

MISSION REPORT

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KEDAH - PERLIS WATER MANAGEMENT STUDY

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SURFACE WATER RESOURCES SURVEY

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by

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( 13<sup>th</sup> November to 2<sup>nd</sup> December 1978 )

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## INTRODUCTION

- a) - *Within the framework of the KEDAH and PERLIS water management study, the aim of this mission was to make a general assessment of the existing water resources, analyse the hydrometeorological data and make remarks about the part of foreseen processing (Simulation Model), concerning the surface water resources.*

*The consultant was assisted during his stay in MALAYSIA by*

- M. ONG TIONG EE : Hydrologist of the RENARDET Singapore Office, and  
M. HUI YAN KHOON : Assistant design engineer of the YUSSOF IBRAHIM SEHU Sdn*

*and thanks them for their cooperation.*

b) - Time schedule

. 13th - 20th November :

*Kuala-Lumpur : visits to Government Offices, meetings with RENARDET and YUSSOF IBRAHIM SEHU engineers, gathering and analysis of the hydrometeorological data.*

. 21th - 24th November :

*Alor Setar (KEDAH) : visits to MADA and DID, inspection on the field of the stream gauging stations, visit of the PEDU Dam site.*

. 25th November - 2nd December :

*Meetings with the consultants and engineers in charge of the study and particularly with M. NADEAU, Project Manager. Setting up the programme of needs, requirements to the computation center of D.I.D., and preliminary report for the inception report.*

c) - V i s i t s

- *Encik WONG KOK HENG, Associate Director of the YUSSOF IBRAHIM SEHU Sdn, Deputy project manager of the study (Water Resource*
- *Encik S.H. THAVARAJ, Assistant Director General, Drainage and Irrigation Department.*
- *Encik TAN HOE TIM, Hydrology Branch - D.I.D.*
- *Dr. RADSUAN AB. RAHMAN, University Pertanian MALAYSIA.*
- *Encik SIEH KOK CHI, Hydrology Branch D.I.D.*
- *Prof. ENOCH, University Pertanian MALAYSIA*

- Mr. BRIAN O'CONNOR, Computation Center D.I.D.
- Encik ISMAIL HAMID, Assistant Director E.P.U.
- Encik CHOW CHOON, Director, D.I.D. - KEDAH
- Encik WANG CHANG WAI, Hydrology Section - D.I.D. - KEDAH

## 1. - ANALYSIS and NEEDS FOR the STUDY

### 1.1. - RAINFALL

#### 1.1.1. - Available data

Rainfall data have been collected for many years in KEDAH and PERLIS and according to the inventory index provided by D.I.D. (which is not exhaustive) the approximate number of stations in 1977 was as follows :

	PERLIS		KEDAH	
	in operation	-closed	in operation	-closed
- Rain gauges	10	(1)	54	(11)
- Recording rain gauges	2	(3)	13	( 1)

In KEDAH and PERLIS, 13 rainfall stations were in operation before the second War, the first records dating from January 1907 (ALOR STAR HOSPITAL). During the second War, many records were lost and there are uncertainties on the reliability of the records concerning this period, with important lack of data for mostly stations.

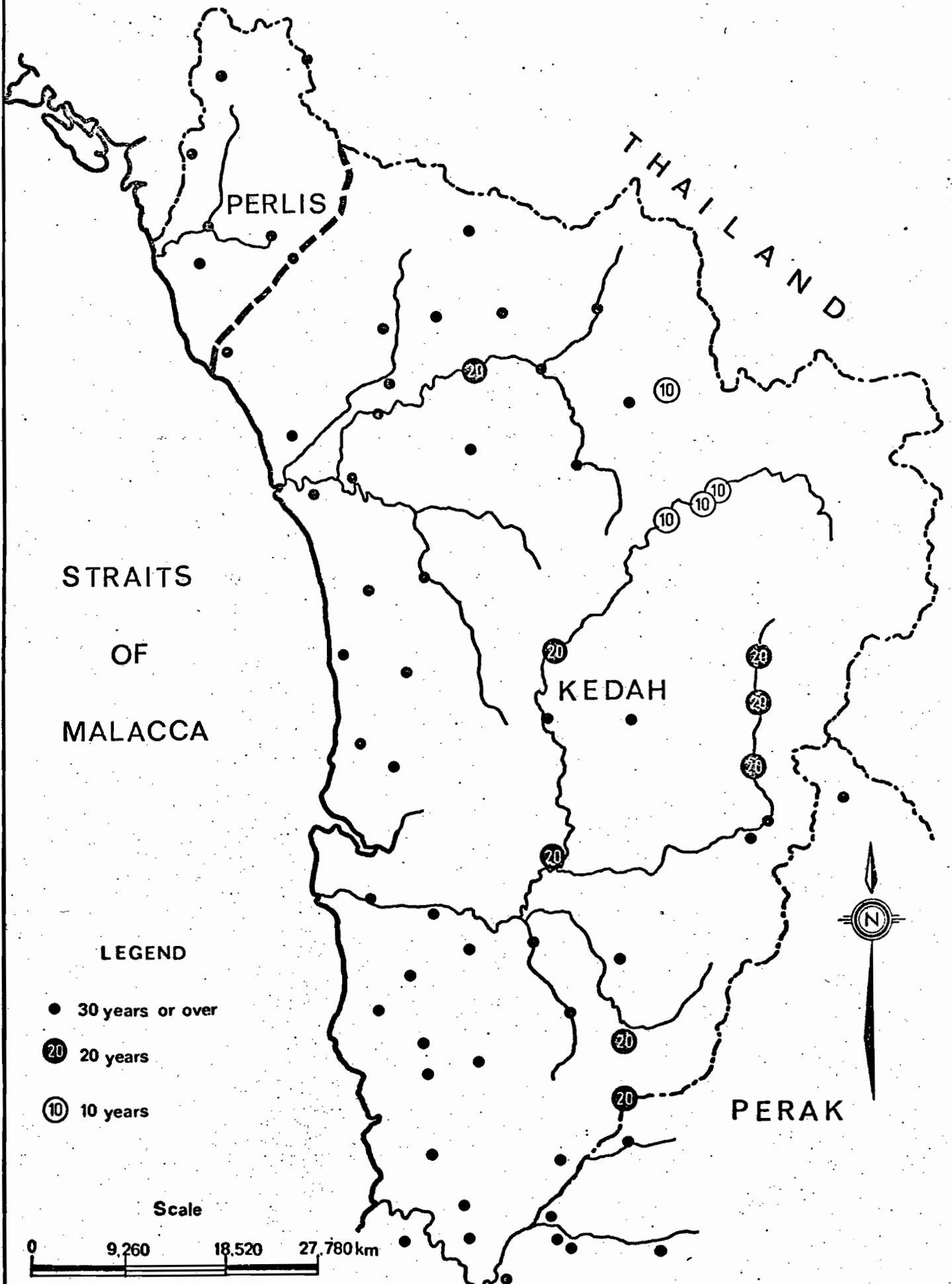
From 1946-1947, a consistent network was equipped and maintained and the density may be considered as satisfactory on the central area and the inter-land. However, there are no rainfall stations in the mountainous nord-east zone, and for this reason, no records are available for the PEDU and MUDA catchments. (The station 6207032 installed at the PEDU Dam site in September 1964, and the station 6108062 at the MUDA Dam site, opened in September 1964, are not representative of the average rainfall on these catchments).

#### 1.1.2. - Setting up the file of reliable data

##### 1.1.2.1. - Selection of rainfall stations

Taking into account the aboved considerations, the period 1947-1977 (31 years) may be chosen for the study (the updating to 1977 is important, a severe drought having affected KEDAH and PERLIS in 1977) and the list of selected rainfall stations is given in Annex. This list is rather exhaustive and includes the further extension of the study.

# RAINFALL STATIONS



number of stations Duration	PERLIS	KEDAH	WELLESLEY	PERAK
30 years	6	37	7	10
20 years	0	8	0	0
10 years	0	4	0	0

Notes

1. - The four stations with 10 years records are located on the upper part of the Sungai PEDU and the Sungai MUDA.
2. - The eight stations of KEDAH having 20 years records, have been chosen for their geographical situation, in particular on the upper part of the Sungai KETIL.
3. - Ten stations of PERAK have been selected for the knowledge of the rainfall in the Sungai KRIAN catchment since the right bank of this river is situated in KEDAH.
4. - Several stations of WELLESLEY have been taken in order to evaluate if necessary the rain amount on the lowest part of the MUDA catchment and of the KULIM catchment.

1.1.2.2. - Considerations on existing data and needs

- All the rainfall data which can be useful for this study, and its developments, are gathered and kept by the H.Q. of D.I.D. in Kuala-Lumpur and the records have been published (in inches of monthly and annual rainfall for all years for which observations have been made) up to 1975 [8].
- The rainfall records 1879-1958 have been manually processed.
- The rainfall records 1959-1970 have been manually processed, loaded on a carrier and print-out by the I.C.T. Computer of the Statistics Department. New station numbers have been allotted to the rainfall stations.

- The rainfall records 1970-1975 have been computed by automatic processing with digitalization of the recording rain gauge charts (reading table), using the computer of the hydrology Branch in D.I.D. A third numbering system is applied and the two others cancelled.

For the moment, the rainfall data storage in Data Bank covers a wide range of years for each station. Depending on the station the beginning of stored data is 1936 in the best case, and 1953 the most frequent.

From several years, the metric system unit is used (accuracy to tenth of millimeter) for the digitalization of the recording rain gauge charts.

From published (D.I.D.) rainfall and meetings with D.I.D. Hydrological Section officers, it appears :

- . The "blue rainfall record books" published by the D.I.D are not really suitable for a water management study, because of discrepancies e.g. they present "uncertified" monthly rainfalls of stations with significant proportions of missing daily rainfalls as though they were complete without any indication on the print-out, (hence requiring voluminous daily print outs to be checked).

For obtaining and processing the rainfall data over the period 1947-1977, the following procedure should be adopted in agreement with the Hydrology Branch of D.I.D., as follows :

- . Putting into the computer system, or on carrier, the daily rainfall values not yet stored in the Data Bank (the '+' for each station of the list given in Annex I indicates the beginning of the existing data storage).

For the purposes of this study and considering the delays which are necessary for the input of the data on "carrier", only the daily readings of rain gauges may be put in, the digitalization of the recording rain gauge charts will take too much time.

- . Updating to December 1977.
- . Print-out on a suitable format and for every station of a summary of the monthly and annual total values, in calendar year (January to December) in tenth of millimeter. This print-out will be given to the consultants.



- . As the monthly totals presenting include some missing daily rainfalls which are not differentiated by brackets, a free access to the print-outs of daily rainfall values in D.I.D. is necessary to check the summary.
- . Duplication on a magnetic tape (9 tracks, density 800 or 1600 BPI) of all the monthly and annual rainfall totals of the Annex I; this tape will be sent to Paris for the foreseen processing (Simulation Model) in a suitable form. Because of the time required, the priority of the loading on carrier might be :
  1. - Rainfall stations of the Sungai PADANG TERAP catchment
  2. - Rainfall stations of the Sungai MUDA catchment
  3. - Rainfall stations of the irrigated area (coastal zone)
  4. - Rainfall stations of PERLIS
  5. - Rainfall stations of the Sungai KRIAN catchment

and the supply of the print-out by D.I.D. should be carried out in conformity.

As soon as each section will be completed e.g. the magnetic tapes, that section must be sent to Paris for processing.

It is very important to obtain from the D.I.D. as quickly as possible, an evaluation of the time which is required to complete the data bank. If the delays are too considerable, it will be necessary to reduce the number of stations to be punched.

#### 1.1.2.3. - Complètement and Homogeneity checking

The rainfall data file which will be provided by D.I.D. being the picture of the source-document (raw-data), the scrutiny of the series of observations to reveal sudden changes in values and find cause of non-homogeneity (relocation of a station, changes in the environment, replacement of the equipment) with different methods like curves of accumulated values, cannot be systematically carried out and only a few stations will be scrutinized in order to determine either the non-homogeneity of the rainfall series is the most frequent case or not.

The completion of missing values (a few days or a whole month) will be carried out manually in Kuala-Lumpur by comparison with the closest stations, if the amount of corrections is not too heavy.

If not, the monthly completion will be processed at Paris.

#### 1.1.2.4. - Use of rainfall data

The use of rainfall data will permit to set up :

- An inventory of the monthly and annual rainfall for the last thirty years in tenth of millimeter and in calendar year and could be attached as Annex to the present study.
- A sample of the rainfall feeding directly the irrigation area (Simulation Model).
- A tool to the extension of runoff series by hydropluviometrical multiple correlations (Simulation Model).

### 1.2. - RUNOFF

#### 1.2.1. - Inventory of available data

The two principal rivers, Sungai PADANG TERAP and Sungai MUDA, have gauging stations for 1946-1947 with automatic recorders for 58-60, but the stations at Lengkuas and Nami on the PADANG TERAP and the MUDA, have been closed unfortunately respectively in July 1967 and June 1973.

There are actually on the MUDA four stations with automatic recorders from Jeniang down to LDG Victoria and at TITI SYED OMAR measurements of water quality are carried out for December 1974, and sediment transportation measurements for April 1976.

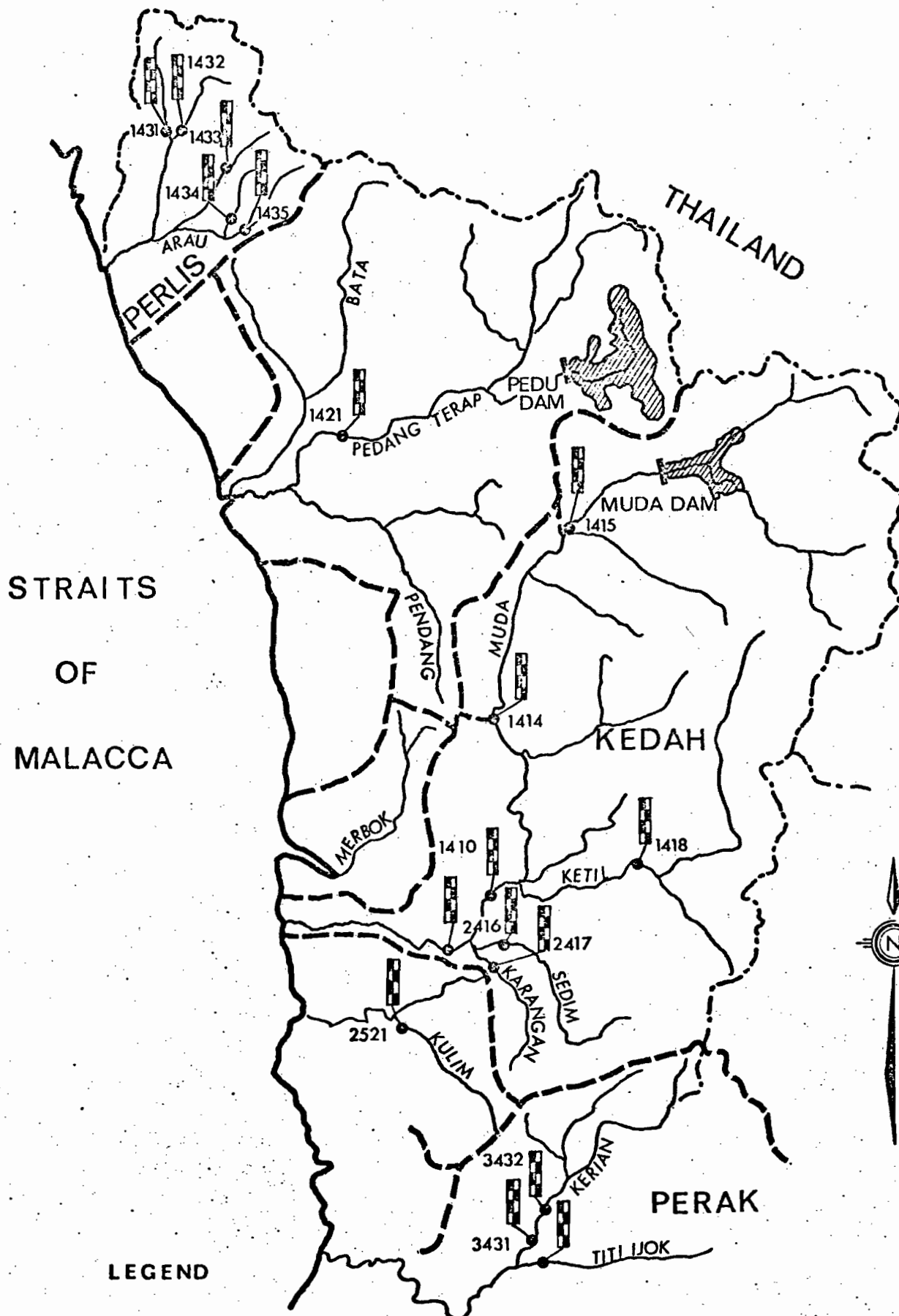
In the state of PERLIS, the information about runoff is relatively scarce, the gauging stations have records for only 4 or 5 years, and the data contain some anomalous figures due to fact that its surface catchment does not correspond always with the ground-water catchment (Sungai GIAL).

On the Sungai KRIAN, which the right bank is situated in KEDAH, two gauging stations are in operation from 1954 and 1960.

It may be considered that the runoff information is enough to assess roughly the surface water resources of the interland area, but there is a lack of coverage for the Sungai PADANG TERAP catchment because at the stick gauges of the Sungai BATA, Sungai TIAN GERAP and Sungai PADANG, no discharge measurements have been made up to now, and there is therefore no calibration.

# RIVER GAUGING STATIONS

Fig- 2



STRAITS  
OF  
MALACCA

THAILAND


PERLIS

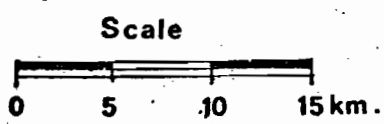
KEDAH

PERAK

### LEGEND

--- Primary catchment boundaries

 River gauging stations with old number system.



A tabulation of reliable stations (river stage and discharge stations) is as follows :

Catchment Equipment	Sg. PERLIS		Sg.PADANG TERAP		Sg. MUDA		Sg. KRIAN	
	Opened	Closed	Opened	Closed	Opened	Closed	Opened	Closed
Auto- recording	2	0	0	1	7	1	2	0
Stick gauges	1	3	0	0	0	0	1	0

#### 1.2.2. - Setting up the file of reliable data

##### 1.2.2.1. - Selection of gauging stations

The hereafter table gives the gauging stations which may be used for the study (see page 7).

##### 1.2.2.2. - Needs for the study

The D.I.D. collects data from 1932 and all the hydrological information is kept at the Hydrology Branch in Kuala-Lumpur. The monthly discharges (in cusecs per sq. mile) and the total annual discharge (in acre feet) have been already published up to 1970 [8]

- The stream flow records 1941-1960 have been manually processed by use of staff gauge readings at 6. a.m. and 6. p.m. and automatic recorders.

- The stream flow records 1960-1970 have been processed by the computer Section of the Statistics Department (ICL 1904 A), the two daily water level readings of staff gauges, or the 6 hourly mean water level readings extracted from water level recorder chart being punched cards and afterwards translated into discharges by a program using the stage discharge rating table in punched cards.

HYDROLOGICAL STATIONS INVENTORY

STATION N <sup>o</sup>		STATION NAME	GEOGRAPHICAL COORDINATES		Catchment Area s q. km	D A T E		OBSERVATIONS Cl = closed Q = sediment S = water chemistry
New	Old		Longitude	Latitude		Staff Gauge installed	Automatic Recorder installed	
5806414	- 1414	Sg. MUDA at JENIANG Cableway	100 37 55	05 49 10	1 710	10/46	9/58	
6007415	- 1415	Sg. MUDA di NAMI	100 46 00	06 03 20	1 220	11/60	6/61	Cl. 6/73
6204421	- 1421	Sg. PADANG TERAP di LENGKUAS	100 27 15	06 12 45	1 270	9/46	9/60	Cl. 7/67
5606410	- 1410	Sg. MUDA di TITI SYED OMAR	100 37 35	05 36 35	3 330	8/74	8/74	Q (12/74) S (4/76)
5506413	- 1413	Sg. MUDA BATU PEKAKA	100 36 55	05 35 45	3 340	47	8/60	Cl. 6/73
5505412	- 1412	Sg. MUDA LDG VICTORIA	100 34 20	05 31 55	4 010	47	3/62	
6502431	- 1431	Sg. PELARIT di TITI KONKERIT BARU	100 12 40	06 35 15	57	1/72	8/73	
6502432	- 1432	Sg. TASOH di TITI K.B.	100 13 50	06 35 20	117	1/72	8/73	
5608418	- 1418	Sg. KETIL di KUALA PEGANG	100 48 45	05 38 20	704	8/74	8/74	
5405421		Sg. KULIM ARA KUDA	100 30 50	05 26 10	129	50	12/60	
5206432	- 3432	Sg. KRIAN SELAMA	100 41 20	05 13 45	629	54	6/60	Q (7/75)
5106431	- 3431	Sg. KRIAN DUSUN RIMAU	100 40 00	05 11 40	694	6/60	6/60	Cl. 11/73
6402434	- 1434	Sg. GIAL di TITI JALAN ARAU	100 15 40	06 26 45	21.8	7/70 ?	-	Cl. 6/77
6402435	- 1435	Sg. ARAU di TITI JALAN ARAU	100 16 20	06 25 45	88.6	7/70 ?	-	Cl. 3/75
6502433	- 1433	Sg. JERNEH di TITI HURAN DARI	100 16 00	06 31 10	29.7	7/70 ?	-	Cl. 4/74
6502401		Sg. JERNEH di TITI TEMPANG	100 16 15	06 32 20	23.5	5/74	-	
5506416	- 2416	Sg. SEDIM MERBAU PULAS	100 38 20	05 34 00	440	47	-	Cl. 12/72
5506417	- 2417	Sg. KARANGAN TITI KARANGAN	100 37 10	05 31 20	82.9	47	-	Cl. 1/73

- The stream flow records for 1970 up to now are processed by the computer of the Hydrology Branch which has set up a Data Bank since 1974. The trace of water level chart is digitalized by means of a reading table, the daily, monthly and annual discharges are given in liter per second.

From meetings with D.I.D. Hydrological Section officers, it appears :

- The rating curves are manually plotted and then digitalized.
- The tables of mean daily water levels are printout (including monthly and annual instantaneous maximum and minimum water level readings). The missing values are given by asteriks (\*\*\*) .
- Tables of mean daily discharges are printout (tabulated year by year with daily mean , monthly mean, monthly and annual instantaneous maximum and minimum). The missing values are given by\*\*\* .In case of missing values, the average is established on the basis of the available daily records, hence there is no difference between a complete year and a partly year.
- Summary of monthly and annual discharges are tabulated year by year. If all the data of a month are missing, the indication 99999 is printed.

Taken into account the aboved considerations and the needs of the study which required to use an information as complete as possible, the following procedure should be adopted in agreement with the Hydrology Branch of D.I.D. as follows :

- Putting into the computer system of D.I.D. the daily readings (at 6.00 a.m. and 6.00 p.m.) for the following periods whether not yet in the Data Bank i.e.

N° Station	P e r i o d	
5806414	From 10/46 to 6/65	and from 7/75 to 12/77 (if not already made )
6007415	" 7/70 to 6/73	
6204421	" 9/46 to 6/65	
5606410	" 8/74 to 12/77	
5506413	" 47 to 6/73	
5505412	" 47 to 12/77	
6502431	" 1/72 to 12/72	and from 7/75 to 12/77
6502432	" 1/72 to 12/72	and from 7/75 to 12/77
5608418	" 7/75 to 12/77	
5405421	" 12/60 to 12/77	
5206432	" 54 to 12/77	
5106431	" 6/60 to 12/77	
6402434	" 1/77 to 12/77	
6502433	" 7/70 (?) to 4/74	
6502401	" 5/74 to 12/77	
5506416	" 47 to 12/77	
5506417	" 47 to 1/73	

- Considering the time required, the input schedule might be as follows :
  1. - Stations 6204421 ( Sg. PADANG TERAP di Lengkuas)  
 6007415 ( Sg. MUDA di Nami)  
 5806414 ( Sg. MUDA at Jeniang cableway)  
 5606410 ( Sg. MUDA di Titi Syed Omar)  
 5506413 ( Sg. MUDA BATU Pekaka )  
 5505412 ( Sg. MUDA LDG Victoria)
  2. - Other stations of the MUDA catchment.
  3. - Stations of PERLIS
  4. - Stations of the KERIAN catchment
  5. - Station 5405421 (Sg. KULIM ARA KUDA)
- Digitalization by D.I.D. of all the rating curves used for every station and the stage discharge tables will be given to the consultants.  
 Attention is drawn to the fact that the calibration curves are furnished under the responsibility of the D.I.D., and the consultants will have no part in the scrutiny of the main events having occurred during the observations (variation of the zero level of the gauge, relocation of the staff gauges), in the extrapolation of the rating curves or in the improvements of the calibrations.
- The D.I.D. will also provided.
- The print-out of mean daily water levels including monthly and annual instantaneous maximum and minimum water level readings (in metric system and in calendar year)
- The print-outs of mean daily discharges including monthly and annual instantaneous discharges (in metric system and in calendar year).
- The print-outs of the summary of monthly and annual discharges tabulated year by year (in metric system and in calendar year)
- For the foreseen processing (Simulation Model) a magnetic tape (9 tracks, density 800 or 1600 BPI) of all the existing water level readings will be sent to Paris in a suitable form.

### 1.2.2.3. - Use of stream flow records

- The use of streamflow records will permit to set up :
  - . An inventory of the mean daily, monthly and annual discharges in cubic-meter per second, in calendar year and could be attached as Annex to the present study.
  - . The hydropluviometrical multiple correlations will permit us to extend the observed streamflow records over the period for which only data rainfall are known.
  - . A statistical analysis of the runoff sample (observed and extended) will serve for the computation of a synthetic sample which will represent the water resources (in quantity and in interannual fluctuation) entering as input in the Simulation Model. A short description of the methodology used is given thereafter.

### 1.2.2.4. - Supplemental requests

- The consultants have not recommendations to do for improvement measures or for supplemental discharge measurements in the field during low-waters and high-waters period for the existing stations, since the D.I.D. will provide directly the rating curves, but it should be desirable to be carried out during the dry season some discharge measurements on rivers chosen by the hydrogeologists in order to estimate roughly the capacity of the aquifers.
- The need to obtain records of the uncontrolled flow measured by MADA at the location of MUDA Irrigation Headworks; to verify the rainfall/runoff, correlation established for the catchment below the PEDU Dam.
- The need to obtain records relating to abstractions (e.g. pumpages) from the rivers studied for irrigation or water supplies; to link the measured river flows to the natural river flows.

## 1.3. - EVAPORATION

### 1.3.1. - Existing data

In Peninsular MALAYSIA, direct measurement of evaporation has been limited primarily to pan evaporimeter observations by the MMS, the D.I.D. and the NEB.



In line with WMO recommendations all departments now use the US Class A Land pan. In KEDAH and PERLIS, the D.I.D. has 11 pans in operation and 10 of them have over 10 years or records (often 15 years). The oldest station is TELAGA BATU JITRA installed in June 1959.

Evaporation is also recorded at ALOR SETAR, K BATAS AIRPORT for a long time.

Number of stations (D.I.D.)		Duration of records	
		0 - 9 years	10 years or over
PERLIS	- in operation	1	-
	- closed	1	1
KEDAH	- in operation	0	10
	- closed	1	2

#### 1.3.2. - Needs for the study

- The density, the geographical repartition and the duration of records of the evaporation stations in operation is roughly enough to evaluate the evaporation in the irrigation area.
- A study carried out in 1976 [ 9 ] gives an estimation of the evaporation in Peninsular MALAYSIA and also assesses the quantity of evaporation by use of the Penman's Method and Hargreave's Method at 15 climatological stations of KEDAH and PERLIS where the necessary parameters were recorded.
- The two pans installed at the MUDA and PEDU Dam sites at the end of 1969 (8 years of observations) allow us to calculate the open-water evaporation on the two reservoirs and the MADA will provided the records.

#### 1.4. - D A M S

Knowledge of the characteristics of the PEDU and MUDA Dams is essential for carrying out this study and represent an important part of the Simulation Model, therefore it is necessary to obtain for the two reservoirs:

- . The reservoir storage curves
- . The releases for irrigation compensation flows.

- . The spillage (quantity and date).
  - . The capacity curve of the Saiong Tunnel.
  - . The daily variations of the water level in the reservoirs.
  - . The evaporation data observed at the PEDU and MUDA Dam sites (see evaporation).
- The MADA agree to provide to the consultants this information.

## 2. - USE OF THE SURFACE WATER RESOURCES IN THE SIMULATION MODEL

### 2.1. - GENERAL CONSIDERATIONS

From the hydrological point of view, when a simulation model is used (for comparison of the resources and needs, for instance on a monthly time scale) the work of the hydrologist is to give an appraisal as reliable as possible of the probability of satisfying the needs which are increasing in time, whatever be their use.

It is evident that such an obligation necessitates a knowledge of the amount of water resources both in time and space.

Due to the inevitable delays to obtain the existing hydropluviometrical data on a carrier permitting automatic processing, it seems that the first step of model elaboration is to consider if the MUDA irrigation scheme may be benefited by an optimisation of the water resources in particular of the Sungai PEDANG TERAP catchment up to the Headworks. It concerns therefore the reservoir of PEDU and the upper part of the Sungai MUDA, the reservoir of MUDA filling the PEDU by means of the Saiong Tunnel.

The second step in the Simulation Model should be to take into account the MUDA catchment downstream of the MUDA Dam.

We shall give in point 2.2. some remarks about certain aspects of the data processing which may be served to constitute the water data input of the Simulation Model. As for the moment, the general scheme of the Simulation Model is not yet established (depending from the instructions of the water demand study team) it is obvious that the hereafter given example is only indicative and does not represent necessary the procedure which will be used.

### 2.2. - REMARKS ABOUT THE CONSTITUTION OF THE "RESOURCE SAMPLES"

The available chronics of discharges will be used as well as the available chronics of rainfall, and it must be kept in mind that the longest the common period of rainfall-discharge, the greatest is the possibility to obtain a good correlation and therefore a good reconstitution of the discharges for the period where only the rainfalls are recorded. This is why unless the D.I.D. supplies completely the existing records, there is little chance to reconstitute a reliable sample of the resources. However, it is also possible that a part of the Simulation Model will be established only with discharge relations.

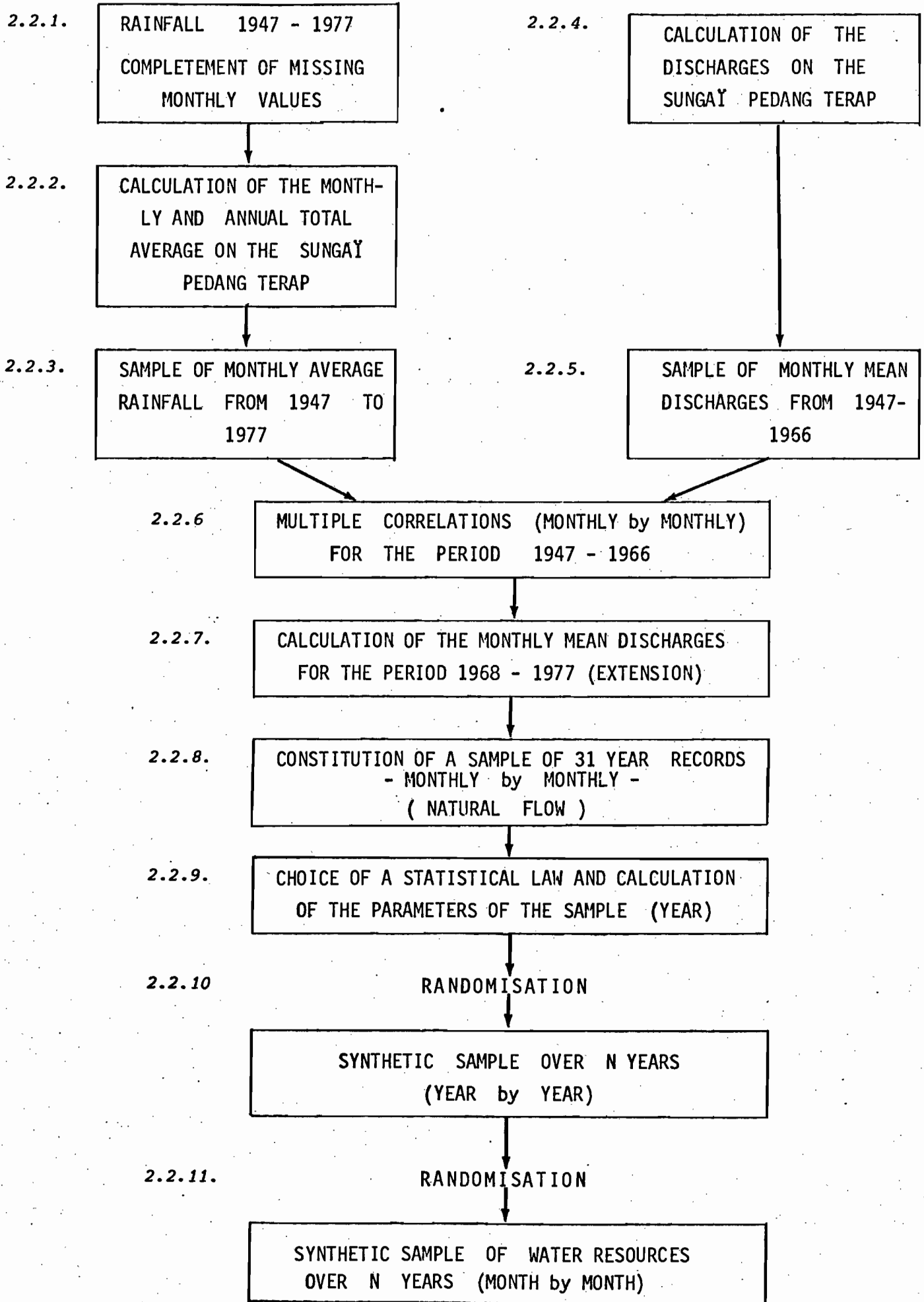
An example of one type of process widely used is given below using the Sungai PEDANG TERAP catchment at Lengkuas for which a

synthetic sample of natural runoff is set up (a similar procedure may be followed for the PEDU Reservoir : calculation of the inflow since 1970, use of correlations, calculation of the "uncontrolled runoff", difference natural runoff-inflow...).

- 2.2.1. - The chosen period of rainfall is 1947-1977. The missing monthly values are completed by use of the observations of nearby stations and correlations.
- 2.2.2. - The monthly average of rainfall is calculated on the Sun-gaī PEDANG TERAP catchment by the THIESSEN's Method.
- 2.2.3. - The sample of monthly average rainfall covers the period 1947 to 1977.
- 2.2.4. - The calculation of the monthly mean discharges at the  
2.2.5. Station of Lengkuas is provided by D.I.D. and the sample of values covers the period 1947-1966.
- 2.2.6. - Use of a program of multiple correlations on rainfall and discharge on a monthly basis for the periode 1947-1966 (STEPWISE's Method).
- 2.2.7. - The monthly mean discharges of the period 1968-1977 are computed by the some programs (extension from the rainfall information).
- 2.2.8. - The sample of 31 years records (month by month) corresponds for a part at observed records and for another part at extended records. The gain of knowledge of water resources is verified.
- 2.2.9. - Use of a statistical program which indicates by a test of goodness of fit at what law the sample fit the best (GAUSS, GAUSSO-Log, PEARSON III, PEARSON V, FRECHET, GOODRICH, Log PEARSON III, GUMBEL) and which gives the law parameters and values for a various range of probabilities.

The calculation is only carried out on a yearly basis.

F L O W C H A R T



2.2.10. - A randomisation is carried out to constitute a synthetic sample of N yearly mean discharges (for instance 100 or 200 years). This operation does not constitute an extension of the knowledge about the water resources, but allows to simulate in the frame of the statistical law chosen of different occurrences in abundance of runoff (with in particular possible series of wet or dry years) Controls are made in order to check that there are no systematically "too exceptional" values.

2.2.11. - The last step is the constitution of a synthetic sample on a monthly basis. For that a checking is made to estimate the relation existing between the value of the yearly mean discharge and the shape (month by month) of the annual hydrograph (This check is carried out on the observed records 1947 to 1966). If there is no significant relation, a sample of twenty shapes corresponding to the twenty observed annual shapes is computed).

A second randomisation is carried out for giving a shape at every yearly mean discharge value of the synthetic sample (2.2.10) and the synthetic sample on a monthly basis is constituted.

(If there is a significant relation, a shape is given according to the importance of annual value).

A special program is employed for 2.2.10. and 2.2.11.

- Attention is drawn to the fact that the programs of multiple correlations and of the constitution of synthetic samples require special function in the computer library and a core in the central unit of the computer which exceeds greatly the core size of the computer of the D.I.D. For these reasons, the processing will be carried out in Paris.

It may be noted as well that the simulation program model will require roughly 200 K and it should be convenient for the routine use of the Model in Kuala-Lumpur to contact the National Electricity Board which possesses the adequate capacity.

### 3. - CONCLUSIONS

- The general survey of the existing water resources (rainfall, discharges) and other parameters, like the evaporation, indicates that there are enough data to undertake a reliable study at least for the state of KEDAH.

However, it is important to emphasize that such a water management study needs a systematical resort to the use of automatic processing and the time to constitute the sample of water resources in very short.

In spite of the fact that the Hydrology Branch of D.I.D. is rather in advance in the use of computer, the huge amount of hydrometeorological data to be updated and stored in data bank for the Peninsular MALAYSIA explains why such a problem actually exists at this level. Hence is the D.I.D. able to supply in time the required data? If not, the frame of the study should be considerable reduced. In our mind, it is not possible to process only the period of data stored since the 60's, the correlations and the statistical procedures would be meaningless.

- For this reason, the most urgent task is to obtain from the D.I.D. a time table for each section of our request, and the information relating to part 1 and 2 (see 1.1.2.2.) and part 1 (see 1.2.2.2.) must be stored at first, and the corresponding magnetic tape must be sent to Paris as soon as possible.
- It may be noted, too, that the preparation of the input data for the Simulation Model requires a chain of programs which can be processed only in Paris.

4. - A N N E X





A N N E X

4.1. - LIST OF THE RAINFALL STATIONS WITH PERIOD OF RECORDS

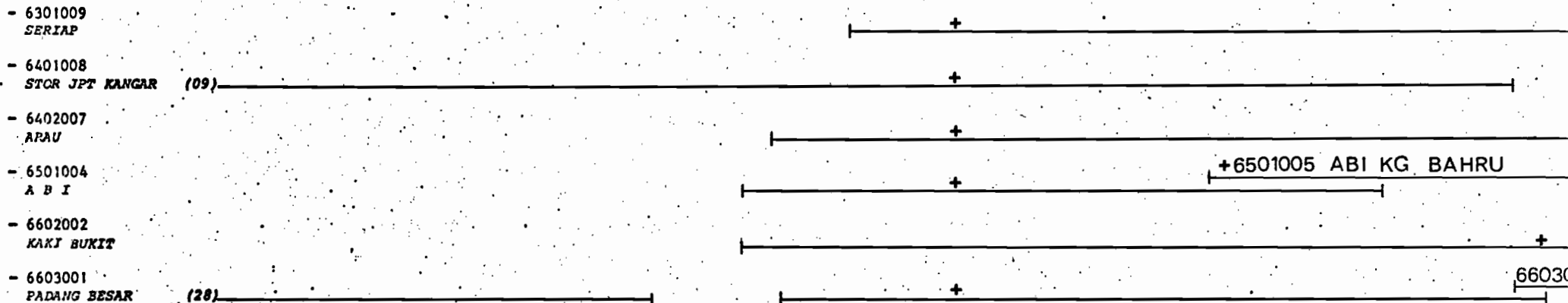
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R A I N F A L L S T A T I O N S

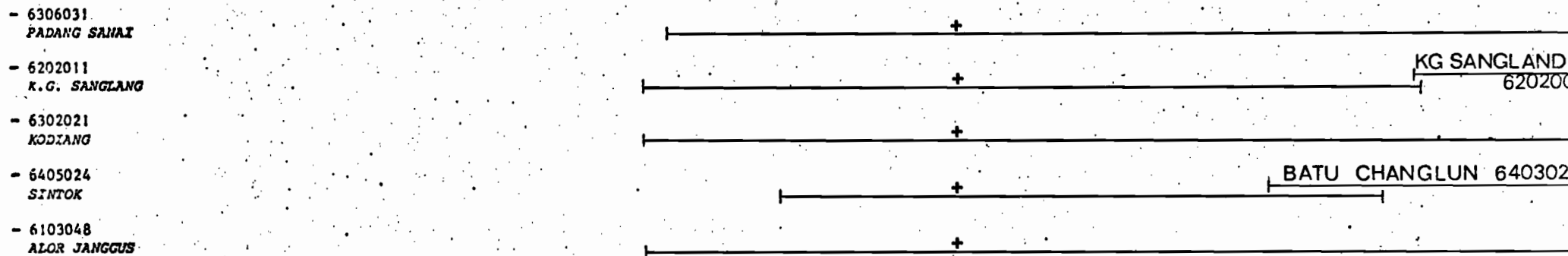
Y E A R S

35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 7

P E R L I S



K E D A H

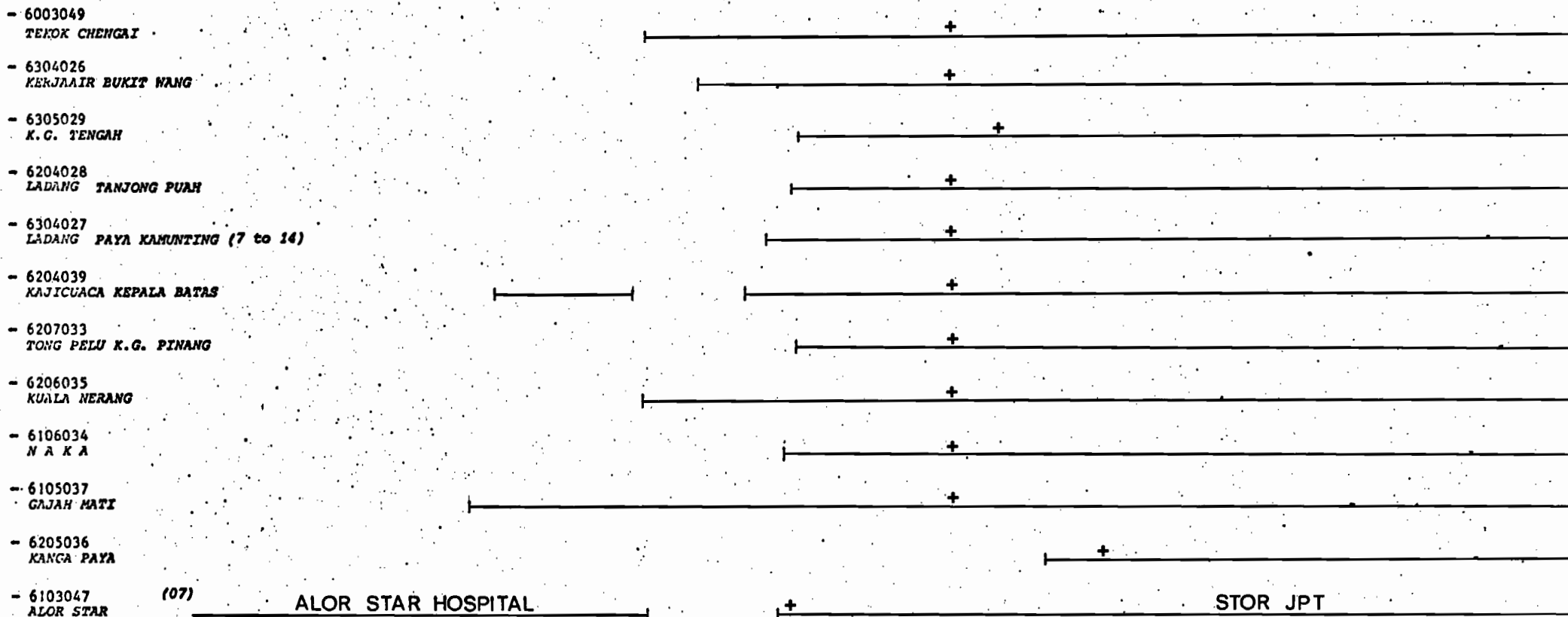


**RAINFALL STATIONS**

**Y E A R S**

**K E D A H**

35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76



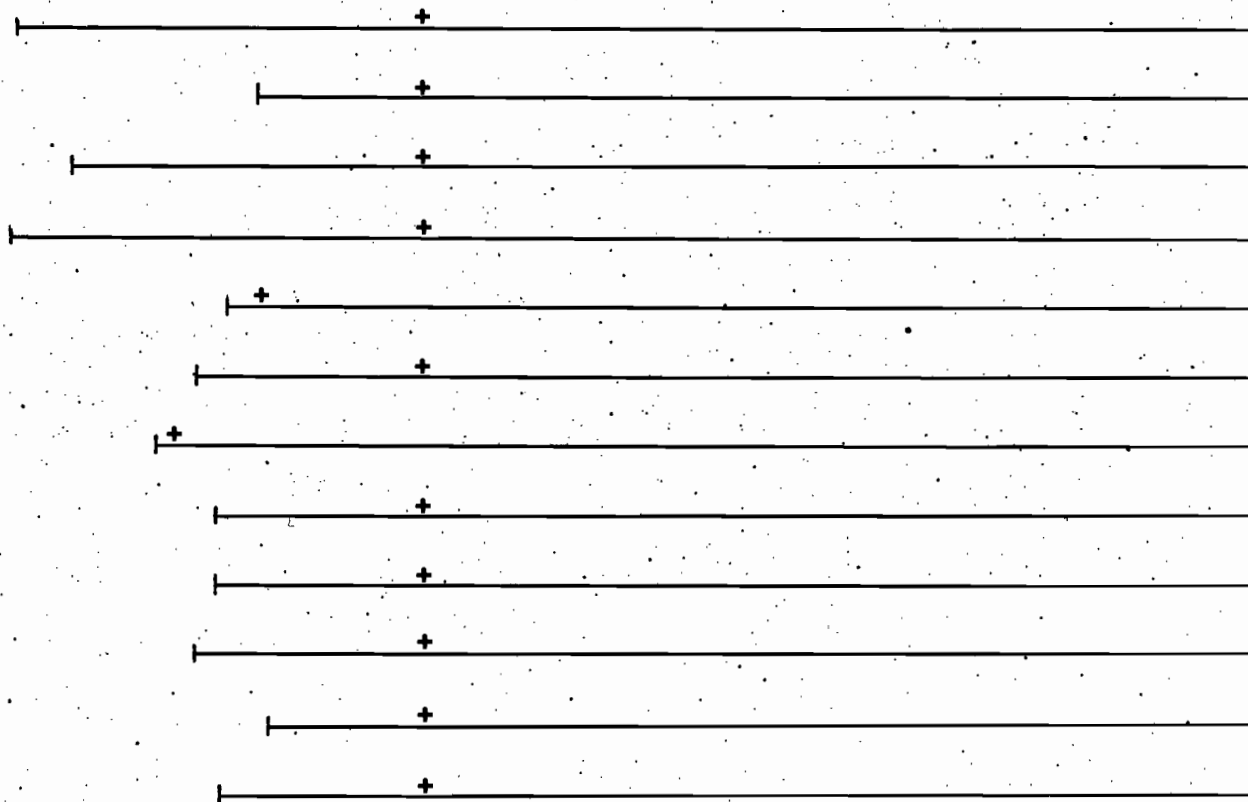
R A I N F A L L   S T A T I O N S

Y E A R S

K E D A H

35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76

- 5904051  
ROTA SARANG SEMOT
- 5904043  
PEDANG
- 5804053  
GUAR CEMPEDAK
- 5803052  
SANGA LIMAU
- 5704057  
IBI BEKALAN TUPAH
- 5704054  
IBU BEKALAN YEN
- 5704058  
SENELING
- 5806066  
JENIANG
- 5807067  
S I K
- 5506082  
LADANG POKIT KARANGAN
- 5504085  
RANTAU PANJANG
- 5505084  
LADANG HENRIETTA

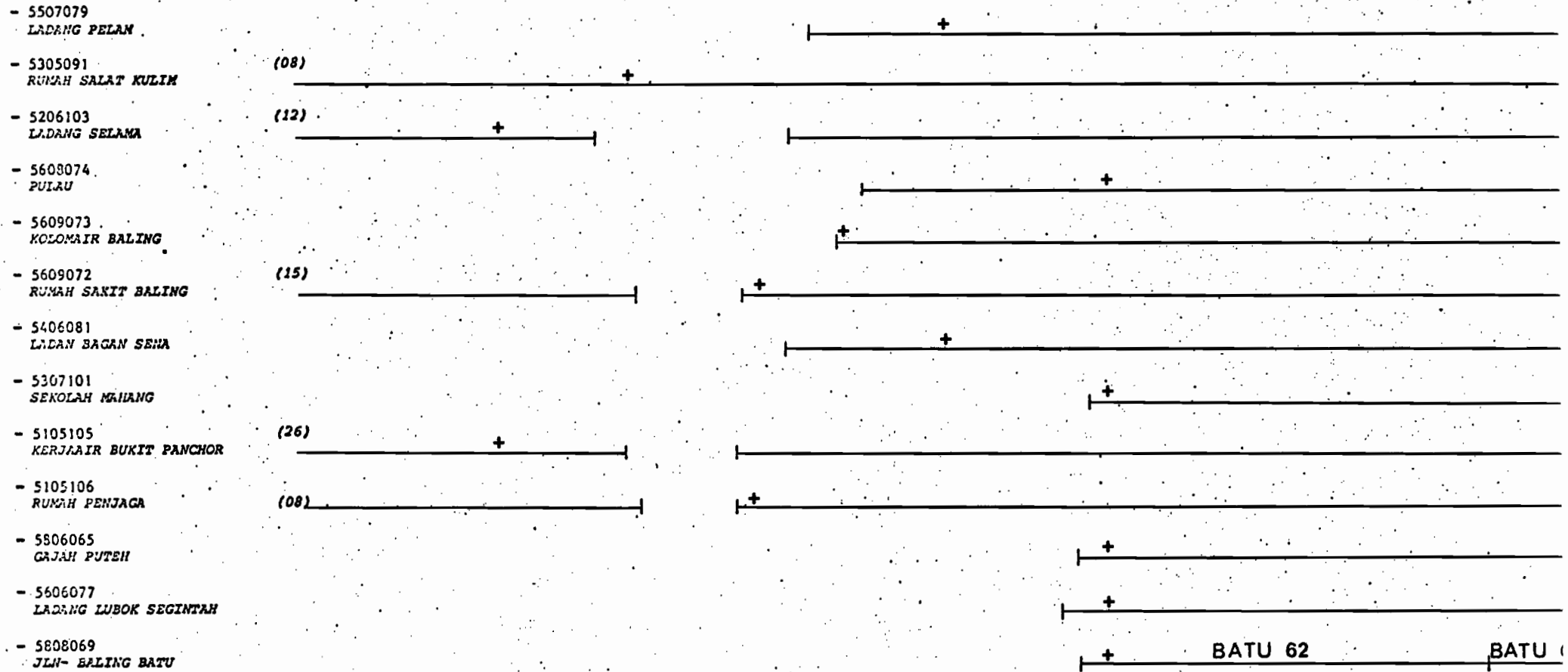


RAINFALL STATIONS

Y E A R S

K E D A H

35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76



RAINFALL STATIONS

Y E A R S

35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76

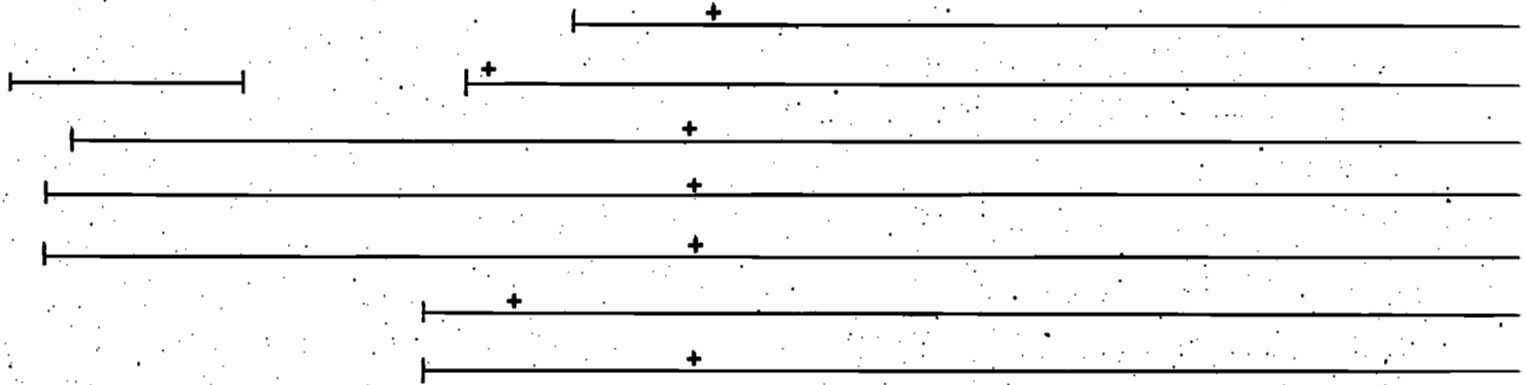
K E D A H

- 5708071  
KG. TERABAK
- 5808070  
KG. LUBOK PADAK
- 5407080  
LADANG DUBLIN



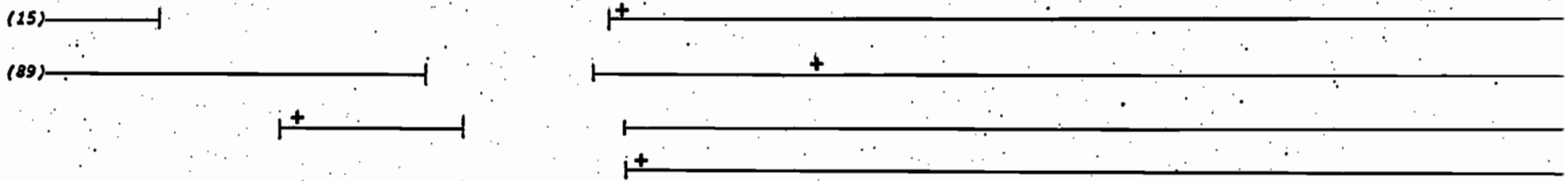
WELLESLEY

- 5505033  
RUMAH PAM PINANG TUNGGAL
- 5404041  
LADANG MALAKOFF
- 5304045  
KOLAMAIR BUKIT BERAPIT
- 5304047  
KOLAMAIR CHEROK TO KUN
- 5105051  
KOLAH TAKANGAN PANCHOR
- 5205050  
SEKOLAH KEBANGSAAN SG. BAKOP
- 5404044  
STH PETAK UJIAN BUKIT MERAK



P E R A K

- 5710061  
KROH DISPENSARY (15)
- 5206003  
SELAMA HOSPITAL (89)
- 5107007  
LADANG HOLLYWOOD SELAMA
- 5006009  
ALOR PONGSU-LADANG HOCK



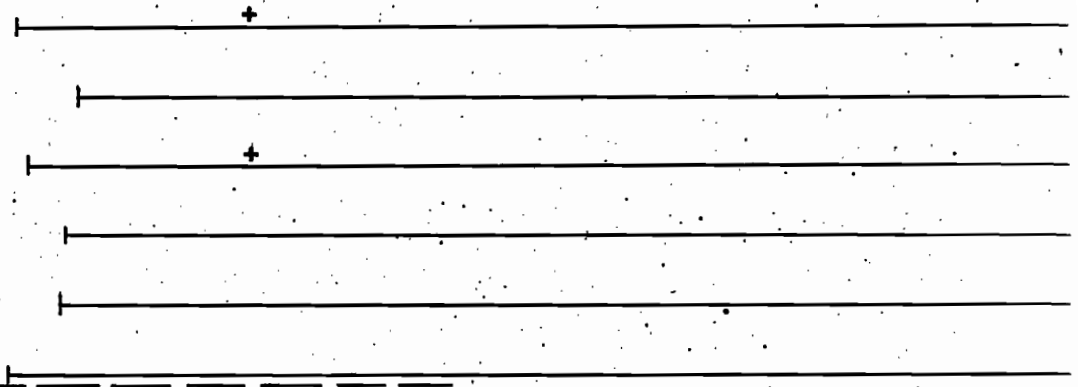
RAINFALL STATIONS

Y E A R S

35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76

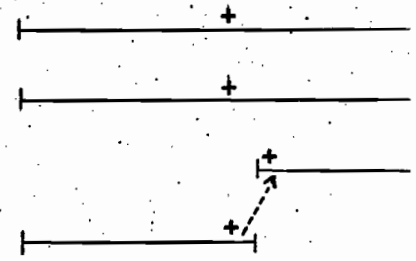
P E R A K

- 5005010  
LADANG KRIAN
- 5104001  
RUMAH SAKIT PARIT BUNTAR (88)
- 5108005  
IBU BEKALAN ULU IJOK
- 5106004  
ADANG LUMBOK KLUANG SELAMA
- 5106008  
ADANG HIBERNIA SELAMA (16)
- 5207002  
LADANG SELDINGS, SELAMA (12)



K E D A H (New stations)

- 6207032  
AMPANG PEDU
- 6007063  
N A M I
- 6108001  
COMPLEX RUMAH MUDA
- 6108062  
AMPANG MUDA



#### 4.2. - LIST OF REQUESTS TO BE MADE TO D.I.D.

##### RAINFALL

- 1.- D.I.D. to complete storing daily rainfall records on to carrier to cover the period 1947 - December 1977.

Stations involved shall be as follows (with ranking of urgency) :

- . Sungai PADANG TERAP catchment
  - . Sungai MUDA catchment
  - . MUDA Irrigation Area
  - . PERLIS
  - . BUTTERSWORTH + Sungai PATANI
  - . KRIAN
- in millimeter

- 2.- Print-out for each station shall be monthly and annual values with calendar year "January to December" (ranking as 1)  
1 copy of each is required.
- 3.- D.I.D. to permit ready access to their files of daily rainfall records for correction of months with incomplete data (photo-copying of some records will be necessary).
- 4.- D.I.D. to supply on a magnetic tape the monthly and annual rainfall data described in 1, 2, 3.

##### STREAM FLOW

- 5.- D.I.D. to complete storing daily stream readings (at 6.00 and 6.00 pm) for the following (with ranking of urgency) :

- . Sungai TERAP of MUDA main stations
  - . Other stations of MUDA catchment
  - . Stations of PERLIS
  - . Stations of KRIAN catchment
  - . Sungai KULIM ARA KUDA
- in metric system.

- 6.- Print-out for each stream station shall be mean daily water levels including monthly and annual instantaneous maximum and minimum water level readings with calendar year "January to December" (ranking as 1)  
1 copy of each is required.



- 7.- All the rating curves used for every station and the stage-discharge tables.
- 8.- Print-out for each stream station shall be mean daily water flows in metric system including monthly and annual instantaneous, maximum and minimal flow discharges with calendar year "January to December" (ranking as 1).  
1 copy of each is required.

EVAPORATION

- 9.- Records of the US Class A Land pans shall be monthly and annual values in millimeters with calendar year "January to December".

	D.I.D.	MADA
- Number of evaporation pans in PERLIS	3	0
- Number of evaporation pans in KEDAH	13	2

DATA/PERTAINING TO THE PEDU AND MUDA RESERVOIRS (From MADA)

- 10.- PEDU and MUDA reservoirs storage curves
- 11.- Capacity curve of the Saiong Tunnel
- 12.- Daily reservoir water levels
- 13.- Releases for irrigation and compensation flows
- 14.- Spillages and date of occurrence
- 15.- Print-outs of uncontrolled flow in Sungai PADANG TERAP at location of MUDA Irrigation Headworks and differentiation into flow diverted for irrigation and flow to waste.
- 16.- NOTES : How much time will be required by D.I.D. to complete each part of the hereabove requests.

As soon as each section will be completed, that section must be sent to Paris for processing.

4.3. - PROGRAM of Mr. O N G1°/ - D A M S

- . Reservoir storage curves.
- . Releases
- . Spillage (quantity and date)
- . Capacity curve of the Saiong Tunnel
- . Evaporation date observed at the PEDU Dam and MUDA Dam sites
- . Daily variations of the water level in the reservoir

2°/ - R U N O F F

Daily records {

- . Estimation of the uncontrolled stream flow of PADANG TERAP river at the Headworks (corresponding really to the catchment downstream the dam, discharge compensation, releases and spillage being not included).
- . Gathering all the existing runoff information of the tributaries and estimation of the available runoff.

3°/ - R A I N F A L L

- . In collaboration with Mr. HUI, checking of the missing data by scrutiny in D.I.D. the print-outs of daily rainfall data. Put on the summary given by D.I.D. (monthly and annual total rainfall) the corresponding total month value between brackets and indicate on the summary the number of days without observations.
- . Calculation of the THIESSEN's coefficients on the different catchments (PEDANG TERAP, MUDA, PERLIS...) This is necessary to compute further the average of rainfall. This task could be carried out by Mr. HUI.
- . In collaboration with Mr. HUI, scrutiny of the possible non homogeneity of rainfall data series at about twenty rainfall stations well disseminated on the area (simple mass curve method). Further indication will be given how to use the double mass curve method if necessary.

4°/ - O T H E R T A S K S

- . Inventory of all the pumping stations and estimation of the quantity of pumped water (on a montly basis)
- . General survey of the other main intakes.

#### 4.4. - PROGRAM of Mr. HUI

##### 1°/ - D A M S

- . Using the reservoir storage curves, releases, spillage, capacity curve of the Saiong Tunnel, data on evaporation at the two dam sites (monthly observed total multiplied by 0.9) and daily variations of the water level in the reservoirs, compute the estimated inflow in the two reservoirs, since the filling of the dams.

##### 2°/ - RAINFALL

- . Checking of the missing rainfall data by scrutiny in D.I.D. the print outs of daily rainfall data. Put on the summary given by D.I.D. (monthly and annual total rainfall) the corresponding total month value between brackets and indicate on the summary the number of days without observations.
- . Scrutiny of the non homogeneity of the rainfall data series (see Mr. ONG).

##### 3°/ - OTHER TASKS

- . Inventory (in cooperation with Mr. ONG) of all the pumping stations and estimation of the quantity of pumped water (on a monthly basis).
- . General survey of the other main intakes.

##### 4°/ - LIAISON WITH HYDROLOGY BRANCH of D.I.D.

- . To be in a close contact with the Computation Center of D.I.D. for checking the progress of the data storage.
- . To be the agent between D.I.D. and RENARDET for obtaining regularly the print-outs on the magnetic tapes which are requested and give to Paris any information concerning the specifications necessary to be known for the suitable use of the magnetic tapes (tracks, density, blocksize, format of values and so on)

- R E F E R E N C E -

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- (1) - KEDAH/PERLIS Water Resource Management Study Proposal  
by YUSOFF IBRAHIM SEHU and RENARDET Engineering - 1978.
- (2) - MUDA River Project - Report on the supply of irrigation water from  
the rivers MUDA and PADANG TERAP, for double crop rice cultivation in  
the costal plains of KEDAH and PERLIS - Sir William HALCROW and partners-  
November 1961
- (3) - Report on the development of the ALOR STAR Water Supply, by STEEN  
SEHESTED and partners, in association with VATTENBY G.G. NADS BYRAN  
(SWEDEN) - September 1962.
- (4) - Report on the MUDA River Project revised - Sir William HALCROW and partners  
November 1963.
- (5) - Report on a reappraisal of the MUDA River Project - Sir William HALCROW  
and Partners - November 1964.
- (6) - Feasibility report on tertiary irrigation facilities for intensive agri-  
cultural development in the MUDA irrigation schema -  
By MUDA Agricultural Development Authority - January 1977
- (7) - KEDAH-PERLIS Development Study - Draft final report  
By Economic Consultants limited in association with SHANKLAND Cox Part-  
nership; ULG Consultants limited; Robertson Research International Limited;  
Sir William HALCROW and partners and Fisheries Development Limited.  
ALOR STAR - 15 May 1978.
- (8) - Publications on Hydrological Data  
By D.I.D.  

( see list herewith attached )
- (9) - Publication of Water Resources  
By D.I.D.
  - W R P N° 1 - Surface Water Resource Map (Provisional)  
of Peninsular MALAYZIA
  - W R P N° 2 - Hydrological Regions of Peninsular MALAYZIA
  - W R P N° 5 - Evaporation in Peninsular MALAYZIA - 1976
  - W R P N° 6 - Average annual surface water resources of  
Peninsular MALAYZIA - 1976.

- Reference -

- Hydrological Data - Rainfall Records 1879 - 1958
- Hydrological Data - Rainfall Records 1959 - 1965
- Hydrological Data - Streamflow Records 1910 - 1940
- Hydrological Data - Streamflow Records 1941 - 1960
- Hydrological Data - Streamflow Records 1960 - 1965
- Hydrological Data - Rainfall Records 1965 - 1970
- Hydrological Data - Streamflow Records 1965 - 1970
- Hydrological Data - Water Quality Records 1974
- Hydrological Data - Water Quality Records 1975
- Hydrological Data - Rainfall Records 1970 - 1975
- Hydrological Data - Water Quality Records 1976
- Hydrological Data - Streamflow Records 1970 - 1975