OPEN FILE 84-10

ESTIMATED OIL AND GAS RESERVES FOR GARFIELD 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 GARFIELD COUNTY, COLORADO

Introduction

This report is the eighth* 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 Garfield County, located in northwestern Colorado, approximately 20 miles north of Grand Junction, within the Piceance Basin. Garfield County covers 3,000 square miles. In this county, oil and/or gas are produced from, in descending order of age, the Wasatch Sandstone, Rollins Sandstone, Cozette Sandstone, Corcoran Sandstone, Mesaverde Sandstone, Niobrara Limestone, Mancos Shale, Dakota Sandstone, Buckhorn Sandstone, Morrison Sandstone, and Entrada Sandstone.

There are 20 fields considered active producers as of September 30, 1983. All 20 are classified as gas fields (based on cumulative GOR >15:1).

* 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 84-5: Estimated Oil and Gas Reserves for Adams County, Colorado;
OPEN-FILE REPORT 84-6: 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; and
OPEN-FILE REPORT 84-9: Estimated Oil and Gas Reserves for Cheyenne County, Colorado.

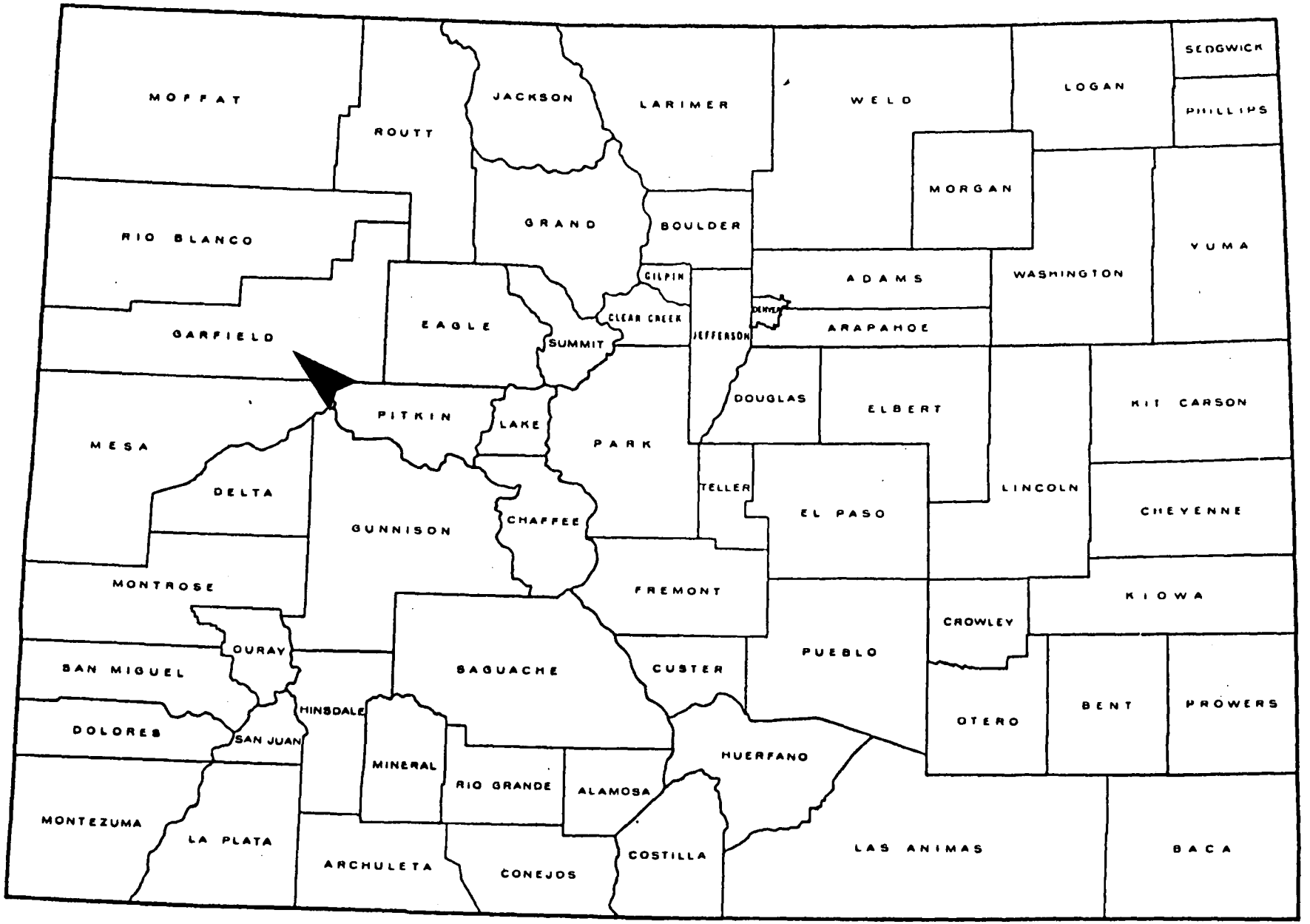

Figure 1. County Location Map

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 35 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 is one oil field-horizon, Bridle-Entrada. Its production history has allowed for a decline rate to be calculated. This decline rate was then applied to the equation:

$$Rr = \frac{q1 - qf}{-\ln (1-dy)}$$

where: Rr = remaining reserves
q1 = current annual production
qf = 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 I.

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.

Gas Reserve Calculations

There are 34 gas field-horizons. Production histories have allowed for decline rates to be calculated for 17 of these. The remaining 17 gas field-horizons have not produced for a long enough time (less than 4 years) to determine a reliable decline rate. Decline rates were determined for the previously mentioned 17 field-horizons (see Table I) 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 I.

Results can be found in Table I.

Only one gas field-horizon, South Canyon-Dakota/Morrison, had "associated" condensate production. In this case a decline rate was determined and applied to the oil reserve equation previously discussed. An economic limit of zero was used in this case as the condensate production is 'secondary' with respect to the gas production.

Results

The following figures are for those field-horizons for which reserves could be calculated. Estimated oil reserves for Garfield County totaled 17,047 barrels. Estimated gas reserves for Garfield County totaled 51,330,082 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 four to five years, roughly half of the estimated oil reserves in Garfield 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 five to six 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 (15.65 percent per year for oil and 12.45 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 (804 Bbls. of oil and 1,567,717 MCF of gas) additional reserves of 4,724 Bbls. of oil and 11,710,606 MCF of gas were obtained. This gives total county reserves (Class I and II) of 21,771 Bbls. of oil and 63,040,688 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 Encrochment
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
OPEN FILE 84-10
RESERVE DATA FOR GARFIELD 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.)	GAS (MCF)	OIL (Bbls.) ()Condensate (Bbls.)	GAS (MCF)	
1.Baldy Creek/ Cozette	7S-90W	1980		50.0 -o		305,390		718		306,108	NOTE: Used Proj. '83 value to calc. S. N.P. Also Prod. in Rio Blanco Co.
2.Baxter Pass/ Dakota	4S-103W	1982	Gas Exp.		(804)	478,126					Also Prod. in Rio Blanco Co.
3.Baxter Pass/ Mancos B	4S-103W	1980				9,404					N.P.
4.Baxter Pass/ Morrison	4S-103W	1977	Gas Exp.			17,898					N.P. Prod.'77,'82 &'83. SI 12/82;Also prod. in Rio Blanco Co.
5.Baxter Pass So./ Morrison	5S-102W	1978	Gas Exp.			282,924					SI-1983
6.Bridle/Entrada	8S-104W	1980		9.9 -o	5,483		12,432		17,915		
7.Bridle/Dakota-Morrison	8S-104W	1976		13.0 -g	(68)	6,859,790		9,749,475	(+68)	16,609,265	
8.Calf Canyon/ Dakota	6S-102W	1982				53,172					N.P.
9.Calf Canyon/ Dakota-Morrison	6S-102W	1982				38,694					N.P.
10.Calf Canyon/ Mesaverde	6S-102W	1982				47,401					N.P.
11.Calf Canyon/ Niobrara	6S-102W	1982				136					N.P.
12.Carbonera/ Dakota	7S-104W	1959		6.4 -g	(121)	757,665		150,104	(+121)	907,769	NOTE: No Gas Prod. from 1965 thru 1971.
13.Carbonera/ Dakota-Morrison	7S-104W	1959		6.0 -g		321,400		159,572		480,972	NOTE:No Gas Prod. from 1972 thru 1981.
14.Divide Creek/ Cozette-Rollins-Corcoran	7&8S-91W	1980				85,144					N.P. Also Prod. in Mesa Co.

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GARFIELD 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.)	GAS (MCF)	OIL (Bbls.) ()Condensate (Bbls.)	GAS (MCF)	
15.Divide Creek/ MesaVerde	7&8S-91W	1962		3.2 -g		1,290,009		155,070		1,445,079	NOTE: No Gas Prod. 1963,'64,'73 thru 1977,Also Prod. in Mesa Co.
16.Douglas Pass/ Dakota-Morrison	5S-102W	1978			(123)	991,050					SI 12/82, & 9/83.
17.Douglas Pass/ Dakota	5S-102W	1978				850,278					N.P.
18.DryFork/Dakota	7S-99W	1982				105,774					N.P.
19.Evacuation Creek/Dakota	4S-102W	1981	Gas Exp.			63,324					N.P.; SI 12/82 & 9/83. Also Prod. in Rio Blanco Co.
20.Foundation Ck/ Mancos B	4S-102W	1977	Gas Exp.	8.5 -g		66,757		73,051		139,808	Also Prod. in Rio Blanco Co.
21.Logan Wash/ Cozette-Corcoran	8S-97W	1982				16,460					N.P.
22.Logan Wash/ Mesaverde	8S-97W	1982				133,005					N.P.
23.Mam Creek/ Mesaverde	6S-93W	1965		11.6 -g	(443)	771,707	69,932		(+443)	841,639	
24.Prairie Canyon/ Dakota-Dakota-Morrison	7S-104W	1959		3.4 -g		2,337,990	783,274			3,121,264	NOTE: Field SI 9/83.
25.Rock Canyon/ Dakota	5S-102W	1975				242,023					Erratic and Inc. Gas Prod.

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GARFIELD 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.)	GAS (MCF)	OIL (Bbls.) ()Condensate (Bbls.)	GAS (MCF)	
26.Rulison/ Mesaverde	6&7S-93-95 W	1959	Gas Exp.	2.8 -g	(6,723)	5,564,594		9,866,297	(+6,723)	15,430,891	
27.Rulison/ Wasatch	6&7S-93-95W	1973	Gas Exp.	10.2 -g		3,235,073		9,995,283		13,230,356	
28.Soldier Can/ Dakota	4S-100W	1977	Gas Exp.	50.0 -g		69,446		52,206		121,652	Also Prod. in Rio Blanco Co.
29.Soldier Can/ Mancos 'B'	4S-100W	1978		21.5 -g	200	11,702		6,751	+200	18,453	Used Actual 1983 Prod. thru 9/83 for 'a';Also prod. in Rio Blanco Co.
30.South Canyon/ Dakota-Morrison	6&7S-102-104W	1978		25.7 -o 25.0 -g	(5,104)	7,149,139	(4,615)	5,320,881	(9,719)	12,470,020	Econ.Limit -0- wells;Also prod. in Mesa Co.
31.South Canyon/ Dakota-Buckhorn	6&7S-102-104W	1959		12.0 -g	(802)	21,335,891		14,393,426		35,729,317	Also Prod. in Mesa Co.
32.Trail Canyon/ Dakota	4S-101W	1975	Gas Exp.	18.7 -g	(35)	285,442		279,817	(35)	565,259	Also prod. in Rio Blanco Co.
33.Twin Buttes/ Dakota	5S-102W	1978		40.0 -g		225,364		145,000		370,364	
34.Twin Buttes/ Morrison	5S-102W	1951		18.2 -g	(61)	3,469,105		129,943		3,599,048	NOTE: No Gas Prod. 1966 thru 1975.
COUNTY TOTAL OF ESTIMATED RESERVES							17,047 Bbls.	51,330,082 MCF			

Reference List

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

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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

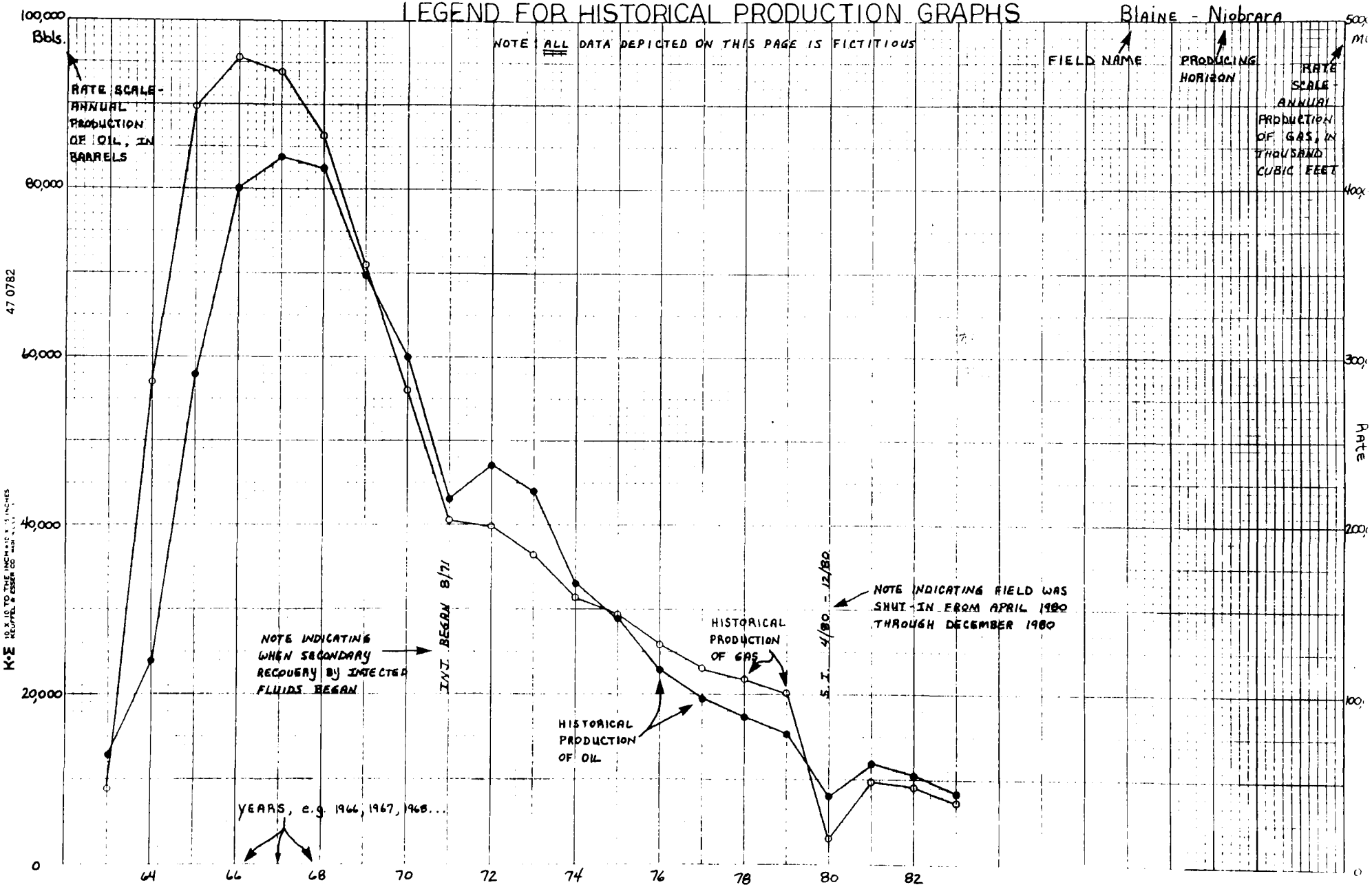
Historical production decline curve graphs for Garfield County. These graphs are presented in alphabetical order by Field name and then by producing horizons within each field.

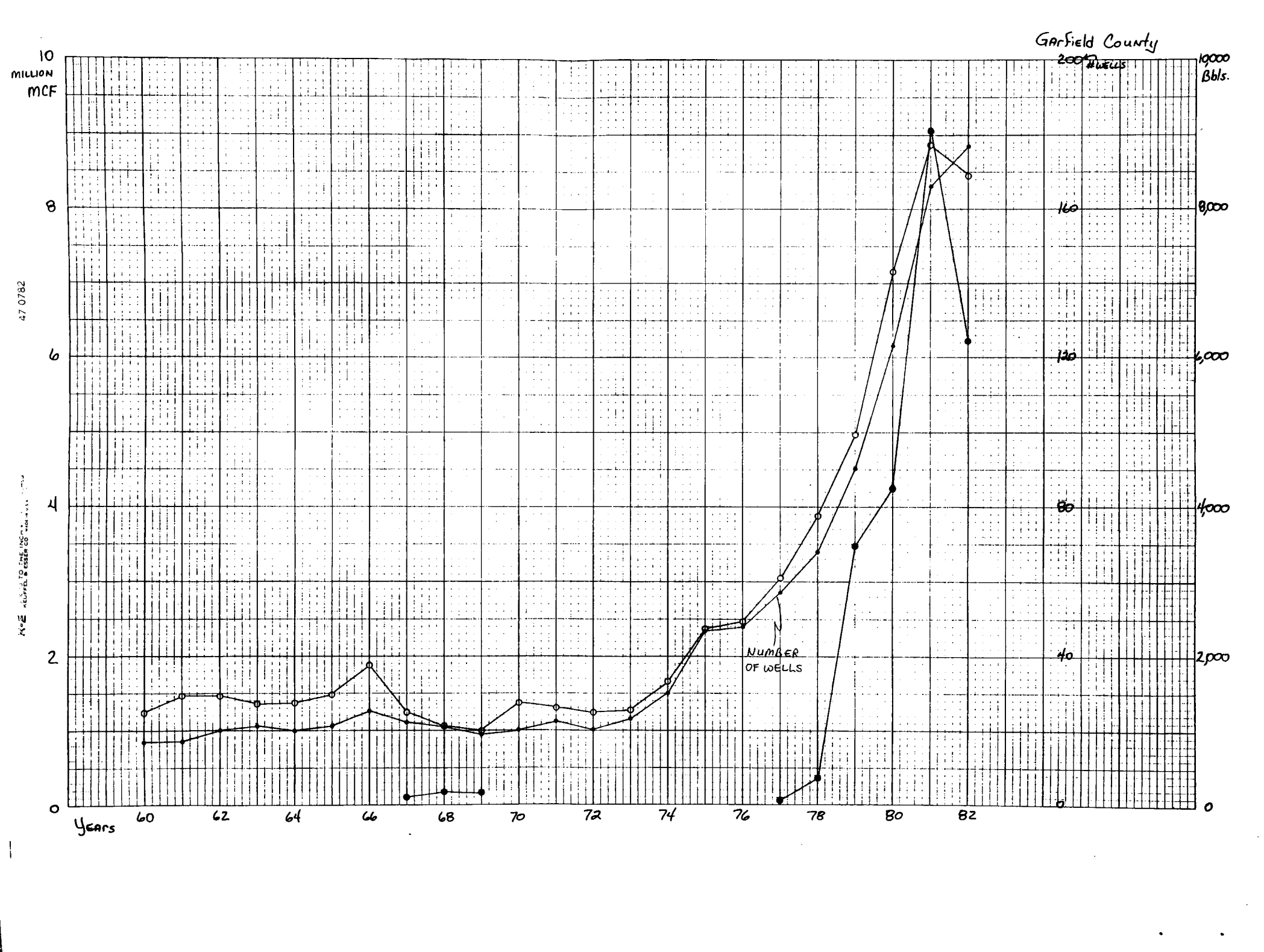
Note that only those fields actively producing as of 9-30-83 are included. Abandoned fields or field-horizons are not included.

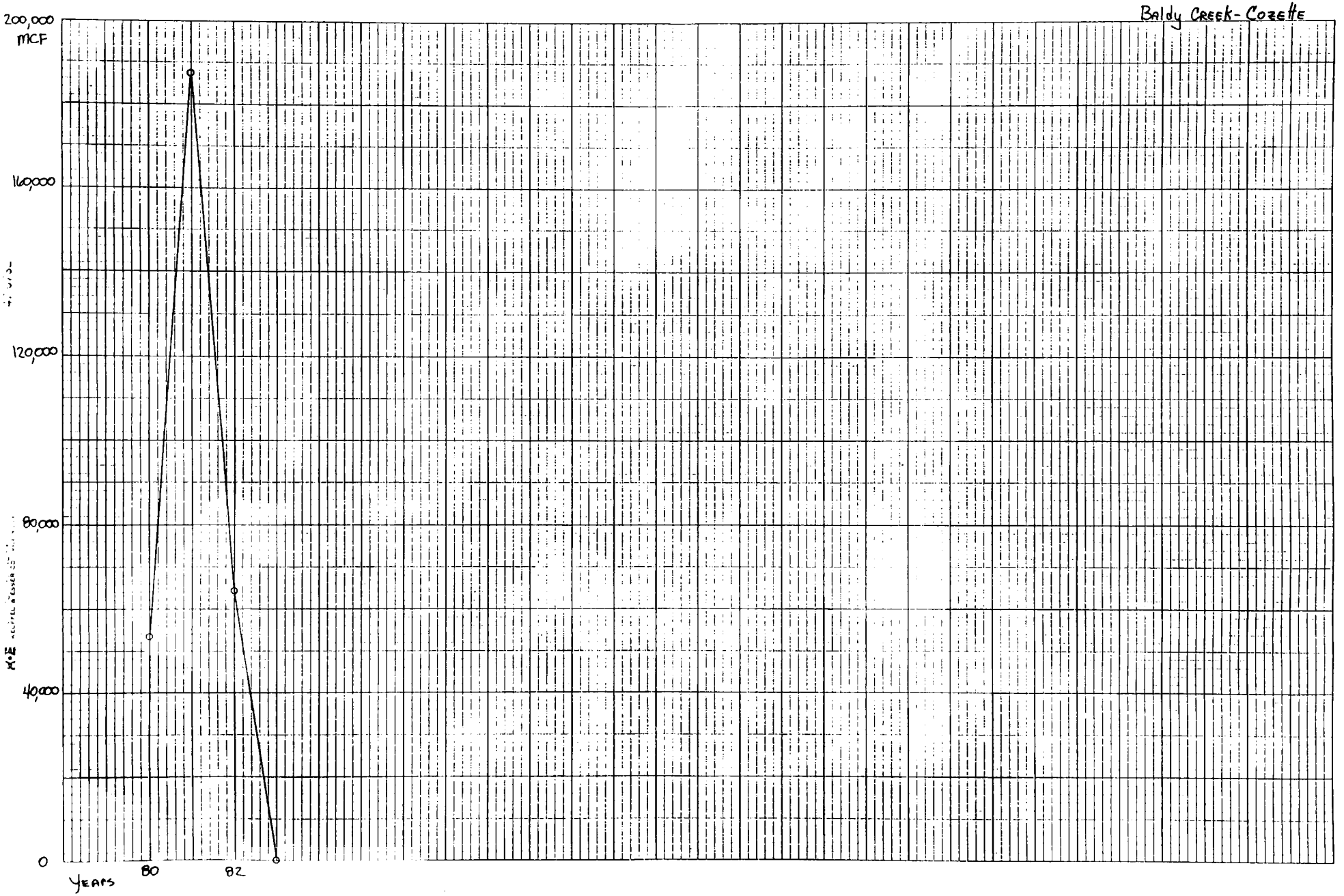
LEGEND FOR HISTORICAL PRODUCTION GRAPHS

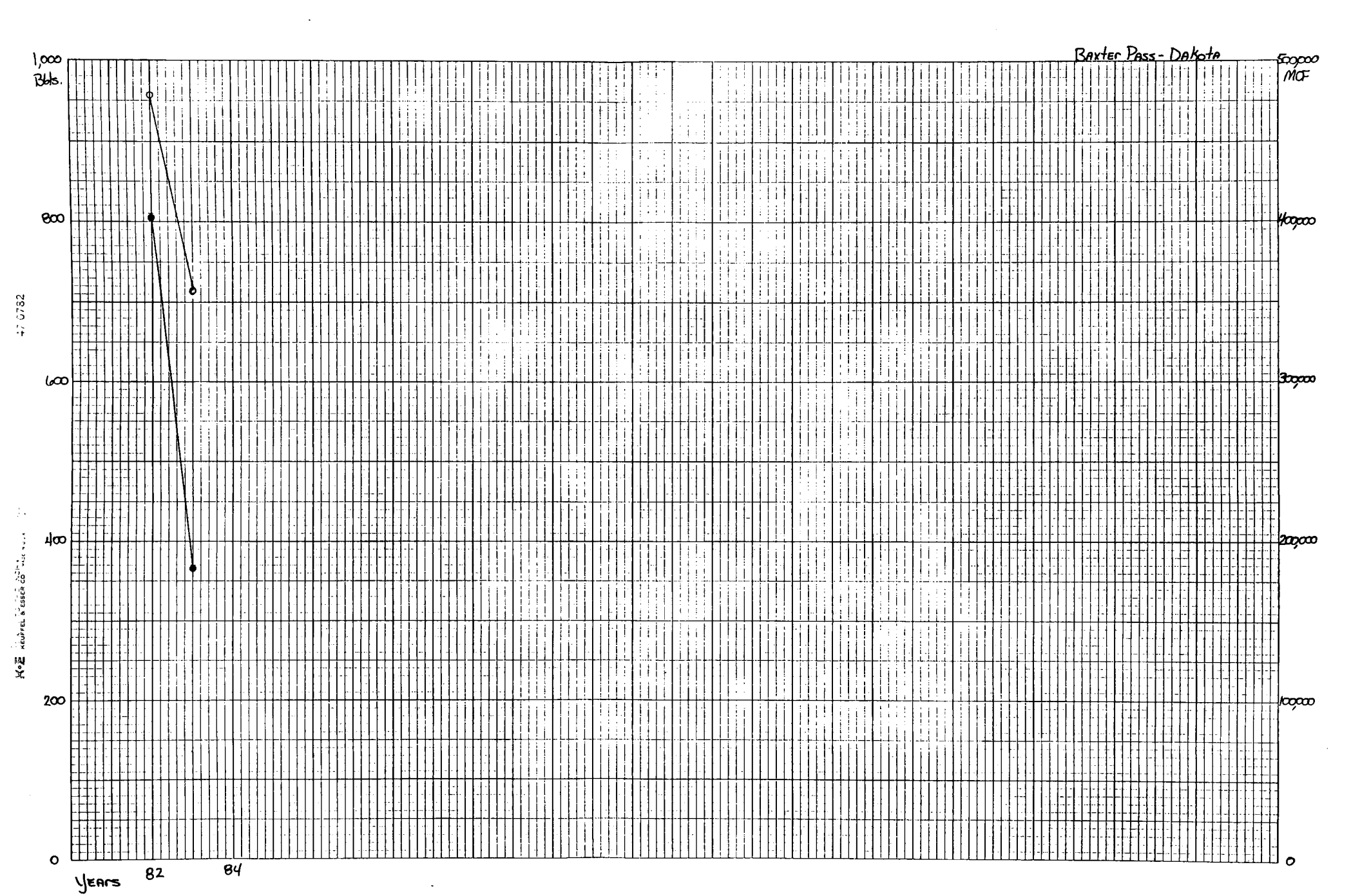
Blaine - Niobrara

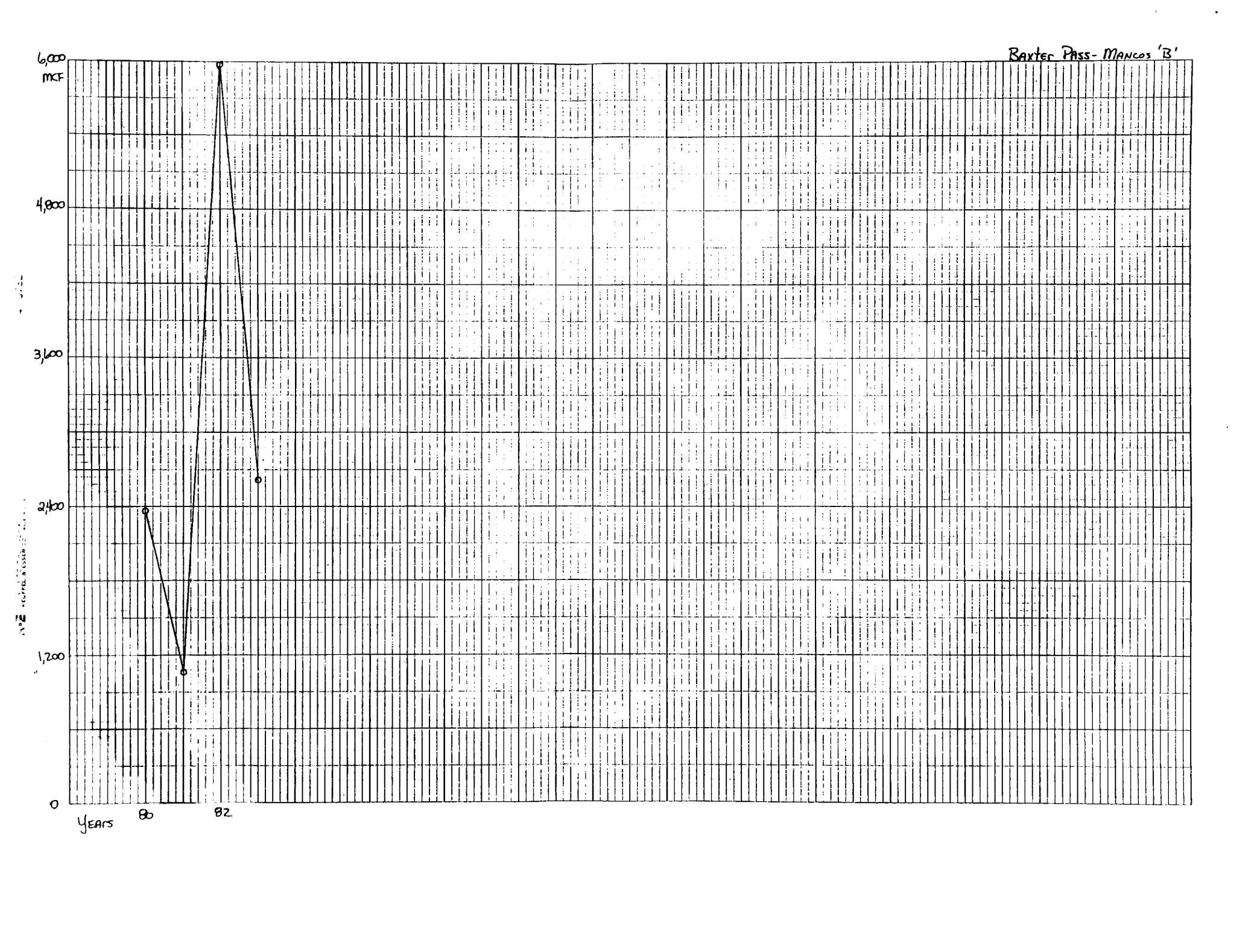
NOTE: ALL DATA DEPICTED ON THIS PAGE IS FICTITIOUS



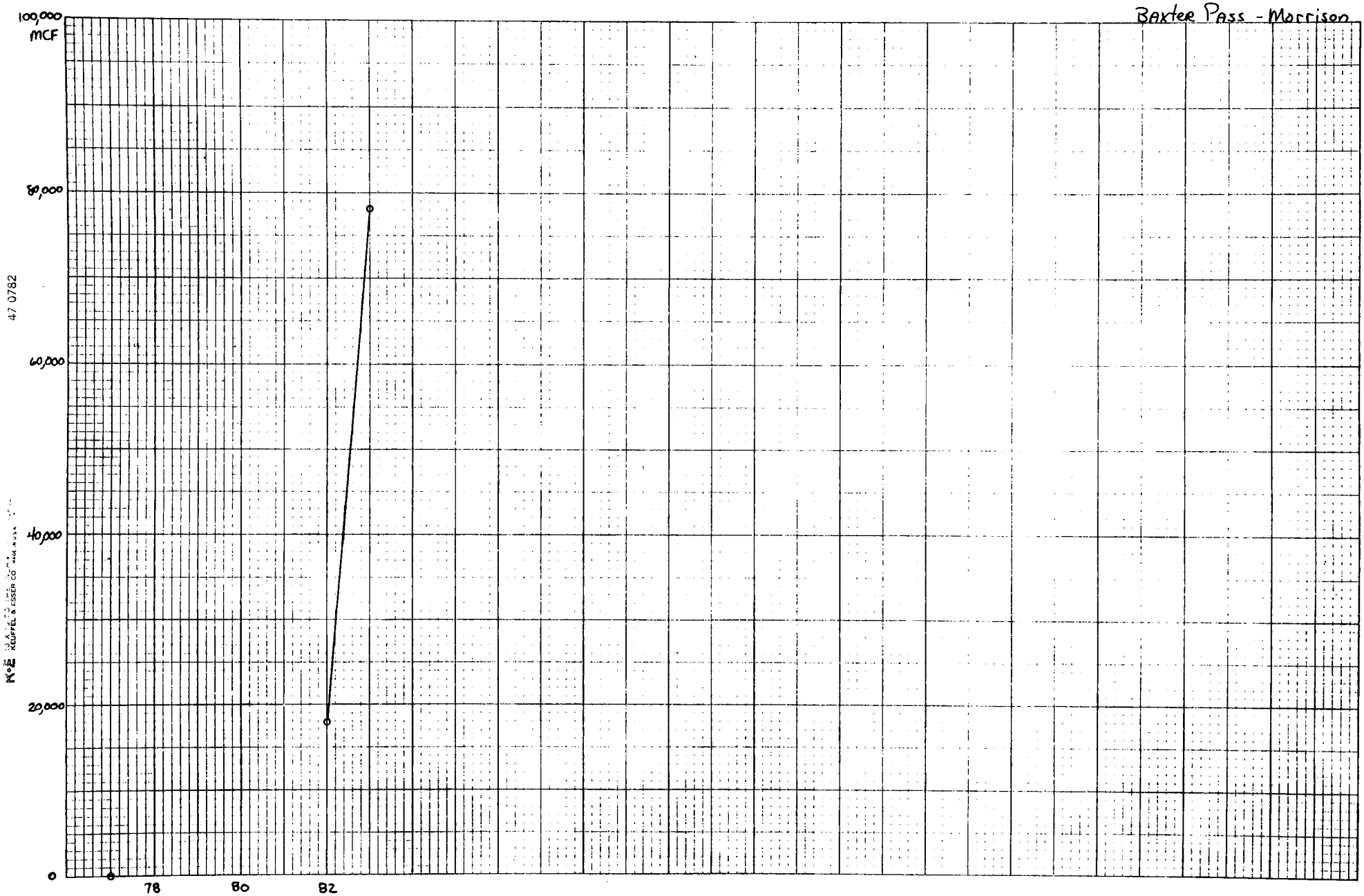

Garfield County
10
MILLION
MCF
8
6
4
2
0
Years
60
62
64
66
68
70
72
74
76
78
80
82
#WELLS
200
160
120
80
40
0
10000
Bbls.
8,000
6,000
4,000
2,000
0
NUMBER
OF WELLS
47 0782


Baldy Creek - Cozette
200,000
MCF
160,000
120,000
80,000
40,000
0
80
82
YEARS


Baxter Pass - Dakota
1,000
Bbls.
800
600
400
200
0
500,000
MCF
400,000
300,000
200,000
100,000
0
Years
82
84


Baxter Pass- Mancos 'B'
6,000
MCF
4,800
3,600
2,400
1,200
0
Years
80
82

Baxter Pass - Morrison



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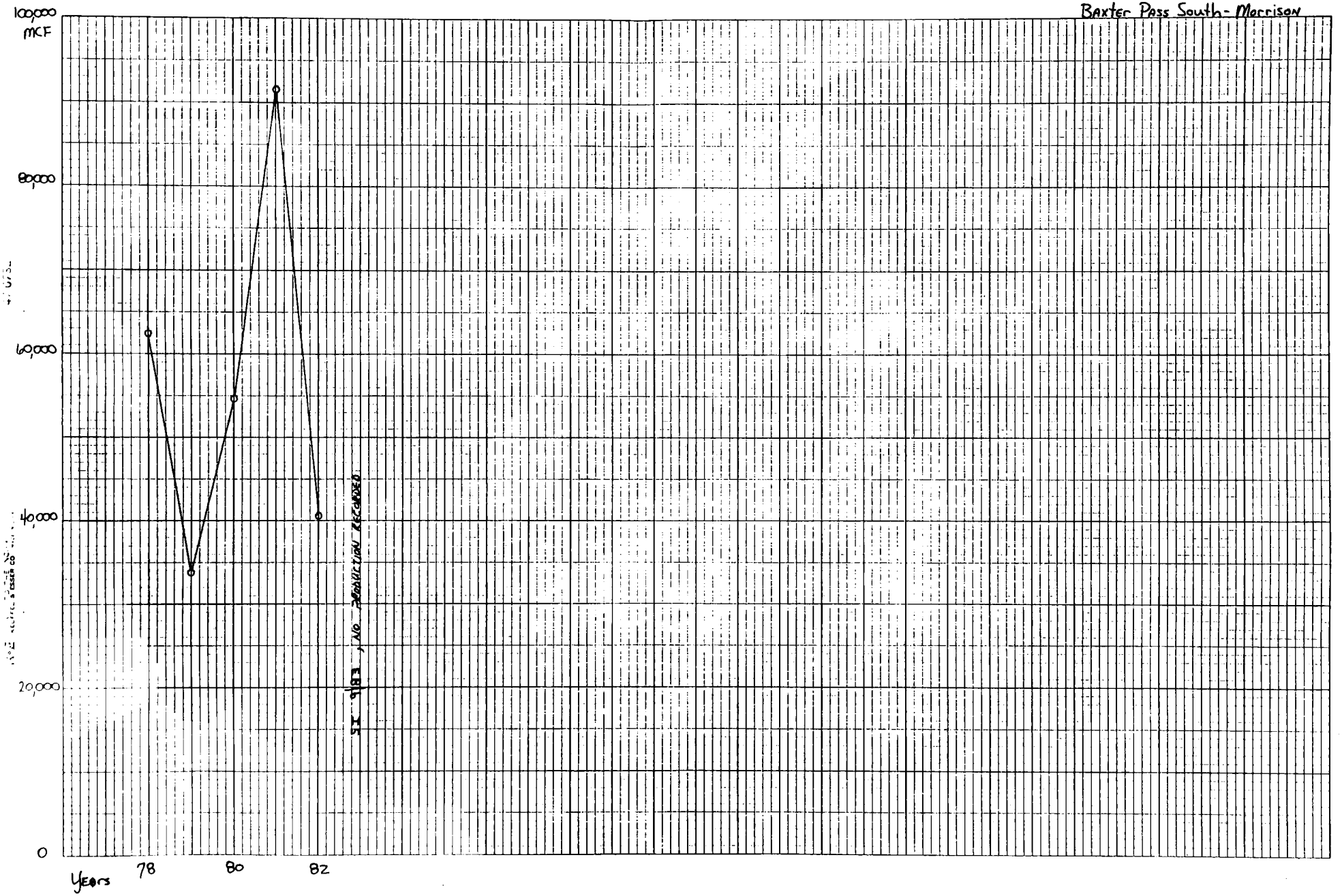
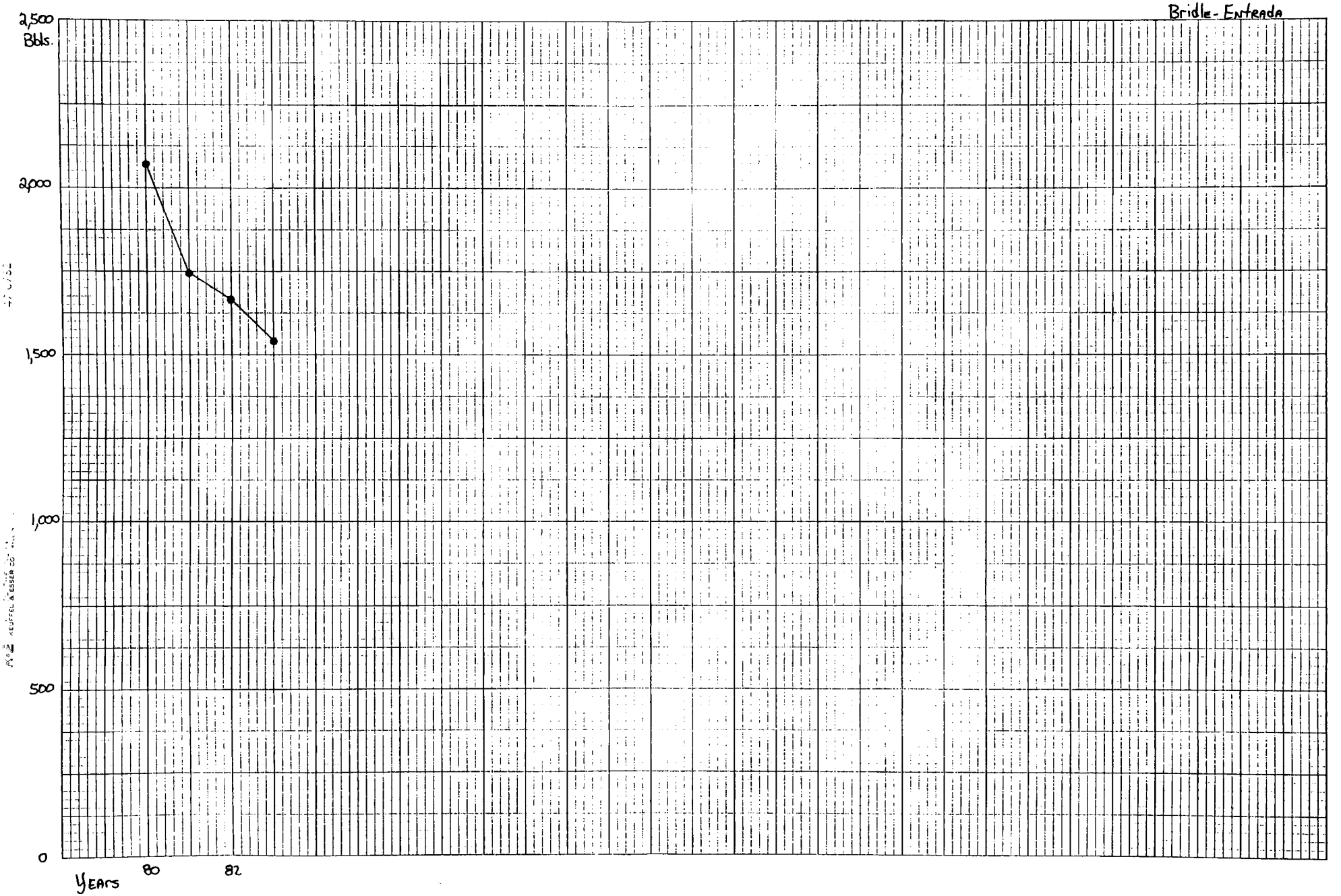
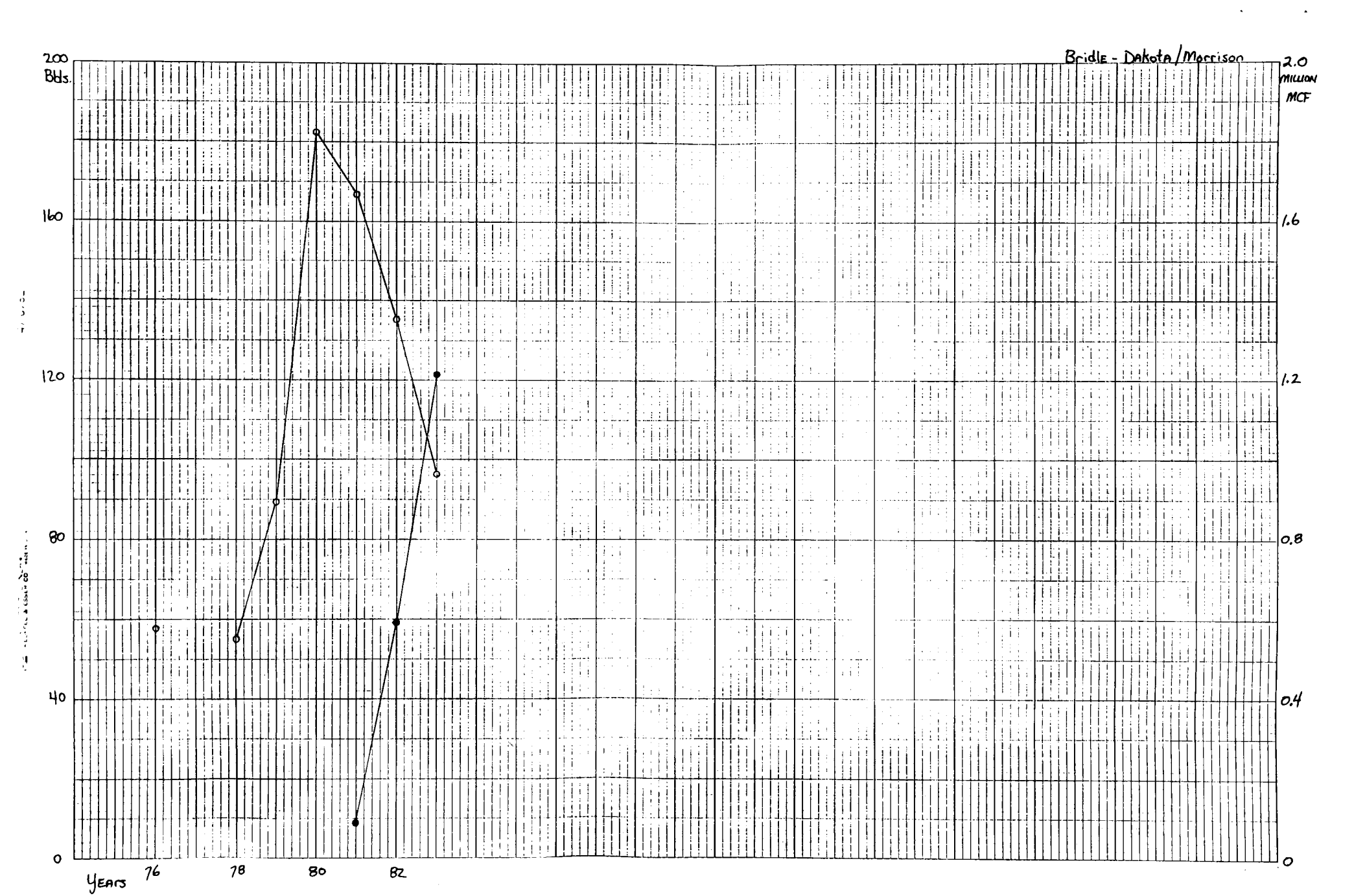
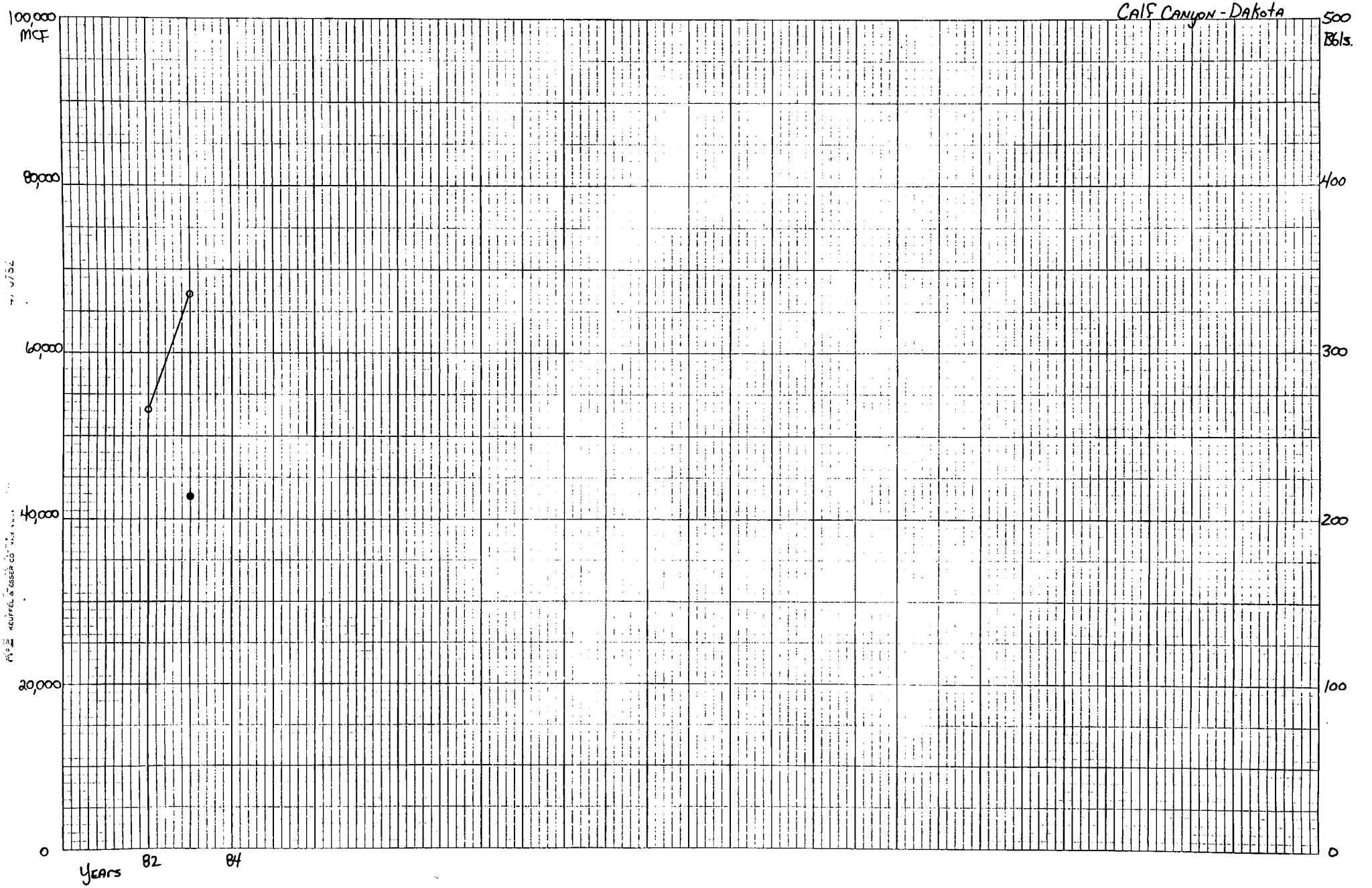
KEUFFEL & ESSER CO

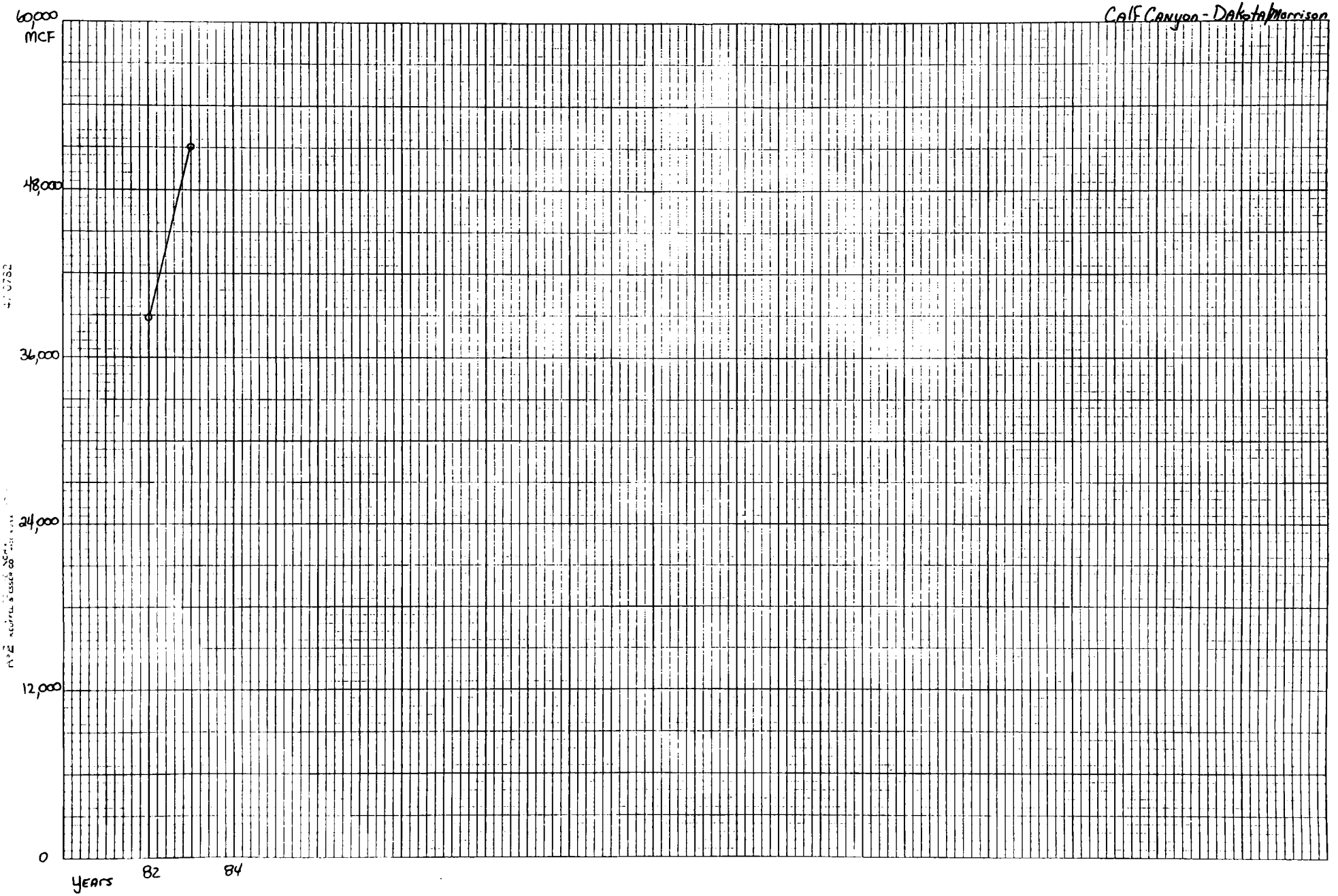
Baxter Pass South - Morrison

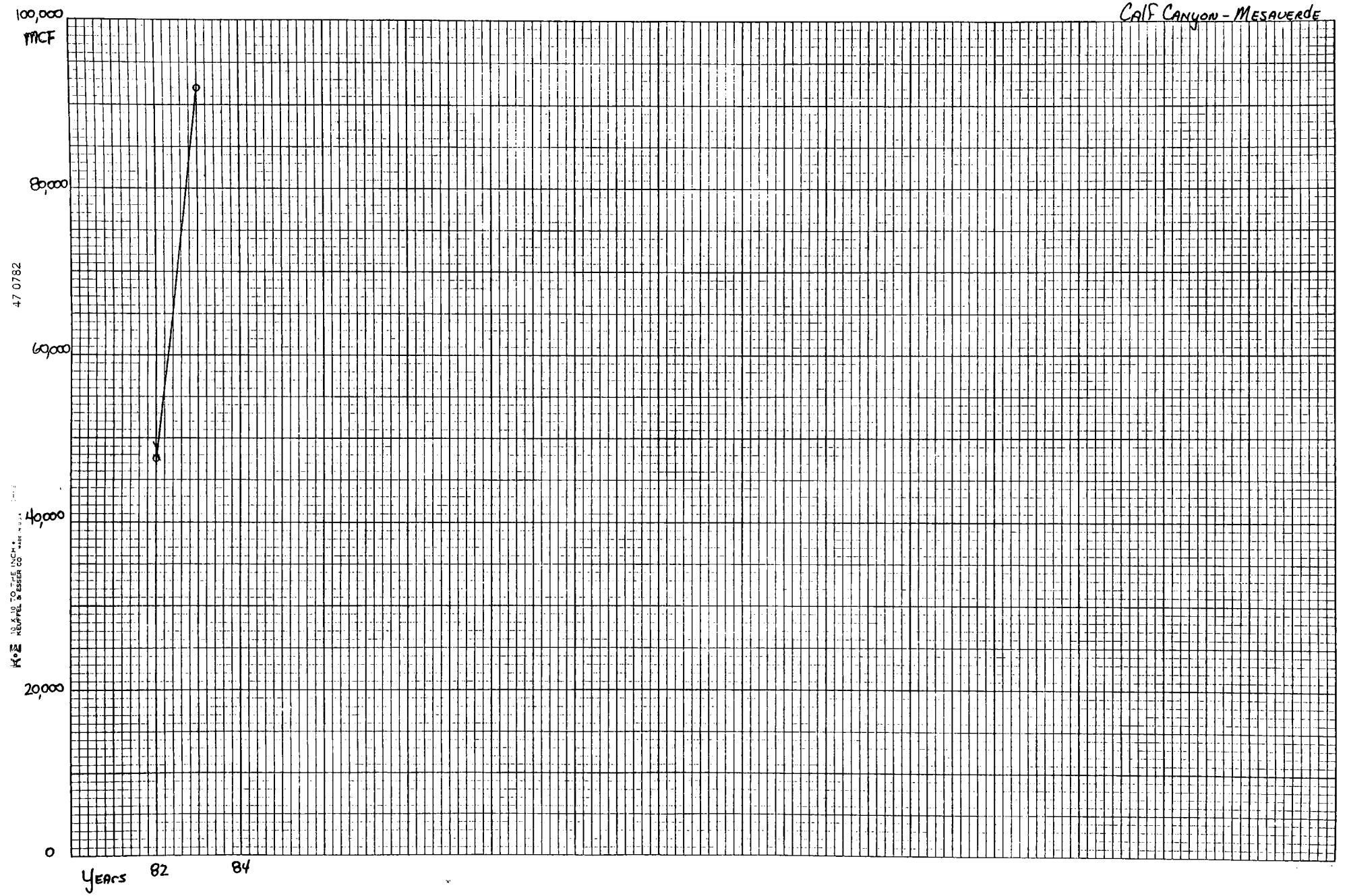



Bridle - Entrada
2,500
Bbls.
2,000
1,500
1,000
500
0
80
82
Years

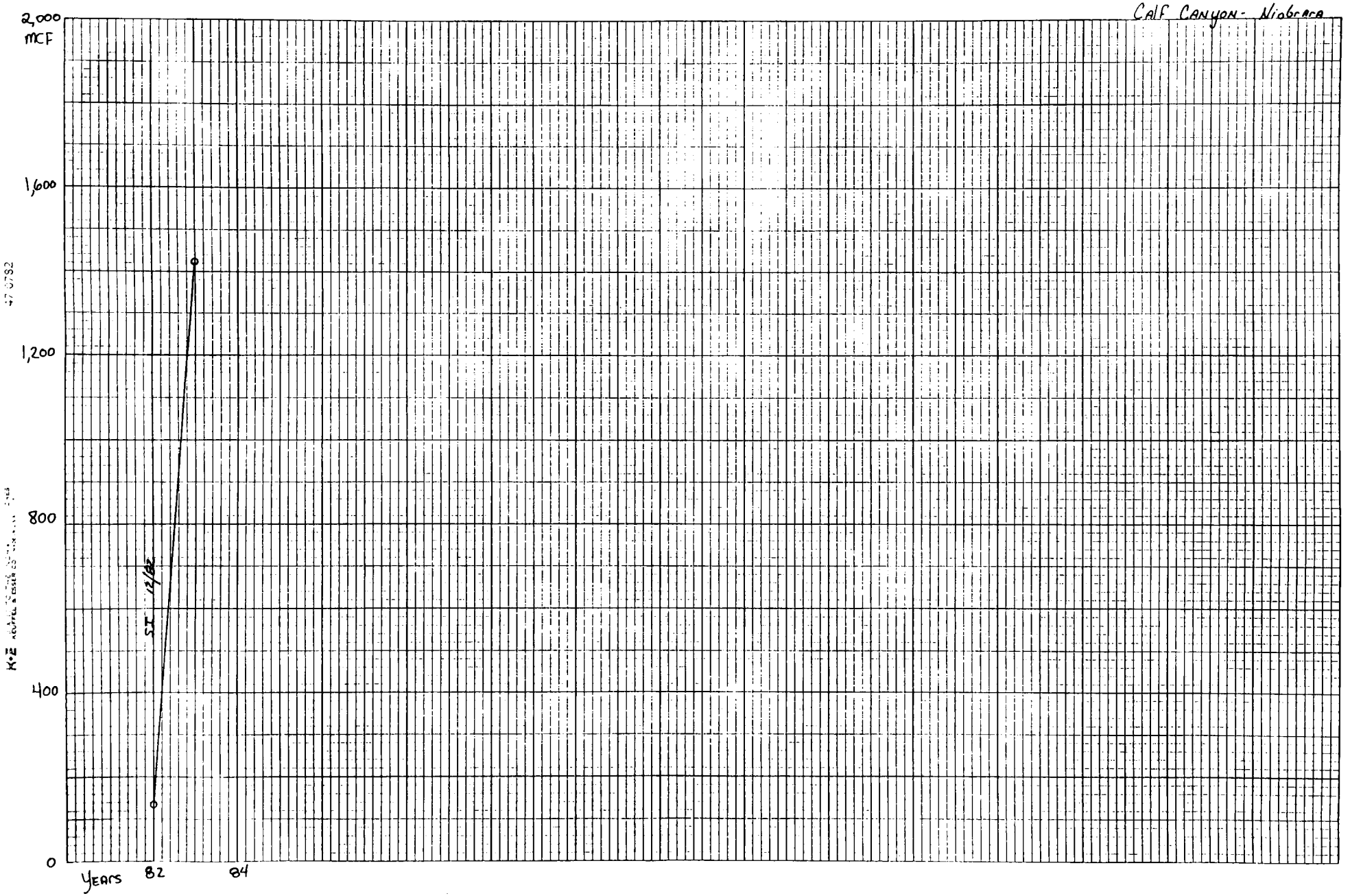

Bridle - Dakota / Morrison
200
Bbls.
160
120
80
40
0
2.0
MILLION
MCF
1.6
1.2
0.8
0.4
0
YEARS
76
78
80
82

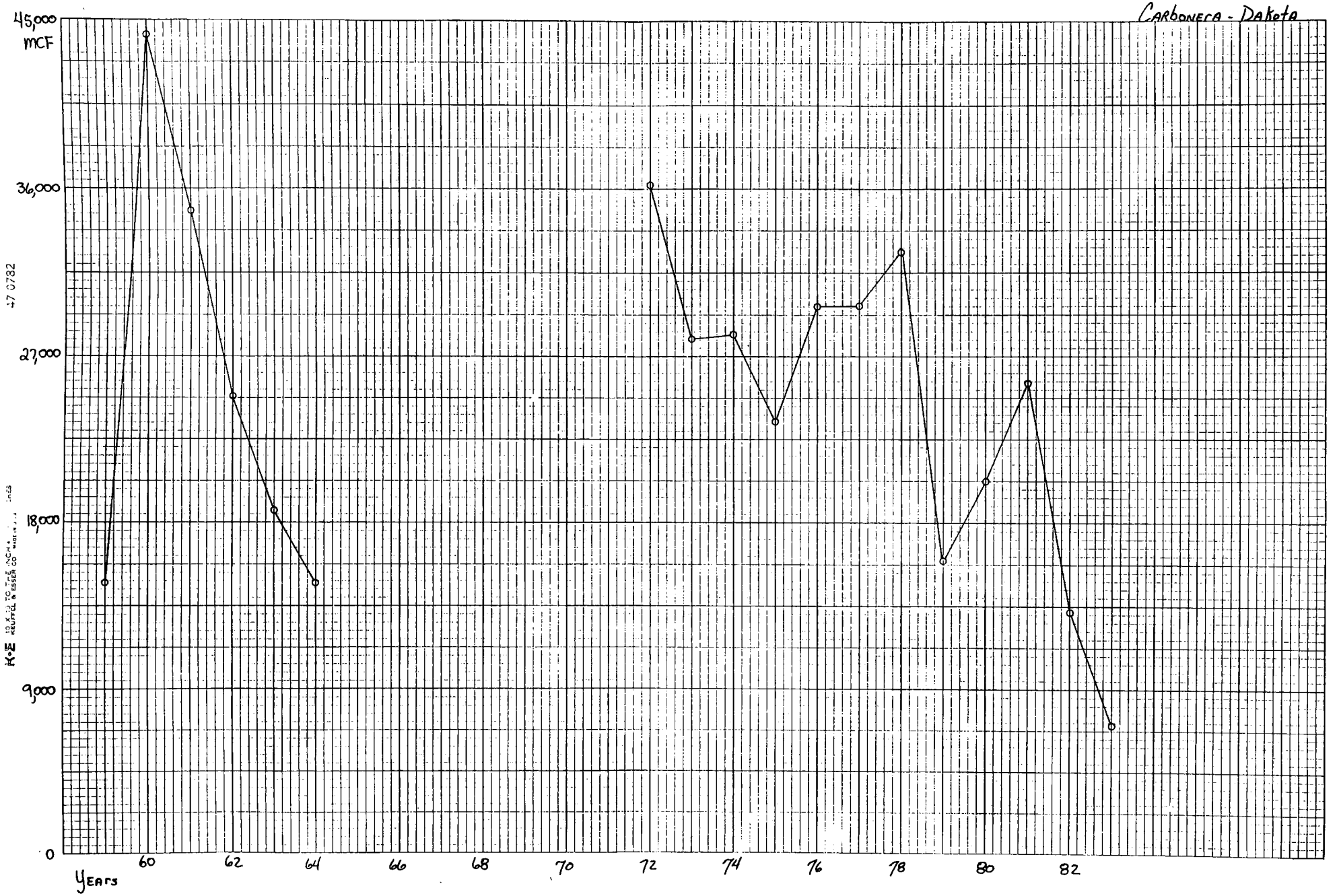

CALF CANYON - DAKOTA
100,000 MCF
80,000
60,000
40,000
20,000
0
500 Bbls.
400
300
200
100
0
Years
82
84

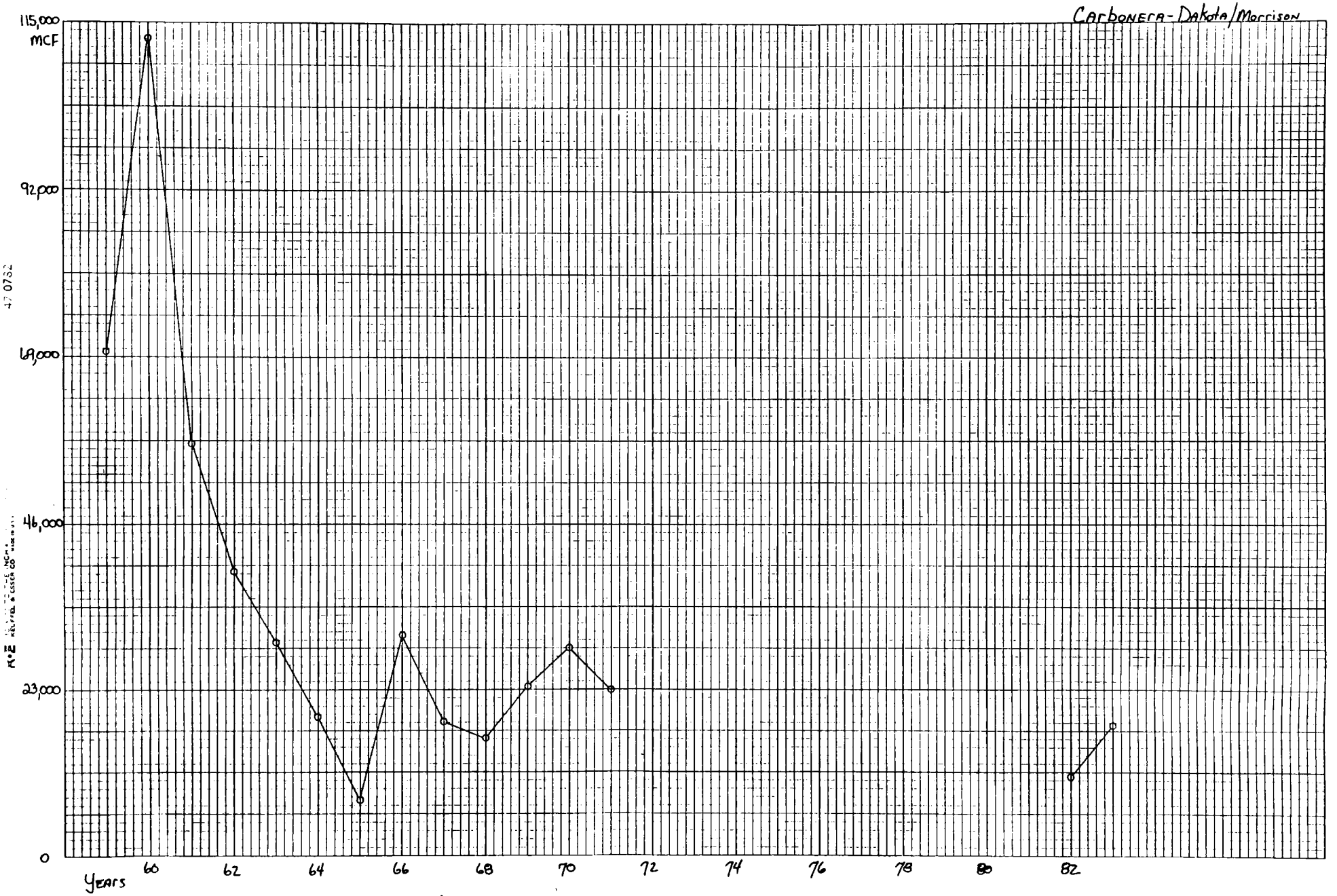

Calf Canyon - Dakota/Morrison
60,000
MCF
48,000
36,000
24,000
12,000
0
Years
82
84

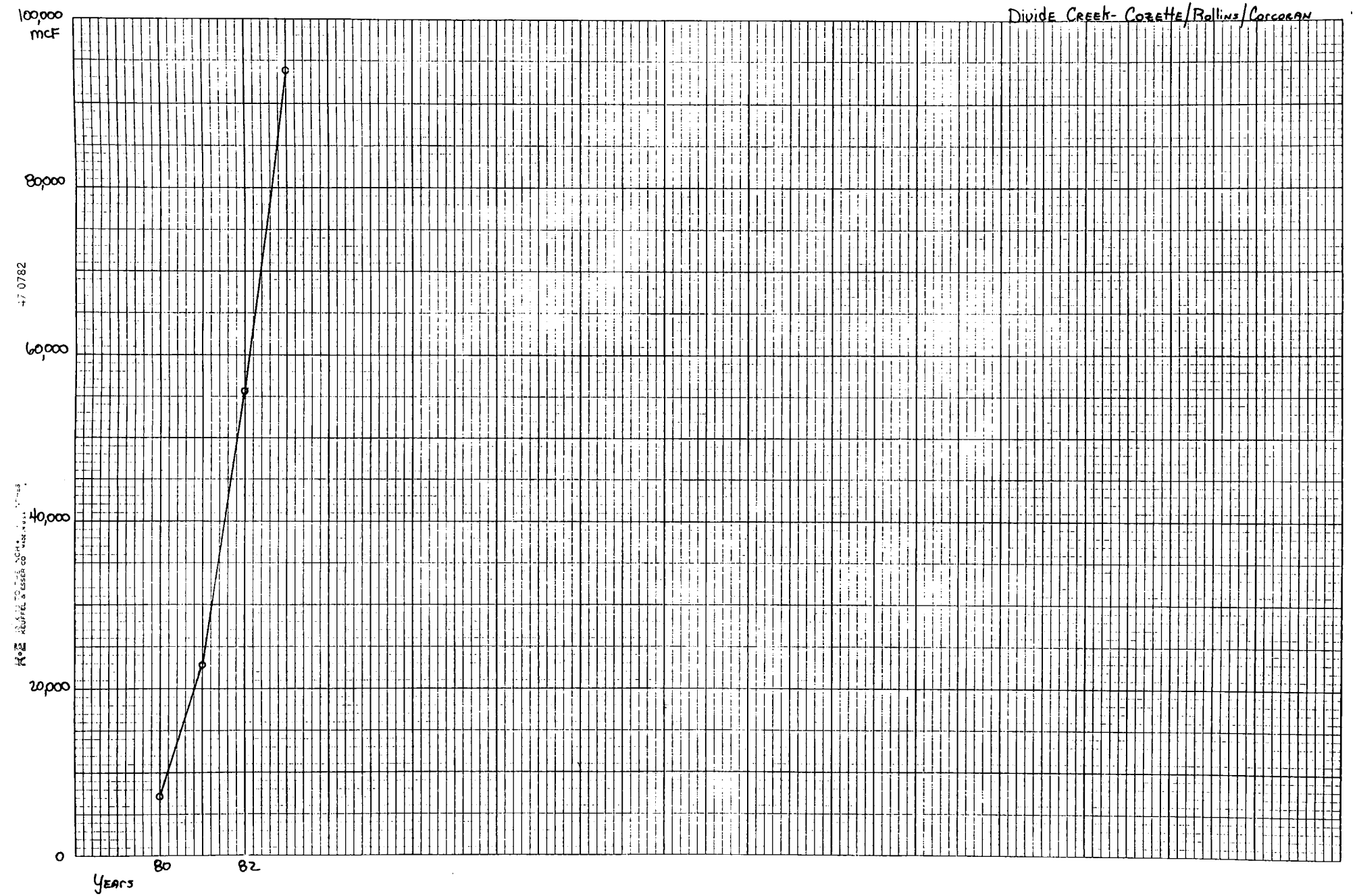

CALF CANYON - MESAVERDE
100,000
MCF
80,000
60,000
40,000
20,000
0
YEARS
82
84
47 0782
KEUFFEL & ESSER CO

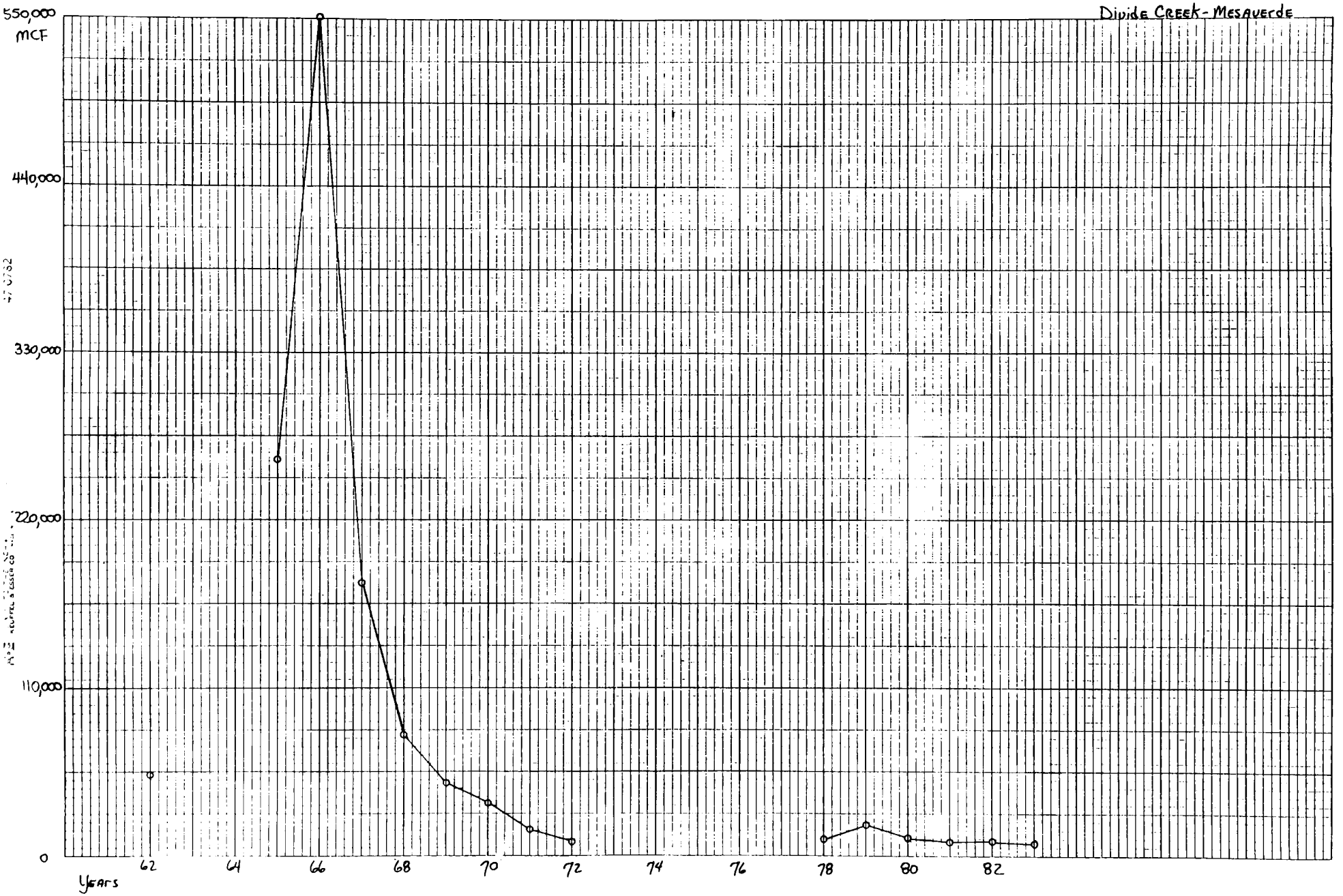
CALF CANYON - Niobrara

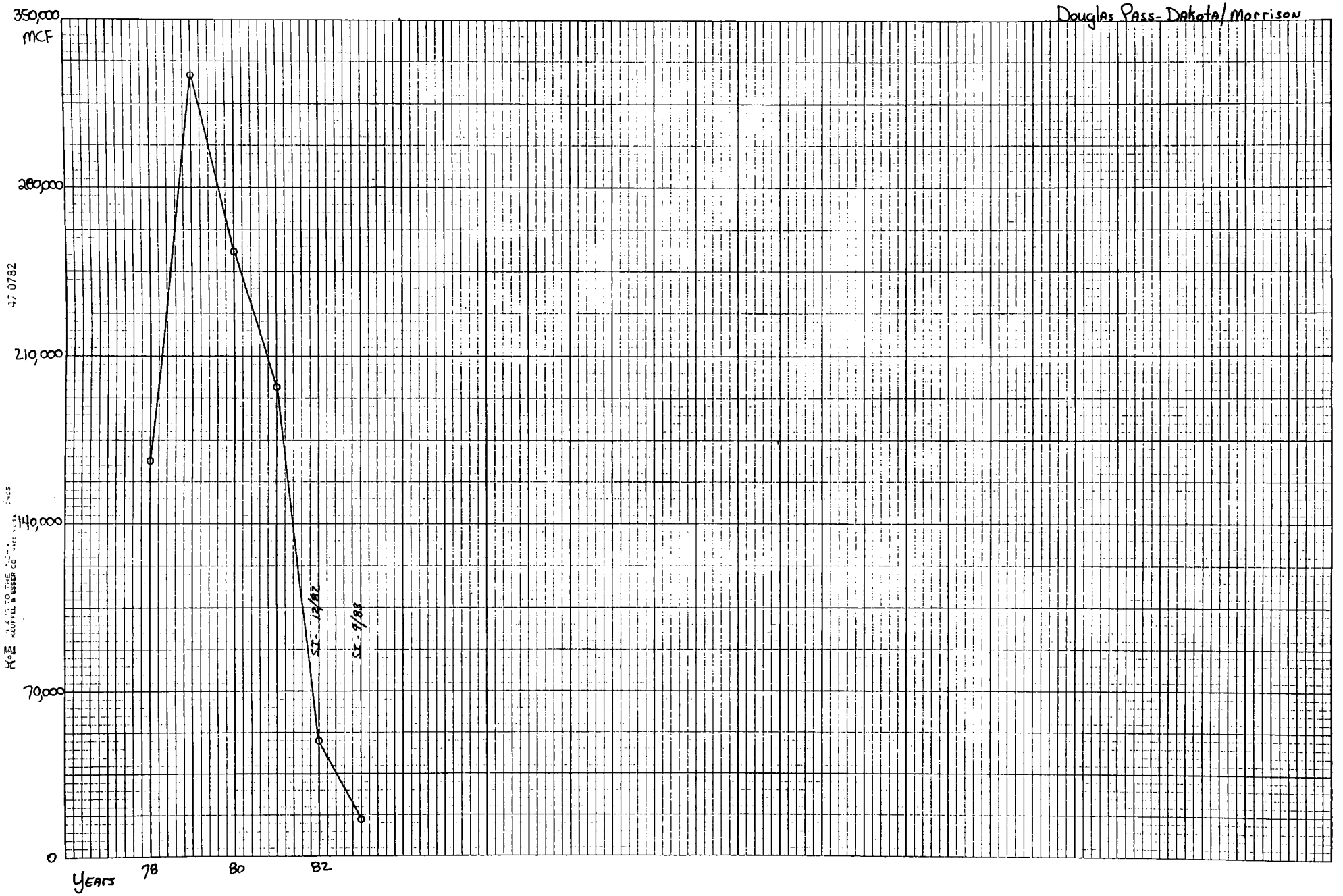


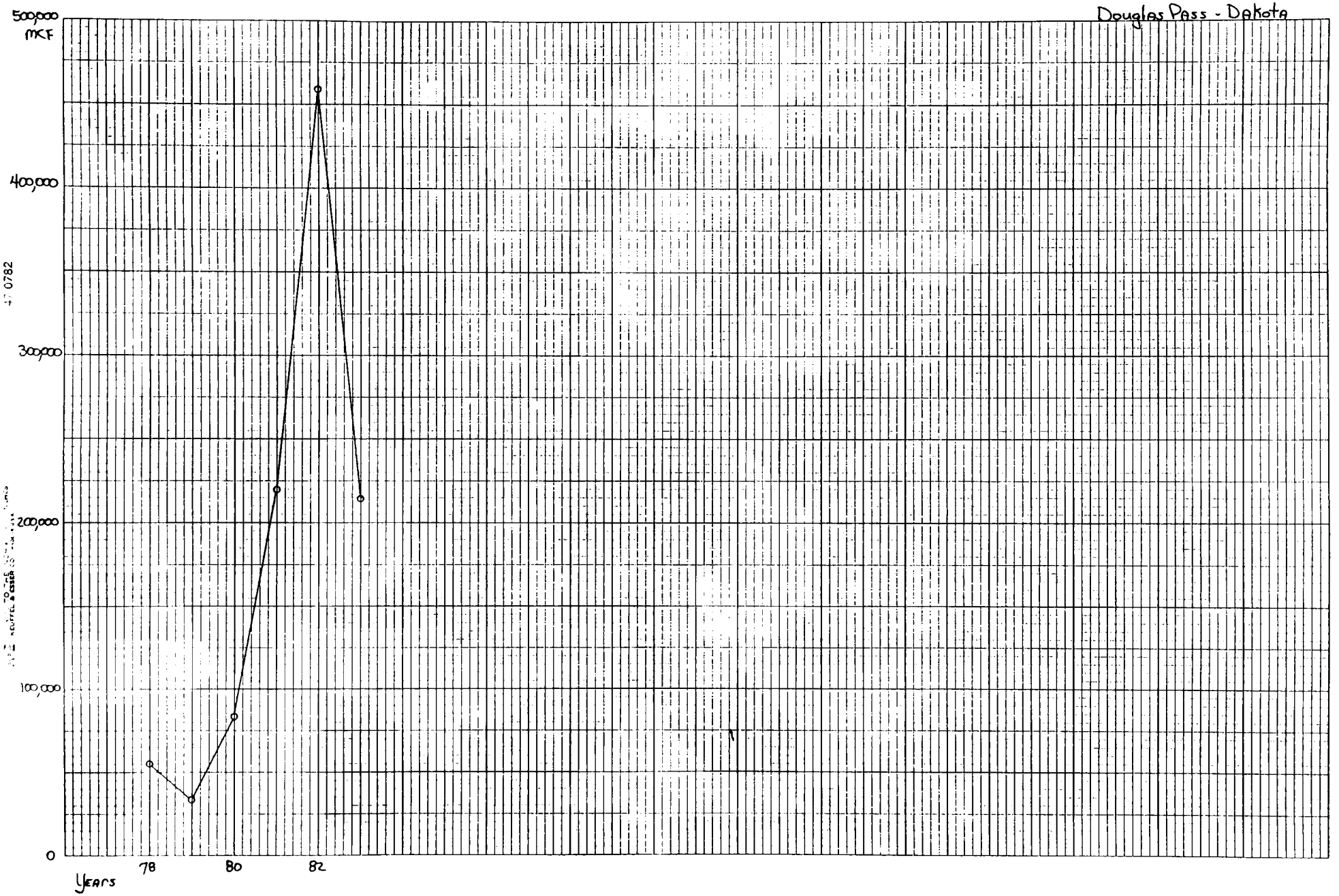

CARBONERA - DAKOTA
45,000
MCF
36,000
27,000
18,000
9,000
0
60
62
64
66
68
70
72
74
76
78
80
82
YEARS

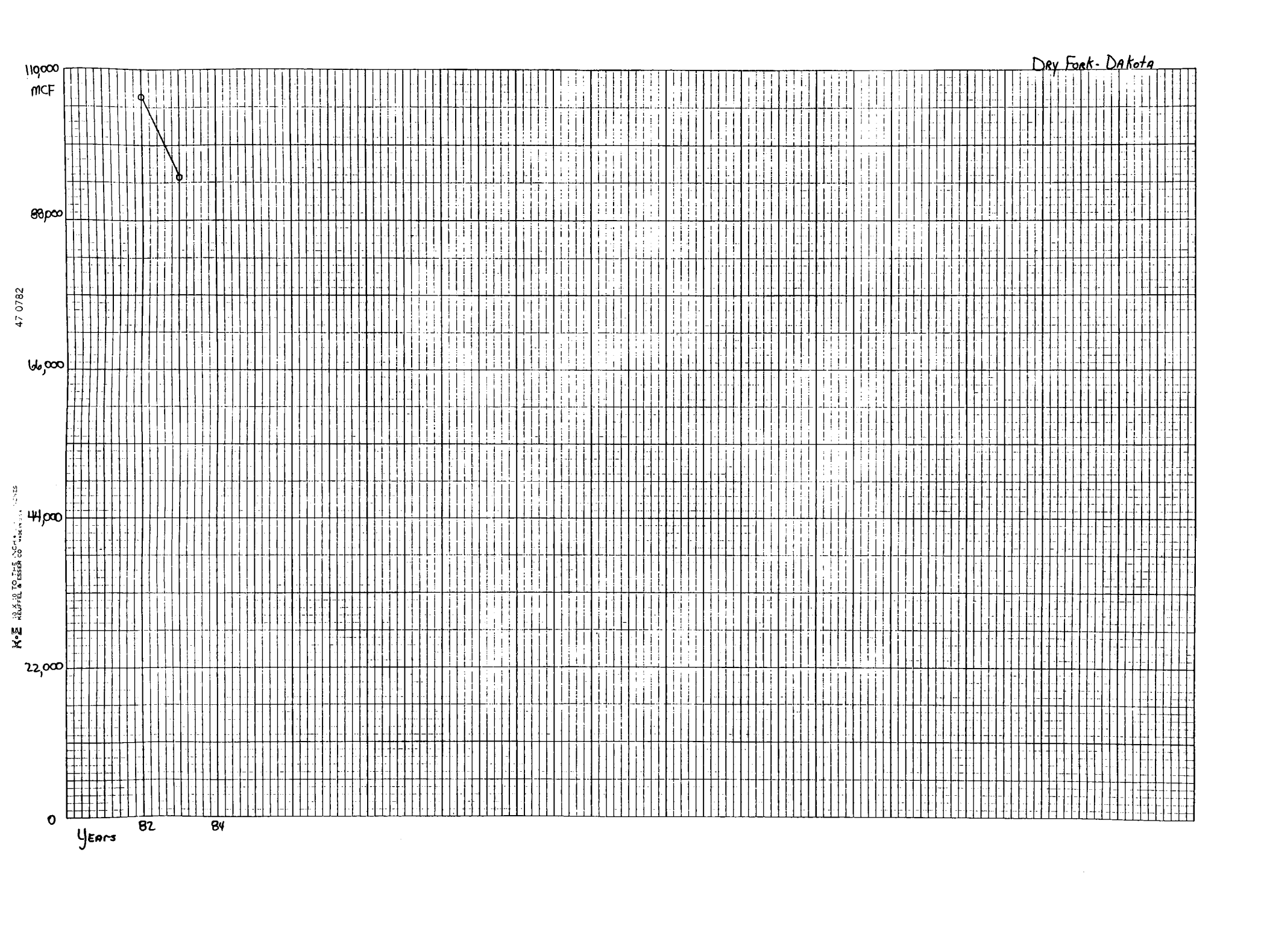

Carbonera - Dakota/Morrison
115,000
MCF
92,000
69,000
46,000
23,000
0
Years
60
62
64
66
68
70
72
74
76
78
80
82

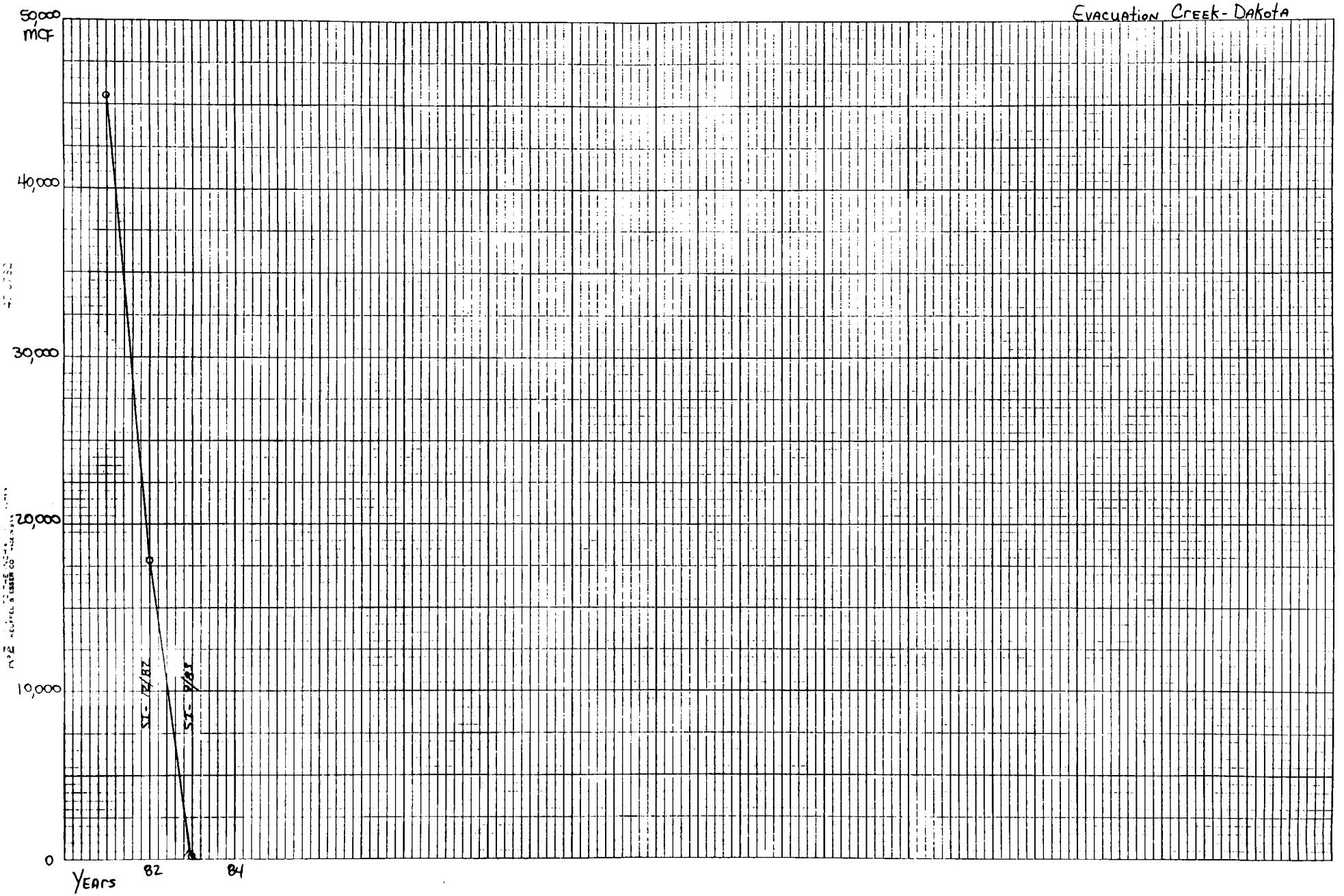

Divide Creek- Cozette/Rollins/Corcoran
100,000
mcf
80,000
60,000
40,000
20,000
0
80
82
Years
47 0782
K-2


Divide Creek - Mesaverde
550,000
MCF
440,000
330,000
220,000
110,000
0
62
64
66
68
70
72
74
76
78
80
82
Years

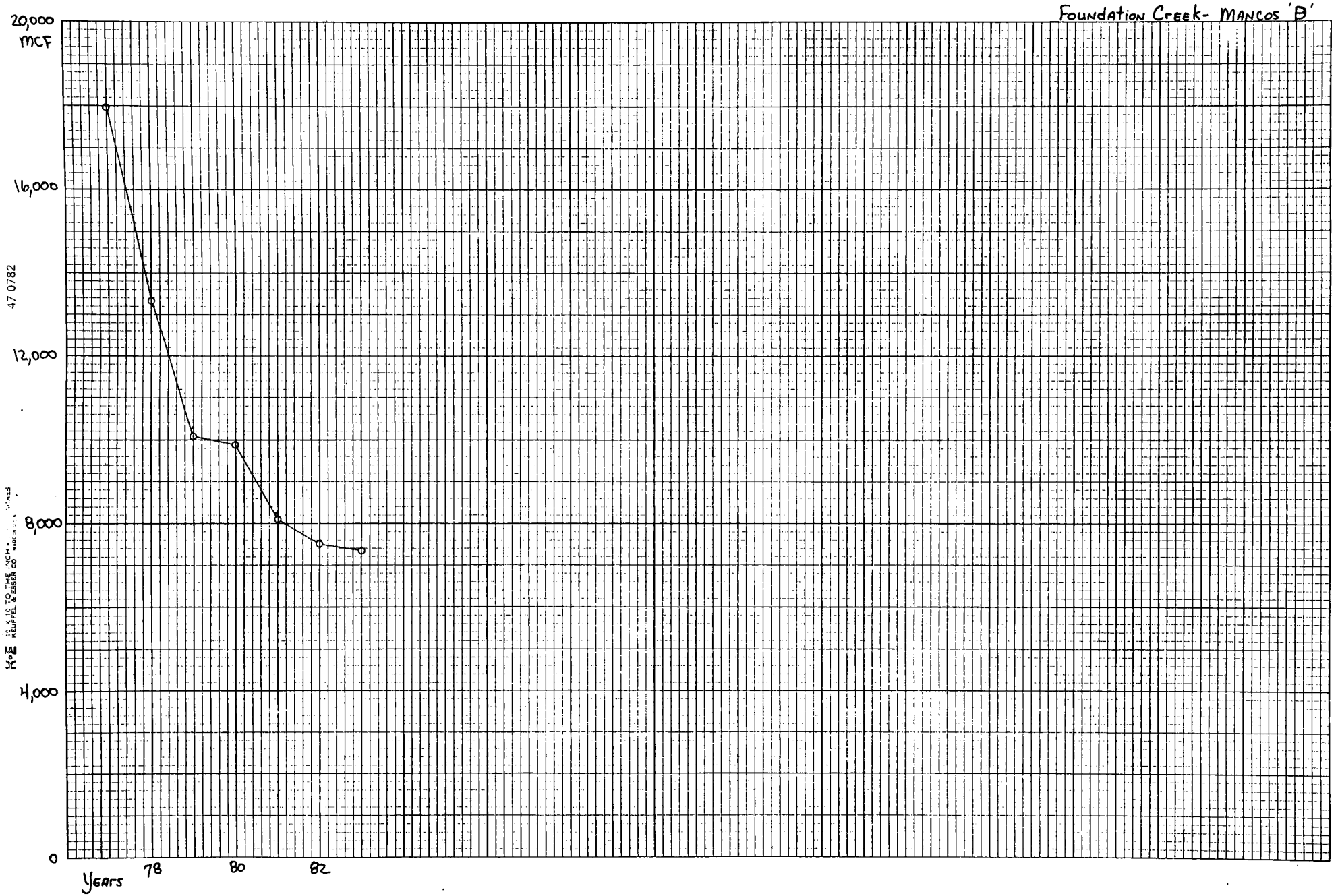

Douglas Pass- Dakota/ Morrison
350,000
MCF
280,000
210,000
140,000
70,000
0
47 0782
St. 12/82
St. 9/82
78
80
82
YEARS


Douglas Pass - Dakota
500,000
MCF
400,000
300,000
200,000
100,000
0
78
80
82
Years


Dry Fork - Dakota
110,000
MCF
88,000
66,000
44,000
22,000
0
82
84
Years
47 0782
KEUFFEL & ESSER CO

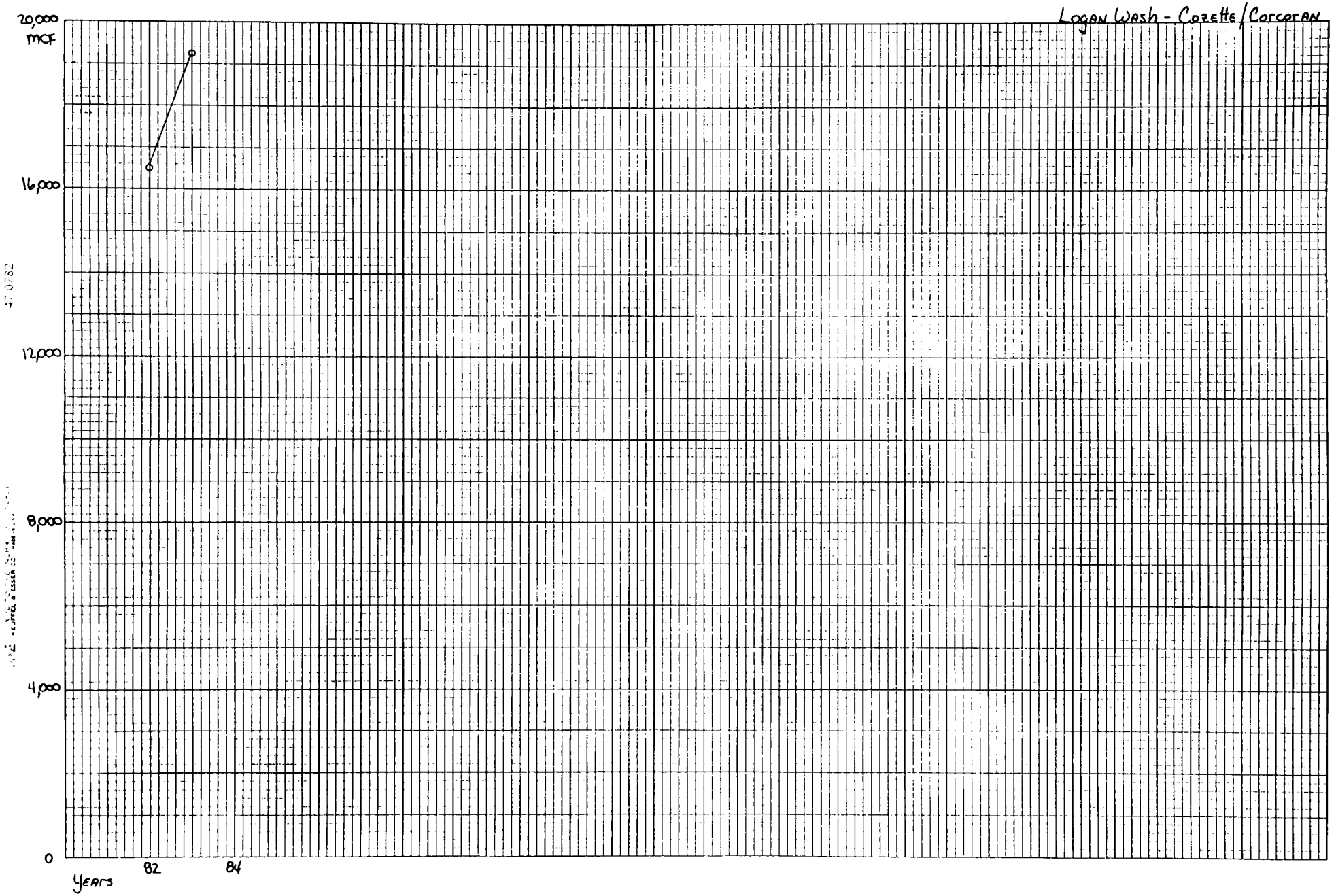

Evacuation Creek - Dakota
50,000
MCF
40,000
30,000
20,000
10,000
0
Years
82
84
SI - 12/87
SI - 8/81

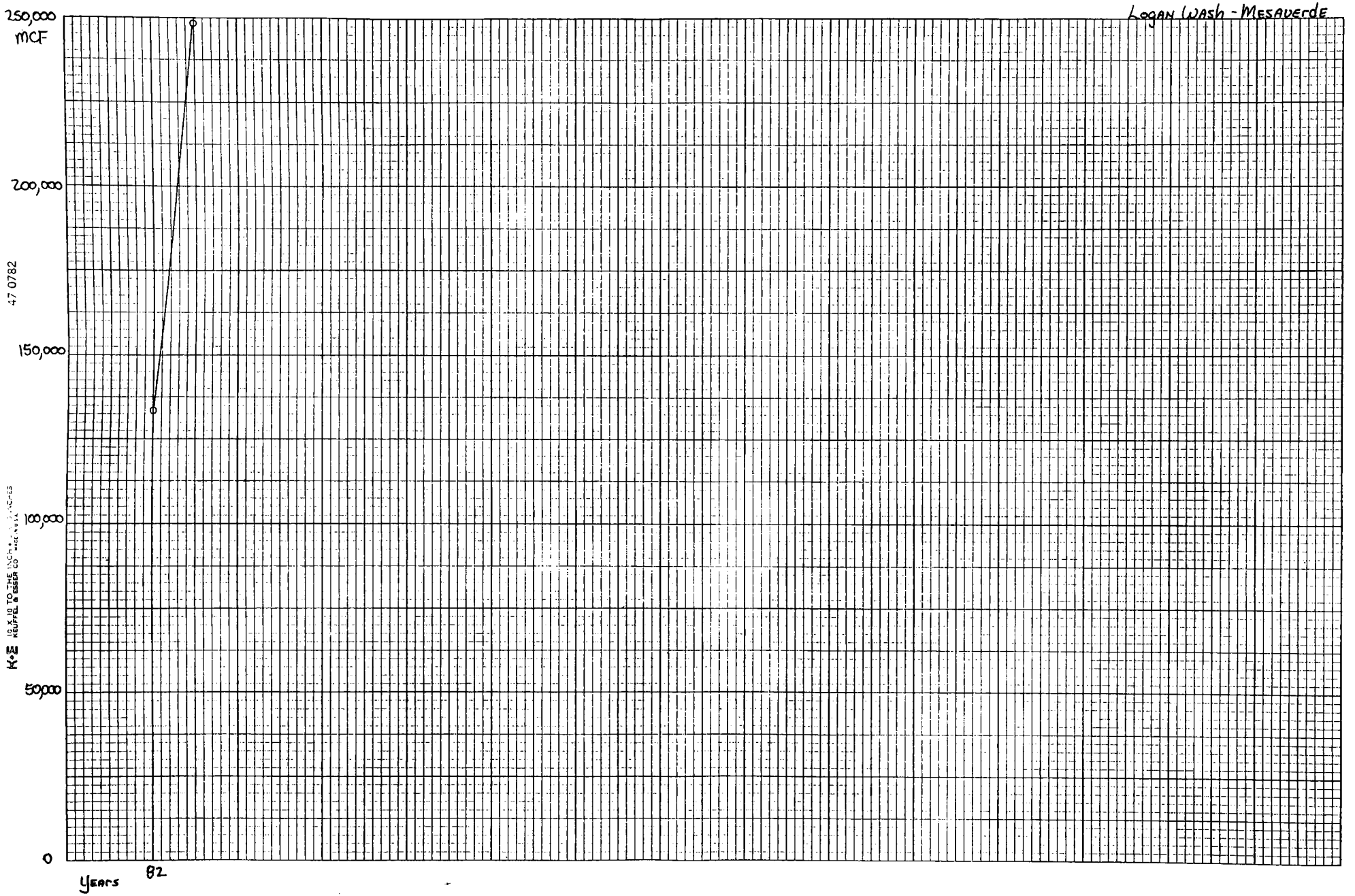
Foundation Creek- Mancos 'B'

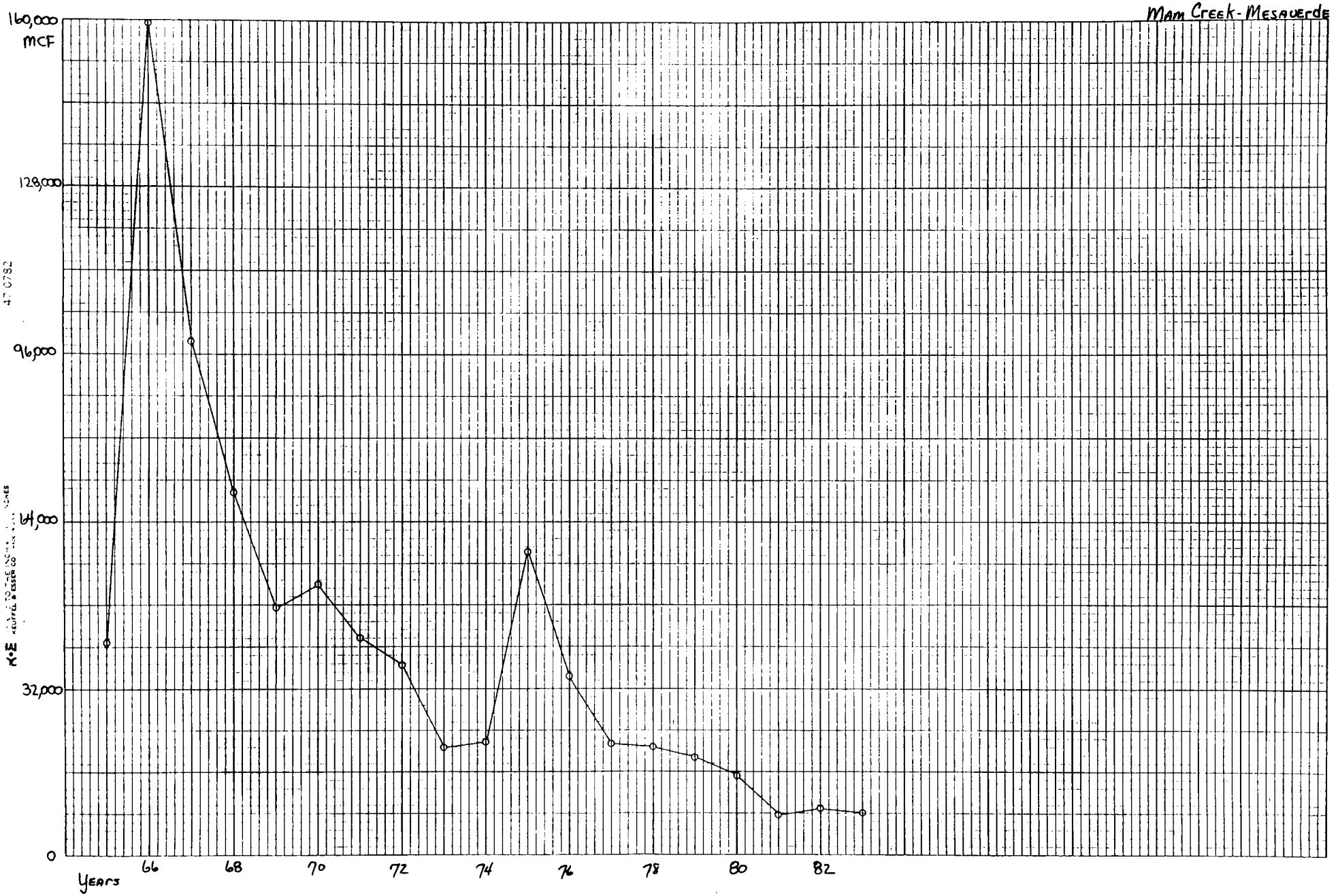


47 0782

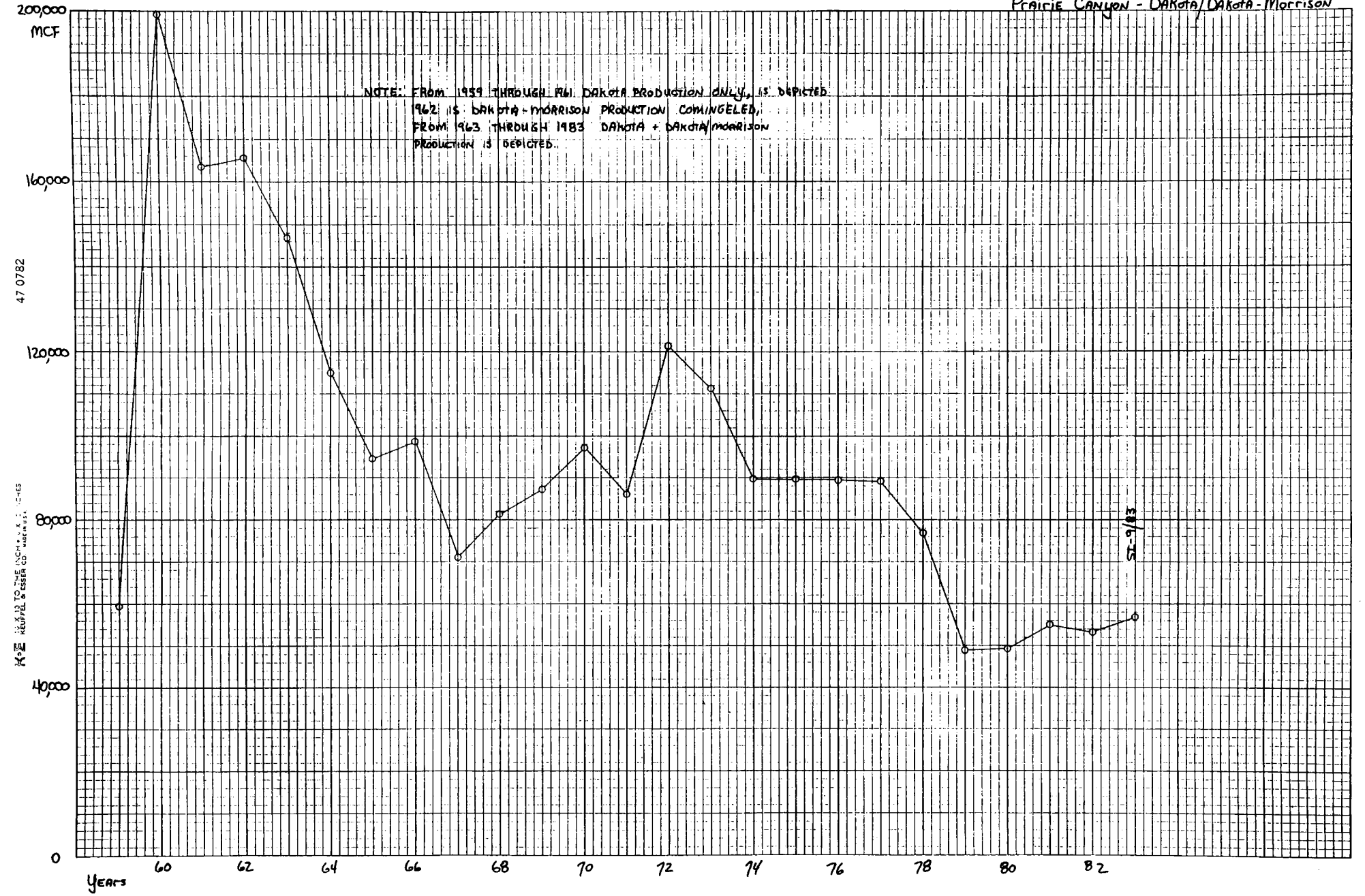
K&E 10 X 10 TO THE INCH
KEUFFEL & ESSER CO.


Logan Wash - Cozette/Corcoran
20,000
MCF
16,000
12,000
8,000
4,000
0
82
84
Years


Logan Wash - Mesaverde
250,000
MCF
200,000
150,000
100,000
50,000
0
Years
82
47 0782
K+E 10 X 10 TO THE INCH KEUFFEL & ESSER CO MADE IN U.S.A.

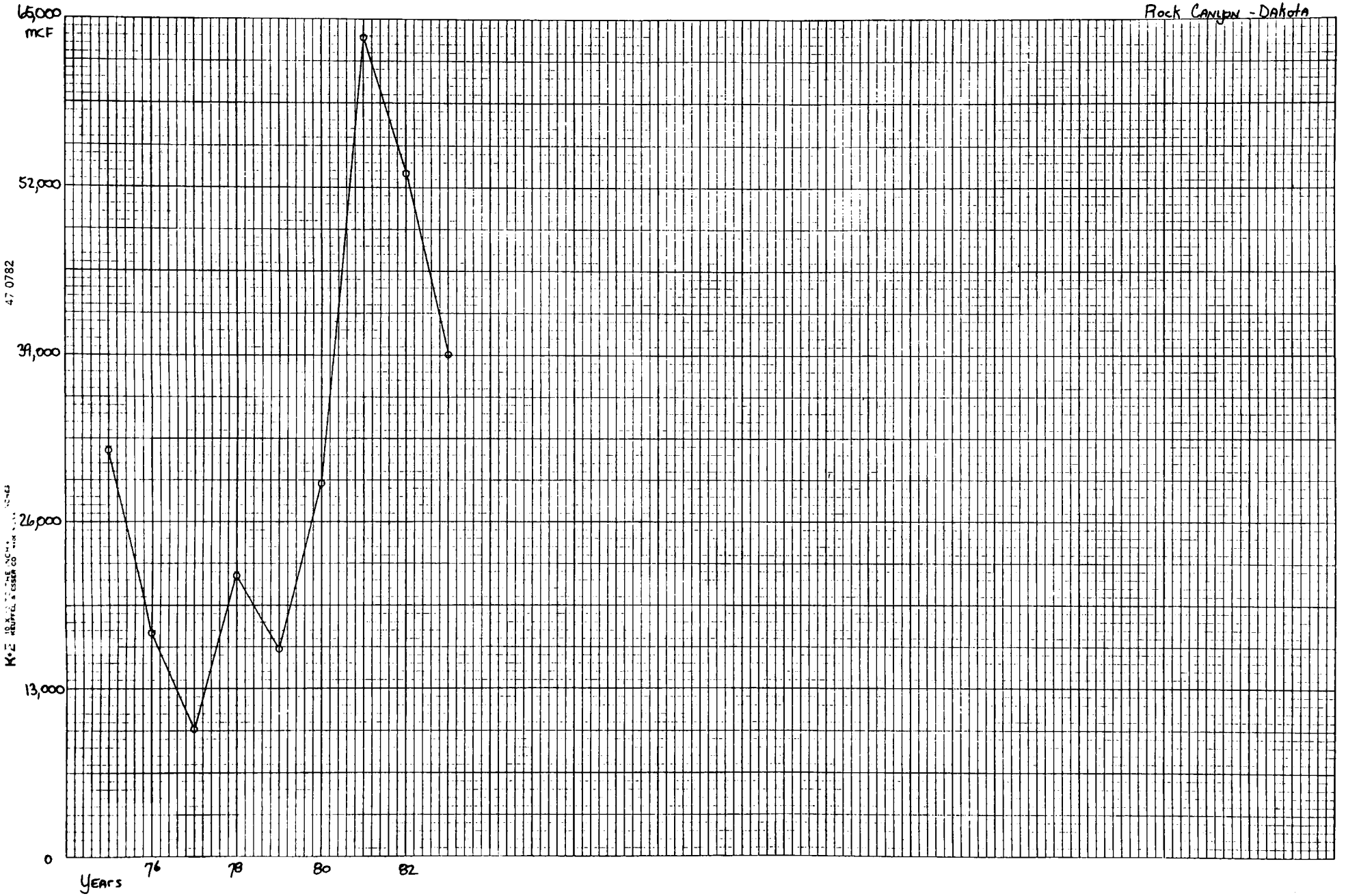

Mam Creek - Mesaverde
160,000
MCF
128,000
96,000
64,000
32,000
0
Years
66
68
70
72
74
76
78
80
82

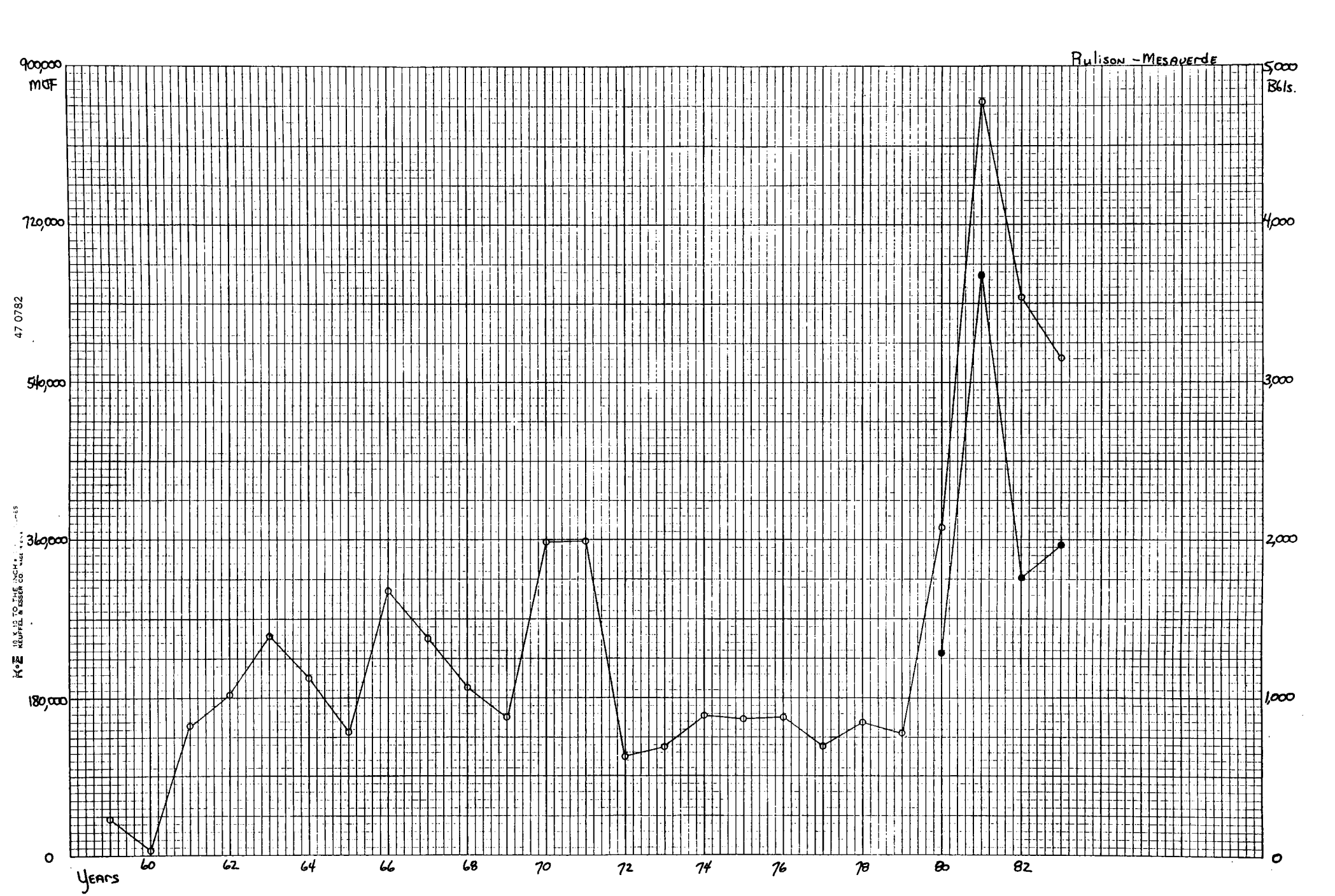
Prairie Canyon - Dakota/Dakota-Morrison

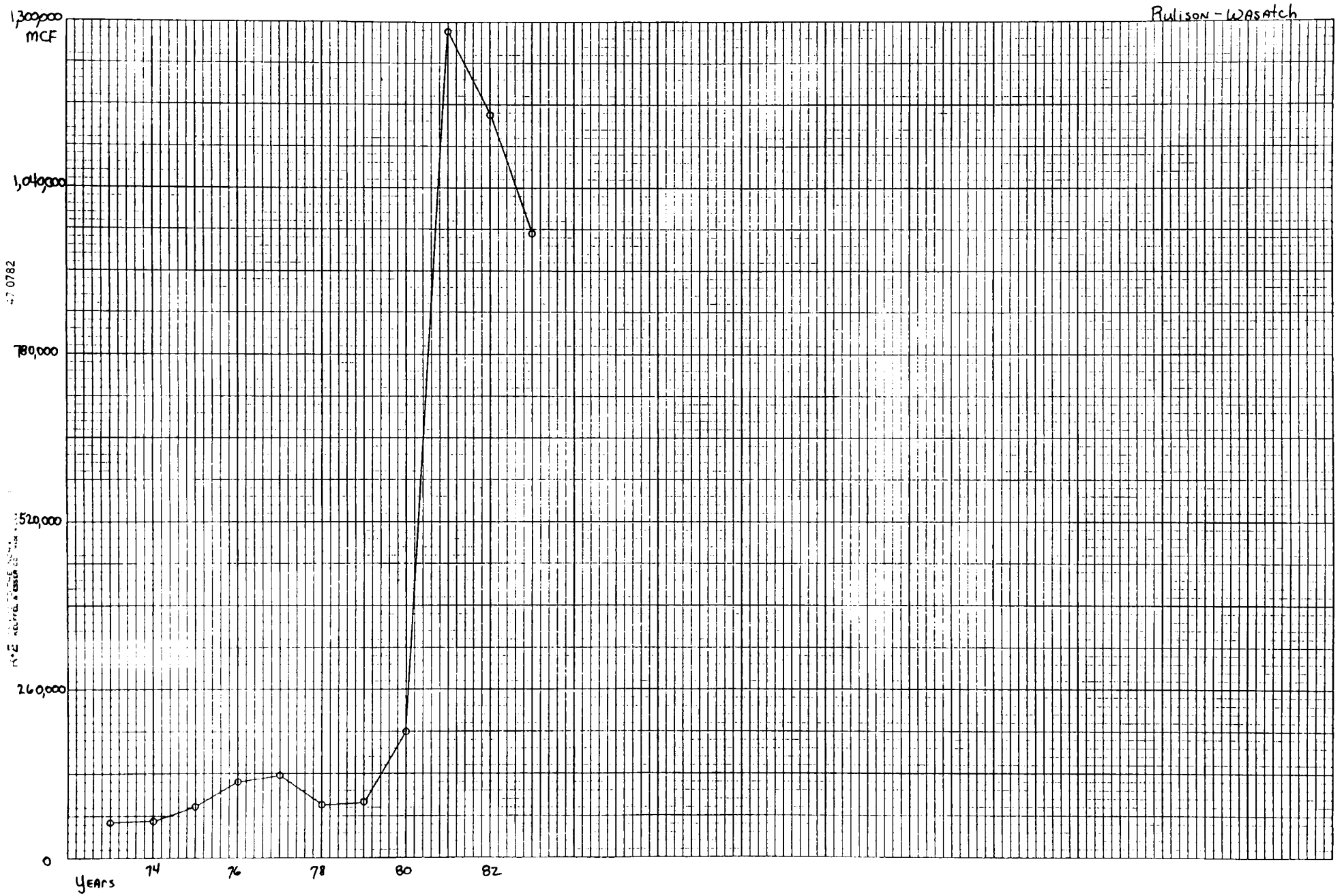


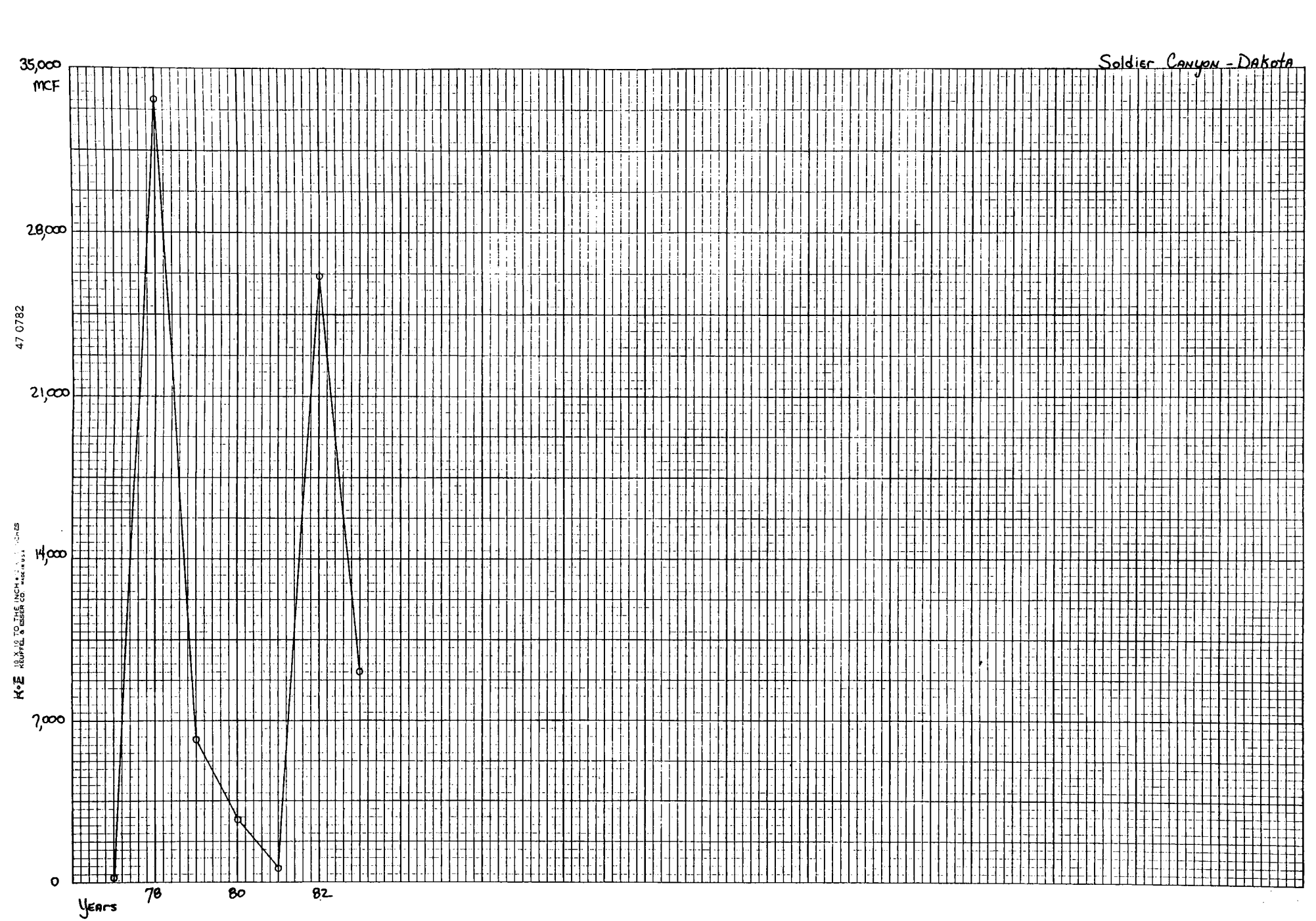
47 0782

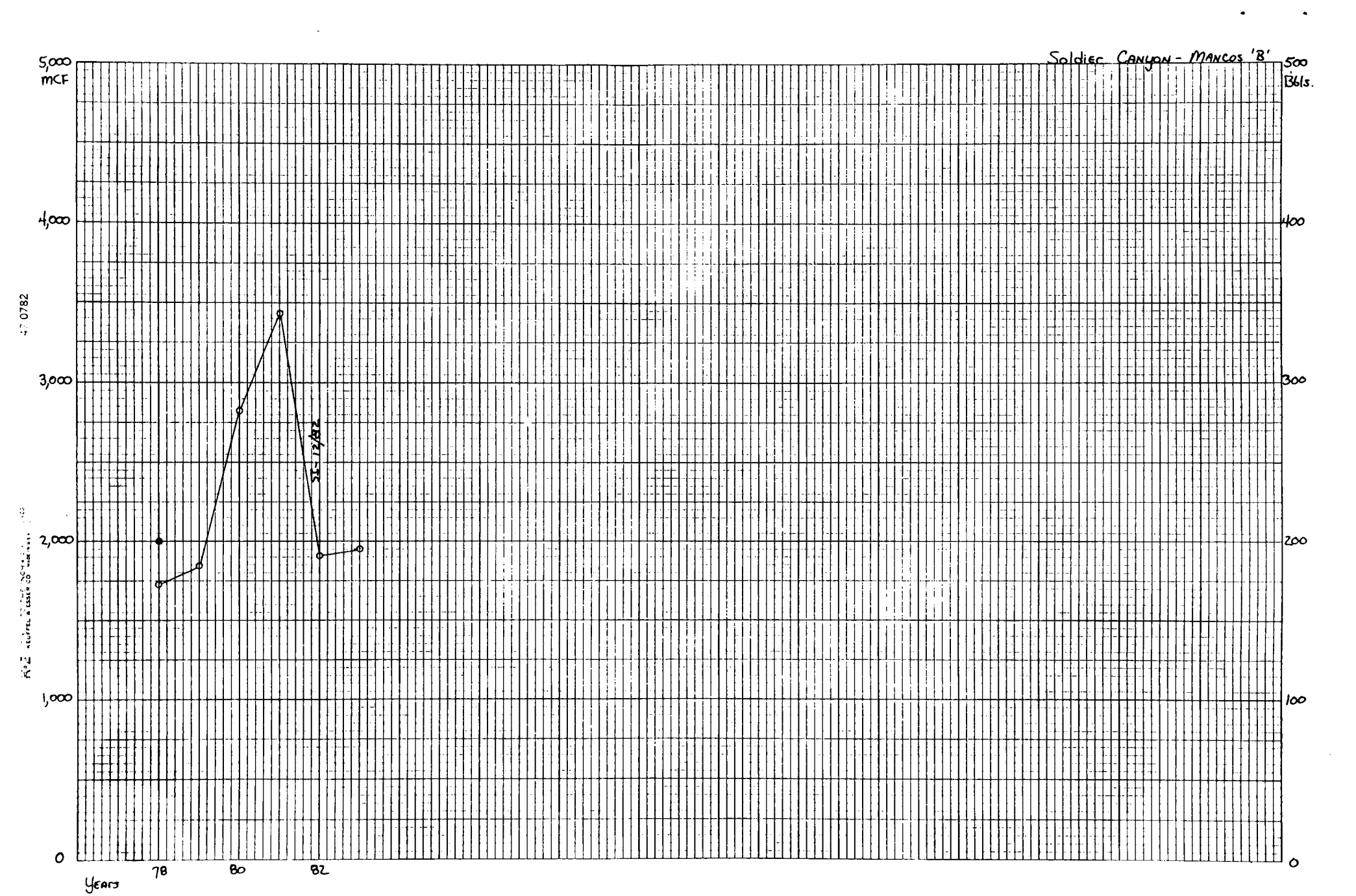
KE 10 X 10 TO THE INCH • KEUFFEL & ESSER CO

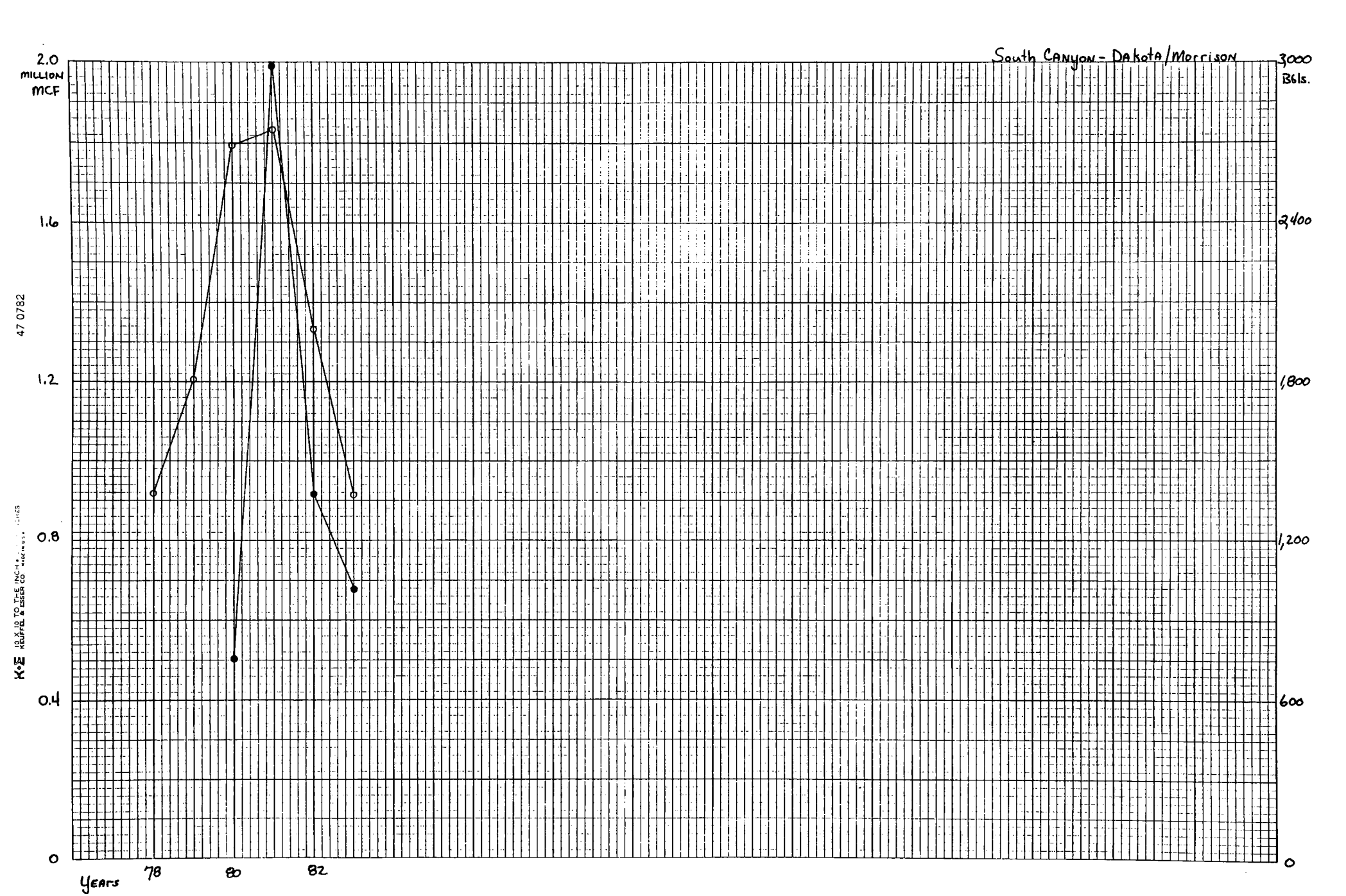

Rock Canyon - Dakota
65,000
MCF
52,000
39,000
26,000
13,000
0
76
78
80
82
Years
47 0782


Rulison - Mesaverde
900,000
MCF
720,000
540,000
360,000
180,000
0
5000
Bbls.
4,000
3,000
2,000
1,000
0
Years
60
62
64
66
68
70
72
74
76
78
80
82
47 0782
KEUFFEL & ESSER CO


Rulison - Wasatch
1,300,000
MCF
1,040,000
780,000
520,000
260,000
0
Years
74
76
78
80
82


Soldier Canyon - Dakota
35,000
MCF
28,000
21,000
14,000
7,000
0
78
80
82
Years
47 0782
K&E 10 X 10 TO THE INCH
KEUFFEL & ESSER CO


Soldier Canyon - Mancos 'B'
5,000
MCF
4,000
3,000
2,000
1,000
0
500
Bbls.
400
300
200
100
0
78
80
82
Years
SI - 12/82


South Canyon - Dakota/Morrison
2.0
MILLION
MCF
1.6
1.2
0.8
0.4
0
3000
Bbls.
2,400
1,800
1,200
600
0
Years
78
80
82
47 0782
K&E 10 X 10 TO THE INCH
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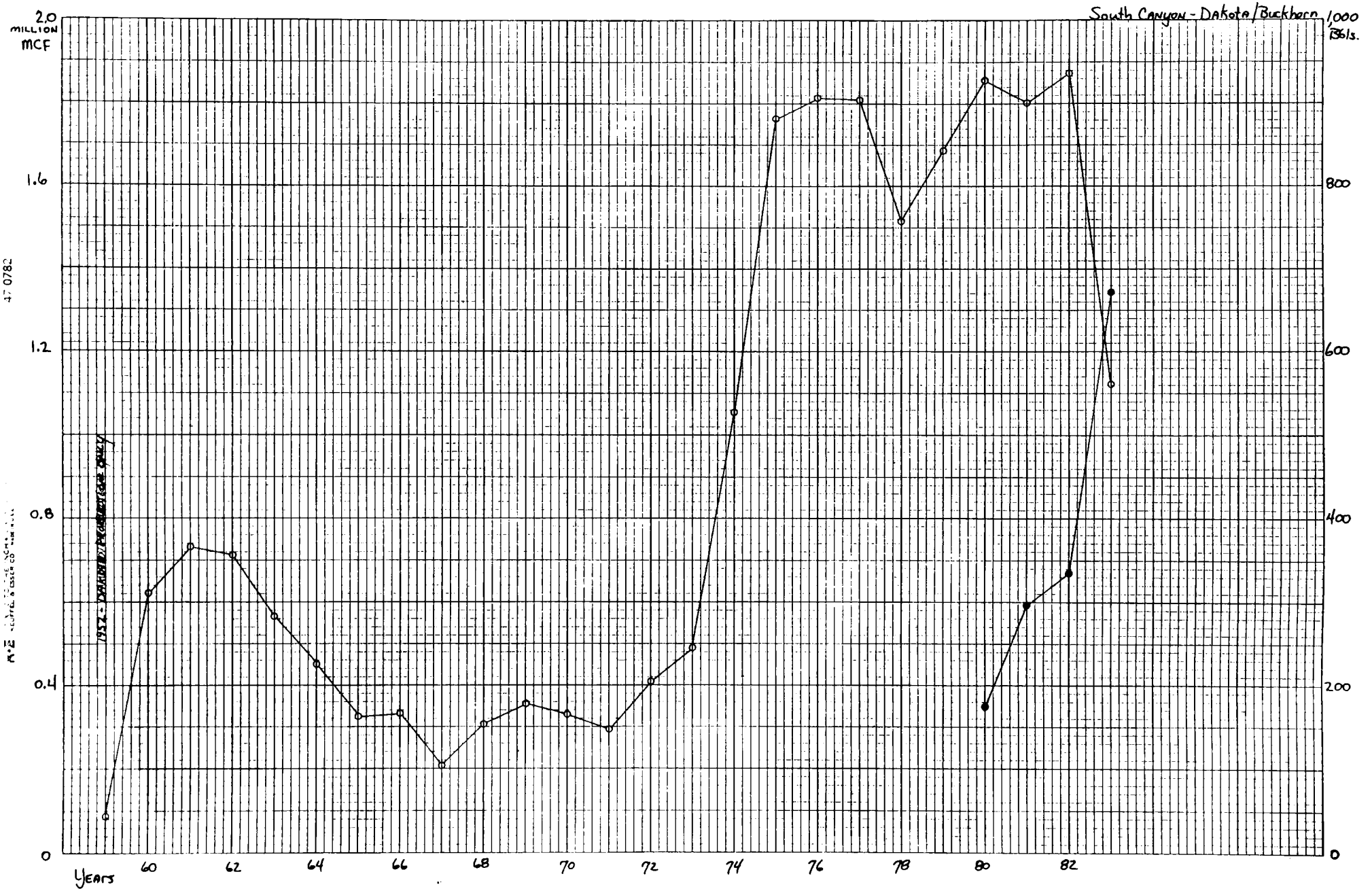
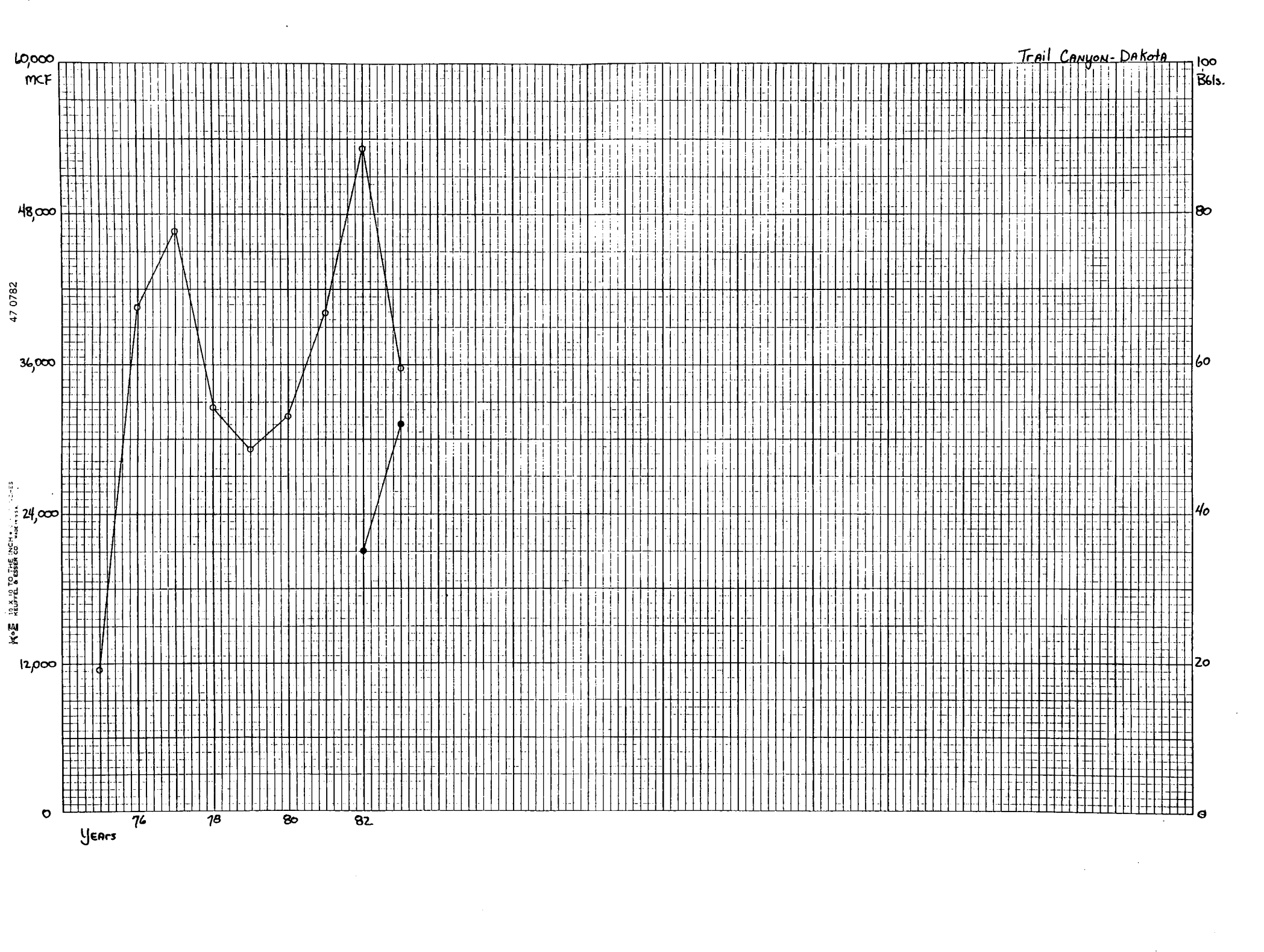
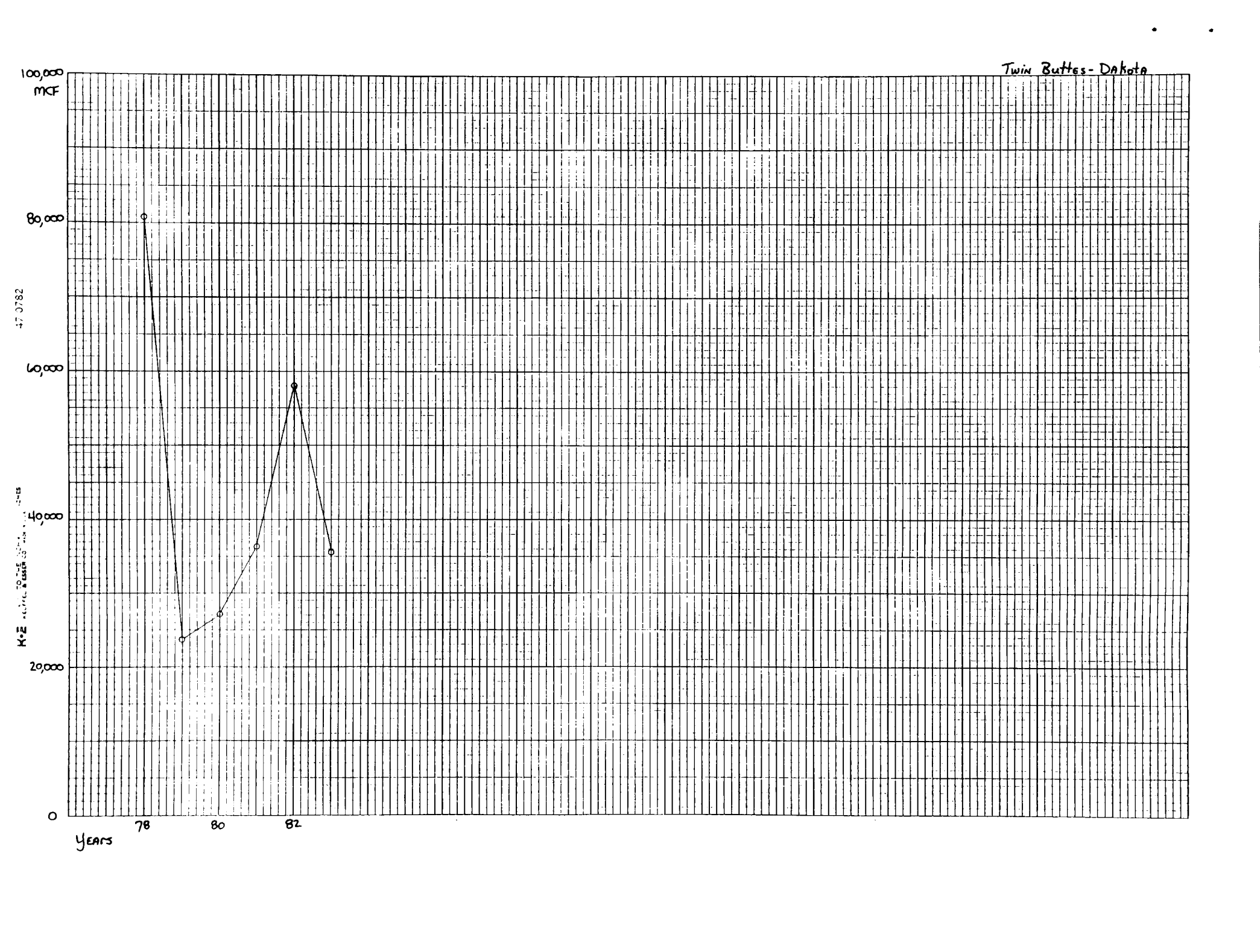
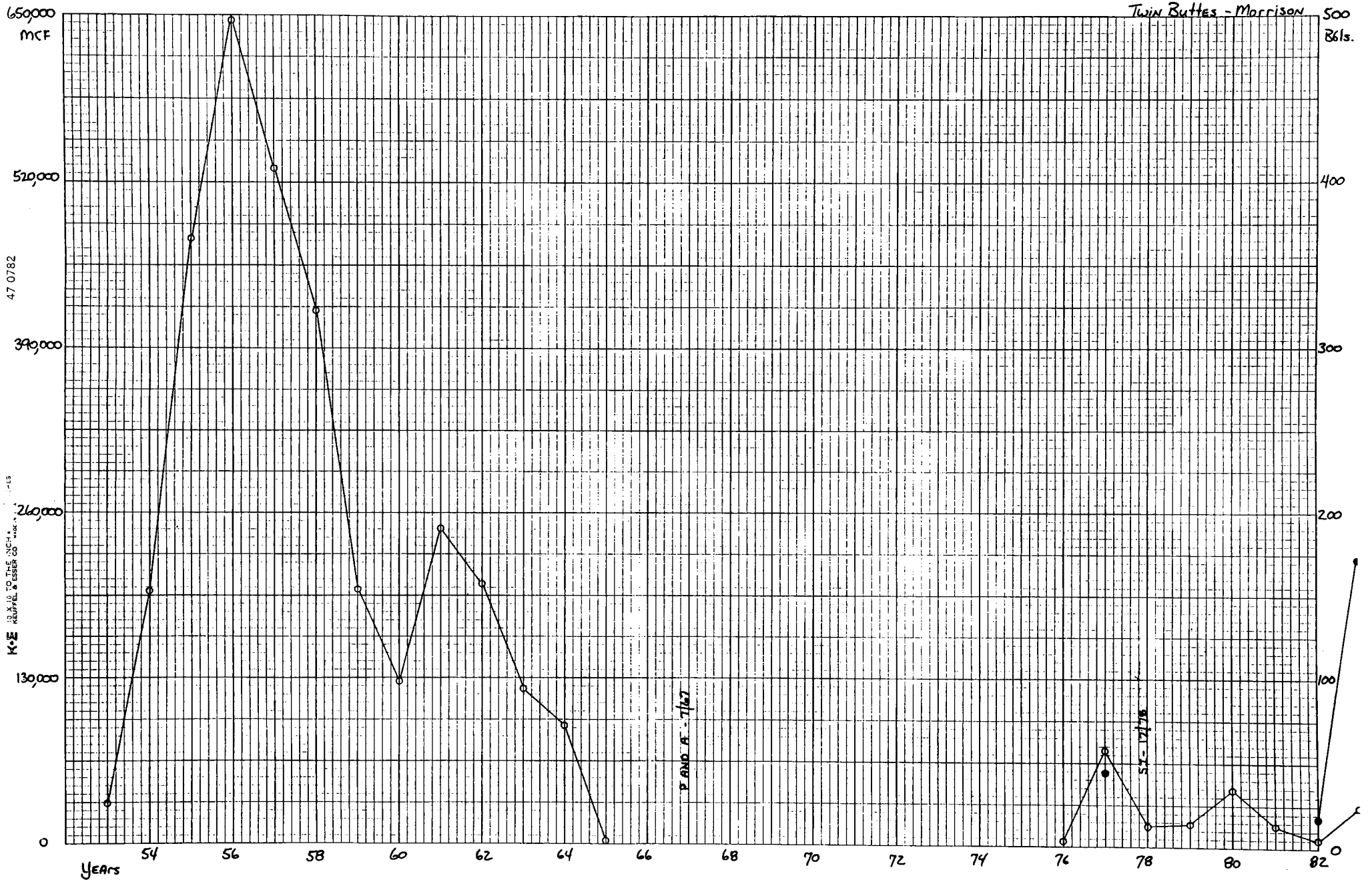

South Canyon - Dakota/Buckhorn
2.0
MILLION
MCF
1.6
1.2
0.8
0.4
0
1,000
BBls.
800
600
400
200
0
Years
60
62
64
66
68
70
72
74
76
78
80
82


Trail Canyon- Dakota
60,000
MCF
48,000
36,000
24,000
12,000
0
100
Bbls.
80
60
40
20
0
76
78
80
82
Years
47 0782


Twin Buttes - Dakota
100,000
MCF
80,000
60,000
40,000
20,000
0
78
80
82
Years


Twin Buttes - Morrison
650,000
MCF
520,000
390,000
260,000
130,000
0
500
Bbls.
400
300
200
100
0
Years
54
56
58
60
62
64
66
68
70
72
74
76
78
80
82
P AND A - 7/67
SI - 12/78
47 0782
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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;
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