FRESHWATER INPUTS TO HUSKY LAKES AND LIVERPOOL BAY

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ABSTRACT

Gushue, W., E.C. Carmack and R.W. Macdonald, 1996. Freshwater inputs to Husky Lakes and Liverpool Bay, Can. Tech. Rep. Hydrogr. Ocean Sci., 175: 23 pp.

Husky Lakes and Liverpool Bay comprise an estuarine system of Canada's Beaufort Sea. This report presents an evaluation of the freshwater budget. We calculate the areas of the various drainage basins and, using available surface-water runoff data from the Water Survey of Canada, estimate yields. The yields for the gauged regions are prorated to ungauged regions to obtain a complete freshwater budget. The total surface area of the drainage basin is 91,400 km^2. The surface areas of Husky Lakes and Liverpool Bay adds an additional 6,300 km^2. The total inflow to the combined system is 7.4 km^3 yr^{-1} which implies a yield of 0.080 m yr^{-1} and an annual mean inflow of 236 m^3 s^{-1}. Data are presented to show the magnitude of annual and inter-annual variability.

keywords: Freshwater budget, Husky Lakes, Liverpool Bay, precipitation, runoff

RESUMÉ

Gushue, W., E.C. Carmack and R.W. Macdonald, 1996. Apports d'eaux douces aux lacs Husky et à la baie Liverpool, Can. Tech. Rep. Hydrogr. Ocean Sci., 175: 23 pp.

Les lacs Husky et la baie Liverpool forment un système estuarien dans la partie canadienne de la mer de Beaufort. Nous avons calculé les surfaces de divers bassins de drainage et en utilisant les données de ruissellement des eaux de surface de la Division des relevés hydrographiques du Canada, nous avons estimé la lame d'eau ruisselée. Les résultats des régions avec relevés ont été extrapolés aux régions non répertoriées pour obtenir un bilan complet des eaux douces. La surface totale du bassin de drainage est de 91,400 km^2 auquel s'ajoute une surface de 6,300 km^2 pour les lacs Husky et la baie Liverpool. Le débit total du système complet est de 7.4 km^3 an^{-1} ce qui signifie une lame d'eau ruisselée de 0.080 m an^{-1} et un débit annuel moyen de 236 m^3 s^{-1}. Enfin, les données présentées démontrent l'ampleur des variations annuelles et inter-annuelles.

Mots-clés: Bilan d'eaux douces, lacs Husky, baie Liverpool, précipitation, ruissellement

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1. INTRODUCTION

In this report we provide a preliminary assessment of freshwater inputs to the Husky Lakes and Liverpool Bay areas of the Northwest Territories (Figure 1). While runoff from Canada's major arctic river, the Mackenzie, has been measured at a series of sites and is well documented, this discharge is not necessarily indicative of the hydrological cycle for smaller northern rivers. Indeed, the Mackenzie River itself, cannot be considered typical of an arctic river because much of its basin lies south of the tree line and much of the flow derives from large headwater lakes. It is expected, therefore, that smaller rivers adjacent to the arctic coast will be more variable on annual and interannual time scales, and will exhibit runoff characteristics (e.g., timing of freshet, duration of discharge, volume of flow) that may have important regional consequences to arctic estuaries.

The Husky Lakes and Liverpool Bay systems lie east of the Mackenzie delta (between latitudes 66° and 71° N and 122° to 135° W). These estuarine systems discharge freshwater directly into the Beaufort Sea. The combined drainage of the two basins is approximately 91,400 km^2. The drainage basin, shaped by Quaternary continental ice sheets interacting with the low lying ancient shield bedrock, has elevations rarely exceeding 300 metres, and is comprised of numerous lakes, rivers, and marshes showing little orientation (Burns, 1972).

The annual estimated mean precipitation for the region varies from about 13 to 38 cm yr^{-1} (Burns, 1972). However, accurate and representative precipitation measurements are difficult to obtain in extreme northern climates due to spatial variability, temperature extremes and redistribution of snow by winds. Here we use gauged runoff to compute the yield (volume over area) and this is compared with precipitation estimates where available.

2. METHODS

2.1 Area and Discharge Calculations

Areas for the entire drainage basin and for subcomponents of the drainage basin were calculated (Figure 1); the subcomponents include four gauged and three ungauged regions. Four 1:1 000 000 scale maps (Department of Energy, Mines, and Resources maps: Firth River (2062), Horton River (2061), Great Bear River (2079), Peel River (2078)) were used to planimeter basin areas. The Lambert Conformal Conic used in these maps is an equal area projection.

Historical annual discharge for each of the four gauged drainage systems was compiled from records collected by Water Survey of Canada at gauging stations 10NCOO1 (GS2 on Figure 1), 10NAOO1 (GS3), 10ND002 (GS5), and 10ND004 (GS6) (Environment Canada, 1992). This value was then used to estimate an annual yield in m yr^{-1}.

The final calculation was to extrapolate the mean yield of the gauged regions to the ungauged regions to obtain a total area yield. Calculations were done separately for the Husky Lakes and Liverpool Bay drainages.

Timing of precipitation within the year was calculated using the monthly and yearly discharge data (historical data) for each of the four gauged drainage basins. These data were then used to generate hydrographs.

2.2 Total Precipitation Calculations

The variability of precipitation throughout the study area and the difficulty in making representative precipitation measurements makes generalization of a few precipitation measurements to the entire region questionable. For this reason evaporation and transpiration rates, and discharge to precipitation rates/ratios were only possible for one meteorological station area in the study region.

Total precipitation for Inuvik Airport and the Tuktoyaktuk Airport (just outside the drainage region) were calculated from Environment Canada's Atmospheric Environment Service publication "Monthly Record of Meteorological Observations in Canada," 1986, 1987, 1988, 1989. The normal expected precipitation numbers were used to create total expected precipitation numbers for the two sites. The Inuvik Airport numbers were then used to compare runoff timing and amounts to total precipitation timing and amounts. Finally, a ratio of precipitation to runoff was calculated.

The predominant source of error is in the extrapolation of calculated drainage basin discharge rates onto ungauged drainage basins. This assumes a homogeneous system, e.g., uniform vegetation, slope, bedrock, precipitation regime, and temperature. A second uncertainty derives from direct precipitation onto water surfaces; it is difficult to estimate direct precipitation onto the Husky Lakes and Liverpool Bay, which comprise about 6.5% of the drainage basin. Planimeter measurement errors were estimated to be small.

3. RESULTS AND CONCLUSIONS

3.1 Discharge and Yield Estimates

The combined area of land draining into Husky Lakes (7,462 km^2) and Liverpool Bay (83,953 km^2) is estimated to be 91,400 km^2. The surface areas of Husky Lakes (1,690 km^2) and Liverpool Bay (4,619 km^2) contribute an additional 6,300 km^2 to the drainage basin, bringing the total precipitation catchment area to 97,700 km^2 (Table 1).

Mean discharge rates for gauging stations and their corresponding drainage basins are summarized in Table 1. Region 2 (gauged at GS2) has the largest discharge at 3.08 $km^3\ yr^{-1}$. The contribution from Region 3 (gauged at GS3), which also flows through GS2, is accounted for by subtraction. Region 3 (gauged at GS3) has the second highest discharge at 1.42 $km^3\ yr^{-1}$. Regions 5 (0.007 $km^3\ yr^{-1}$) and 6 (0.028 $km^3\ yr^{-1}$) have lower discharge rates reflecting their smaller areas.

Yields from the four gauged regions are similar: Region 2 is 0.088 m yr^{-1}; Region 3 is 0.066 m yr^{-1}; Region 5 is 0.123 m yr^{-1}; and Region 6 is 0.088 m yr^{-1}. The yield for the Husky Lakes drainage basin alone (based on Regions 5 and 6) is 0.095 m yr^{-1} producing an annual runoff of 0.71 $km^3\ yr^{-1}$. Similarly, the yield for Liverpool Bay (based on Regions 2 and 3) is 0.080 m yr^{-1} producing an annual runoff of 6.72 $km^3\ yr^{-1}$. This total annual runoff into Husky Lakes and Liverpool Bay is, therefore, 7.43 $km^3\ yr^{-1}$; this inflow implies an average input of 236 $m^3\ s^{-1}$. The weighted average yield of the four gauged regions is found to be 0.080 m yr^{-1} (this figure is mostly a reflection of Regions 2 and 3 which are much larger (Figure 1)). We note this value is much lower than the yield of 0.173 m yr^{-1} computed for the whole arctic region by Walsh *et al.* (1994).

3.2 Annual and Inter-annual variability

Discharges within the Husky Lakes and Liverpool Bay drainages are highly seasonal (Figures 2 to 10; Tables 2-10). This variability demonstrates the need for long-term data to produce reliable estimates of mean discharge and yield. This annual and interannual variability will have important consequences to the estuarine circulation and must be taken into account in circulation modeling.

3.3 Precipitation Budgets

Regional precipitation ranges from 130 to 380 mm yr^{-1} (Burns, 1972). For Inuvik and Tuktoyaktuk Airports mean values are 267 and 163 mm yr^{-1}, respectively (Table 11,

Figure 12). Using the Inuvik precipitation value, and the yield of the Trail Valley Creek basin near Inuvik (Region 5, GS5), the ratio of runoff to precipitation is calculated to be 0.31. Hence, based on this comparison using sparse precipitation data, about one-third of the direct precipitation enters the fluvial system, while the remainder is lost through evaporation, sublimation, and storage. We note this ratio is much lower than that found by Walsh et al., 1994) for the Arctic domain (0.74), but is consistent with the findings of Marsh and Bigras (1988) that evaporation is an important component of the water balance in the Mackenzie delta region.

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Table 1. Drainage Delineation Area Measurements

land	area (km^2)	historical mean discharge (km^3/yr)	1992 mean discharge (km^3/yr)	historical yield (m/yr)	1992 yield (m/yr)
1	27400	n/a	n/a	n/a	n/a
2	34900	3.077	3.097	0.088	0.089
3	21600	1.418	1.823	0.066	0.084
4	7000	n/a	n/a	n/a	n/a
5	80	0.007	0.005	0.083	0.060
6	320	0.029	0.028	0.089	0.085
Sub-Total	91400		**Average =**	**0.081**	**0.080**

water		
7	1700	Husky Lakes)
8	4600	iverpool Ba
Sub-Total	6300	
Total	**97700**	

Table 2. Total Annual Run-off Calculations

DRAINAGE	Historical Yield (m/yr)	Area (km^2) Polygon 1	Area (km^2) Polygon 2	Area (km^2) Polygon 3	Area (km^2) Polygon 4	Area (km^2) Polygon 5	Area (km^2) Polygon 6	Annual Runoff
Entire Basin	0.081	27400	34900	21600	7000	80	320	7.438
Husky Lakes	0.086				7000	80	320	0.641
Liverpool Bay	0.077	27400	34900	21600				6.455

Table 3. Gauged Discharge Data for Liverpool Bay Drainage 1970-1990
Station No. 10NC001
Station Name: ANDERSON RIVER BELOW CARNWATH RIVER
Data Source: WATER SURVEY OF CANADA, 1991

Mean Monthly Discharge (m^3/s)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1970	36.9	24.0	19.6	19.2	123.0	456.0	220.0	207.0	292.0	136.0	72.0	45.8	137.63
1971	29.8	21.9	20.2	19.1	395.0	785.0	281.0	287.0	494.0	283.0	139.0	79.0	236.17
1972	48.1	32.7	24.5	21.0	46.9	1520.0	377.0	221.0	230.0	104.0	66.9	49.2	228.44
1973	36.0	23.4	14.9	13.6	733.0	656.0	241.0	237.0	242.0	148.0	67.5	38.6	204.25
1974	25.0	18.0	13.9	12.6	482.0	385.0	198.0	102.0	66.9	39.3	28.2	24.9	116.32
1975	22.6	17.7	12.8	12.3	584.0	434.0	170.0	67.1	49.8	32.4	24.3	17.5	120.38
1976	11.6	10.5	10.1	9.5	191.0	296.0	115.0	112.0	86.8	61.3	25.2	18.4	78.95
1977	14.3	11.2	9.3	8.2	380.0	797.0	460.0	170.0	114.0	79.1	49.2	26.9	176.60
1978	17.8	13.4	10.8	9.7	33.0	628.0	362.0	130.0	72.4	50.6	27.1	18.0	114.40
1979	13.9	9.6	4.7	4.7	309.0	298.0	142.0	62.7	146.0	77.8	38.5	24.2	94.25
1980	17.0	12.1	9.4	9.3	711.0	1000.0	320.0	154.0	113.0	36.6	20.1	19.8	201.86
1981	20.9	15.1	9.1	9.0	376.0	388.0	188.0	159.0	200.0	207.0	112.0	69.3	146.12
1982	45.9	29.8	17.2	11.8	684.0	1010.0	349.0	134.0	90.8	45.2	29.1	21.3	205.68
1983	14.3	11.2	10.0	9.8	54.3	902.0	181.0	96.8	71.4	70.2	60.5	38.0	126.63
1984	22.5	14.8	12.4	12.1	1000.0	696.0	244.0	177.0	267.0	140.0	55.2	42.7	223.64
1985	25.2	17.0	14.6	15.1	300.0	347.0	159.0	85.2	58.5	36.8	24.3	21.1	91.98
1986	14.9	11.3	8.6	7.2	113.0	330.0	125.0	57.4	47.0	29.3	15.9	14.8	64.53
1987	14.2	10.9	7.7	7.0	276.0	442.0	119.0	93.2	109.0	61.0	27.1	17.2	98.69
1988	12.4	9.8	8.3	7.6	128.0	391.0	143.0	66.1	163.0	113.0	47.0	32.0	93.43
1989	26.4	24.1	23.1	22.9	170.0	583.0	218.0	102.0	98.8	74.1	31.6	21.2	116.27
1990	16.7	13.6	11.1	9.8	173.0	530.0	328.0	142.0	83.7	52.0	25.0	16.0	116.74
MEAN	23.16	16.76	12.97	11.97	345.82	613.05	235.24	136.31	147.43	89.37	46.94	31.23	**142.52**

Table 4. Gauged Discharge Data for Liverpool Bay Drainage
Station No. 10NA001
Station Name: CARNWATH RIVER BELOW ANDREW RIVER
Data Source: WATER SURVEY OF CANADA, 1991

	Mean Monthly Discharge (m^3/s)												
YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**MEAN**
1983	0.00	0.00	0.00	0.02	266.00	334.00	40.70	17.30	9.52	14.10	11.10	3.23	58.00
1984	0.84	0.06	0.00	0.03	550.00	207.00	43.50	45.50	117.00	38.50	10.10	3.15	84.64
1985	0.25	0.00	0.00	0.00	33.80	79.40	32.00	10.90	6.56	3.54	0.60	0.00	13.92
1986	0.00	0.00	0.00	0.00	41.20	95.50	19.90	7.89	5.88	2.66	0.63	0.23	14.49
1987	0.07	0.00	0.00	0.00	217.00	261.00	39.50	50.60	67.60	34.60	10.00	3.80	57.01
1988	1.67	0.52	0.14	0.09	90.10	240.00	55.00	18.90	81.90	35.70	12.30	4.55	45.07
1989	1.94	0.96	0.51	0.40	128.00	195.00	48.40	16.90	43.40	34.50	7.49	1.97	39.96
1990	0.60	0.16	0.03	0.00	122.00	253.00	120.00	39.30	15.60	6.19	2.01	0.39	46.61
MEAN	0.67	0.21	0.09	0.07	181.01	208.11	49.88	25.91	43.43	21.22	6.78	2.16	**44.96**

Table 5. Gauged Discharge Data for the Husky Lakes Drainage
Station No. 10ND002
Station Name: TRAIL VALLEY CREEK NEAR INUVIK
Data Source: WATER SURVEY OF CANADA, 1991

	Mean Monthly Discharge (m^3/s)												
YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**MEAN**
1980	0.00	0.00	0.00	0.00	0.00		0.05	0.74	0.87	0.00	0.00	0.00	0.15
1981	0.00	0.00	0.00	0.00	0.83	2.19	1.14	0.73	0.26	0.02	0.00	0.00	0.43
1982	0.00	0.00	0.00	0.00	0.01	2.88	0.13	0.03	0.14	0.09	0.01	0.00	0.27
1983	0.00	0.00	0.00	0.00	0.00	1.60	0.01	0.01	0.06	0.01	0.00	0.00	0.14
1985	0.00	0.00	0.00	0.00	1.26	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.19
1986	0.00	0.00	0.00	0.00	0.00	1.73	0.02	0.05	0.08	0.01	0.00	0.00	0.16
1987	0.00	0.00	0.00	0.00	0.00	1.42	0.05	0.50	0.23	0.02	0.00	0.00	0.18
1988	0.00	0.00	0.00	0.00	0.00	1.14	0.05	0.34	0.48	0.01	0.00	0.00	0.17
1989	0.00	0.00	0.00	0.00	0.57	1.09	0.16	0.52	0.78	0.10	0.00	0.00	0.27
1990	0.00	0.00	0.00	0.00	0.57	0.65	0.31	0.02	0.02	0.01	0.00	0.00	0.13
MEAN	0.00	0.00	0.00	0.00	0.32	1.52	0.19	0.29	0.29	0.03	0.00	0.00	**0.22**

Table 6. Gauged Discharge Data for the Husky Lakes Drainage

Station No. 10ND004
Station Name: HANS CREEK ABOVE ESKIMO LAKES
Data Source: WATER SURVEY OF CANADA, 1991

Mean Monthly Discharge (m3/s)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1988	0.00	0.00	0.00	0.00	0.00	5.61	0.99	0.21	1.92	0.67	0.07	0.00	0.79
1989	0.00	0.00	0.00	0.00	0.00	6.11	1.61	1.10	2.57	1.56	0.39	0.06	1.12
1990	0.00	0.00	0.00	0.00	0.05	6.97	2.47	0.37	0.02	0.02	0.00	0.00	0.83
MEAN	0.00	0.00	0.00	0.00	0.02	6.23	1.69	0.56	1.50	0.75	0.15	0.02	**0.91**

Table 7. Gauged Discharge Data for Liverpool Bay Drainage

Station No. 10NC001
Station Name: ANDERSON RIVER BELOW CARNWATH RIVER
Year: 1992
Data Source: WATER SURVEY OF CANADA, 1993

Month:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mean:	17.9	16.1	15.6	14.6	301.0	896.0	308.0	123.0	72.2	52.8	35.5	24.5
Dam3:	48000	40400	41900	37900	30600	2320000	826000	329000	187000	141000	91900	65600
Max:	19.8	16.5	15.9	15.1	1900.0	1530.0	501.0	172.0	92.6	62.0	42.5	29.2
Min:	16.6	16.0	15.2	14.2	14.2	522.0	130.0	93.6	42.0	43.0	29.5	20.5

Summary for the year 1992

Mean Discharge: 156 m^3/s
Total Discharge: 4930000 DAM3
Maximum Daily Discharge: 1900 m^3/s ON MAY 27
Minimum Daily Discharge: 14.2 m^3/s ON APR 26

Table 8. Gauged Discharge Data for Liverpool Bay Drainage

Station No. 10NA001
Station Name: CARNWATH RIVER BELOW ANDREW RIVER
Year: 1992
Data Source: WATER SURVEY OF CANADA, 1993

Month:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mean:	0.337	0.067	0.001	0.000	213.000	384.000	65.900	18.000	7.830	4.010	1.570	0.574
Dam3:	902	167	2	0	570000	994000	17600	48300	20300	10700	4080	1540
Max:	0.610	0.160	0.008	0.000	1440.000	1210.000	114.000	30.400	11.200	5.060	2.500	0.890
Min:	0.170	0.010	0.000	0.000	0.000	119.000	31.800	11.200	5.100	2.600	0.920	0.350

Summary for the year 1992

Mean Discharge: 57.8 m^3/s
Total Discharge: 1830000 DAM3
Maximum Daily Discharge 1440 m^3/s ON MAY 30
Minimum Daily Discharge: 0 m^3/s ON MAR 6

Table 9. Gauged Discharge Data for the Husky Lakes Drainage

Station No. 10ND002
Station Name: TRAIL VALLEY CREEK NEAR INUVIK
Year: 1992
Data Source: WATER SURVEY OF CANADA, 1993

Month:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mean:	0.000	0.000	0.000	0.000	0.306	1.610	0.024	0.001	0.002	0.000	0.000	0.000
Dam3:	0	0	0	0	819	4180	65	2	5	0	0	0
Max:	0.000	0.000	0.000	0.000	5.760	6.000	0.109	0.002	0.006	0.000	0.000	0.000
Min:	0.000	0.000	0.000	0.000	0.000	0.156	0.002	0.000	0.000	0.000	0.000	0.000

Summary for the year 1992

Mean Discharge: 0.160 m^3/s
Total Discharge: 5070 DAM3
Maximum Daily Discharge 6.0 m^3/s ON JUN 1
Minimum Daily Discharge: 0 m^3/s ON JAN 1

Table 10. Gauged Discharge Data for the Husky Lakes Drainage

Station No. 10ND004
Station Name: HANS CREEK ABOVE ESKIMO LAKES
Year: 1992
Data Source: WATER SURVEY OF CANADA, 1993

Month:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mean:	0.000	0.000	0.000	0.000	0.007	8.520	1.890	0.166	0.004	0.000	0.000	0.000
Dam3:	0	0	0	0	18	22100	5060	445	11	0	0	0
Max:	0.000	0.000	0.000	0.000	0.120	20.300	4.380	0.581	0.023	0.000	0.000	0.000
Min:	0.000	0.000	0.000	0.000	0.000	0.200	0.661	0.025	0.000	0.000	0.000	0.000

Summary for the year 1992

Mean Discharge: 0.873 m^3/s
Total Discharge: 27600 DAM3
Maximum Daily Discharge: 20.3 m^3/s ON JUN 8
Minimum Daily Discharge: 0 m^3/s ON JAN 1

Table 11. Total Precipitation in Inuvik and Tuktoyaktuk

Source: Environment Canada - Atmospheric Environment Service Monthly Record of Meterological Observations in Canada: 1986,1987,1988,1989

	MONTHS													
STN. NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	TOTAL
Inuvik	17.7	10.5	12.0	14.9	17.6	24.0	33.5	43.7	23.9	33.5	17.8	17.4	22.2	266.5
Tuktoyaktuk A.	7.7	11.3	6.5	6.5	3.0	11.4	18.2	22.8	23.1	20.7	18.1	13.6	13.6	162.9

Table 12. Comparison of Historical Precipitation to Discharge

	MONTHS													
VARIABLES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN	
Inuvik precip.	17.7	10.5	12.0	14.9	17.6	24.0	33.5	43.7	23.9	33.5	17.8	17.4	22.2	mm
Trail Valley Creek	0.00	0.00	0.00	0.00	0.32	1.52	0.19	0.29	0.29	0.03	0.00	0.00	0.22	m^3/s

HUSKY LAKES AND LIVERPOOL BAY DRAINAGE

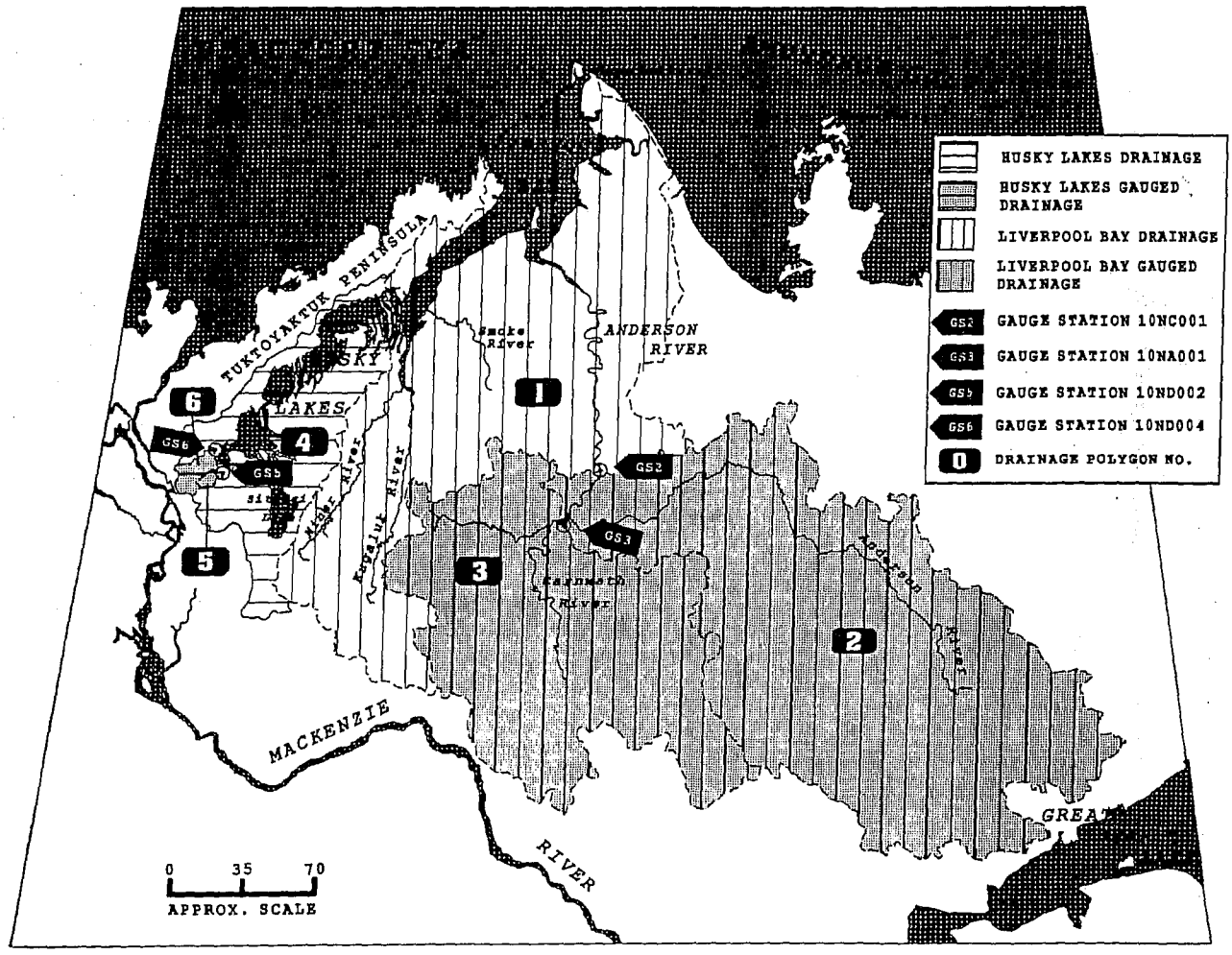

Figure 1. HUSKY LAKES AND LIVERPOOL BAY DRAINAGE

Figure 2. ANDERSON RIVER HYDROGRAPH 1970-1990

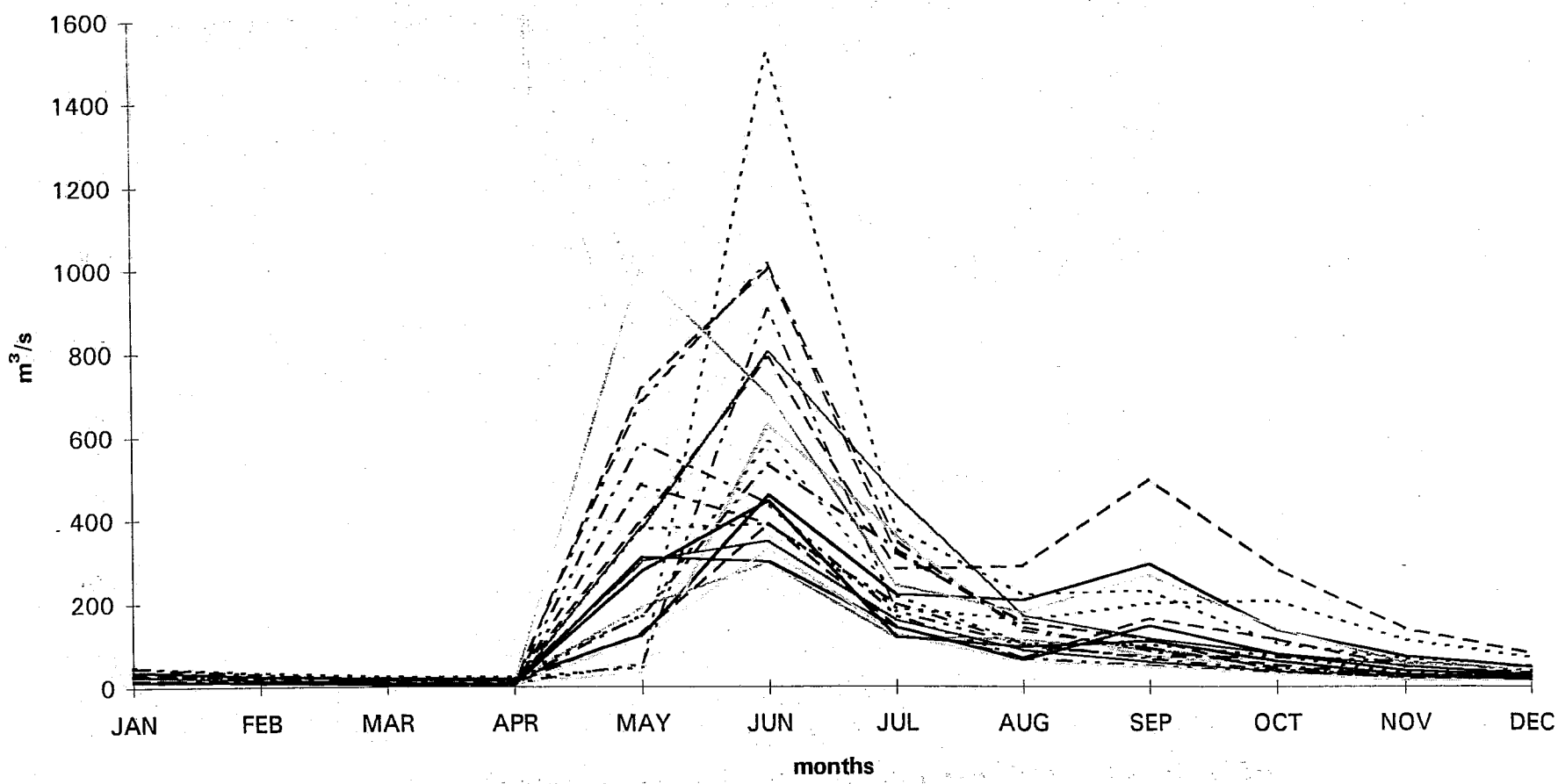

Figure 3. ANDERSON RIVER LOGARITHMIC HYDROGRAPH 1970-1990

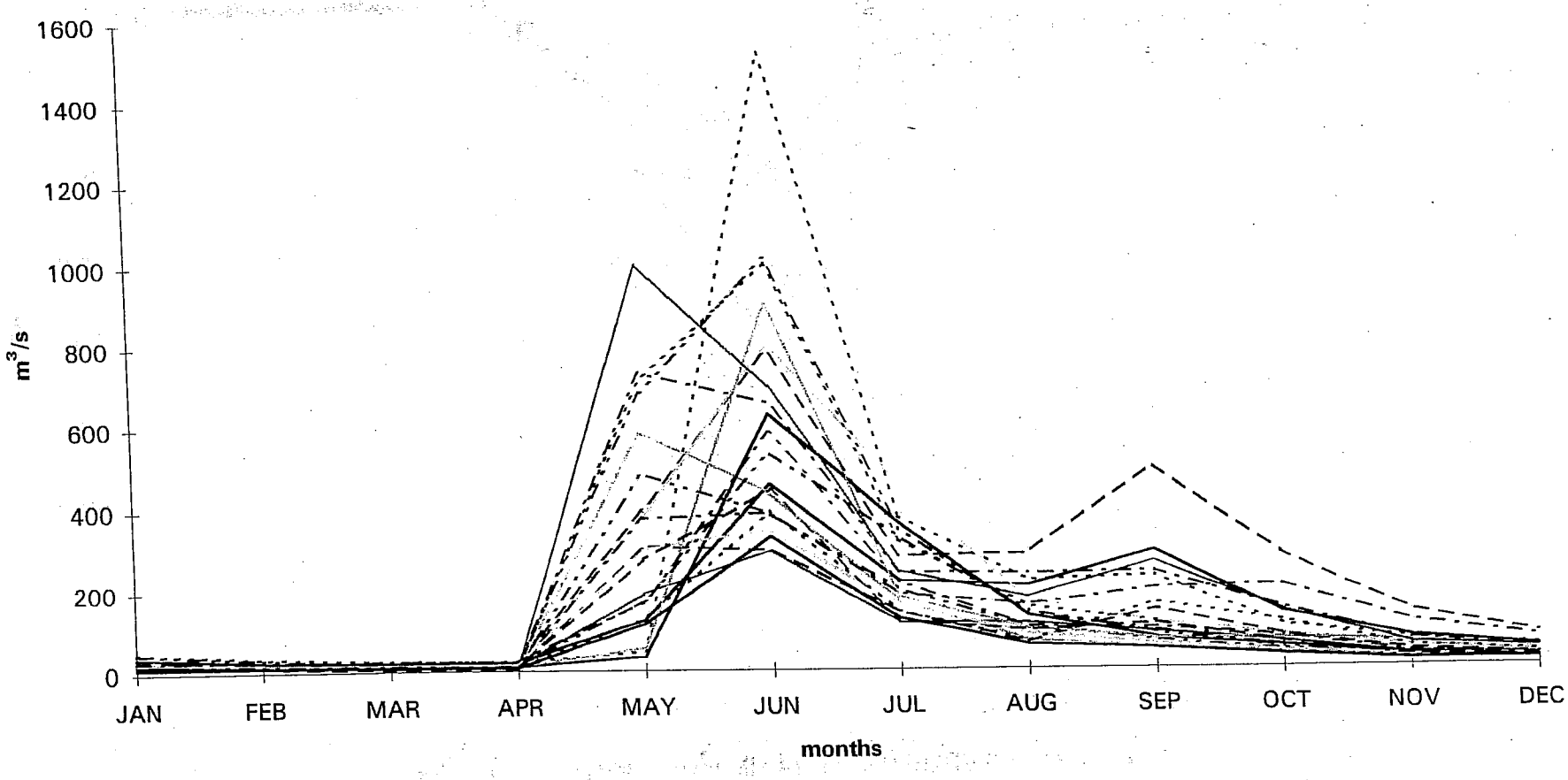

Figure 4. CARNWATH RIVER HYDROGRAPH 1983-1990

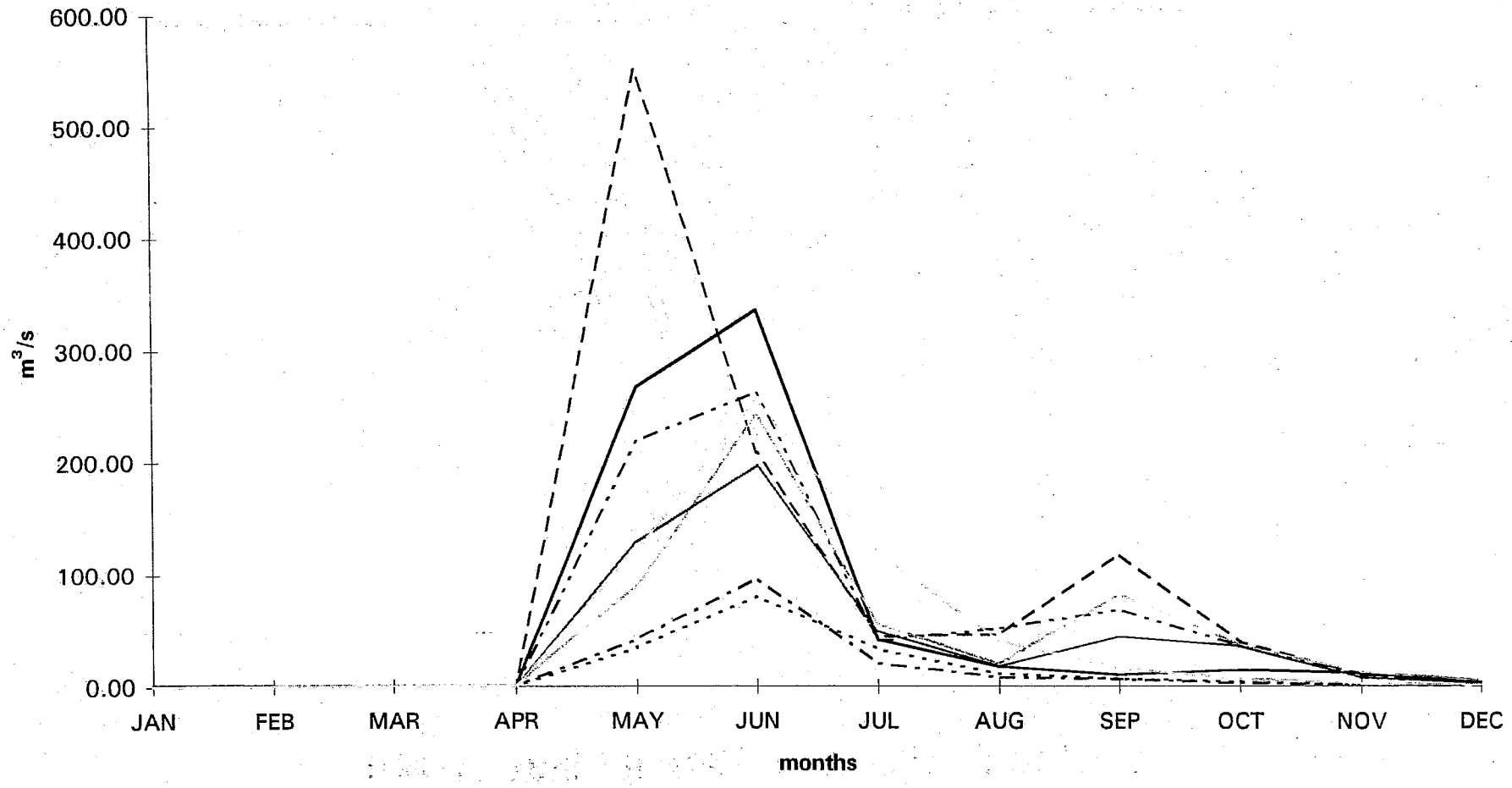

Figure 5. TRAIL VALLEY CREEK HYDROGRAPH 1980-1990

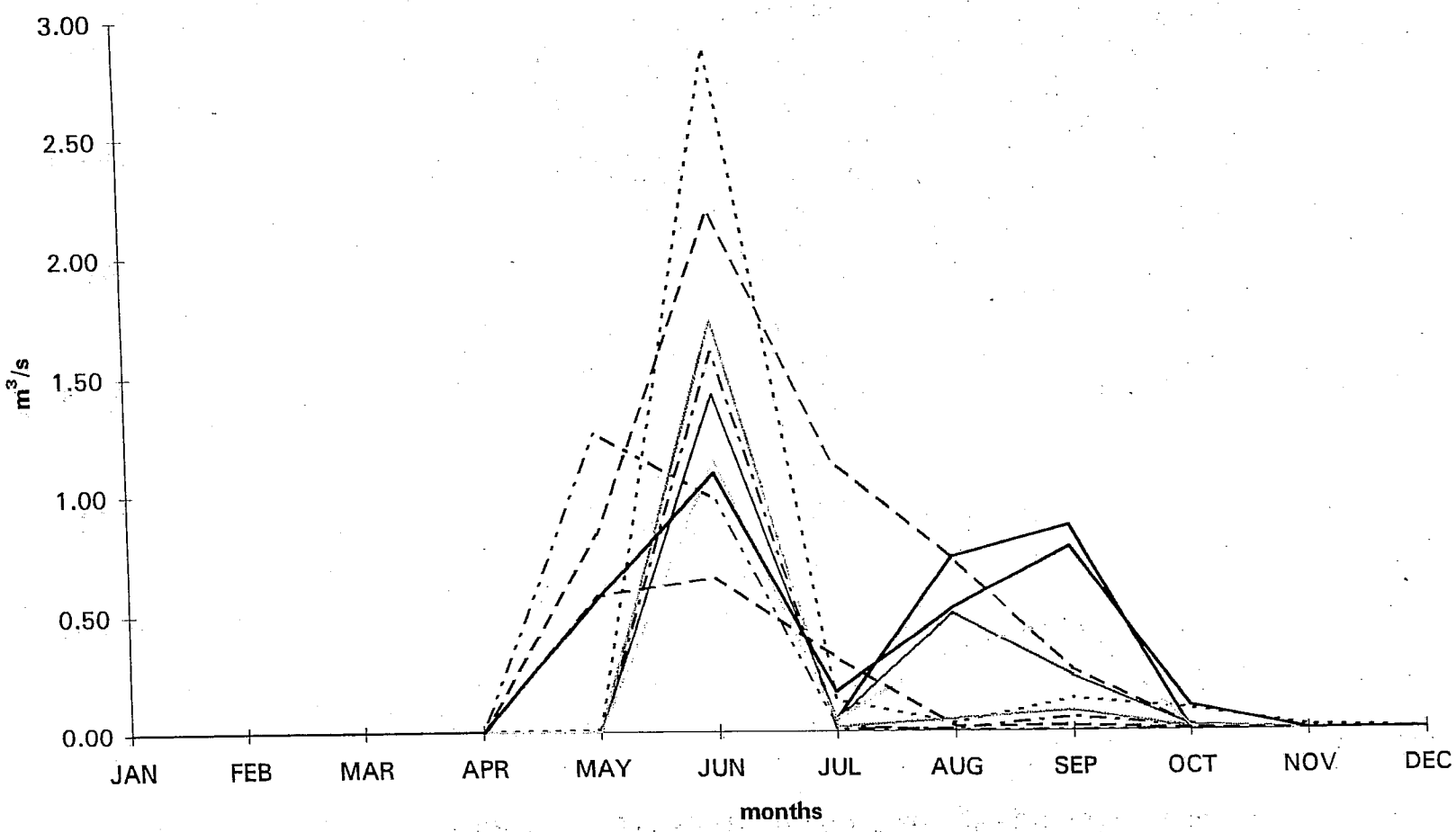

Figure 6. HANS CREEK HYDROGRAPH 1988-1990

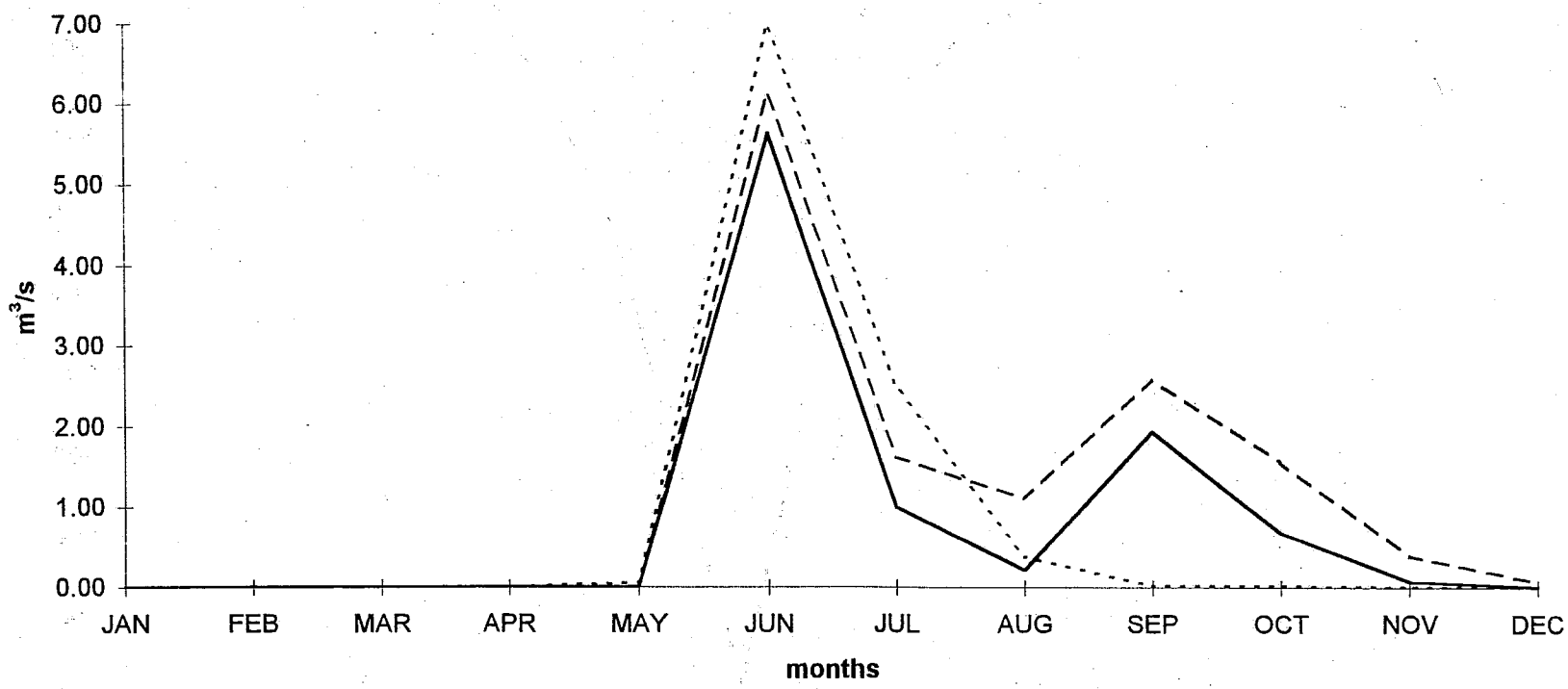

Figure 7. STATION 10NC001

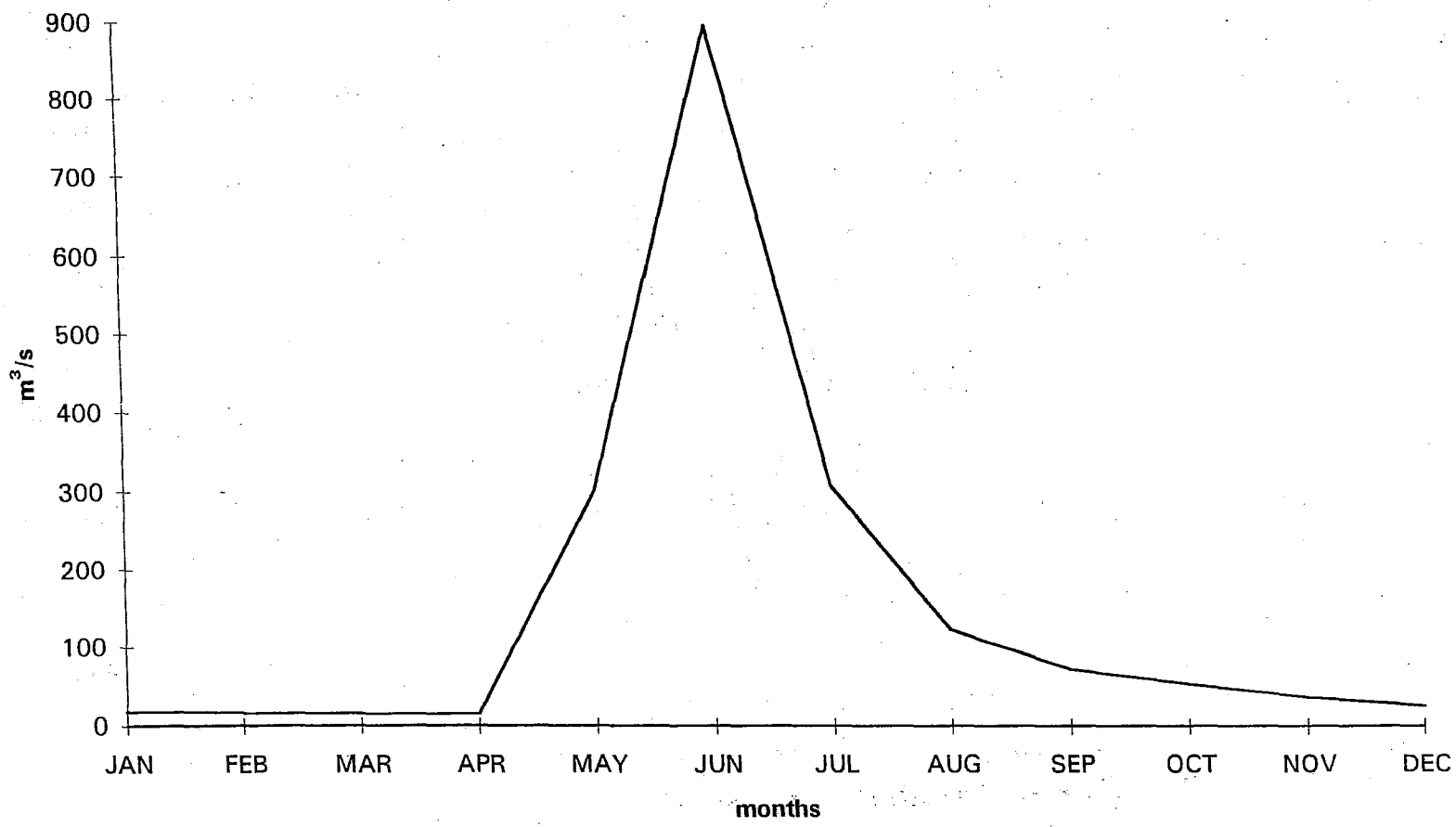

Figure 8. STATION 10NA001

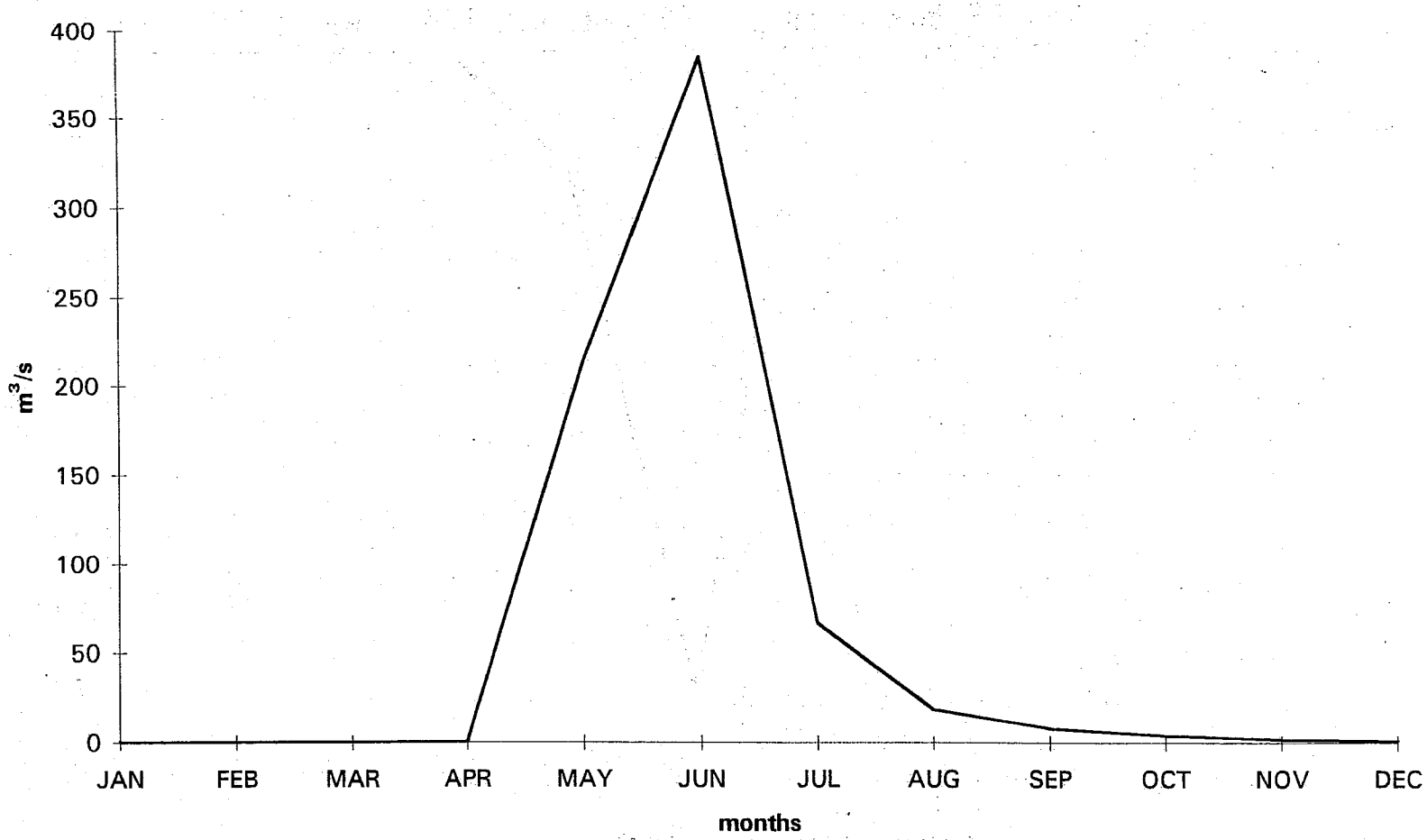

Figure 9. STATION 10ND002

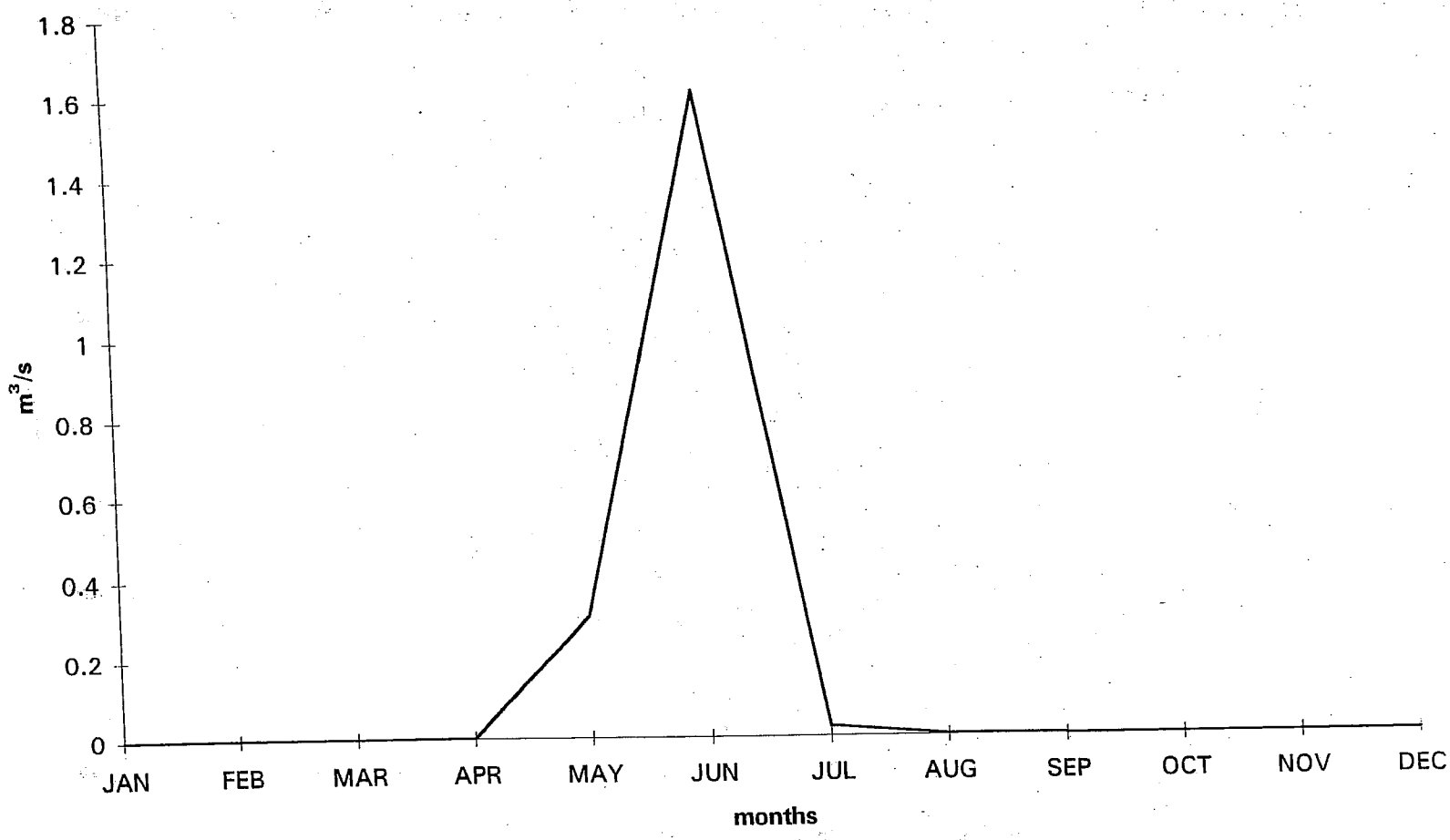

Figure 10. STATION 10ND004

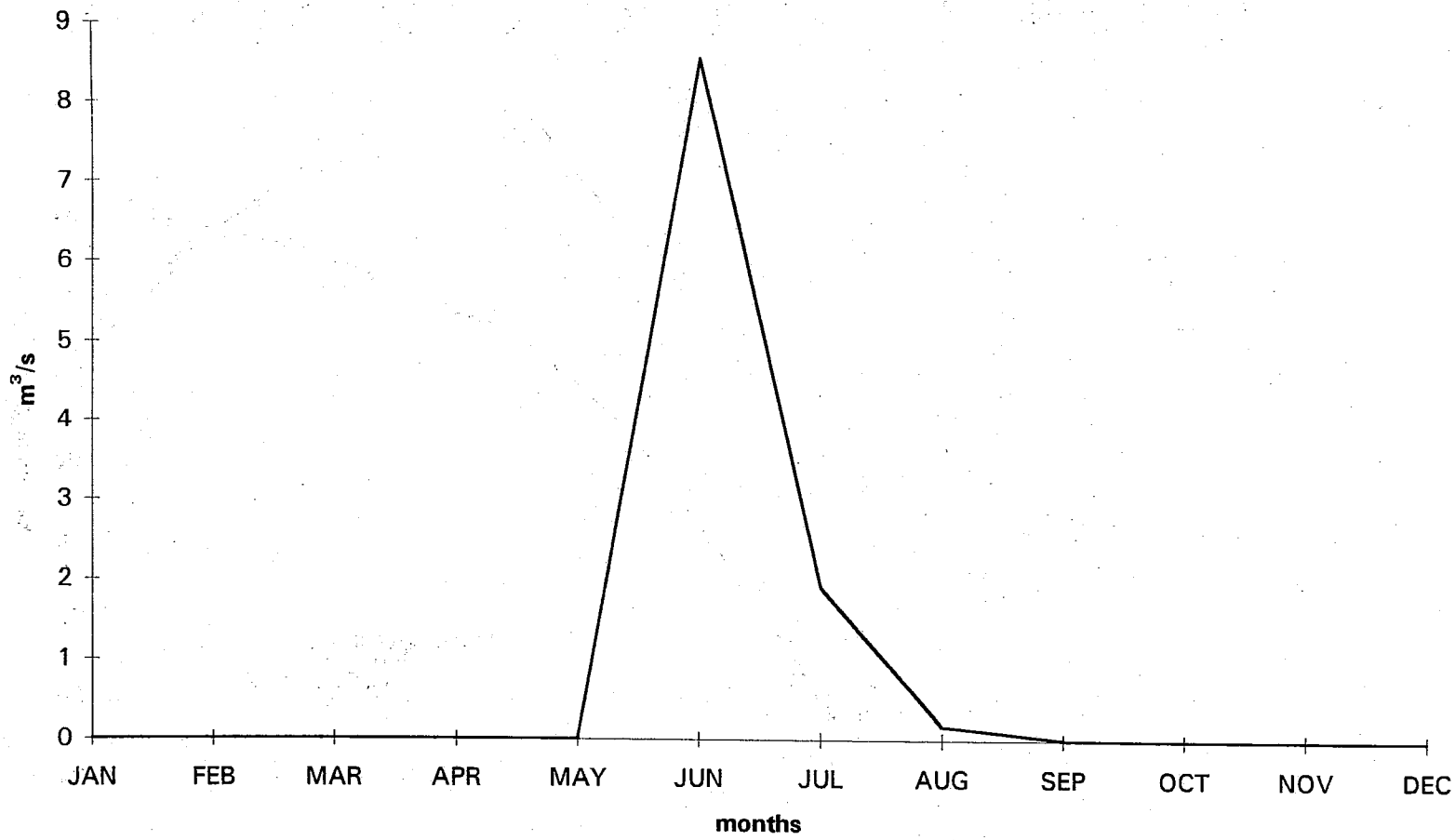

Figure 11. EXPECTED MONTHLY PRECIPITATION

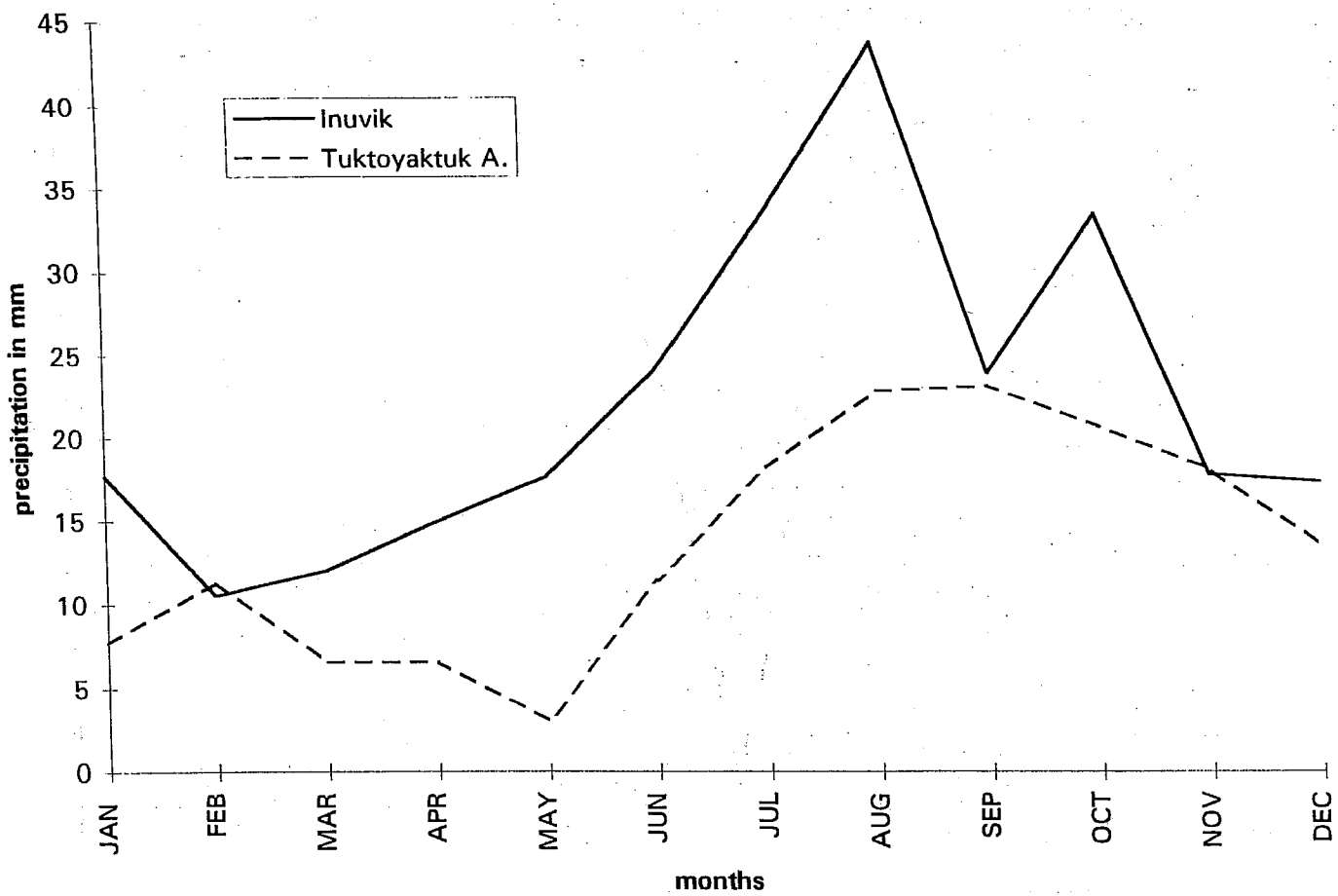

Figure 12. EXPECTED PRECIPITATION AND DISCHARGE NEAR INUVIK