HYDROLOGICAL PROCEDURE NO. 13

THE ESTIMATION OF STORAGE-DRAFT RATE CHARACTERISTICS FOR RIVERS IN PENINSULAR MALAYSIA

1976

JABATAN PENGAIRAN DAN SALIRAN
KEMENTERIAN PERTANIAN MALAYSIA

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THE ESTIMATION OF STORAGE-DRAFT RATE CHARACTERISTICS FOR RIVERS

IN

PENINSULAR MALAYSIA

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SYNOPSIS

Where the low flow of a river is insufficient to meet the demand for water, storage may be utilized to increase the guaranteed water supply to the user. The hydrological aspects which must be considered are the amount of storage necessary to sustain a given draft rate and the associated risk of insufficient storage to meet this draft rate.

This procedure provides a simple method of deriving storage-draft rate characteristics for both gauged and ungauged rivers in Peninsular Malaysia. The procedure has application for quick estimates for prefeasibility studies and in cases where time, facilities and data constraints do not permit a more detailed analysis.

THE ESTIMATION OF STORAGE-DRAFT RATE CHARACTERISTICS FOR RIVERS IN PENINSULAR MALAYSIA

1. INTRODUCTION

1.1 *The problem*

The reliability of water supply from a stream or river depends on the low flow characteristics. Where the low flows are insufficient to satisfy the required water demand, artificial regulation of the river flows may be imposed to reduce the severity of low flows and increase the guaranteed water supply to the user. The problem is to determine the amount of storage necessary to sustain a given draft rate or drawoff, and the associated risk of insufficient storage to meet this draft rate.

The relationship between inflow, storage, and drawoff is complex. A recent approach to the problem has been to model the river system and the proposed water storage scheme. Long term synthetic streamflow records are generated and the response of the proposed storage scheme is examined to determine the design parameters. A comprehensive treatment of the simulation approach is given by Mass et al (1962).

Although this approach allows a detailed analysis of the numerous alternatives available to the designer, the accuracy of the results is still largely dependent on the accuracy of the historical streamflow record which forms the basic input to the model. The time and cost of such an approach must be justified in terms of the overall project objectives.

In many cases, particularly for small storage schemes, constraints such as lack of data, time and expertise preclude the application of the simulation approach. Also, it is often useful to have some quick assessment of the storage-draft rate alternatives available for prefeasibility studies of major storage schemes.

The need exists therefore for a relatively simple procedure to assess the storage-draft rate relationship for rivers in Peninsular Malaysia, particularly where streamflow records are non-existent.

1.2 *Objective*

The objective of this procedure is to develop a method of estimating the storage-draft rate characteristics on a recurrence interval basis for gauged and ungauged rivers in Peninsular Malaysia.

2. DEVELOPMENT OF PROCEDURE

2.1 *Storage-draft rate analysis*

The storage-draft rate characteristics were analysed for 65 streamflow stations operated by the D.I.D. following the method of analysis used by Stall (1962). A brief description of the method is given below. The basic data used were monthly runoff values over the period 1948 to 1970.

For each station, 36 partial series of low flow for varying durations were selected and fitted with the type III extreme value distribution using an approximate least squares method (Taylor and Goh 1975). The range of durations investigated was from 1 to 12 months in intervals of 1 month and from 14 to 60 months in intervals of 2 months. The upper limit of 60 months was arbitrarily set as the maximum likely interval over which a storage reservoir would be subjected to continuous net drawdown.

Each low flow series was selected in such a way that no two events in the series contained runoff occurring on days common to both events. During the low flow series development, some of the low flow values of long duration would exceed the mean annual flow. These high flow values were generated by the low flow series selection procedure and were not considered a legitimate part of the series.

The family of low flow curves for each station was analysed by mass curve analysis. The method is illustrated graphically in Fig. 1 for station 4809443. Fig. 1 shows the low flows for durations of 1 to 12 months plotted against duration for a recurrence interval of 10 years. The mass curve of low flow so defined is non-sequential. The cumulative drawoff corresponding to a constant draft rate of 50% of the mean annual discharge is also plotted in Fig. 1. The maximum positive difference between cumulative drawoff and low flow is the minimum storage necessary to maintain a draft rate of 50% of the mean annual discharge. It would be expected that this storage volume would be sufficient for 9 out of 10 years on the average. The critical duration is the duration of low flow over which the reservoir would be subject to a continuous net drawdown. The distribution of streamflow over this duration is unknown.

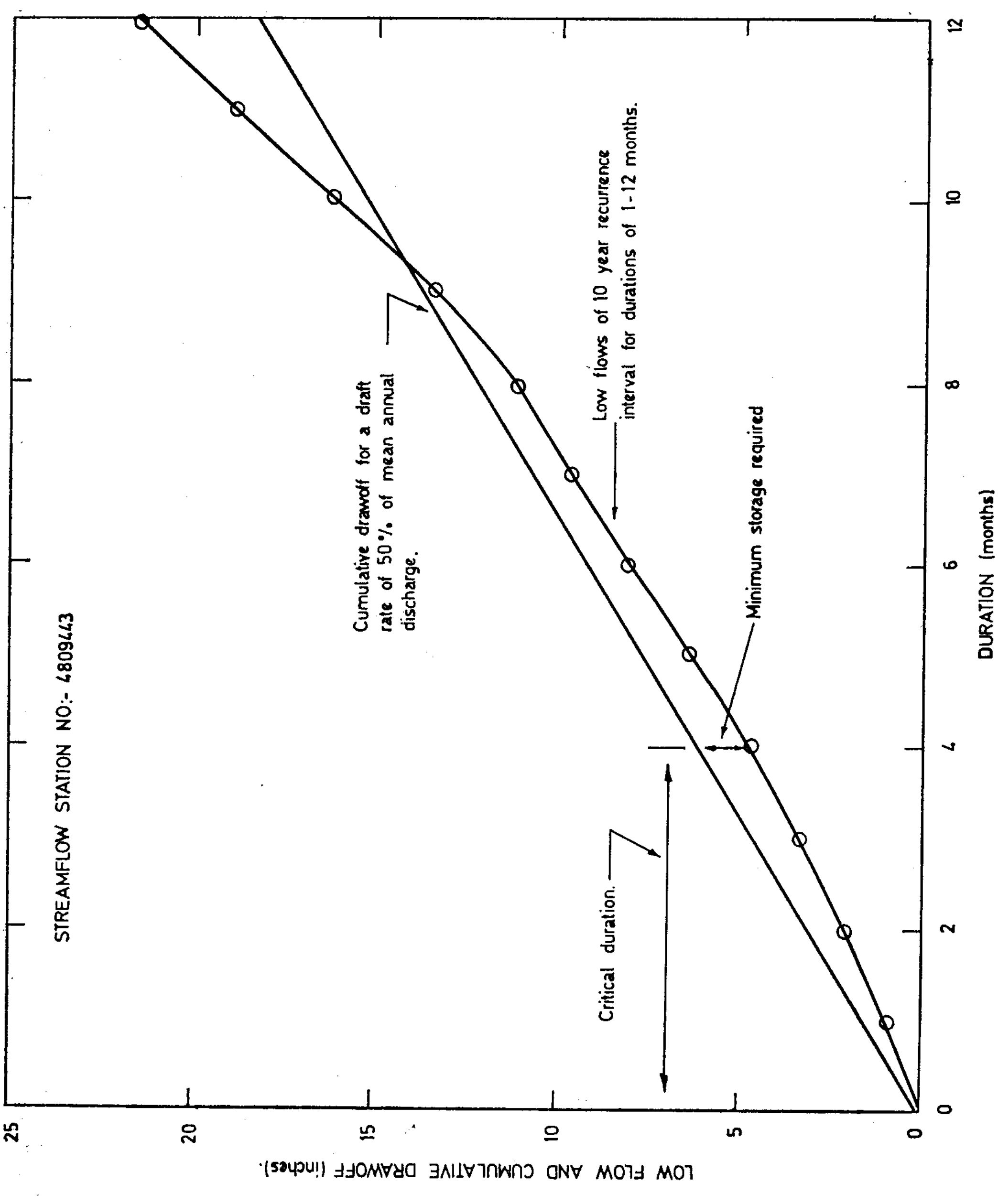

FIG.1 - NON-SEQUENTIAL MASS CURVE ANALYSIS.

The term "draft rate" as used in this procedure refers to the gross rate of drawoff from the reservoir, which includes evaporation and seepage losses, the residual flow to be maintained downstream and the user demand. The term "storage" as used in this procedure means "active storage" that is available for inflow regulation.

The results of the storage-draft rate analysis for individual station records are listed in Appendix A.

2.2 *Regionalization of results*

The purpose of regionalization is to extend the results of the storage-draft rate analysis for individual streamflow station records to ungauged rivers. The variation of storage-draft rate characteristics between stations is partly due to chance variations and partly due to true differences in the streamflow characteristics which determine the storage-draft rate relationship. The regionalization procedure attempts to average the chance variation and preserve the true variation between different streamflow regimes.

The storage required to sustain a given draft rate is a function of the magnitude and variability of streamflow. The variability of monthly streamflow was investigated for each station using the coefficient of variation C_v as an index. On the basis of the derived C_v values, three regions were defined within which the C_v values are sensibly constant. Because of sparse data in some areas of the Peninsula, the boundaries of the regions have been extended on the basis of rainfall variability in the area. It was assumed that the variability of streamflow is reflected in the rainfall variability. Reference was made to the study of rainfall variability by Dale (1959). The three regions are shown in Plate I.

Dimensionless storage-draft rate curves were developed for each region for the 10 year and 25 year recurrence intervals. The regional curve was derived as the median of all station values within the region. The curves are shown in Figs. 2 and 3. Similarly, the regional curves relating critical duration and draft rate ÷ mean annual discharge were derived as the median values of all stations within the region. The curves are shown in Figs. 4 and 5.

So that the actual storage and draft rate can be estimated from the dimensionless curves, the mean annual runoff must be known. The proposed expression relating mean annual runoff Q to mean annual rainfall P is given by equation (1).

$$Q = b \times P^a \qquad \text{.................(1)}$$

Values of a and b were derived for each region by the method of least squares. The regression constants are shown in Table 1.

TABLE 1—REGRESSION CONSTANTS FOR EQUATION (1)

Region	a	b
R1	1.42	0.08
R2	1.68	0.02
R3	1.28	0.14

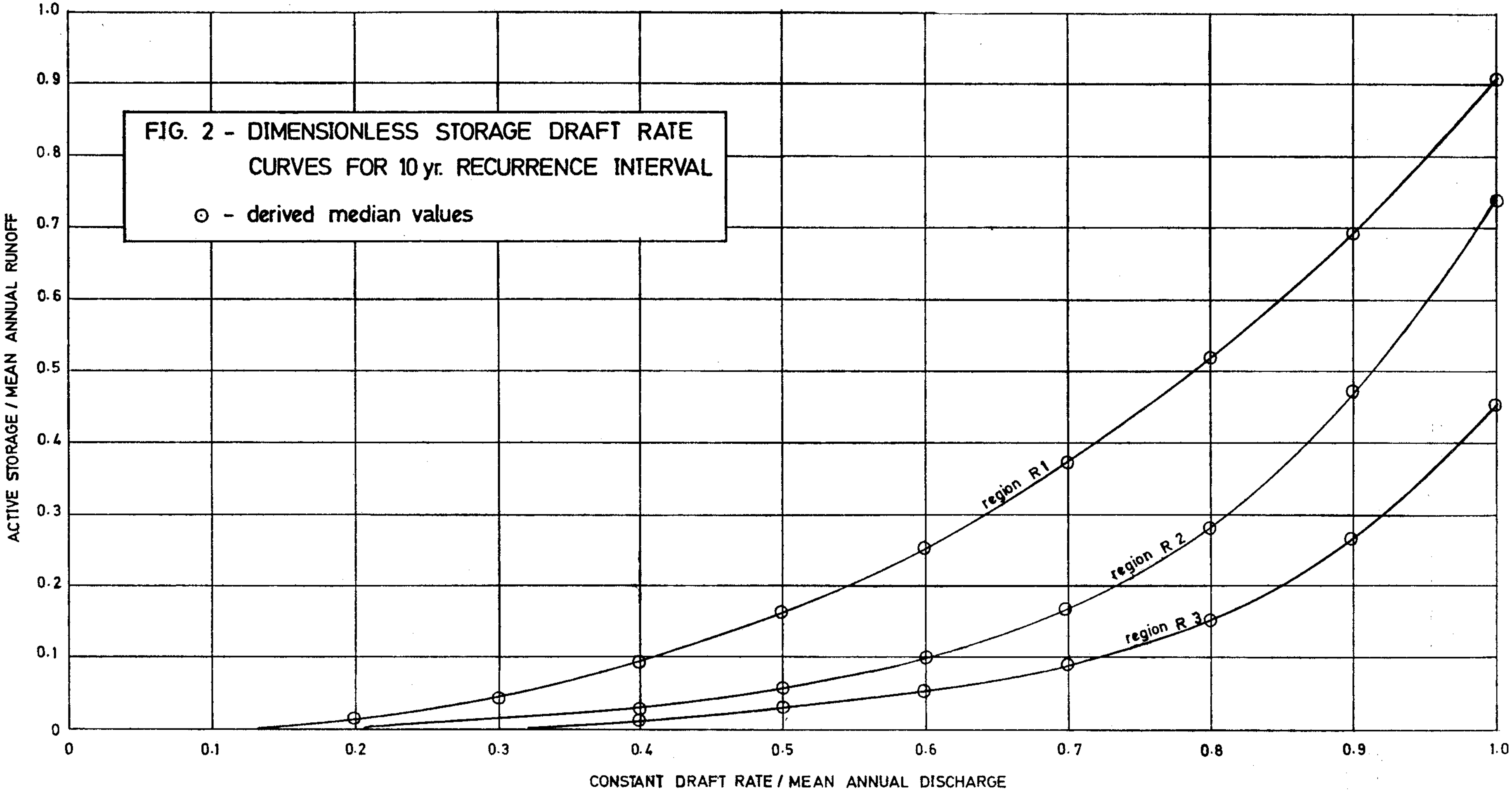

FIG. 2 - DIMENSIONLESS STORAGE DRAFT RATE CURVES FOR 10 yr. RECURRENCE INTERVAL

⊙ - derived median values

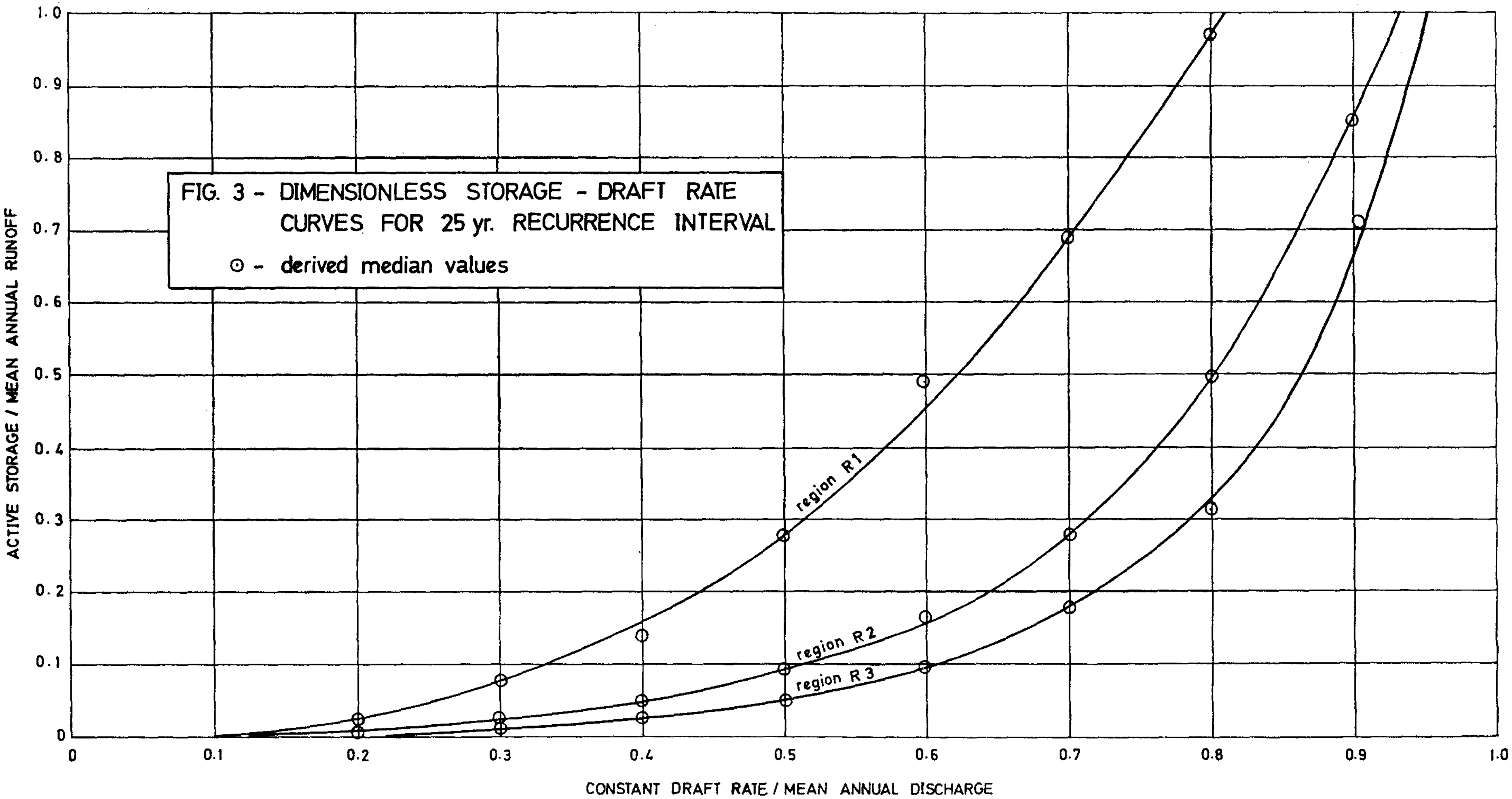

FIG. 3 - DIMENSIONLESS STORAGE - DRAFT RATE CURVES FOR 25 yr. RECURRENCE INTERVAL

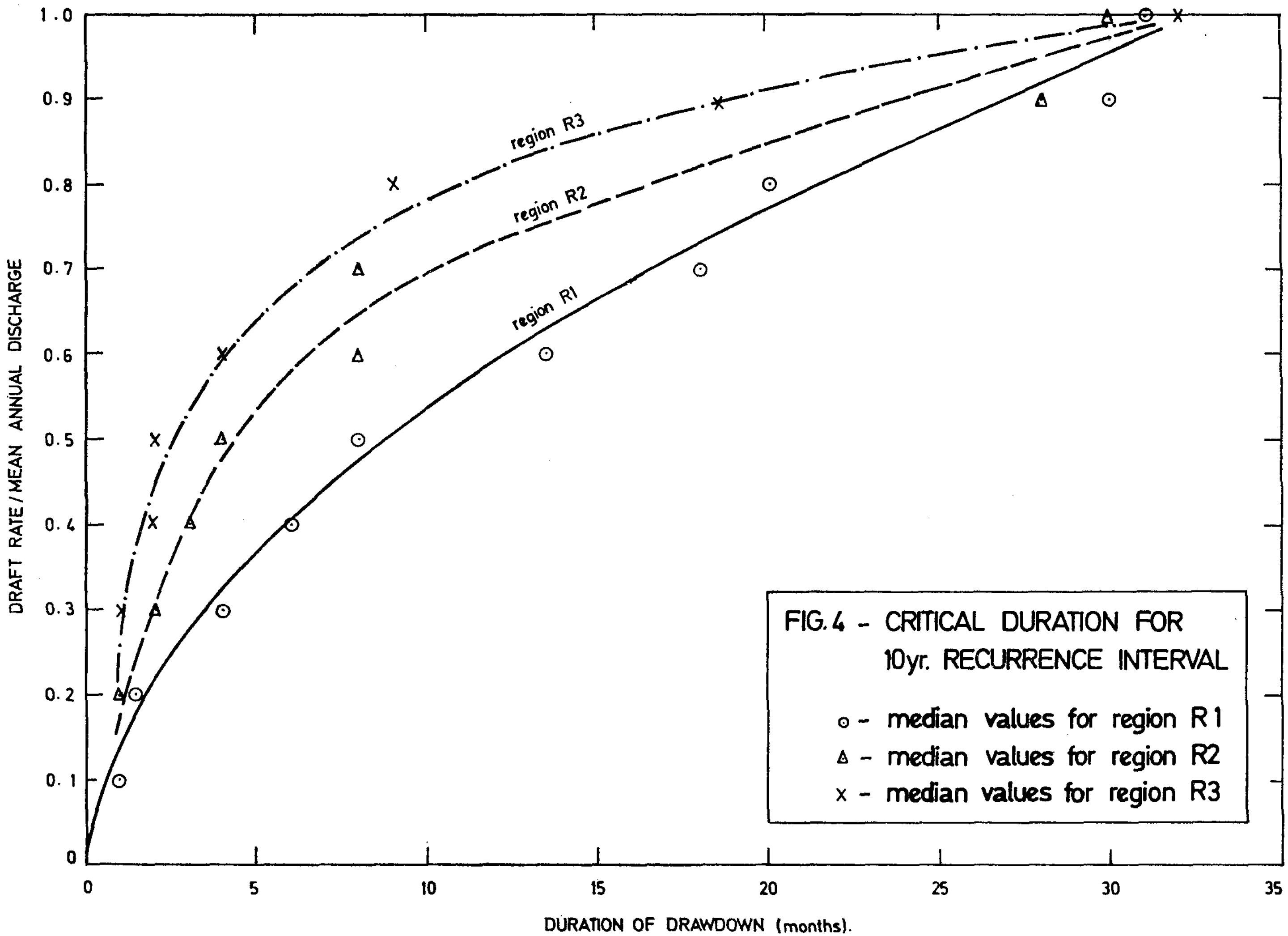

FIG. 4 - CRITICAL DURATION FOR 10yr. RECURRENCE INTERVAL

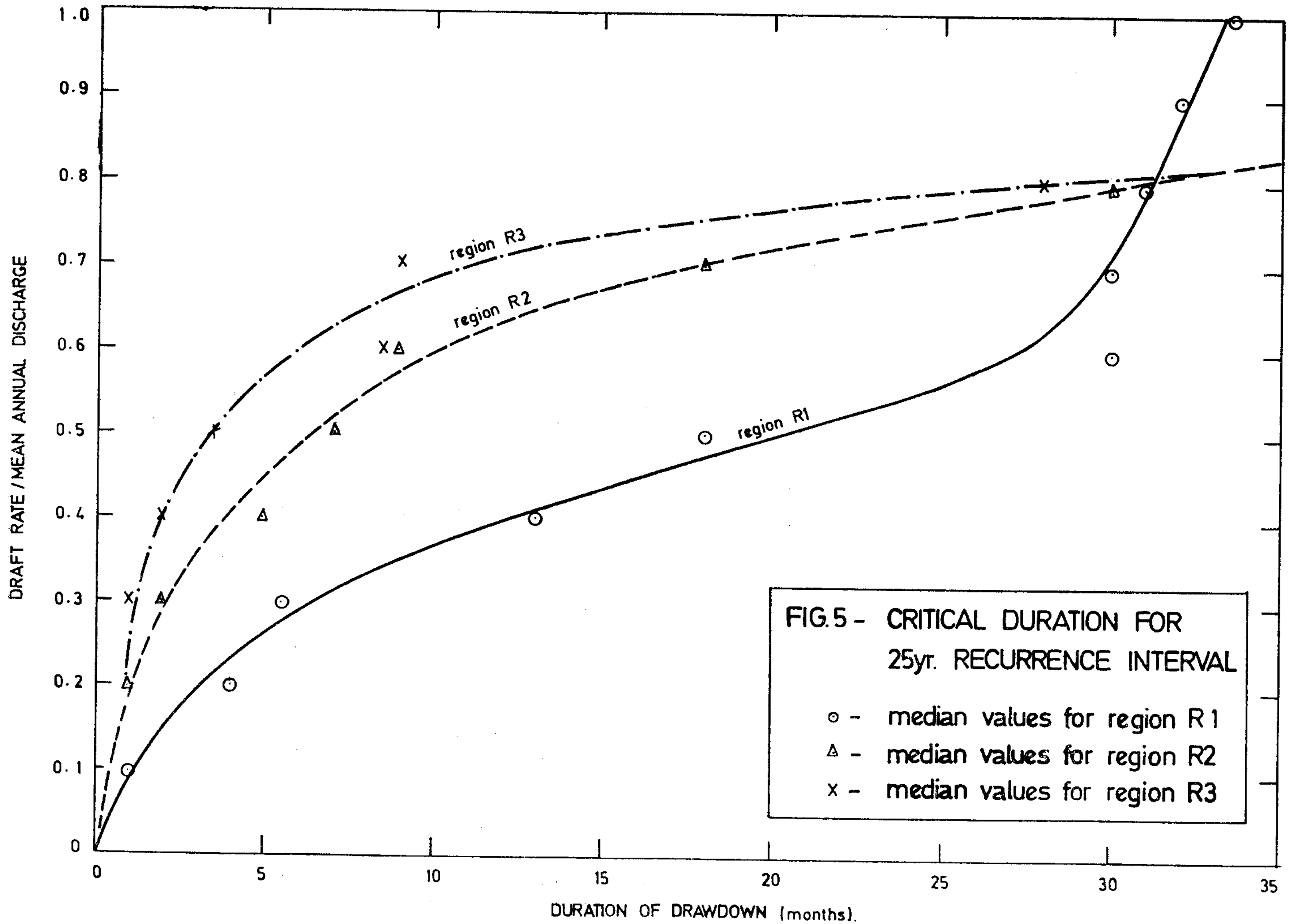

FIG. 5 - CRITICAL DURATION FOR 25yr. RECURRENCE INTERVAL

2.3 *Interpretation of Results*

The method of analysis used in this study yielded storage values for all recurrence intervals up to 25 years. However it is felt that only the 10 year and 25 year values are of practical significance. The storage for a 25 year recurrence interval is based on the most extreme low flow event that can be reliably assessed from the length of records available.

The storage-draft rate relationships shown in Figs. 2 and 3 indicate that the storage required to sustain a given draft rate increases as the variability of streamflow increases, as expected. Some useful results can be observed by looking at the upper and lower limits of the storage-draft rate curves for each region.

The upper limit of storage volume that is practicably feasible is dependent on the economics of the storage scheme. A figure that has been quoted for hydro-electric storage schemes on rivers in Peninsular Malaysia is 20% of the mean annual runoff (Pahang River Basin Study—Work Studies Report, May 1973). Above this point the incremental increase in controlled outflow is small in comparison with the cost of providing additional storage.

The draft rate and critical duration corresponding to a storage of 20% of mean annual runoff are listed in Table 2 for the 3 regions defined in this study. Several observations can be drawn from Table 2. Firstly the upper limit of streamflow which can be developed with this storage volume is about 44% to 85% of mean annual discharge, depending on the region and the recurrence interval chosen. Secondly, over the useful range of draft rates which can be developed, the critical duration is usually less than 12 months, implying that the nature of storage is largely seasonal. This means that reservoirs storing up to 20% of mean annual runoff will be replenished annually.

TABLE 2—DRAFT RATE AND CRITICAL DURATION FOR STORAGE OF 20% MEAN ANNUAL RUNOFF

Region	Draft rate (% q) for recurrence interval shown (years)		Critical duration (months) of recurrence interval shown (years)	
	10	25	10	25
R1	54	44	10	15
R2	73	65	12	12
R3	85	71	14	12

The lower limit of the storage-draft rate relationship is shown on Figs. 2 and 3 where the curves meet the x-axis. The draft rate and critical duration corresponding to zero storage are shown in Table 3. The figures in the second and third columns of Table 3 provide an estimate of the minimum average monthly streamflow that can be developed without storage for the 10 year and 25 year recurrence intervals. The distribution of streamflow over the month is unknown. As expected the minimum average monthly discharge decreases from region R3 to R1 as streamflow variability increases.

TABLE 3—DRAFT RATE AND CRITICAL DURATION FOR ZERO STORAGE

Region	Draft rate (% q) for recurrence interval shown (years)		Critical duration (months) of recurrence interval shown (years)	
	10	25	10	25
R1	10	10	1	1
R2	20	10	1	1
R3	30	20	1	1

3. USE OF PROCEDURE

3.1 *Summary*

This section summarizes the steps involved in the application of this procedure. Some worked examples are shown in section 3.2.

To compute the storage-draft rate characteristics for a river:

(1) Determine the catchment location and area from a topographical map.

(2) From Plate I, determine the region containing the catchment outlet at the point of interest.

(3) Compute the mean annual rainfall for the catchment from the available rainfall data.

(4) If streamflow records are not available, compute Q from the regional regression equation. If streamflow records are available, Q is calculated directly from the records. A list of station values is given in Appendix A (*a*).

(5) Using Q as determined from (4), compute the mean annual discharge q, and construct the storage-draft rate curve for the design point from the dimensionless storage-draft rate curve for the region.

3.2 *Examples*

EXAMPLE 1

Derive the storage-draft rate curve for a station on Sg. Lipis for a 25 year recurrence interval given the following:

catchment area = 50 sq. mls.

catchment mean annual rainfall = 78 ins

location of station = 4°00′N, 101° 40′E

From Plate I locate the station in region R1. Since there are no streamflow records, the mean annual runoff is calculated from the regional equation:

$$Q = 0.08 \times P^{1.42}$$

$$= 0.08 \times 78^{1.42}$$

$$= 39 \text{ ins}$$

The mean annual discharge is calculated using the conversion 1 acre-inch = 1 cusec-hour:

$$q = \frac{39 \times 50 \times 640}{365 \times 24}$$

$$= 143 \text{ cusecs}$$

The storage-draft rate characteristics are computed from the dimensionless storage-draft rate curve for region R1 (Fig. 3). A sample calculation is given below.

Consider a (draft rate ÷ mean annual discharge) = 0.40

$$\therefore \text{draft rate} = 0.40 \times q$$

$$= 0.40 \times 143$$

$$= 57 \text{ cusecs}$$

The corresponding (storage ÷ mean annual runoff) = 0.16

$$\therefore \text{storage} = \frac{0.16 \times Q \times 640 \times A}{12}$$

$$= \frac{0.16 \times 39 \times 640 \times 50}{12}$$

$$= 16{,}640 \text{ acre-feet}$$

The calculations for the complete storage-draft rate curve are summarized in Table 4.

TABLE 4—EXAMPLE 1

Draft rate ÷ q (dimensionless) ...	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Draft rate (cusecs)	14	29	43	57	72	86	100	114	129	143
Storage ÷ Q (dimensionless) ...	0.00	0.02	0.08	0.16	0.28	0.46	0.69	0.97	—	—
Storage (acre-feet × 10^3) ...	0	2	8	17	29	48	72	101	—	—

The estimated storage-draft rate curve for the station is shown in Fig. 6. To develop a constant average draft rate of 50 cusecs, a storage of about 12,000 acre-feet would be sufficient for 24 out of 25 years on the average. From Fig. 5 the critical duration for this storage volume is about 9 months indicating that storage is seasonal.

EXAMPLE 2

Compute the storage-draft rate characteristics for station No. 2816441 for a 10 year recurrence interval. The catchment area is 478 square miles.

In this case the mean annual runoff is available from the station records (Appendix A (*a*)).

$$Q = 45 \text{ inches}$$

Using the conversion 1 acre-inch = 1 cusec-hour

$$q = \frac{45 \times 478 \times 640}{365 \times 24}$$

$$= 1{,}572 \text{ cusecs}$$

From Plate I locate the station in region R1. The storage-draft rate characteristics are computed from the dimensionless curve for the region (Fig. 2). A sample calculation is given below.

Consider a (draft rate ÷ mean annual discharge) = 0.50

$$\text{draft rate} = 0.50 \times q$$

$$= 0.50 \times 1{,}572$$

$$= 786 \text{ cusecs}$$

The corresponding (storage ÷ mean annual runoff) = 0.06

$$\therefore \text{storage} = \frac{0.06 \times Q \times 640 \times A}{12}$$

$$= \frac{0.06 \times 45 \times 640 \times 478}{12}$$

$$= 68{,}832 \text{ acre-feet}$$

The calculations for the complete storage-draft rate curve are summarized in Table 5.

TABLE 5—EXAMPLE 2

Draft rate ÷ q (dimensionless) ...	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Draft rate (cusecs)	157	314	472	629	786	943	1,100	1,258	1,415	1,572
Storage ÷ Q (dimensionless) ...	0.00	0.00	0.01	0.03	0.06	0.10	0.17	0.28	0.47	0.73
Storage (acre-feet × 10^3) ...	0	0	11	34	69	115	195	321	539	837

The storage-draft rate curve for station No. 2816441 is shown in Fig. 7. To develop a constant average draft rate of 1,000 cusecs, 145,000 acre-feet of storage would be sufficient for 9 out of 10 years on the average. From Fig. 4 the critical duration for this storage volume is about 8 months indicating that storage is seasonal.

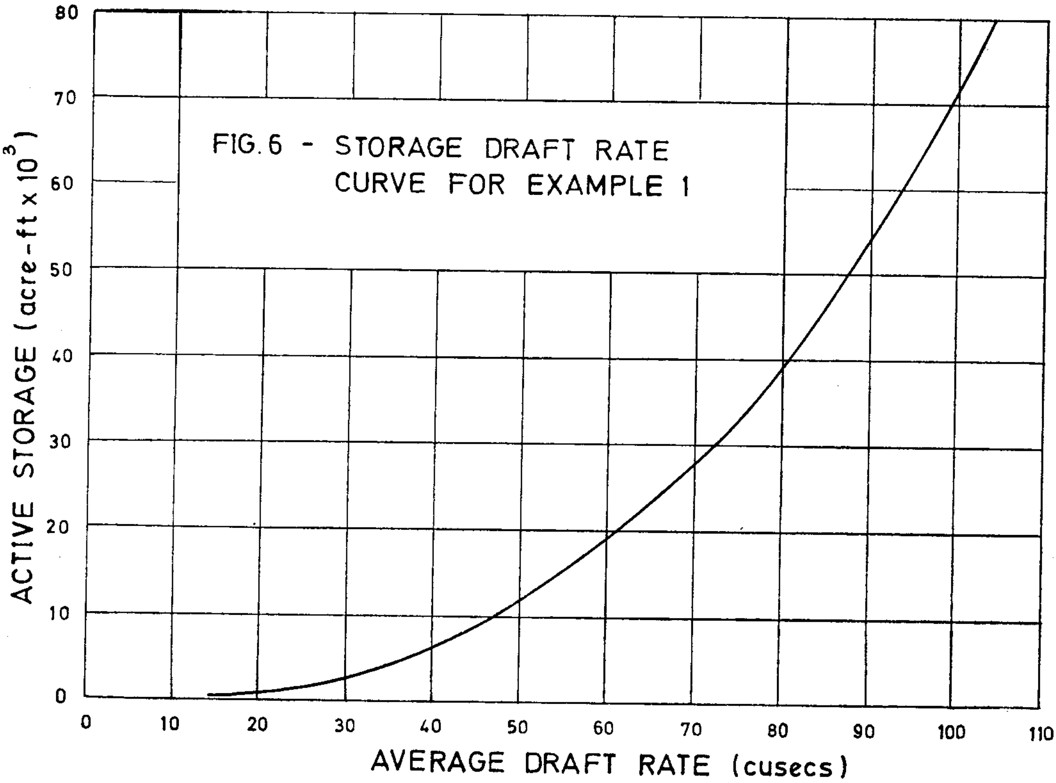

FIG. 6 - STORAGE DRAFT RATE CURVE FOR EXAMPLE 1
ACTIVE STORAGE (acre-ft x 10³)
AVERAGE DRAFT RATE (cusecs)
0
10
20
30
40
50
60
70
80
90
100
110

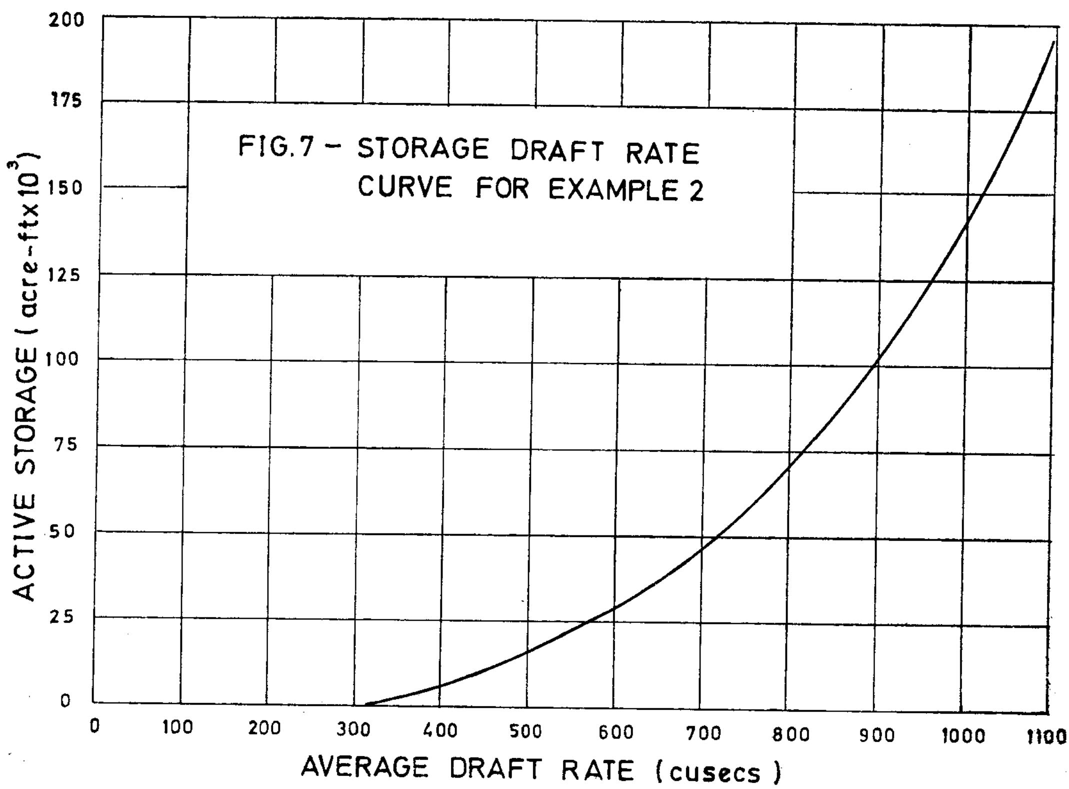

FIG. 7 - STORAGE DRAFT RATE CURVE FOR EXAMPLE 2
ACTIVE STORAGE (acre-ftx10³)
AVERAGE DRAFT RATE (cusecs)
0
25
50
75
100
125
150
175
200
300
400
500
600
700
800
900
1000
1100

4. RELIABILITY OF PROCEDURE

It is not possible to specify quantitatively the accuracy of storage-draft rate estimates made using this procedure. However a qualitative discussion of the inaccuracies involved in the analysis will assist the user in appreciating the limitations of the study. The major sources of error are associated with the frequency analysis, and with the regionalization procedure. In addition there are several theoretical limitations inherent in the method used to analyse the storage-draft rate characteristics. These limitations must be appreciated when applying this procedure to practical problems.

Errors in the frequency analysis are due to errors in fitting the type III extreme value distribution to the low flow series and uncertainties associated with assigning recurrence intervals (or cumulative probabilities) to the events in the series. The latter point has already been discussed in a previous procedure (Taylor and Goh, 1975).

During the development of the partial series from the monthly runoff, the number of values in the series became progressively smaller as the duration increased, partly due to the truncation of runoffs exceeding the mean annual runoff, and partly due to the decreasing number of values developed by the series generation. Near the upper limit of 60 months duration the distribution was fitted to only 2 or 3 values, with consequent loss of accuracy in interpolating the long duration low flows of 10 year and 25 year recurrence intervals. The implications of this error are not too serious since the useful range of low flow durations is around 1 to 12 months.

The regionalization procedure attempts to combine the storage-draft rate characteristics within a homogeneous region. Within each of the homogeneous regions defined, there is some variation in the storage-draft rate curves for individual stations. Since the storage-draft rate relationship is a function of the magnitude and variability of streamflow and since streamflow variability is consistent within a homogeneous region, then the variation in the storage-dratf rate characteristics between stations can be explained partly by the difference in the magnitude of streamflow, and partly by the sampling error involved in analysing relatively short chronological sequences of streamflow. The conversion of the storage-draft rate curves to a dimensionless form eliminates the effect of differences in streamflow magnitude, while the derivation of the median curve for the region averages out the variations due to sampling. Hence the regional curve will give a better estimate of the storage-draft rate relationship for a river within the region than the station records give.

The accuracy of the regression equations relating mean annual runoff to mean annual rainfall may be judged by the correlation between the observed and predicted values of mean annual runoff shown in Table 6.

TABLE 6—CORRELATION BETWEEN OBSERVED AND PREDICTED VALUE OF Q

Region		Correlation coefficient
R1	...	0.91
R2	...	0.92
R3	...	0.88

The method of analysis used to derive the storage-draft rate characteristics for the study data has several theoretical limitations. Firstly it is assumed that the reservoir is full prior to the start of the critical low flow sequence producing maximum drawdown in the reservoir. Secondly a constant average drawoff or draft rate is assumed. The practical implications of these limitations are dependent on the characteristics of the proposed storage system. It is relatively unimportant if fluctuations in demand occur over a short period of say one month. However large month to month fluctuations will change the pattern of cumulative drawoff and hence the derived storage and critical duration. Furthermore, if the storage scheme is multipurpose then the operating policy will introduce further constraints affecting the system design.

Despite these theoretical limitations it is considered that this procedure is useful in the initial stages of a study involving streamflow regulation, particularly where streamflow data is limited. However the answers obtained using this procedure should be interpreted sensibly within the limitations of the study.

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LIST OF SYMBOLS

A	—	catchment area (square miles).
a	—	constant in equation (1).
b	—	constant in equation (1).
C_v	—	coefficient of variation equal to the standard deviation ÷ mean.
P	—	catchment mean annual rainfall (inches).
q	—	mean annual discharge (cusecs).
Q	—	mean annual runoff (inches).

Appendix A

RESULTS OF STORAGE-DRAFT RATE ANALYSIS FOR INDIVIDUAL STATIONS

A (a)—ANALYSIS OF MONTHLY RUNOFF

Region	Station No. Old	Station No. New	No. Months Record	Mean Annual Rainfall (ins)	Mean Annual Runoff (ins) Recorded	Mean Annual Runoff (ins) Predicted	C_v. of Monthly Runoff
R1	1415	6007415	120	77	31	37	0.93
	1421	4204421	168	81	29	40	0.98
	5415	2525415	108	54	29	22	1.13
	5416	2524416	96	59	23	25	0.84
	7414	2528414	192	78	41	38	1.95
	8411	3424411	288	83	48	41	0.85
	8412	4023412	114	82	43	41	0.83
	9411	5724411	204	124	80	73	1.09
	9412	5624412	96	122	65	71	0.99
	9421	5527421	120	141	115	88	1.03
	9432	5130432	264	138	67	85	0.87
	9441	4831441	60	140	106	87	1.07
	0421	6022421	252	124	62	73	1.45
	0442	5721442	105	105	57	58	0.94
R2	1414	5806414	276	100	31	50	0.70
	2412	5505412	120	87	32	40	0.72
	2413	5506413	276	89	39	41	0.74
	2416	5506416	276	122	57	70	0.75
	2417	5506417	108	109	65	58	0.52
	2421	5405421	228	107	75	56	0.60
	3415	3814415	276	109	69	58	0.56
	3421	5007421	264	125	76	73	0.52
	3422	4907422	276	138	75	86	0.56
	3423	5007423	288	143	101	92	0.63
	3432	5206432	108	126	86	74	0.52
	3443	4809443	264	82	37	36	0.66
	3454	4112454	264	133	82	81	0.57
	3461	4410461	288	93	49	44	0.54
	3462	4510462	216	84	40	37	0.63
	3463	4611463	276	91	45	43	0.72
	3464	4311464	264	117	56	65	0.59
	3465	4410465	204	89	56	41	0.55
	3466	4610466	252	85	46	38	0.58
	4421	3414421	240	107	57	56	0.53
	4434	3116434	228	100	53	50	0.52
	4441	2816441	252	99	45	48	0.56
	5412	2625412	156	63	26	23	0.68
	5413	2725413	156	63	21	23	0.64
	5421	2519421	276	88	50	41	0.52
	5423	2520423	252	91	50	43	0.55
	6413	2322413	120	75	22	31	0.71
	6414	2322414	84	69	28	27	0.80

Region	Station No. Old	Station No. New	No. Months Record	Mean Annual Rainfall	Mean Annual Runoff (ins) Recorded	Mean Annual Runoff (ins) Predicted	C_v. of Monthly Runoff
	6432	2224432	216	73	25	30	0.76
	7411	2527411	204	63	24	23	0.73
	7423	1931423	252	91	39	43	0.81
	7451	1737451	84	94	41	45	0.58
	7471	2237471	108	113	69	62	0.77
	8410	3527410	247	82	30	36	0.72
	8462	4019462	186	80	35	35	0.72
	*3459	4112459	60	150	98	99	—
	*3416	3814416	48	111	46	60	—
	*5424	2619424	36	85	53	38	—
	*6415	2322415	36	52	19	17	—
R3	3413	3814413	276	105	46	53	0.48
	3414	3813414	264	122	71	64	0.50
	3431	5106431	120	127	65	67	0.42
	3445	4911445	204	98	39	48	0.42
	3452	4012452	228	130	81	69	0.47
	3455	4111455	204	138	66	75	0.36
	3456	4112456	264	147	73	81	0.42
	3457	3911457	192	116	76	60	0.46
	3458	3913458	264	121	60	63	0.41
	4411	3813411	156	119	69	62	0.41
	4412	3615412	276	127	71	67	0.49
	4433	3116433	252	99	42	49	0.45
	4442	2917442	252	109	54	55	0.44
	4443	2918443	264	100	57	50	0.47
	5431	3022431	264	70	34	31	0.44
	5432	2920432	168	59	25	25	0.39
	*3444	4810444	60	98	40	48	—

* Denotes station records not used in the storage-draft rate analysis.

A (b)—STORAGE FOR LOW FLOW OF 10 YEAR RECURRENCE INTERVAL

Region	*Station No.*	*Storage (ins) for 10 year Recurrence Interval for Draft Rates Shown (%q)*									
		10	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*
R1	6007415	0.08	0.97	2.63	6.15	10.87	16.80	24.65	32.50	40.35	48.20
	4204421	0.32	1.17	2.13	3.15	4.70	6.86	9.02	11.86	16.66	26.21
	2525415	0.88	2.99	5.64	9.16	15.76	23.48	31.19	38.90	46.61	54.33
	2524416	0.41	0.97	1.74	3.04	5.08	7.89	11.67	16.30	21.21	26.12
	2528414	0.00	0.51	1.69	4.10	6.83	11.28	17.44	23.59	30.11	37.06
	3424411	0.00	0.39	1.00	2.12	3.32	4.78	7.44	10.95	18.76	29.57
	4023412	0.00	0.02	0.38	1.08	2.31	4.09	6.98	14.46	26.17	40.40
	5724411	0.00	0.02	1.45	4.34	9.14	15.34	27.36	40.26	55.37	79.78
	5624412	0.03	0.57	1.57	3.62	6.14	9.92	15.34	26.92	43.11	59.30
	5527421	0.92	3.96	9.16	15.85	23.49	32.12	51.21	77.18	105.90	136.44
	5130432	0.00	0.00	0.22	1.47	4.66	8.36	12.48	18.04	30.82	56.43
	4831441	0.00	0.50	4.13	10.13	16.74	30.23	44.32	58.41	72.50	86.58
	6022421	0.66	2.53	5.65	9.71	13.87	19.34	27.66	36.31	45.67	55.03
	5721442	0.00	0.00	0.28	1.33	3.42	6.83	10.64	15.10	27.11	45.43
R2	5806414	0.00	0.06	0.60	1.36	2.39	3.41	4.96	6.93	11.88	17.93
	5505412	0.00	0.09	0.77	1.56	2.79	4.64	6.48	8.46	13.01	21.53
	5506413	0.00	0.24	1.11	2.08	3.19	4.97	6.91	10.03	16.43	26.12
	5506416	0.00	0.54	1.96	3.38	5.44	9.23	13.50	22.98	33.35	43.77
	5506417	0.00	0.00	0.06	1.13	2.76	6.89	11.22	21.55	32.37	43.19
	5405421	0.00	0.04	0.66	1.37	3.33	7.60	12.59	23.78	49.91	86.03
	3814415	0.00	0.00	0.12	0.69	1.54	3.27	6.02	10.65	20.04	36.73
	5007421	0.00	0.00	0.64	1.62	3.27	5.16	7.62	12.71	21.83	34.42
	4907422	0.00	0.03	0.82	2.07	3.88	7.02	11.84	17.73	36.57	72.94
	5007423	0.00	0.00	0.91	2.60	5.05	8.22	11.78	19.54	34.68	51.55
	5206432	0.00	0.00	0.22	1.66	3.10	4.87	7.72	13.40	19.78	26.87
	4809443	0.00	0.00	0.07	0.29	1.22	3.47	7.39	13.50	19.61	25.72
	4112454	0.00	0.00	0.68	2.08	4.13	7.18	11.28	16.83	28.10	65.38
	4410461	0.00	0.00	0.23	0.89	1.95	3.38	6.62	10.92	22.31	37.86
	4510462	0.00	0.15	0.94	2.17	4.83	7.58	10.96	17.31	25.76	35.61
	4611463	0.00	0.18	0.84	1.81	3.60	6.60	9.70	14.32	25.93	42.44
	4311464	0.00	0.00	0.36	1.27	2.60	4.00	6.56	10.38	17.97	32.88
	4410465	0.00	0.00	0.25	0.90	2.31	4.82	8.89	17.69	34.60	54.21
	4610466	0.00	0.00	0.35	1.16	2.30	4.10	7.16	12.69	24.18	35.66
	3414421	0.00	0.00	0.11	0.77	2.19	3.61	6.18	10.46	14.73	22.97
	3116434	0.00	0.07	0.52	1.46	2,78	4.09	7.77	11.71	18.08	37.56
	2816441	0.00	0.17	0.62	1.37	2.22	3.67	6.65	10.27	21.44	32.60
	2625412	0.03	0.25	0.60	1.43	2.71	4.69	6.83	9.39	15.54	21.99
	2725413	0.14	0.41	0.75	1.11	1.78	2.98	5.22	8.15	12.89	17.69
	2519421	0.00	0.12	0.58	1.42	2.35	3.60	6.60	10.05	15.49	26.36
	2520423	0.00	0.00	0.20	0.62	1.14	2.54	4.45	6.86	10.85	21.82
	2322413	0.28	0.82	1.49	2.93	4.37	5.91	7.53	9.15	13.11	17.79
	2322414	0.16	0.68	2.14	4.02	6.14	8.25	10.48	13.14	17.84	22.54
	2224432	0.08	0.46	1.11	1.93	3.52	5.16	6.91	10.43	15.71	21.45

A (b)—STORAGE FOR LOW FLOW OF 10 YEAR RECURRENCE INTERVAL—(*cont.*)

Region	*Station No.*	*Storage (ins) for 10 year Recurrence Interval for Draft Rates Shown (%q)*									
		10	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*
	2527411	0.11	0.84	1.95	3.62	5.71	8.93	15.48	26.63	37.90	49.18
	1931423	0.23	0.92	1.90	2.88	4.15	5.78	8.39	11.51	16.23	21.45
	1737451	0.00	0.09	0.50	1.19	1.88	3.12	5.71	8.47	17.48	29.23
	2237471	0.00	0.50	1.19	2.34	5.06	9.15	13.75	18.35	26.06	37.55
	3527410	0.01	0.26	0.55	1.05	1.81	3.31	5.34	8.72	15.30	21.88
	4019462	0.00	0.19	0.54	1.11	2.73	4.92	9.11	15.06	21.39	27.72
R3	3814413	0.00	0.00	0.26	0.87	2.20	4.70	8.09	12.63	20.32	41.78
	3813414	0.00	0.22	0.81	1.96	3.73	6.06	11.12	16.44	27.43	54.08
	5106431	0.00	0.00	0.00	0.65	1.74	3.07	4.70	7.36	12.24	19.81
	4911445	0.00	0.00	0.03	0.43	1.40	3.04	5.49	9.72	14.97	20.72
	4012452	0.00	0.31	0.99	1.66	2.93	4.83	7.51	10.20	17.25	34.70
	4111455	0.00	0.00	0.00	0.00	0.34	1.46	3.10	5.77	11.43	22.77
	4112456	0.00	0.00	0.60	1.52	3.18	7.03	12.37	26.29	55.09	90.45
	3911457	0.00	0.00	0.17	1.18	2.91	5.05	8.64	19.66	37.57	57.77
	3913458	0.00	0.00	0.00	0.27	0.84	2.09	5.71	10.20	17.82	28.77
	3813411	0.00	0.00	0.19	0.81	2.21	4.03	6.34	8.64	12.81	24.59
	3615412	0.00	0.00	0.00	0.31	0.90	2.25	4.02	6.38	11.11	28.51
	3116433	0.00	0.00	0.12	0.51	1.33	2.39	4.52	7.50	10.67	19.28
	2917442	0.00	0.00	0.00	0.38	1.28	2.50	5.26	9.34	15.71	41.95
	2918443	0.00	0.00	0.22	0.70	1.57	3.06	7.35	11.64	18.39	36.71
	3022431	0.00	0.00	0.05	0.33	0.65	1.49	2.62	5.05	7.87	14.39
	2920432	0.00	0.00	0.00	0.16	0.58	1.25	2.09	3.63	6.79	10.16

A (c)—STORAGE FOR LOW FLOW OF 25-YEAR RECURRENCE INTERVAL

Region	*Station No.*	*Storage (ins) for 25-year Recurrence Interval for Draft Rate Shown (%q)*									
		10	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*
R1	6007415	0.37	3.46	9.03	16.41	23.82	31.67	39.52	47.37	55.22	63.07
	4204421	0.52	1.49	2.51	4.34	6.57	11.41	19.09	27.79	37.88	49.57
	2525415	1.94	7.69	15.40	23.11	30.83	38.54	46.25	53.96	61.68	69.38
	2524416	0.50	1.36	2.95	6.97	11.88	16.79	21.70	26.61	31.52	36.43
	2528414	0.03	0.88	2.29	5.35	11.83	23.46	37.14	52.18	67.23	82.28
	3424411	0.13	0.66	1.75	2.94	4.39	9.03	16.55	24.54	35.53	49.30
	4023412	0.00	0.16	0.76	1.91	3.69	8.22	21.74	35.76	49.98	64.21
	5724411	0.00	0.14	1.98	9.86	23.21	48.98	78.36	107.73	137.10	166.47
	5624412	0.22	0.96	2.05	4.17	14.42	30.62	46.81	63.00	79.19	95.38
	5527421	1.73	6.81	14.62	33.71	62.72	95.17	127.62	160.07	195.52	224.97
	5130432	0.00	0.00	0.50	3.15	6.29	10.09	16.05	29.53	47.46	77.98
	4831441	0.00	2.28	10.28	24.36	38.45	52.54	66.63	80.71	94.80	108.89
	6022421	0.87	3.48	7.64	11.80	15.96	22.17	28.41	37.26	48.27	64.91
	5721442	0.01	0.00	0.74	2.73	5.63	9.43	14.05	24.52	36.15	62.78
R2	5806414	0.00	0.23	0.99	2.01	3.04	4.56	12.05	19.74	27.42	35.10
	5505412	0.00	0.13	0.84	2.34	4.19	6.05	9.49	16.70	24.61	32.53
	5506413	0.00	0.65	1.62	2.65	4.10	6.43	11.77	17.59	23.86	38.35
	5506416	0.03	1.10	2.52	4.83	8.06	13.49	34.34	58.90	84.92	113.20
	5506417	0.00	0.00	0.30	3.26	7.59	13.36	28.10	43.25	58.40	73.55
	5405421	0.00	0.29	0.92	2.67	6.41	10.58	15.18	27.35	52.71	89.53
	3814415	0.00	0.00	0.39	0.96	2.48	4.74	7.88	21.42	44.26	73.60
	5007421	0.00	0.24	1.01	2.47	4.36	7.12	12.15	24.66	49.39	84.23
	4907422	0.00	0.21	1.40	2.91	4.91	9.24	16.54	31.98	57.23	93.60
	5007423	0.00	0.05	1.53	3.86	6.81	10.63	15.69	33.14	72.71	121.63
	5206432	0.00	0.00	1.09	2.53	3.98	5.42	8.93	14.69	21.66	42.83
	4809443	0.00	0.00	0.00	0.56	2.14	6.74	20.18	33.63	47.07	60.52
	4112454	0.00	0.28	1.36	3.41	7.00	11.11	15.21	20.13	42.95	83.98
	4410461	0.00	0.00	0.47	1.39	3.00	6.34	14.30	24.71	36.88	53.01
	4510462	0.00	0.39	2.41	5.07	7.99	10.99	16.04	28.53	46.07	64.04
	4611463	0.00	0.43	1.27	3.61	6.61	10.92	19.00	36.99	58.00	79.55
	4311464	0.00	0.03	0.75	1.77	3.17	5.19	8.92	17.75	39.78	61.84
	4410465	0.00	0.00	0.38	1.18	3.75	6.57	10.94	30.36	55.02	83.20
	4610466	0.00	0.10	0.75	1.90	4.07	7.13	10.48	20.18	39.16	60.60
	3414421	0.00	0.00	0.25	1.40	2.94	6.24	10.52	14.80	19.08	41.38
	3116434	0.00	0.26	1.10	2.42	4.58	8.52	13.11	24.49	45.01	71.28
	2816441	0.00	0.32	1.06	1.81	3.99	6.97	9.96	17.95	29.86	46.37
	2625412	0.08	0.31	1.12	3.07	5.27	9.37	18.16	26.94	35.73	44.51
	2725413	0.19	0.53	0.89	2.36	5.10	8.03	15.23	22.43	29.64	36.84
	2519421	0.00	0.27	1.09	1.95	3.83	7.17	10.51	13.85	23.11	45.91
	2520423	0.00	0.00	0.39	0.81	2.11	4.10	6.23	9.61	18.60	30.38
	2322413	0.43	1.38	2.85	4.47	6.10	7.72	11.34	16.03	20.71	28.67
	2322414	0.20	1.83	3.86	5.97	8.09	10.92	15.15	19.38	23.61	27.84
	2224432	0.19	0.80	1.94	3.58	5.29	8.73	18.23	28.91	39.58	50.25

Region	*Station No.*	*Storage (ins) for 25-year Recurrence Interval for Draft Rate Shown (%q)* 10	20	30	40	50	60	70	80	90	100
	2527411	0.32	1.39	3.66	6.54	9.76	17.78	28.25	38.72	49.18	59.99
	1931423	0.34	1.24	2.22	3.64	5.83	8.96	13.18	18.40	28.13	41.29
	1737451	0.00	0.20	0.84	1.53	2.70	4.20	10.96	22.71	34.46	46.20
	2237471	0.14	0.71	1.77	4.17	8.35	12.95	17.98	26.51	43.74	60.98
	3527410	0.09	0.34	0.81	1.54	3.02	4.79	7.28	18.11	32.79	47.48
	4019462	0.00	0.27	0.76	2.16	3.89	13.87	24.23	35.57	48.24	60.90
R3	3814413	0.00	0.05	0.56	2.29	5.46	16.61	29.35	43.72	59.36	82.62
	3813414	0.00	0.44	1.61	3.39	7.03	12.36	17.68	23.00	47.37	82.71
	5106431	0.00	0.00	0.23	1.31	2.56	4.18	7.01	11.88	17.16	32.99
	4911445	0.00	0.00	0.17	1.33	3.63	7.21	17.43	33.84	50.25	66.66
	4012452	0.00	0.62	1.29	2.33	4.21	6.89	9.58	22.12	59.79	98.71
	4111455	0.00	0.00	0.00	0.00	0.83	2.47	4.70	11.85	21.81	48.82
	4112456	0.00	0.30	1.09	3.38	8.47	19.27	33.84	50.91	68.88	95.06
	3911457	0.00	0.00	0.42	2.25	4.33	8.49	33.60	68.95	104.31	139.67
	3913458	0.00	0.00	0.00	0.49	1.44	4.53	9.12	31.25	54.16	82.66
	3813411	0.00	0.00	0.45	1.72	3.57	5.88	8.18	12.22	23.94	42.36
	3615412	0.00	0.00	0.02	0.61	1.67	3.45	5.54	10.72	28.44	49.75
	3116433	0.00	0.00	0.27	1.03	2.09	4.74	7.81	10.98	21.08	42.21
	2917442	0.00	0.00	0.00	0.88	1.99	5.38	9.45	13.52	35.16	60.50
	2918443	0.00	0.00	0.45	1.19	3.46	7.75	12.04	28.94	51.64	78.34
	3022431	0.00	0.00	0.19	0.48	1.15	2.42	5.05	10.29	25.34	41.16
	2920432	0.00	0.00	0.00	0.35	0.84	2.07	4.69	8.07	11.45	14.82

A (d)—CRITICAL DURATION FOR LOW FLOW OF 10-YEAR RECURRENCE INTERVAL

Region	Station No.	*Critical Duration (mths) for 10-year Recurrence Interval for Draft Rate shown (%q)*									
		10	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*
R1	6007415	2	4	7	18	20	30	30	9	20	30
	4204421	3	4	4	5	9	9	9	20	20	42
	2525415	5	11	11	18	32	32	32	32	32	32
	2524416	3	3	6	9	14	20	20	26	26	26
	2528414	1	2	4	8	8	18	18	18	20	30
	3424411	1	1	2	3	3	4	8	9	20	30
	4023412	1	1	1	2	5	5	18	22	40	40
	5724411	1	1	3	5	8	18	18	20	32	40
	5624412	1	1	2	4	7	7	18	30	30	30
	5527421	2	4	7	8	8	20	20	30	32	32
	5130432	1	1	1	4	6	7	8	18	30	56
	4831441	1	1	5	7	8	16	16	16	16	16
	6022421	3	6	6	8	8	10	16	18	18	18
	5721442	1	1	1	3	6	8	8	20	30	44
R2	5806414	1	1	3	4	4	4	7	9	20	30
	5505412	1	1	3	3	7	7	7	8	30	30
	5506413	1	2	3	3	4	6	6	16	30	30
	5506416	1	3	3	4	8	8	20	20	22	22
	5506417	1	1	1	3	3	8	8	20	20	20
	5405421	1	1	1	2	4	8	8	20	58	58
	3814415	1	1	1	1	3	3	6	9	22	42
	5007421	1	1	1	2	3	3	8	9	20	20
	4907422	1	1	2	2	3	7	9	20	58	58
	5007423	1	1	2	2	3	4	9	10	20	20
	5206432	1	1	2	2	2	3	7	8	9	10
	4809443	1	1	1	2	4	8	20	20	20	20
	4112454	1	1	1	3	3	6	6	16	34	56
	4410461	1	1	1	2	3	8	8	20	32	54
	4510462	1	1	3	8	8	9	18	22	28	30
	4611463	1	1	2	3	8	8	9	20	44	44
	4311464	1	1	1	2	3	3	8	9	28	34
	4410465	1	1	1	3	3	8	10	36	36	44
	4610466	1	1	1	3	3	8	8	30	30	30
	3414421	1	1	1	2	3	3	9	9	9	28
	3116434	1	1	1	3	3	3	9	9	34	52
	2816441	1	1	2	2	3	8	8	30	30	30
	2625412	1	1	3	4	9	9	10	28	28	28
	2725413	1	2	2	3	7	7	10	26	28	28
	2519421	1	1	2	2	3	3	8	9	26	26
	2520423	1	1	1	1	2	4	5	9	14	52
	2322413	3	3	8	8	8	9	9	9	26	26
	2322414	1	3	7	9	9	9	10	20	20	20
	2224432	1	2	4	4	8	8	9	24	28	28

A (d)—CRITICAL DURATION FOR LOW FLOW OF 10-YEAR RECURRENCE INTERVAL—(*cont.*)

Region	*Station No.*	*Critical Duration (mths) for 10-year Recurrence Interval for Draft Rate shown (%q)*									
		10	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*
	2527411	3	4	8	10	16	16	40	56	56	56
	1931423	2	3	3	3	5	5	9	10	16	16
	1737451	1	1	2	2	2	4	8	8	34	34
	2237471	1	1	2	2	7	8	8	8	20	20
	3527410	1	1	2	2	4	8	8	26	26	26
	4019462	1	1	2	2	7	9	20	22	22	22
R3	3814413	1	1	1	3	5	8	9	14	22	56
	3813414	1	1	1	3	3	7	9	9	44	52
	5106431	1	1	1	2	2	3	3	9	9	16
	4911445	1	1	1	2	3	7	8	16	16	32
	4012452	1	1	1	1	2	4	4	4	26	26
	4111455	1	1	1	1	2	3	3	8	16	44
	4112456	1	1	1	2	4	8	9	42	58	58
	3911457	1	1	1	2	3	4	9	20	32	32
	3913458	1	1	1	1	2	3	9	9	20	22
	3813411	1	1	1	2	3	4	4	4	9	28
	3615412	1	1	1	1	1	3	3	8	8	56
	3116433	1	1	1	2	3	3	8	9	9	32
	2917442	1	1	1	2	2	3	9	9	58	58
	2918443	1	1	1	1	2	9	9	9	26	50
	3022431	1	1	1	1	2	4	4	9	14	30
	2920432	1	1	1	1	2	4	4	8	16	16

A (e)—CRITICAL DURATION FOR LOW FLOW OF 25-YEAR RECURRENCE INTERVAL

Region	*Station No.*	*Critical Duration (mths) for 25-year Recurrence Interval for Draft Rate shown (%q)*									
		10	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*
R1	6007415	4	16	28	28	30	30	30	30	30	30
	4204421	4	4	5	9	10	32	32	42	42	54
	2525415	11	32	32	32	32	32	32	32	32	32
	2524416	3	6	9	26	26	26	26	26	26	26
	2528414	1	4	6	16	34	34	44	44	44	44
	3424411	1	2	3	3	4	18	20	20	32	32
	4023412	1	1	2	5	5	38	38	40	40	40
	5724411	1	2	3	4	30	30	30	30	30	30
	5527421	4	7	20	20	34	34	34	34	34	34
	5130432	1	1	2	5	6	7	18	32	32	60
	4831441	1	5	16	16	16	16	16	16	16	16
	6022421	3	8	8	8	8	12	12	18	32	32
	5721442	1	1	2	5	8	8	22	22	56	56
R2	5806414	1	2	4	4	4	7	30	30	30	30
	5505412	1	1	3	7	7	8	20	30	30	30
	5506413	1	3	3	4	6	16	18	18	20	58
	5506416	1	3	3	6	8	44	44	54	58	60
	5506417	1	1	3	8	8	16	28	28	28	28
	5405421	1	1	1	6	6	7	8	22	58	60
	3814415	1	1	1	1	3	5	8	30	40	54
	5007421	1	1	2	3	3	8	8	32	44	56
	4907422	1	1	2	3	4	9	22	40	58	58
	5007423	1	1	2	3	4	6	6	28	58	58
	5206432	1	2	2	2	2	2	8	8	12	30
	4809443	1	1	1	5	8	44	44	44	44	44
	4112454	1	1	3	3	6	6	6	16	60	60
	4410461	1	1	2	3	6	14	20	30	30	52
	4510462	1	3	8	8	9	9	16	44	54	54
	4611463	1	2	3	8	8	20	32	56	56	58
	4311464	1	1	2	3	3	8	8	32	58	58
	4410465	1	1	1	5	6	6	10	48	60	60
	4610466	1	1	3	3	8	8	9	32	56	56
	3414421	1	1	1	3	4	9	9	9	9	56
	3116434	1	1	3	3	9	9	26	26	60	60
	2816441	1	1	2	2	8	8	9	32	32	58
	2625412	1	1	4	9	10	40	40	40	40	40
	2725413	2	2	3	16	16	42	42	42	42	42
	2519421	1	1	2	3	8	8	8	8	50	56
	2520423	1	1	1	1	4	5	7	11	28	32
	2322413	3	8	9	9	9	9	26	26	26	54
	2322414	1	8	9	9	9	18	18	18	18	18
	2224432	2	4	8	8	9	46	52	52	52	52
	2527411		8	12	16	16	52	52	52	52	54

A (e)—CRITICAL DURATION FOR LOW FLOW OF 25-YEAR RECURRENCE INTERVAL—(*cont.*)

Region	*Station No.*	*Critical Duration (mths) for 25-year Recurrence Interval for Draft Rate shown (%q)*									
		10	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*
	1931423	2	3	3	5	9	10	16	16	40	54
	1737451	1	1	2	2	4	7	34	34	34	34
	2237471	1	1	2	7	8	8	10	30	30	30
	3527410	1	1	2	5	7	7	10	58	58	58
	4019462	1	1	2	6	6	36	36	44	44	44
R3	3814413	1	1	3	8	9	30	36	40	60	60
	3813414	1	1	3	3	9	9	9	9	58	60
	5106431	1	1	2	2	3	3	9	9	16	50
	4911445	1	1	2	7	7	30	50	50	50	50
	4012452	1	1	1	2	4	4	4	52	58	58
	4111455	1	1	1	1	2	3	6	16	22	60
	4112456	1	1	2	8	9	20	28	28	30	60
	3911457	1	1	2	3	4	9	56	56	56	56
	3913458	1	1	1	1	3	8	44	46	46	60
	3813411	1	1	1	3	4	4	4	10	32	32
	3615412	1	1	1	1	3	3	4	30	30	42
	3116433	1	1	1	3	3	8	9	9	52	52
	2917442	1	1	1	2	3	9	9	9	56	56
	2918443	1	1	1	2	9	9	9	44	56	56
	3022431	1	1	1	1	3	9	10	28	56	56
	2920432	1	1	1	2	3	8	16	16	16	16

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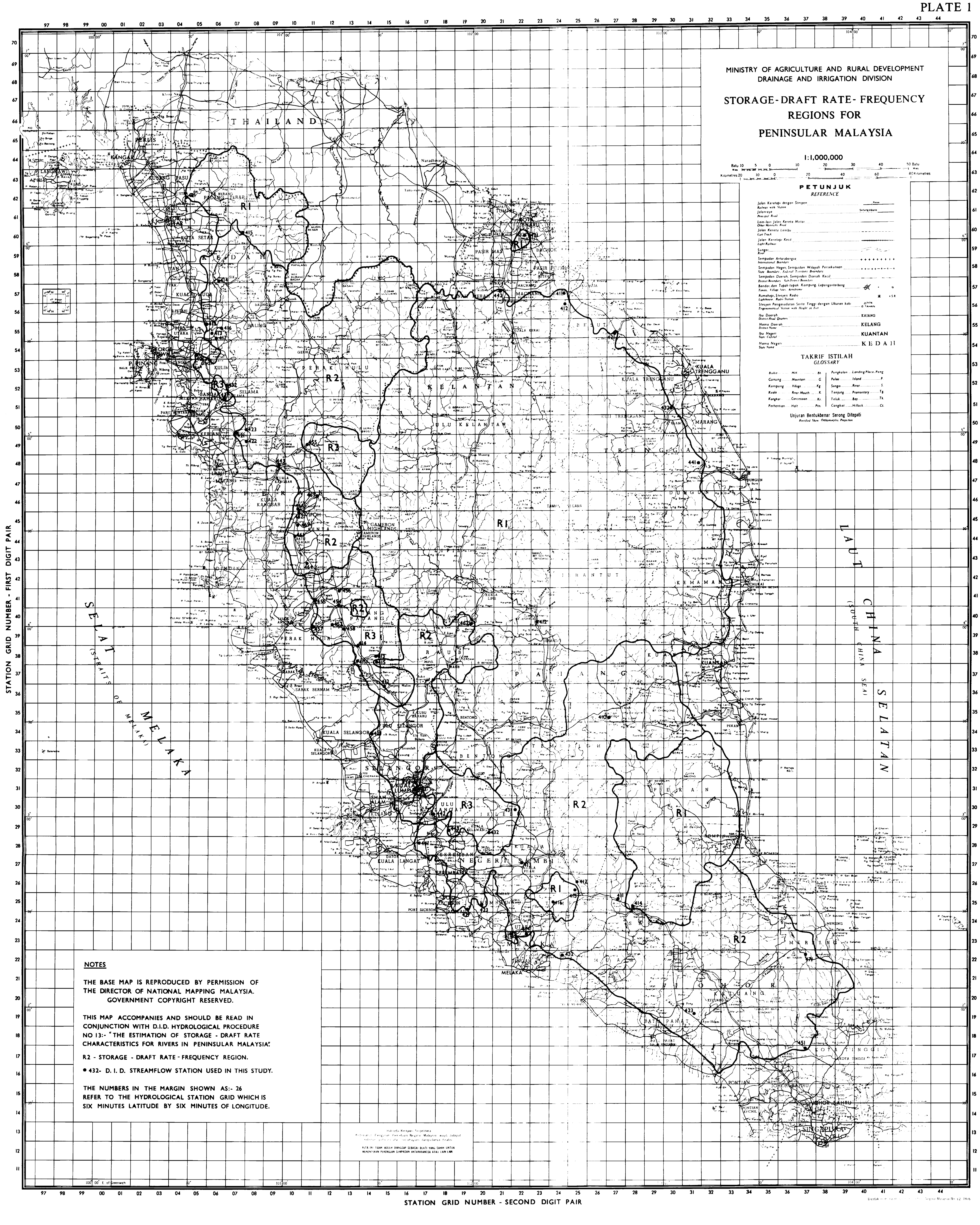
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT
DRAINAGE AND IRRIGATION DIVISION
STORAGE-DRAFT RATE-FREQUENCY
REGIONS FOR
PENINSULAR MALAYSIA
1:1,000,000
Batu 10 5 0 10 20 30 40 50 Batu
Kilometres 20 10 0 20 40 60 80 Kilometres
PETUNJUK
REFERENCE
Jalan Keretapi dengan Stesyen / Railway with Station
Jalanraya / Principal Road
Lain-lain Jalan Kereta Motor / Other Motorable Road
Jalan Kereta Lembu / Cart Track
Jalan Keretapi Kecil / Light Railway
Sungai / River
Sempadan Antarabangsa / International Boundary
Sempadan Negeri, Sempadan Wilayah Persekutuan / State Boundary, Federal Territory Boundary
Sempadan Daerah, Sempadan Daerah Kecil / District Boundary, Sub-District Boundary
Bandar, dan Tapak-tapak Kampung, Lapanganterbang / Towns, Village Sites, Aerodrome
Rumahapi, Stesyen Radio / Lighthouse, Radio Station
Stesyen Penigasudutan Serta Tinggi dengan Ukuran kaki / Trigonometrical Station with Height in Feet
Ibu Daerah / District Head Quarters — KAJANG
Nama Daerah / District Name — KELANG
Ibu Negeri / State Capital — KUANTAN
Nama Negeri / State Name — KEDAH
TAKRIF ISTILAH
GLOSSARY
Bukit — Hill — Bt.
Gunung — Mountain — G.
Kampung — Village — Kg.
Kuala — River Mouth — K.
Kongkar — Concession — Kr.
Perhentian — Halt — Ptn.
Pengkalan — Landing Place — Peng.
Pulau — Island — P.
Sungai — River — S.
Tanjung — Promontory — Tg.
Teluk — Bay — Tk.
Cangkat — Hillock — Ct.
Unjuran Bentukbenar Serong Ditepati
Rectified Skew Orthomorphic Projection
NOTES
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THIS MAP ACCOMPANIES AND SHOULD BE READ IN CONJUNCTION WITH D.I.D. HYDROLOGICAL PROCEDURE NO 13:- "THE ESTIMATION OF STORAGE - DRAFT RATE CHARACTERISTICS FOR RIVERS IN PENINSULAR MALAYSIA".
R2 - STORAGE - DRAFT RATE - FREQUENCY REGION.
● 432- D. I. D. STREAMFLOW STATION USED IN THIS STUDY.
THE NUMBERS IN THE MARGIN SHOWN AS:- 26 REFER TO THE HYDROLOGICAL STATION GRID WHICH IS SIX MINUTES LATITUDE BY SIX MINUTES OF LONGITUDE.
THAILAND
SELAT MELAKA
(STRAITS OF MELAKA)
LAUT CHINA SELATAN
(SOUTH CHINA SEA)
KELANTAN
TRENGGANU
PAHANG
SELANGOR
JOHOR
R1
R2
R3
STATION GRID NUMBER - FIRST DIGIT PAIR
STATION GRID NUMBER - SECOND DIGIT PAIR