WATER RESOURCES PUBLICATION NO. 1

SURFACE WATER RESOURCES MAP (Provisional) OF PENINSULAR MALAYSIA

JABATAN PENGAIRAN DAN SALIRAN
KEMENTERIAN PERTANIAN MALAYSIA

Bahagian Parit dan Taliair **Water Resources Publication No. 1**

SURFACE WATER RESOURCES MAP (Provisional)

OF

PENINSULAR MALAYSIA

KEMENTERIAN PERTANIAN DAN PERIKANAN
MALAYSIA

ACKNOWLEDGEMENT

This is the first of several publications of the Drainage and Irrigation Department and forms a part of the work in connection with the preparation of an inventory of water resources of Peninsular Malaysia. The work has been carried out by officers of the Water Resources Section, Hydrology Branch of the Department in association with the Engineering Export Association of New Zealand Inc. (ENEX) whilst the latter was retained as Consultants to assist the Drainage and Irrigation Department to expand its hydrological activities and upgrading its hydrological services in Peninsular Malaysia. The use of climatological data provided by the Malaysian Meteorological Services is gratefully acknowledged.

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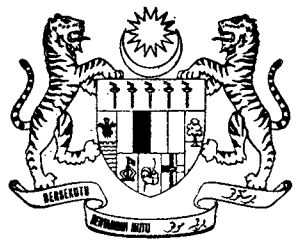

SURFACE WATER RESOURCES MAP (Provisional)

OF

PENINSULAR MALAYSIA

AND

Explanatory Notes

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1974
MINISTRY OF AGRICULTURE AND FISHERIES
MALAYSIA

SURFACE WATER RESOURCES MAP (PROVISIONAL) OF PENINSULAR MALAYSIA

EXPLANATORY NOTES

The Annual Precipitation minus Potential Evapotranspiration (P-PE) approach is used to provide the "first line" estimate of the surface water resources of Peninsular Malaysia. Precipitation is based on the average annual rainfall isohyetal map (July 1950-June 1965) prepared and published by the Drainage and Irrigation Department (D.I.D. 1969). Potential evapotranspiration (PE) is based on the average annual PE map prepared by the Hydrology Branch, D.I.D. using the Thornthwaite procedure (Thornthwaite, C.W. 1957).

2. Thornthwaite's method has been used to estimate the evapotranspiration (i.e. potential evapotranspiration) partly because of the availability of mean monthly air temperature from 66 meteorological stations (operated by the Malaysian Meteorological Services) throughout Peninsular Malaysia but mainly due to the fact that the calculated annual potential evapotranspiration correlates reasonably well with the ground elevation for the range (6′ to 4,750′ above m.s.l.) computed. A plot of these two parameters shows that a straight line relationship can be established, the PE decreasing linearly with elevation. Nieuwolt, S. (1965) used calculated saturation deficit and the actual hours of bright sunshine to estimate evaporation for Peninsular Malaysia and concluded that Thornthwaite's potential evapotranspiration values compare favourably with evaporation values estimated using saturation deficit and sunshine hours. However, Nieuwolt also rightly pointed out that Thornthwaite's values do not show the full extent of the variation from month to month. This is because "in equatorial climates, values computed solely on the basis of average temperature and lengths of day have a very limited variation, both factors being extremely steady." The Australian Engineering Consultants who were engaged in the Pahang River Basin Study (Austec, May 1973) considered Thornthwaite's method of estimating evapotranspiration to be sufficiently accurate in view of the uncertainty of the rainfall estimate used for runoff estimations.

3. The P-PE map was prepared from the topographical map of Peninsular Malaysia (scale: 1:760,000) and the rainfall isohyetal map of the same scale. Grid lines spaced at 5 minute intervals were drawn on the topographical map. At each intersection point, the ground elevation and hence its PE was estimated. Similarly, the average annual precipitation for the same point was estimated from the rainfall isohyetal map. The P-PE was then computed for the point in question. The calculation and the plotting of the P-PE values were greatly facilitated using a programmable calculator. The plotting was done to a scale of 1 = 1,000,000 and the isolines joining places of equal P-PE were drawn by hand.

4. Comparison of estimates of potential surface water resources using the P-PE map with the measured average annual specific discharge values at existing flow stations (D.I.D. Malaysia 1969, 1973) indicates that the P-PE approach under-estimates the surface water resources of Peninsular Malaysia in a number of river basins. These include those in Kelantan and upper Pahang where the difference exceeds 25%. In the state of Kedah, P-PE values correspond quite favourably with the measured specific discharge values. In Perak too, P-PE and the measured values agree reasonably well except for Sg. Kulim, Sg. Kerian, Sg. Ijok and Sg. Ara where the P-PE method underestimates again by over 25%. In other rivers which include Sg. Segamat (Johore), Sg. Linggi, Sg. Pedas (both in Negeri Sembilan), Sg. Seminyih (Selangor) and Sg. Sia (Pahang), the under-estimate exceeds 50%. Comparison cannot be made for a big proportion of the country particularly in Trengganu, Lower Perak, Pahang Tenggara and Johore where few or no flow records exist. The reason for these underestimates can be due to a number of factors, among these are inadequate coverage by the existing network of rainfall stations leading to the underestimation of precipitation; the use of potential evapotranspiration instead of the actual evapotranspiration (AE) values, P-PE gives potential runoff while P-AE gives the actual runoff or specific discharge; artificial abstraction and recharge which have not been accounted for in the estimation of average annual specific discharge; and errors in flow gaugings.

5. In view of the above limitation, the **map should only be used as first approximations for urgent short-term water resource planning and management purposes.** The map provides a pictorial indication of the spatial distribution of potential water resources in Peninsular Malaysia. It gives a rough estimate of the order of potential runoff from a particular area within the limitations mentioned in para 4. The map cannot be used, however, to provide accurate average specific discharge for a particular point on a stream.

6. Refinement of the surface water resources map needed for long term management and planning will be carried out over the next few years. One refinement is to use AE instead of PE values to obtain the P-AE contours. The contours could then be adjusted using both measured specific discharge values (for gauged catchments) and estimated specific discharge values (for ungauged catchments). Further refinement may be achieved by taking into account water abstraction from various catchments.

7. DEFINITIONS

Annual refers to water year i.e. from July of one year to June of the following year.

Specific discharge is the discharge per unit area given in litres per second per square kilometre (lit. sec $-^1$ km $-^2$).

Average annual specific discharge is the annual specific discharge averaged over a long period (in the context of this paper July 1950-June 1965).

Average annual precipitation is the annual precipitation averaged over a long period (in the context of this paper July 1950-June 1965).

Potential evapotranspiration (PE) is the evapotranspiration that would occur were there an adequate soil-moisture supply at all times.

Average annual potential evapotranspiration is the potential evapotranspiration based on long term climatological records (in this context from 1928-1958).

Actual evapotranspiration (AE) is the evaporation from all water, soil, vegetative, and other surfaces, plus transpiration.

8. UNITS AND CONVERSION FACTORS

Precipitation P = millimetres (mm).

Potential Evapotranspiration PE = millimetres (mm).

The conversion factors used are as follows:

Specific discharge (lit. sec $-^1$ km $-^2$) $\times$ 31.5 = P-PE in mm/per annum.

lit. sec $-^1$ km $-^2$ = cusecs miles $-^2$ $\times$ 10.93.

km^2 = $miles^2$ $\times$ 2.59.

9. REFERENCES:

Thornthwaite, C.W. and Mather J.R. (1951), "Instruction and Tables for Computing Potential Evapotranspiration and the Water Balance".

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SURFACE WATER RESOURCES OF PENINSULAR MALAYSIA

1:1,000,000

Batu 10 5 0 10 20 30 40 50 Batu Miles

Kilometres 20 10 0 20 40 60 80 Kilometres

PETUNJUK
REFERENCE

- Jalan Keretapi dengan Stesyen — Railway with Station
- Jalanraya Perintah Kekal — Main 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 Lapangterbang — Town, Village, Site, Aerodrome
- Rumahagas Stesyen Radio — Lighthouse, Radio Station
- Stesyen Pengstudutan Serta Tinggi dengan Ukuran kaki — Triangulation 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	Pengkalan	Landing Place	Peng
Gunung	Mountain	G.	Pulau	Island	P
Kampung	Village	Kg	Sungai	River	S
Kuala	River-Mouth	K	Tanjung	Promontory	Tg
Kurnigkar	Concession	Kr	Teluk	Bay	Tk
Perhentian	Halt	Ptn.	Cangkat	Hillock	Ct

Unjuran Bentukbenar Serong Ditepati
Rectified Skew Orthomorphic Projection

SURFACE WATER RESOURCES MAP OF PENINSULAR MALAYSIA

(PROVISIONAL)
P - PE
(1950 - 1965)

CAUTION: THIS MAP SHOULD BE USED IN CONJUNCTION WITH THE EXPLANATORY NOTES

LEGEND

P - PE	
ABOVE	2,500 MM.
2,000 MM	- 2,500 MM.
1,500 MM	- 2,000 MM.
1,000 MM	- 1,500 MM.
500 MM	- 1,000 MM.
UNDER	500 MM.

MEAN P - PE = 900 MM.

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