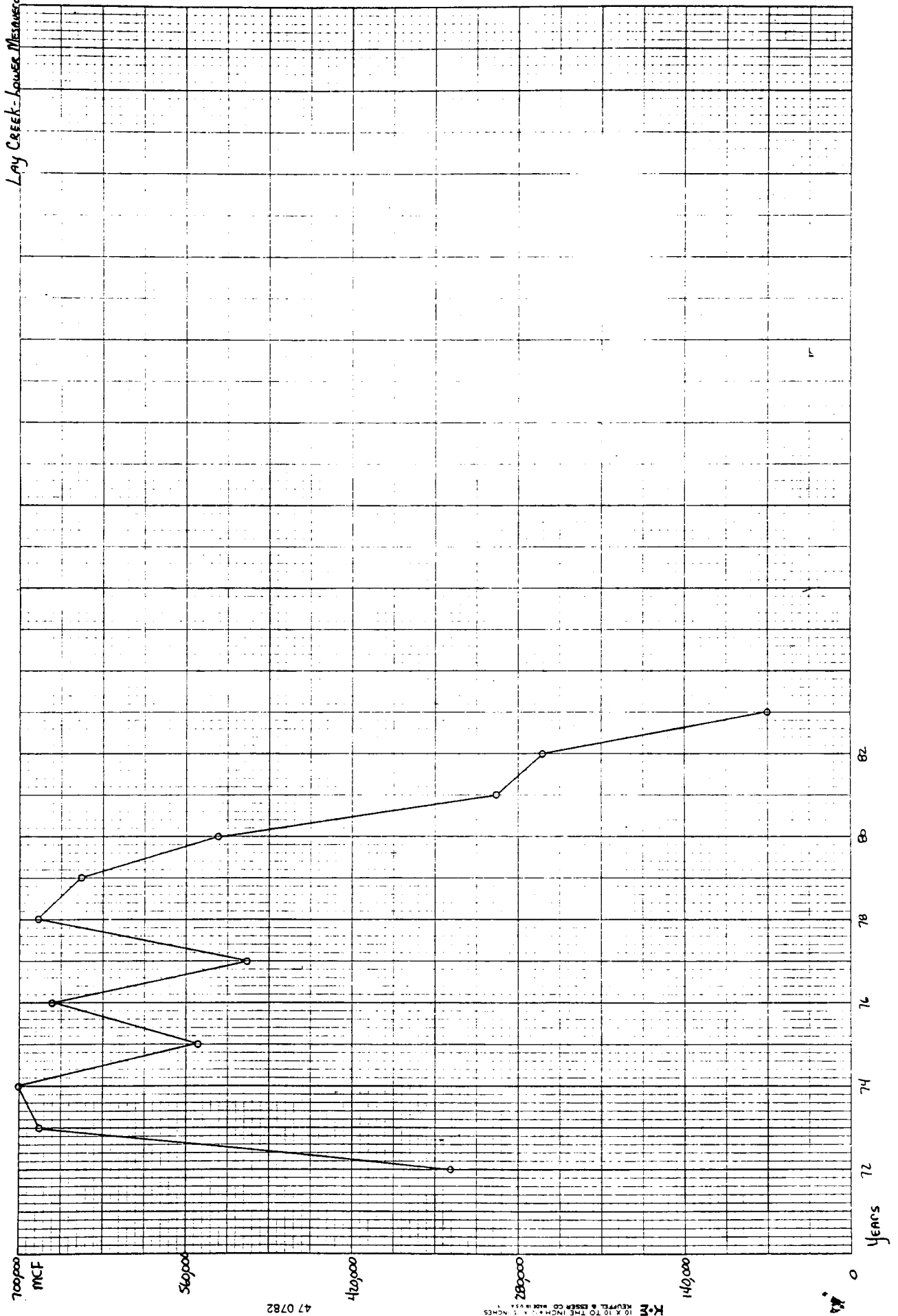
K-1
 10-12 TO THE INCHES
 REVERE & BAKER CO. MADE IN U.S.A.

47 0782

Irish Creek - Mesquite

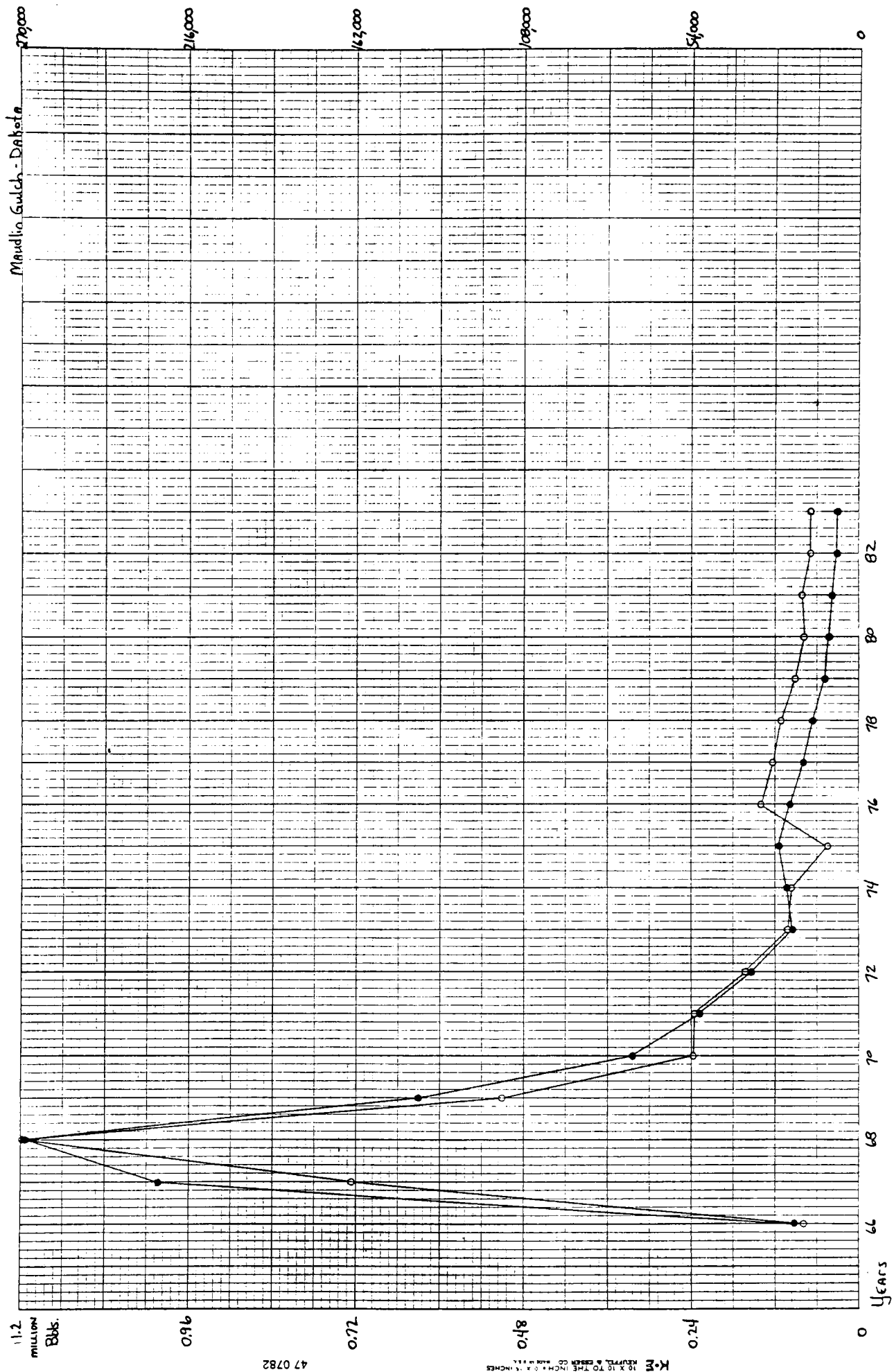


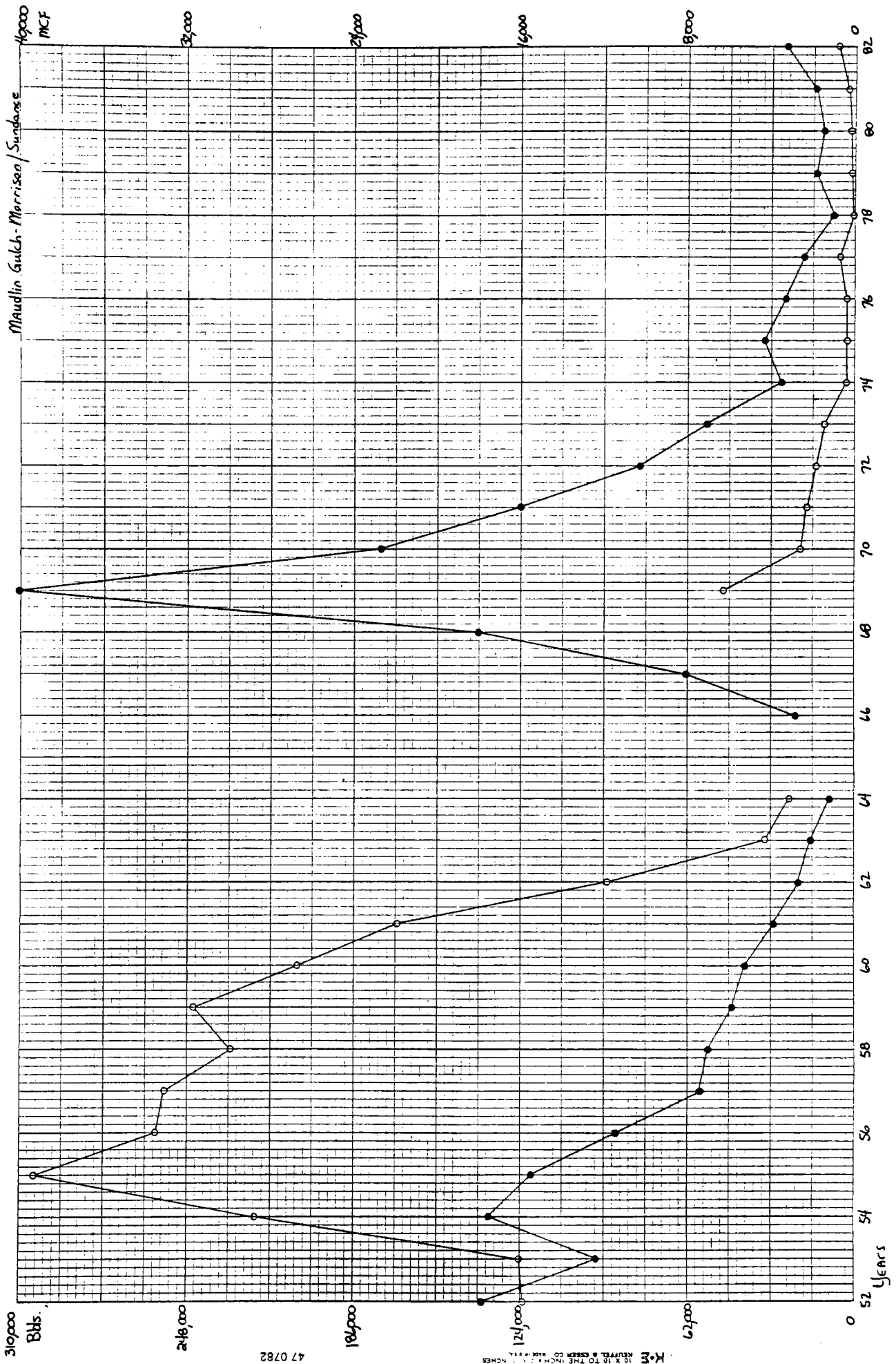
Lay Creek - Lower Mesquite



47 0782

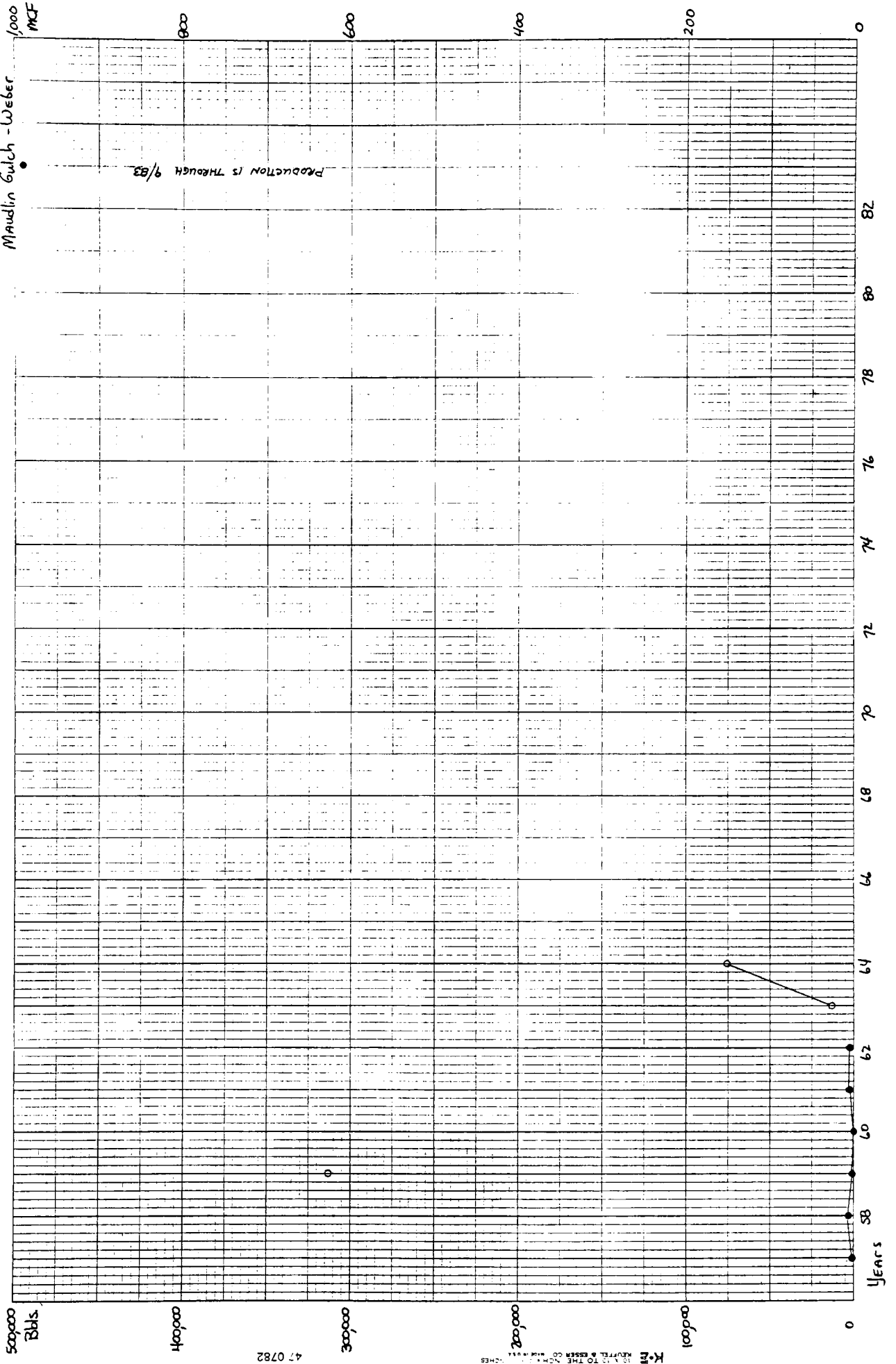
K-M
10 X 10 TO THE INCH
REUPPEL & BROS. CO. MADE IN U.S.A.

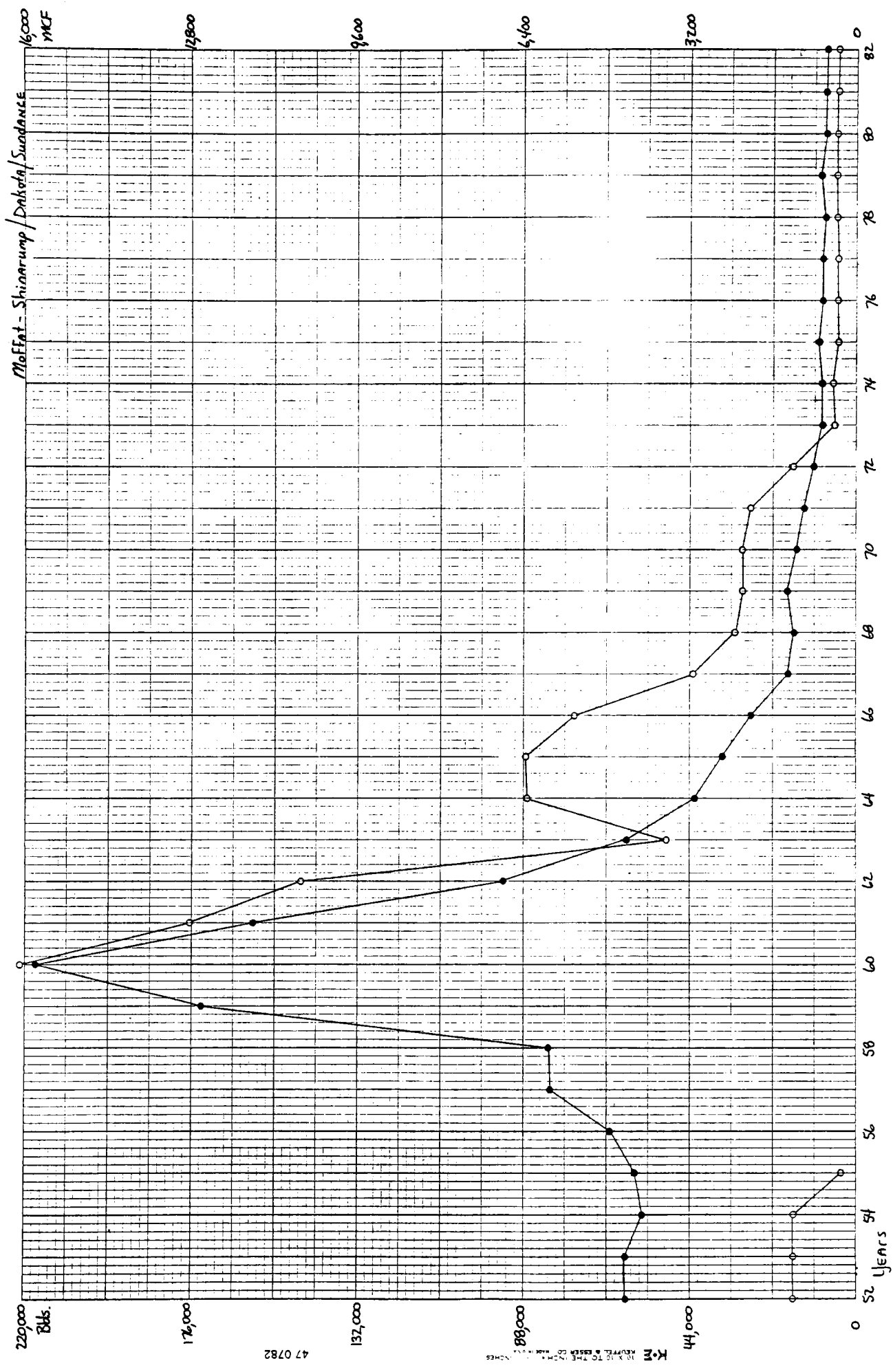


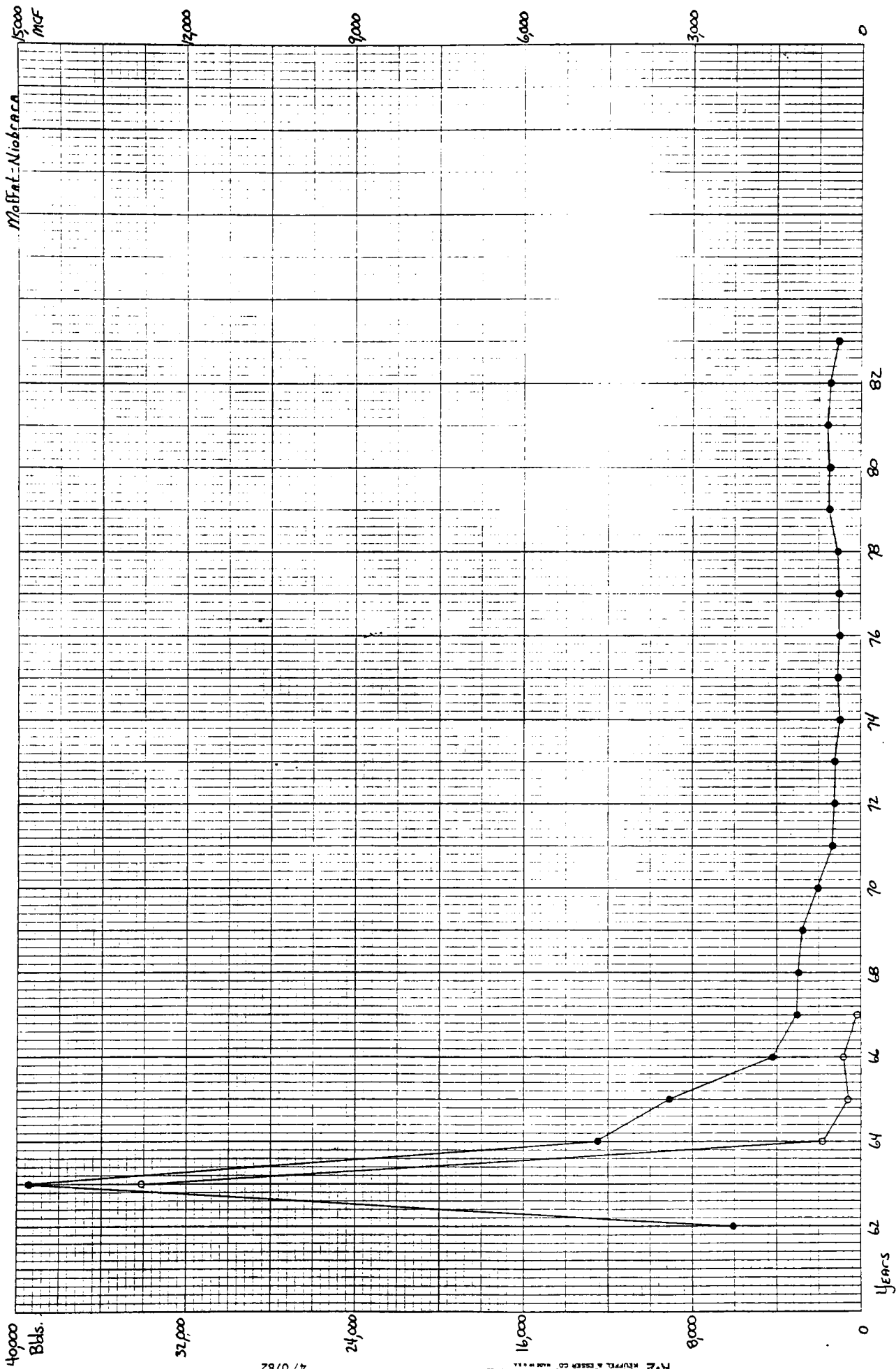


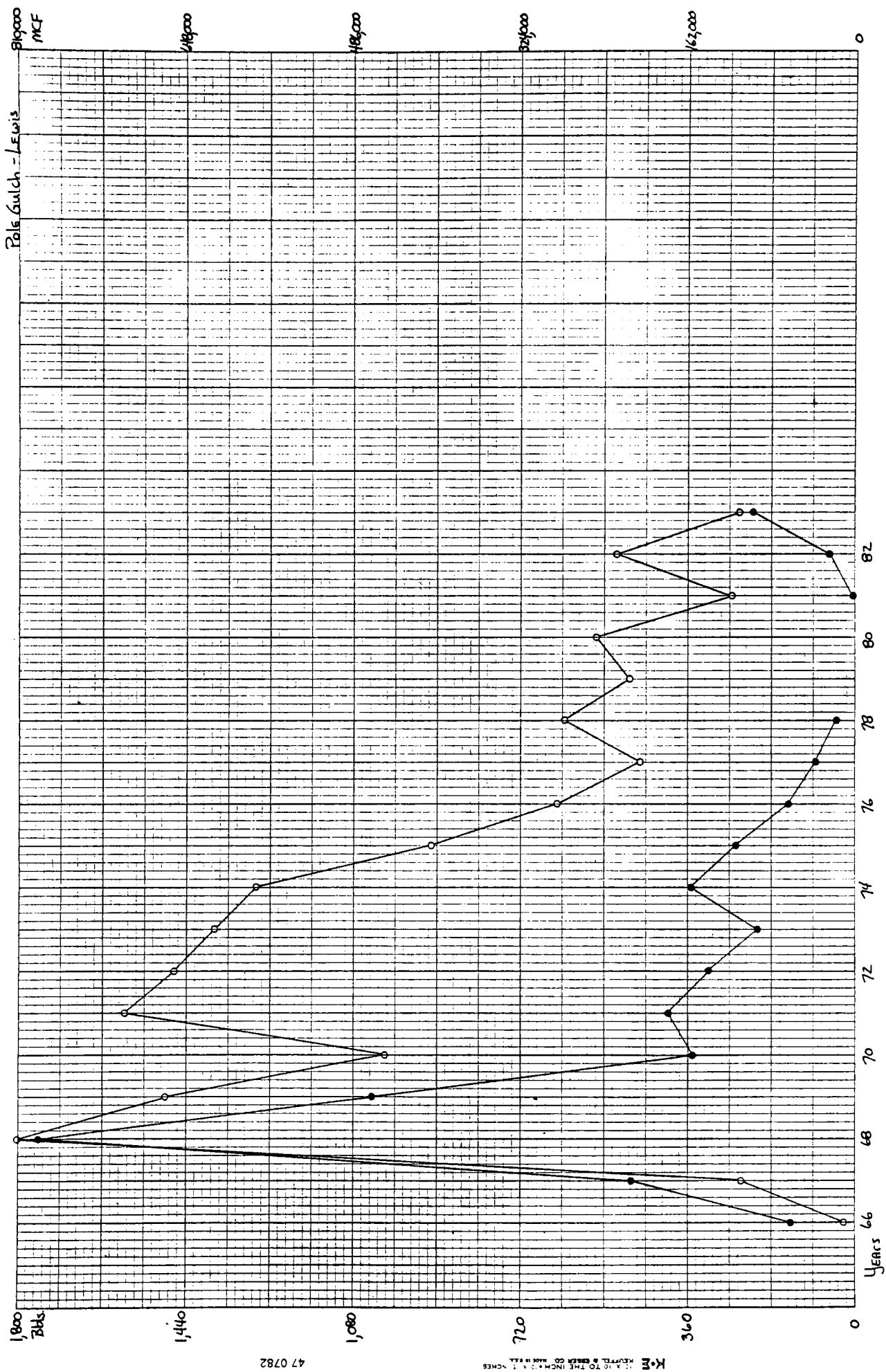
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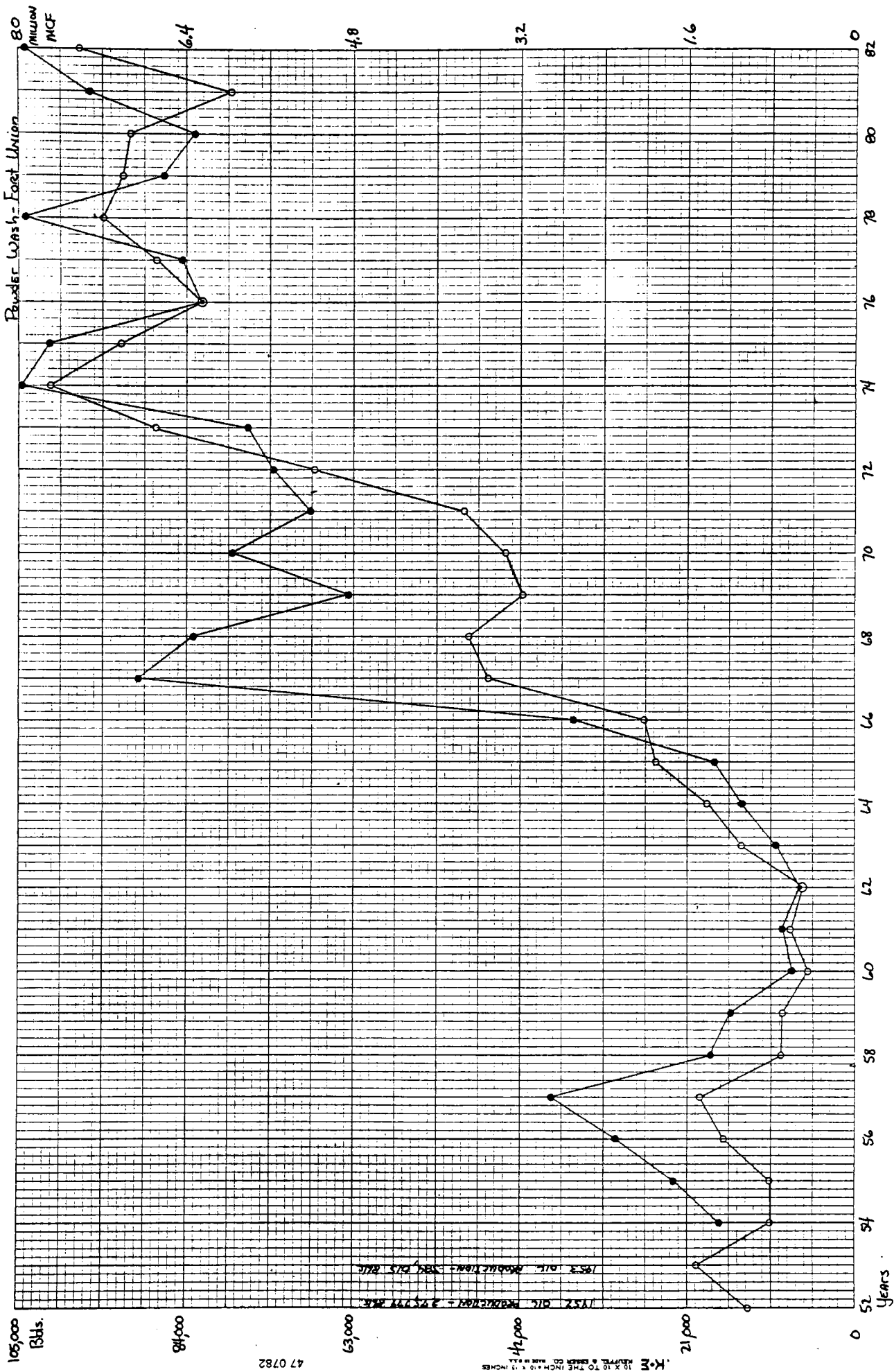
K.E. 10 X 10 TO THE INCHES

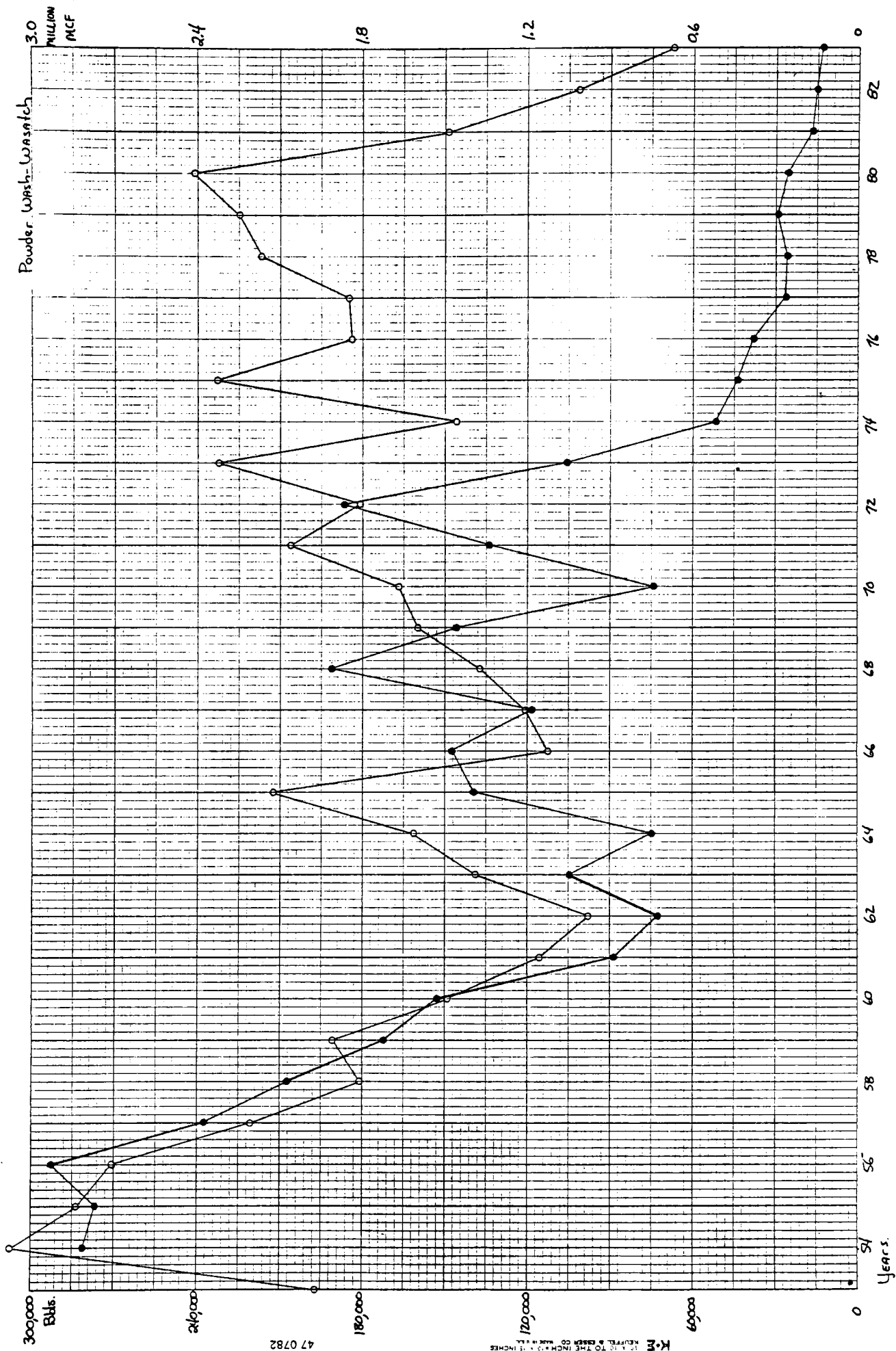












1.0
MILLION
MCF

Shell Creek - Nugget

0.8

0.6

0.4

0.2

0

1000
Bbls

800

600

400

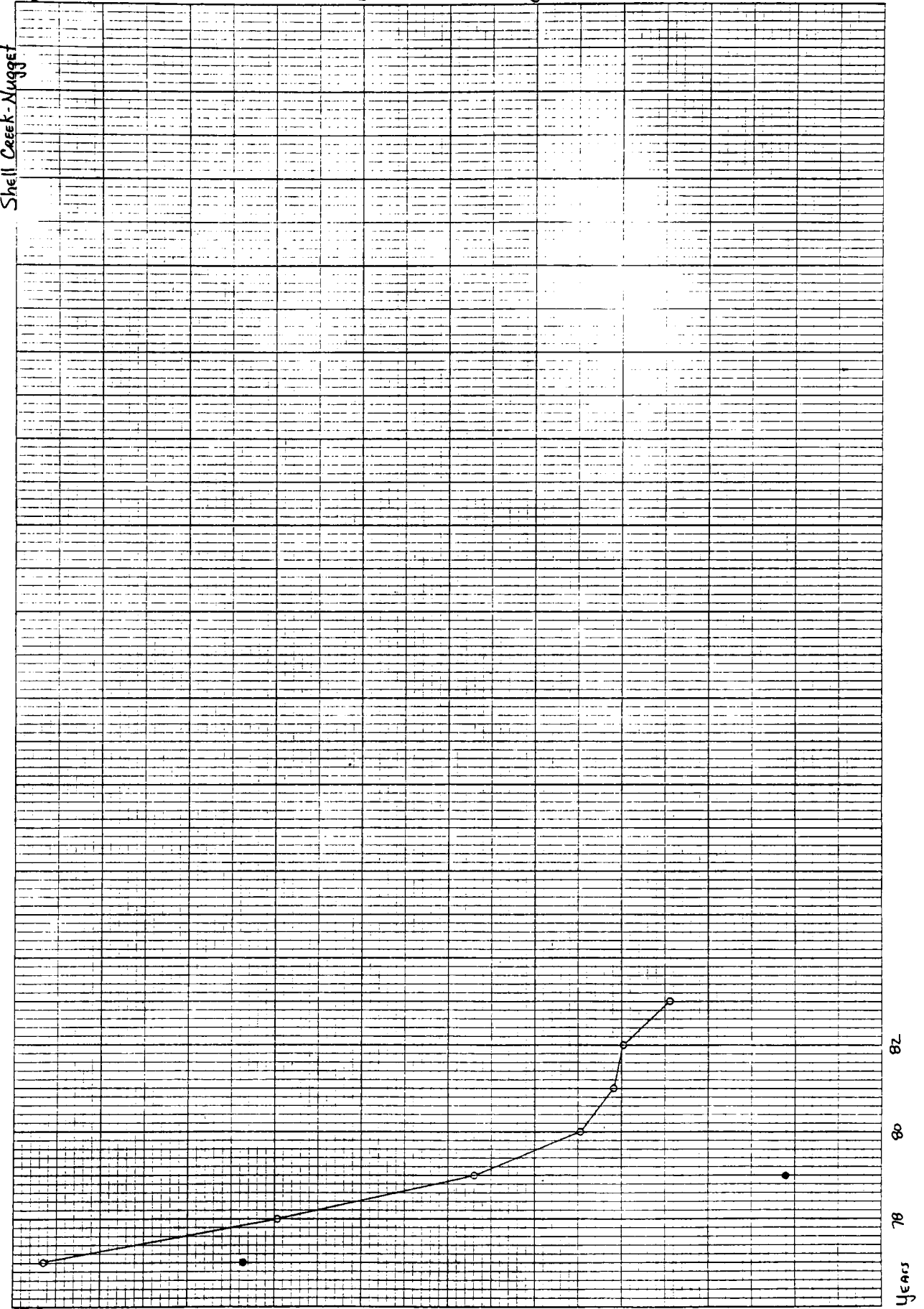
200

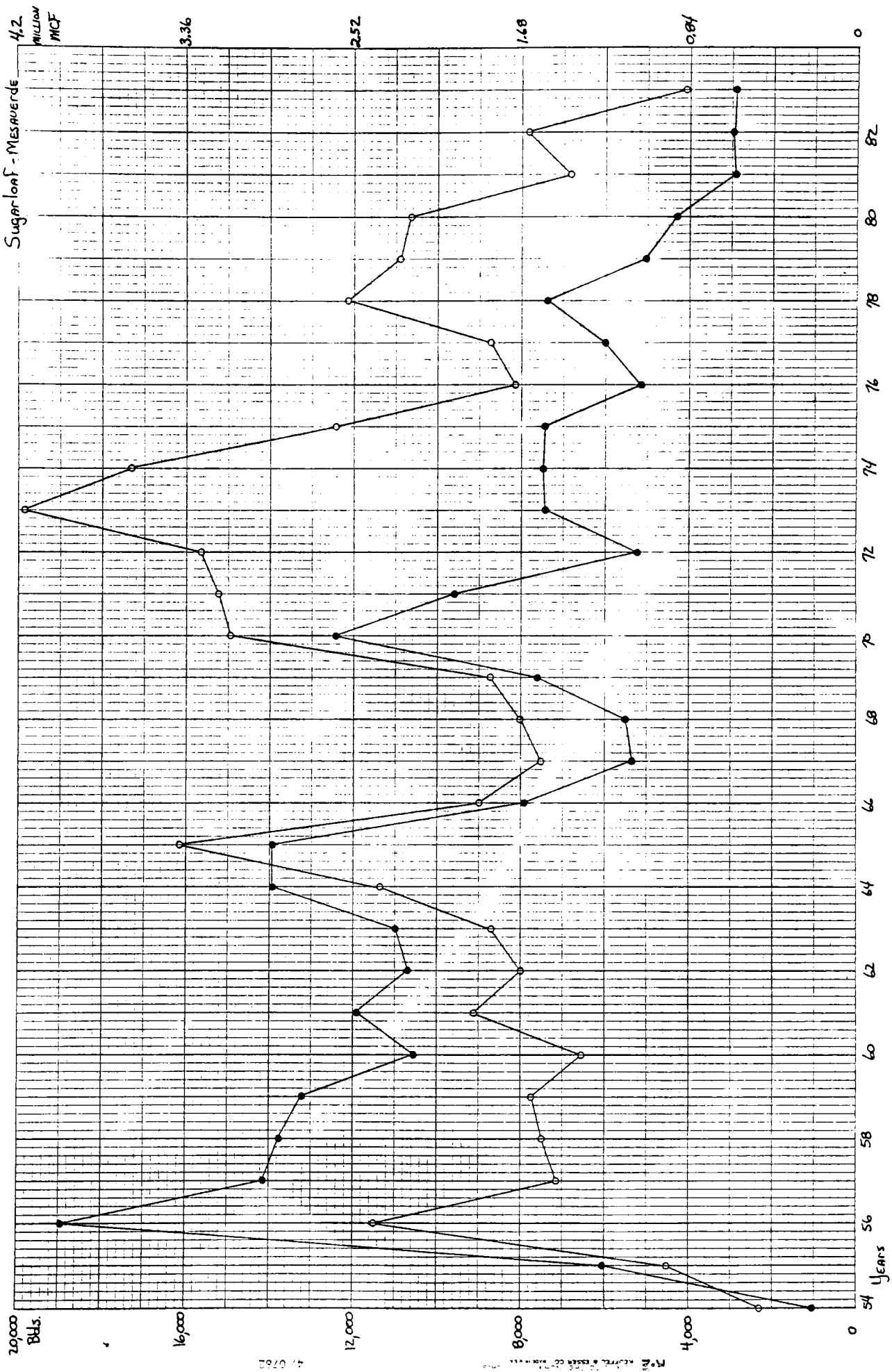
0

47 0782

K&E
K&E TO THE INCHES
K&E TO THE INCHES

Years
76 80 84





20,000
BBLs

16,000

12,000

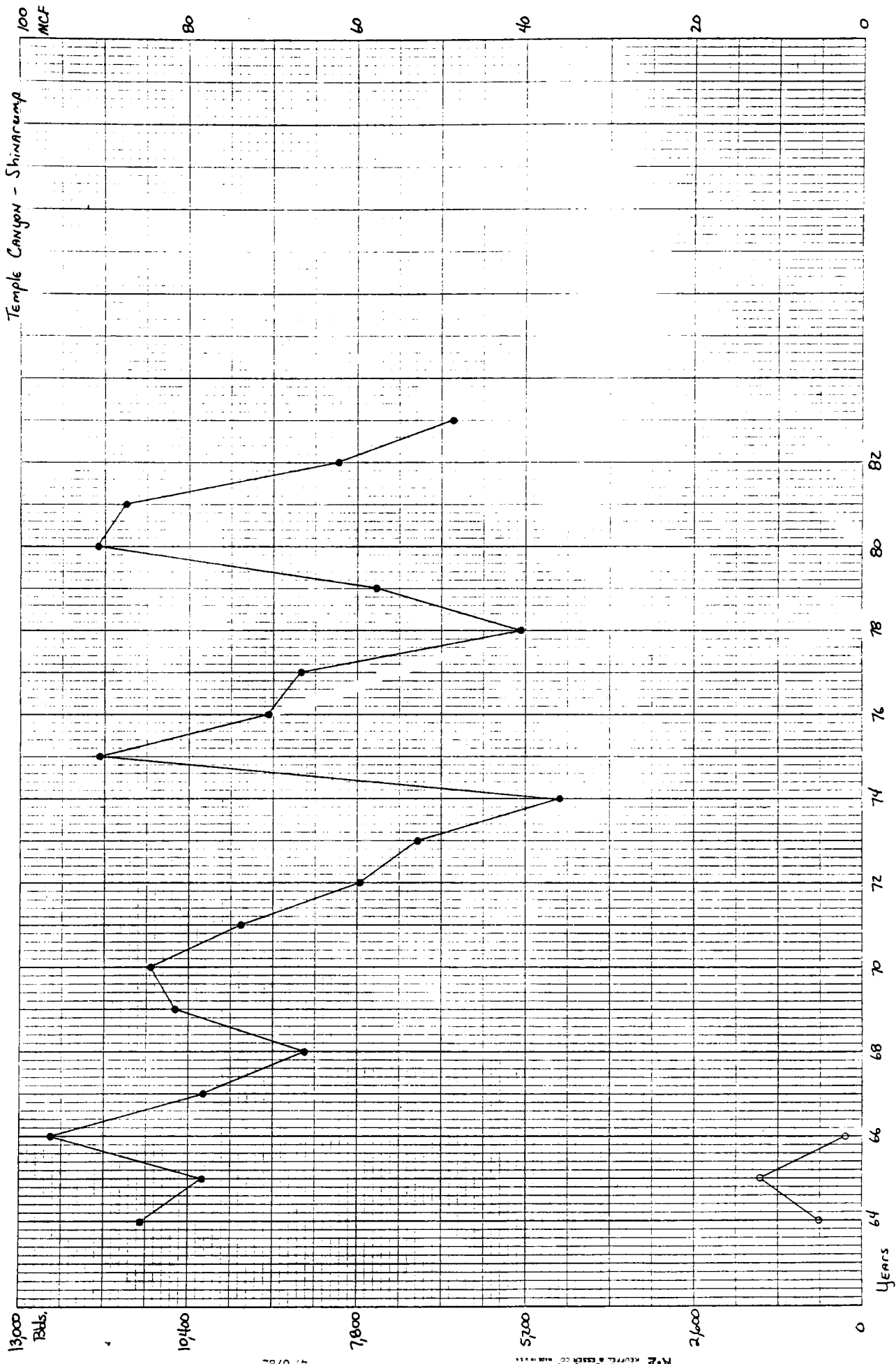
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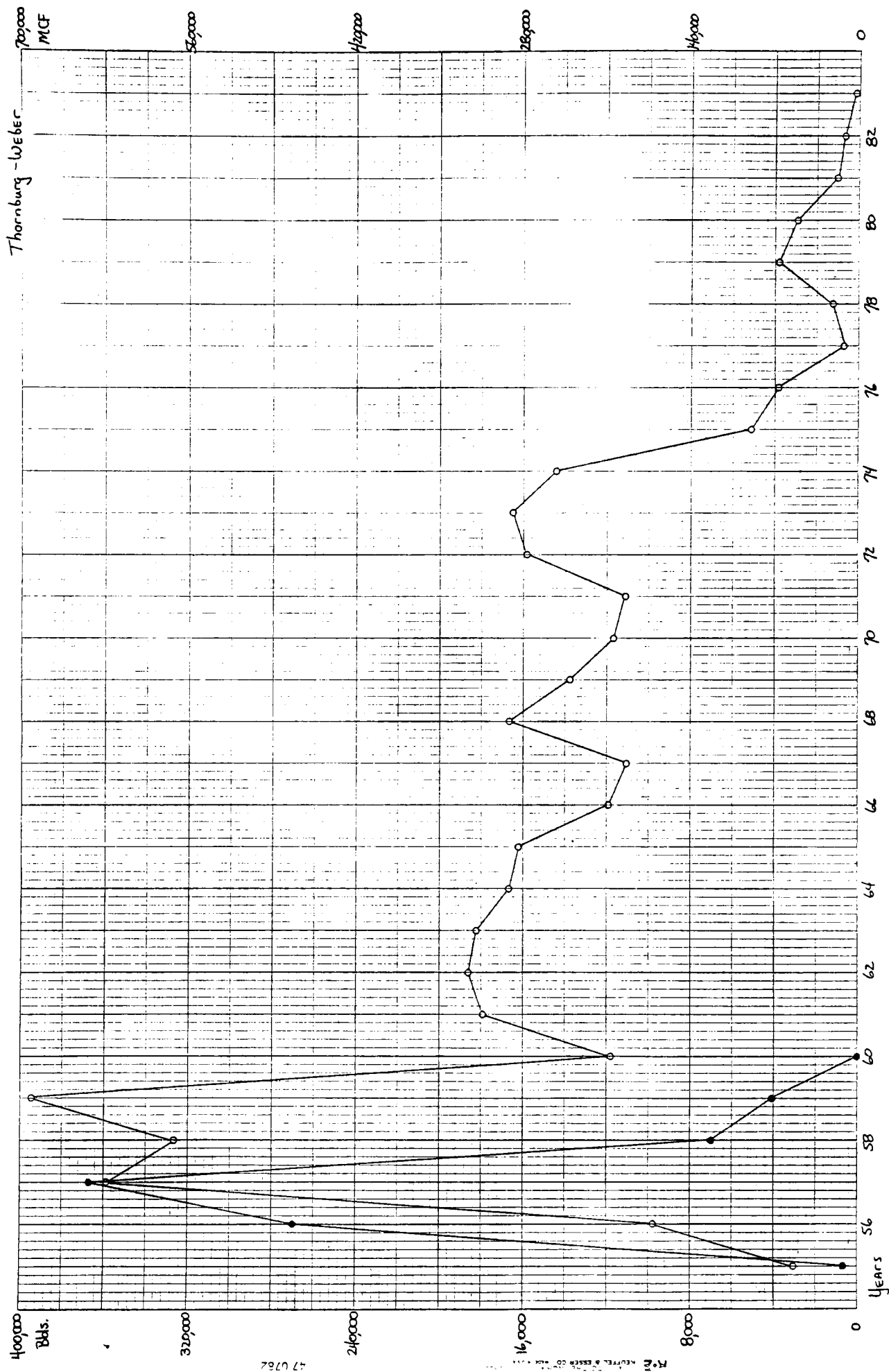
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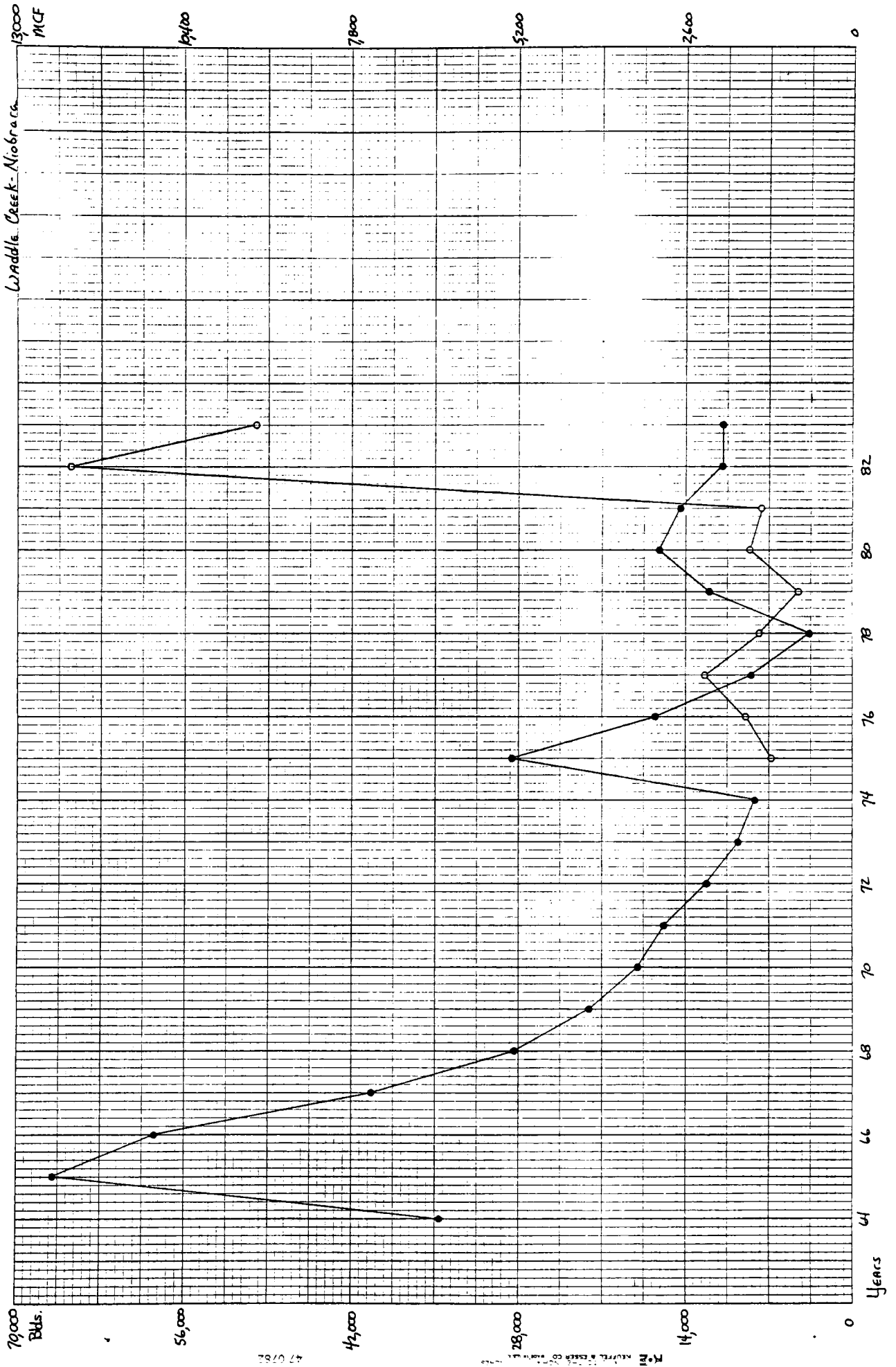
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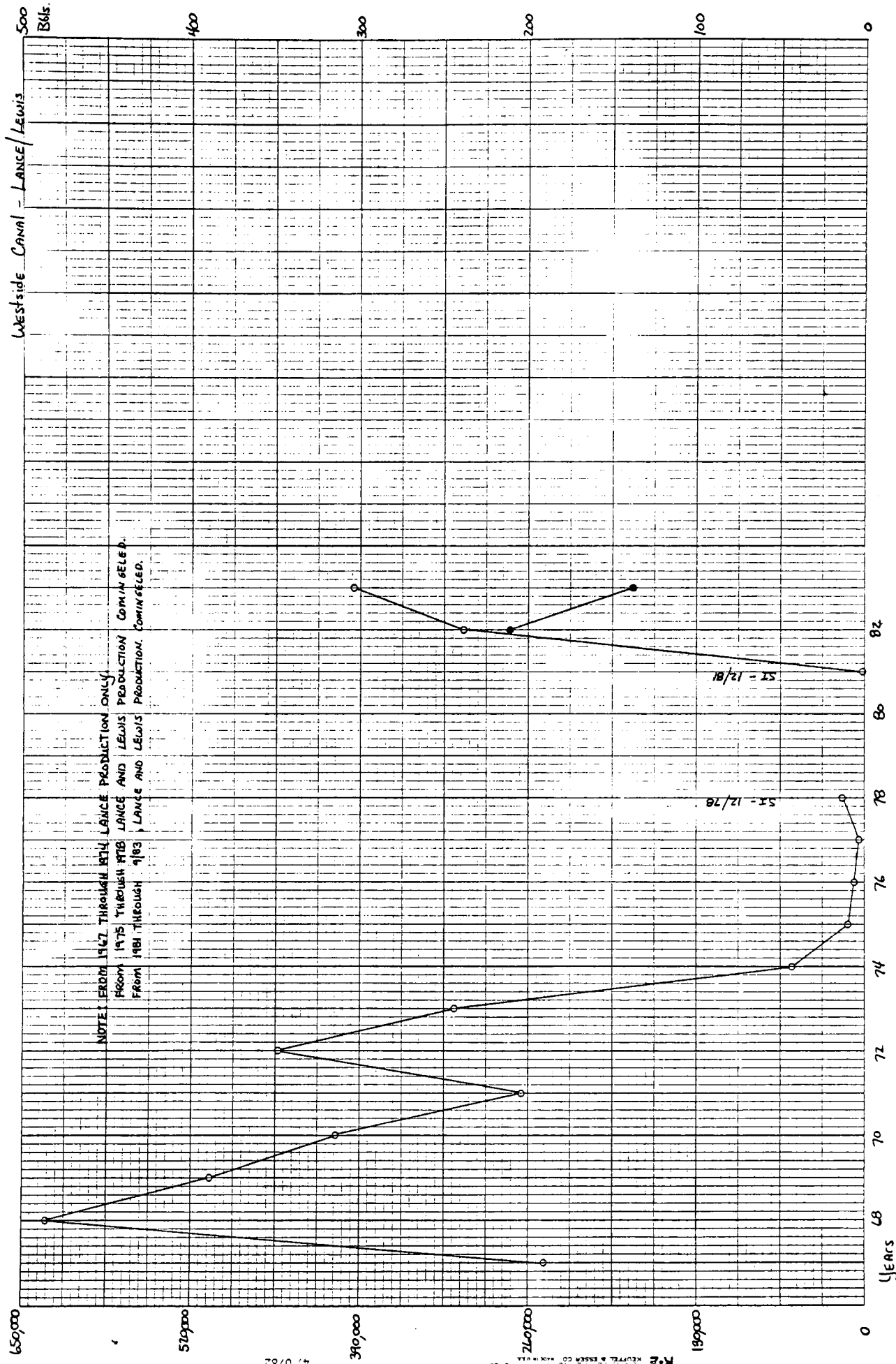
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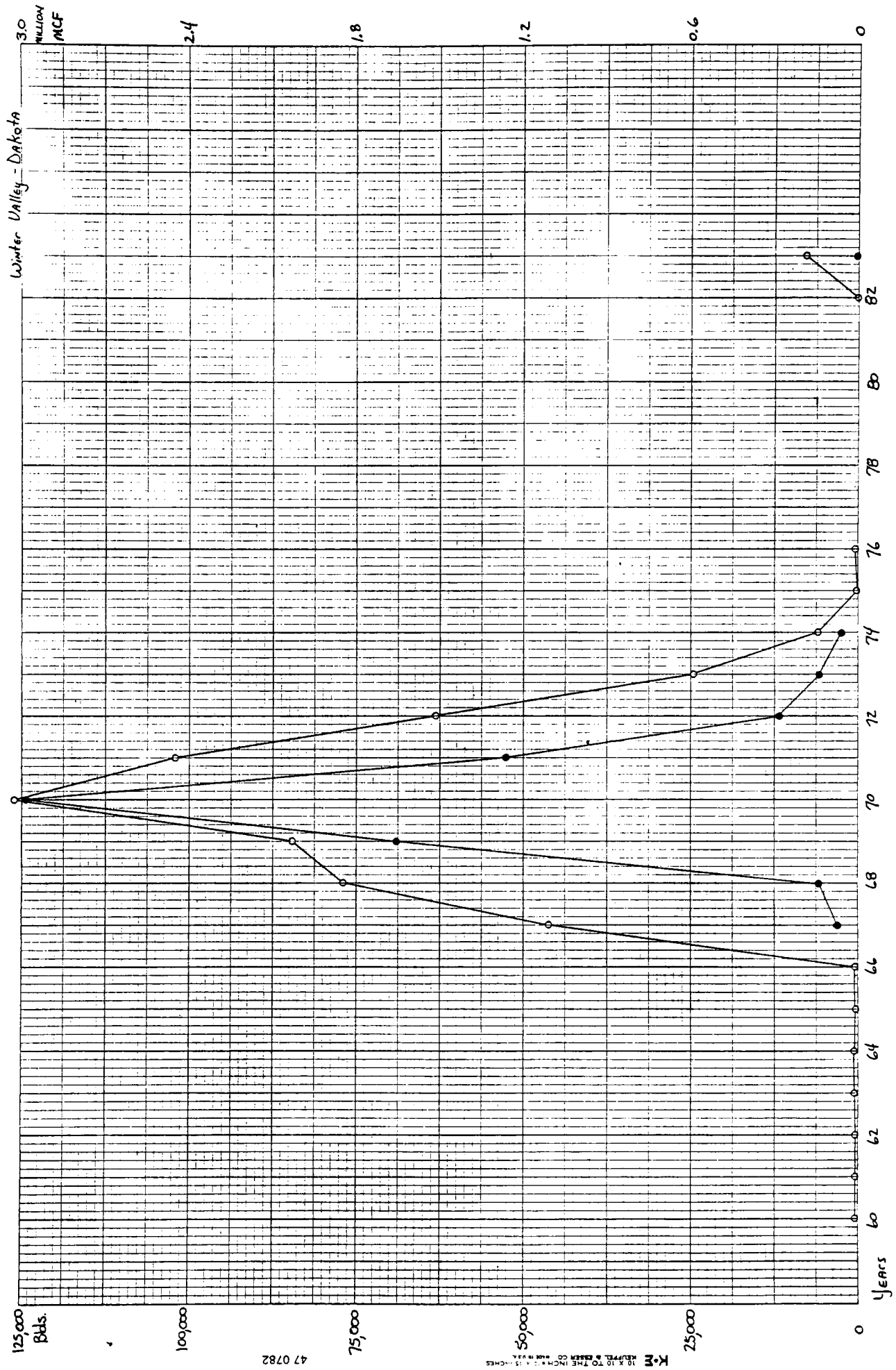
McE. McE. & McE. CO. WASH. D.C.





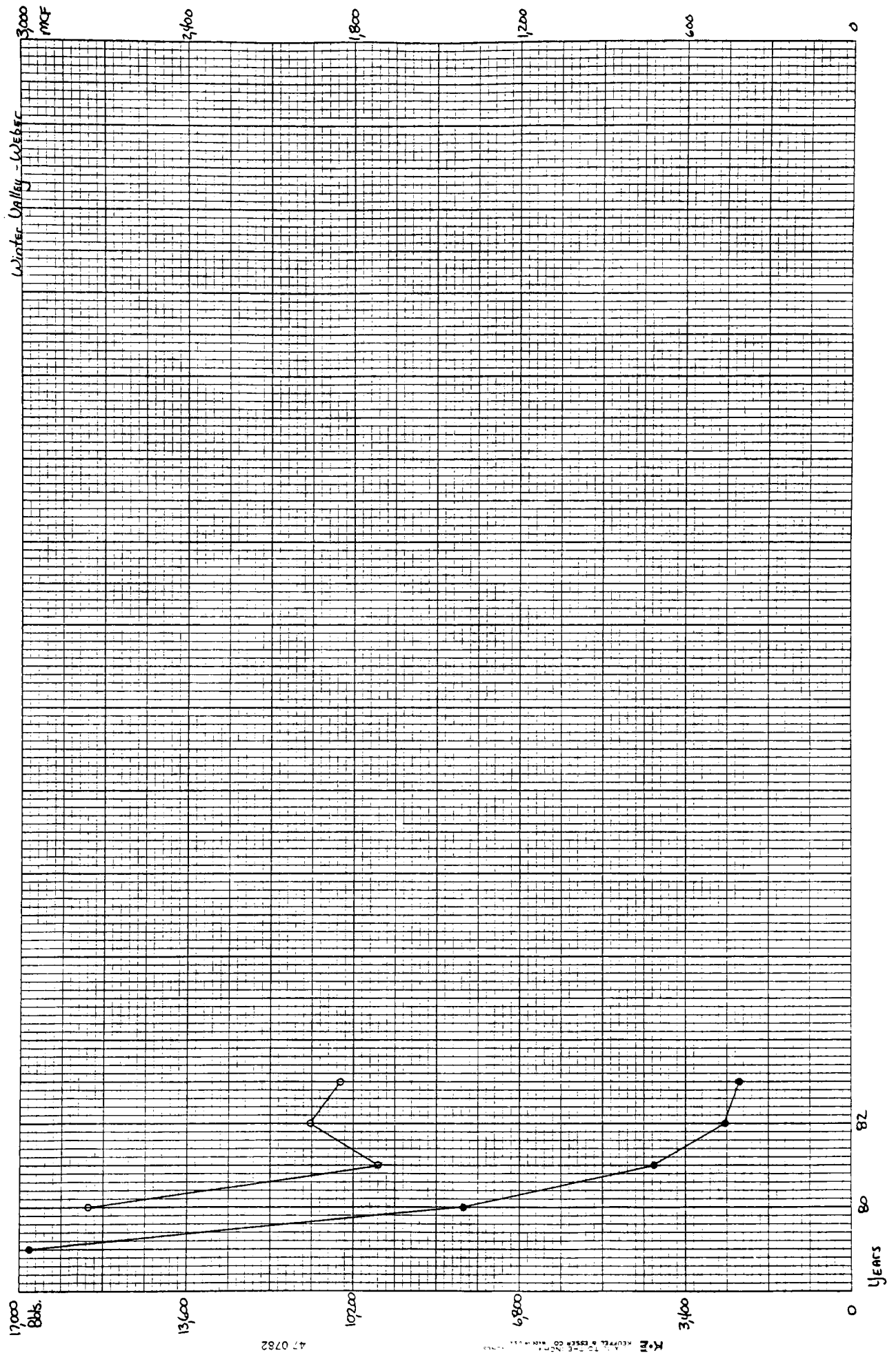






47 0782

K-M
10 X 10 TO 745 INCHES
K&P, P&L & B&B CO.
MADE IN U.S.A.



Other Publications

INFORMATION SERIES 18--Oil and Gas fields of Colorado: Statistical Data through 1981.

MAP SERIES 22--Oil and Gas fields map of Colorado. 1983, (1:500,000).

OPEN-FILE REPORT 84-3: Estimated Oil and Gas Reserves for Washington County, Colorado;

OPEN-FILE REPORT 84-4: Estimated Oil and Gas Reserves for Rio Blanco County, Colorado.

OPEN-FILE REPORT 84-5: Estimated Oil and Gas Reserves for Adams County, Colorado;

OPEN-FILE REPORT 83-6: Estimated Oil and Gas Reserves for Weld County, Colorado;

OPEN-FILE REPORT 84-7: Estimated Oil and Gas Reserves for Arapahoe County, Colorado;

OPEN-FILE REPORT 84-8: Estimated Oil and Gas Reserves for Baca County, Colorado.

OPEN-FILE REPORT 84-9: Estimated Oil and Gas Reserves for Cheyenne County, Colorado.

OPEN-FILE REPORT 84-10: Estimated Oil and Gas Reserves for Garfield County, Colorado;

OPEN-FILE REPORT 84-11: Estimated Oil and Gas Reserves for La Plata County, Colorado;

OPEN-FILE REPORT 84-12: Estimated Oil and Gas Reserves for Moffat County, Colorado;

OPEN-FILE REPORT 84-13: Estimated Oil and Gas Reserves for Elbert County, Colorado;

OPEN-FILE REPORT 84-14: Estimated Oil and Gas Reserves for Mesa County, Colorado;

OPEN-FILE REPORT 84-15: Estimated Oil and Gas Reserves for Routt County, Colorado;

OPEN-FILE REPORT 84-16: Estimated Oil and Gas Reserves for Yuma County, Colorado.

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