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Software for a Hydrological Data Year Book

आपो हि ष्ठा मयोभुवः

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ABSTRACT

Automated data processing using high speed computers has immense potential for handling large volume of hydrologic data in a quick and economic way. In India, a large number of agencies are involved in collection of hydrological and meteorological data. As there is no proper inventory of the data, in the present system there is a possibility of the repetition in data collection. To avoid this, it is necessary to store the collected data by different agencies at one place in the processed and systematic form which can be useful for users.

In the present report, a menu driven, user-friendly software has been developed to handle all type of hydrological and meteorological data. The main objective of this software is preparation of hydrological data book in a form most valuable to the users.

1.0 INTRODUCTION

Hydrological and related meteorological data are needed for proper planning, development, management and optimal utilization of water resources of the country. High quality hydrologic data have historic value, in addition to providing a basis for research and design and evaluation of Projects and Programs for conservation and development of the Nation's Water Resources. Hydrological data are required for design purposes, such as for dam, bridges etc., navigation, for planning of irrigation schemes, domestic water supply & water power etc. In our country, various organisations like CWC, NWDA, IMD, CGWB, state Irrigation Departments etc. are involved in collection of hydrologic and other related data. Data collected on hydrologic process are generally raw data and can not be used directly in most hydrologic analysis work. Therefore, it is necessary to process this data and store all the data of different basins at one place in a particular format. Some of these agencies are publishing their data in the different forms of data books of the available data. Though more stress is given on rainfall and discharge data, still other data like ground water data, climatological data, water quality, sediment and meteorological data are also important.

Advancement of computer technology has opened a new path for speedy and more systematic organization of the data. The laborious and time consuming manual data handling is slowly becoming obsolete. In the present report, a software has been developed for the preparation of a data year book of a basin by adding the available data.

2.0 PURPOSE OF THE REPORT

It is necessary to have the account of hydrological and related meteorological data in each major and medium water sources. The measurement of water availability can be analysed at various times of the year. Therefore, processing or collecting of such data is essential to make them usable for various studies. Various organisations are printing databooks from time to time for different basins. But these data books are specified for particular basins. The objective of this study is to prepare a software for the preparation of Data year book. The data types have been defined in different formats of input and output. If different types of hydrological data are available, the user can prepare a data book by using this software at any interval.

3.0 HARDWARE AND SOFTWARE REQUIREMENTS

The 'DBOOK' package has been written in the programming languages FORTRAN-77, C and dBASE. The hardware and software requirements for using

DBOOK are:

- o Minimum 640 KB memory
- o Hard disk of 20 MB or more (required storage will depend upon the database size)
- o Graphic card
- o DOS with version 5.0 or later
- o A compatible printer with graphical capabilities,
- o For pleasant operation, a colour monitor is preferred.

4.0 SOFTWARE DESCRIPTION

The developed package "DBOOK" is a menu driven and user friendly software. It can display in colours, if a colour monitor is used. The user can move forward to submenus by moving the cursor to the desired position and then pressing the ENTER key. Similarly, he can move backward by pressing F10 key.

It stores the data stationwise using station codes. The user chooses a unique 8-digit code to identify the stations. Using this station code, the user can define the details of the station and the basin in which the station is situated. In many situations online help is also available.

The flow diagram of DBOOK is shown in fig. 1.

DBOOK consists of the following modules:

- o Station Definition / Updation
- o Data Entry / Updation
- o Map Entry / Printing
- o Information Retrieval
- o DOS Commands
- o Exit

4.1 Station Definition / Updation

The data is stored stationwise. To enter the data of a particular station, the details of the station should be available to the system. It consists of :

Station Code	
Station Name	No. of Tributaries
District Name	Basin Origin
State	Basin Length
Latitude	Basin Width
Longitude	Soil Type
Altitude	Geology
Catchment Area	Toposheet Reference
River	Agency

Using Station Definition / Updation option, the user can define a new station, modify an already defined station or delete a station if it is not required. These can be done by selecting any one from the following :

- o Add Station
- o Modify Station
- o Remove Station

4.2 Data Entry/Updation

This option can be used to enter the hydrological data. It has three options :

- o Read Data from Datafile
- o Entry of Constant
- o Add/Update Data

4.2.1 Read Data From File

This option can be used to enter the data from an already existing ASCII data file. The data should be separated by a blank. The layout of the ASCII file for transfer the data to "DBOOK" Software are as follows:

Yearly Data:

Year, Data1, Data2, ...Data30

Monthly Data:

Year, Data1, Data2,.....Data12

Daily Data:

Year, Month, Data1, Data2,.....Data31

Hourly Data:

Year, Month, Day, Data1, Data2,.....Data24

While entering the day or month the values from 1 to 9 should be entered as 01,02,.....09.

After selection of this option the station code is requested. If the station code is already defined, the data file name with path is requested. If the data file exists, the data stored in it will be entered in DBOOK software. In case of any error, appropriate message is displayed and system exits from this option.

4.2.2 Entry of Constants

In many hydrological series, sometimes a particular value is repeated many times. In this situation, for speedy entry of such data through the keyboard, this option may be used. After selection of this option, the station code are requested. If the station is already defined, the starting, ending dates and the constant to be filled will be asked. According to the dates, the constant value will be filled at all the places. In case of any error, the appropriate massage is displayed and the system will exit from this option.

4.2.3 Add/Update Data

Users can edit the data in already existing file. The values at any place can be changed. For data editing, users will select the options of data type, time interval, station code, starting and ending dates. Depending on selected data type and time interval a formatted screen will appear. The user can fill the values on this screen and the data will be stores in the corresponding file.

4.3 Map Entry / Printing

For an optimum and better planning and management of natural resources one of the first requirements is the map of the concerned area. As the area into consideration for such maps is usually of an order of several hundred square kilometres, the space technology of polar orbiting solar synchronous satellite,- viz. Remote sensing satellites play a significant and vital role. The following types of maps can be entered / printed using DBOOK :

o Index Map
o Topographical contour Map
o Soil Map
o Geological Map
o Geohydrological Map
o Geomorphological Map
o Drainage Map
o Landuse Map
o Annual Isohyetal Map
o Flood Inundation Map
o Administrative Map
o Drought prone area Map
o Map showing location of raingauge stations
o Map showing location of observatory wells.
o Map showing location of gauge/discharge sites.

To enter the any of the above map of a station, first it should be scanned /digitized and stored as a .TIF (Tagged Image File Format) file using any software. Then using any WINDOW based software the .TIF file can be converted and saved as .PRN file of the available printer. At the time of map entry, this *.PRN should be entered, so the map of the area will be stored in the corresponding file. Similarly, by selecting the appropriate menus, the map of that area can be printed.

4.4 Information Retrieval

This option can be used to obtain the selected data of a selected station for the selected time interval, in an ASCII file. This ASCII file can then be processed / handled using other popular softwares.

To achieve the above objective, the user has to select the data type and time interval. The system will prompt for the station code. If the first character of the station/series code is a blank character or a carriage return, the control will come out of the option. Otherwise, the 'DBOOK' will ask for the output filename, starting date and ending date. Here the ending date should not be less than the starting date. After specifying all these options, the data for the desired station, for the selected period will be stored in the desired file in ASCII format.

4.5 DOS Commands

Sometimes, it may be helpful to execute a DOS command within 'DBOOK'

package. Using the DOS command option, the user can execute a DOS command within 'DBOOK' and continue the processing. However, no TSR routines of DOS should be loaded as this may result in conflict in memory usage and the computer may hang.

5.0 DATA TYPES

In DBOOK, the basic hydrologic data has been categorized as :

- o Hydrometeorological data
- o Surface Water Data
- o Ground Water Data

This data has been again subdivided in various sections and as per the time interval of their recording as annual, monthly, daily and hourly.

5.1 Hydrometeorological Data

This includes rainfall and climatological data.

5.1.1 Rainfall Data

Since amount of rainfall varies from place to place, it is necessary to install measuring devices at various key points. It is assumed that the amount of rainfall collected in the gauge is representative of a certain area around the point where the measurement is made, it is the rainfall at that gauging station. The rainfall data of various stations is used to determine the average depth of rainfall over an area. The amount of water received over the catchment as rainfall is expressed as depth.

Rainfall Data can be measured Yearly, Monthly, Daily or Hourly. Before proceeding with this option, the user should have averaged rainfall data in his hand for all raingauge stations. The units for all entries should be same.

Table 1 shows the output format of Rainfall data.

5.1.2 Climatological Data

This includes the data on temperature, wind velocity, humidity, sun shine hours, evaporation and vapour pressure. These are obtained using proper instruments in meteorological observatories.

These values can be supplied by user as per their availability. The units of

these data are defined in software. The output of this information will be obtained in a specified form.

Table 2 shows the output format of Climatological data.

5.2 Surface Water Data

These include information on stream flow, springs, reservoirs, lakes and oceans. Most of the surface data obtained as adequate gauge-discharge data or limited gauge discharge data. For ungauged river basins with no discharge records the water resources are assessed either from the runoff records of an adjacent river basin of similar characteristics or by empirical formulae. The long term runoff series can be obtained using the rainfall-runoff curve after working out the rainfall for the past years. The percentage dependability of the runoff values can be determined based on the estimated runoff series.

It includes gauge/discharge data, sediment load data and water quality data.

5.2.1 Gauge / Discharge Data

The discharge computations are usually made from the measurement of gauge. They are applied to an available single valued rating curve developed using discrete measurements at a site at different times. Therefore, the computed discharge hydrograph is forced to adopt the same time distribution as the measured stage hydrograph. In previous years, the discharge data was not available adequately but now many agencies are measuring this data.

After selecting the appropriate option, the user will supply the gauge and discharge data (either monthly, daily or hourly) for each station.

Table 3 shows the output format of Gauge / Discharge data.

5.2.2 Sediment Load Data

The suspended sediment load is the mass of suspended sediment passed through a section per unit time. Suspended sediment observations are generally done by Punjab type bottle sampler from boat or by wanding. The collection can be done at any depth from all points where velocity measurements are made along the cross section of the river. When discharge observation is conducted from bridge or cableway during the days of high flood, samples can be collected from surface. The sediment is generally classified as coarse, medium and fine according to the diameter as

indicated below:

- o Coarse : Sediment above 0.20 mm diameter.
- o Medium : Sediment between 0.20 mm and 0.75 mm diameter.
- o Fine : Sediment below 0.075 mm diameter.

The user can feed the course, medium or fine sediment load (in metric tonnes) in the total runoff (m.cumec) monthly or daily as per data for different stations.

Table 4 shows the output format of Sediment Load data.

5.2.3 Surface Water Quality Data

Surface water quality can be completely defined and estimated by studying its physical, chemical and bacterial characteristics.

a) Physical Characteristics:

It includes colour, taste and odour, turbidity, temperature and specific conductance of water.

b) Chemical Characteristics:

It includes hardness, pH value, hydrogen ion concentration, inorganic nutrients, Suspended solids, dissolved and colloidal solids, dissolved gases and organic matter.

c) Bacteriological Microscopic Characteristics:

It involves detection and elimination of pathogenic organisms. According to the present software, the user can feed the value of pH, oxygen, B.O.D., C.O.D., Hardness, Turbidity, CO_3, HCO_3, Ca^{++}, Mg^{++}, Fe++ and F^+ presented in cumec discharge.

Table 5 shows the output format of Surface Water Quality data.

5.3 Ground Water Data

It is necessary to ascertain the specific yield of the substrata for the estimation of the ground water. The procedure involves the classification of well log data in various classes of materials.

When rainfall is the predominant source for recharge, the ground water estimate would be the available potential less by losses through evapotranspiration and

subsurface drainage, which may be estimated or assumed.

The amount of deep percolation due to seepage from canals reaching the ground water is added to the rainfall recharge to arrive at overall available ground water potential.

It includes water level depth data, ground water quality data, welllog data and pumptest data

5.3.1 Water Level Depth

Water level depth gauge recorders are installed in observation wells. Users can have information about well number with location, latitude, and longitude. Water level versus depth can be measured monthly or daily or hourly on pre or post monsoon basis.

Table 6 shows the output format of Water Level Depth data.

5.3.2 Ground Water Quality Data

Ground water quality is defined and estimated by studying its physical, chemical and bacterial characteristics. Quality of ground water is highly dependent upon the ground water level.

Table 7 shows the output format of Ground Water Quality data.

5.3.4 Welllog Data

The strata chart is very important for welllog data. The type of soil is identified where the user drilled the well. When the drilling starts, the type of strata is to be observed depthwise. According to the depth layers the data is identified.

Table 8 shows the output format of Welllog data.

5.3.4 Pump Test Data

Pump test data in ground water depend upon the radius of the pumping well, distances of the observation wells from the pumping well. Pumping rate may be constant or variable. Users can enter the observed data of pumping rate of discharge, drawdown in pumping well and drawdown in observation wells at different interval of time.

The specific details like type of pump, type of aquifer(tapped), pump test in layered or nonlayered aquifer, step drawdown test are also very important. This information should also have with users before handling the pump test data.

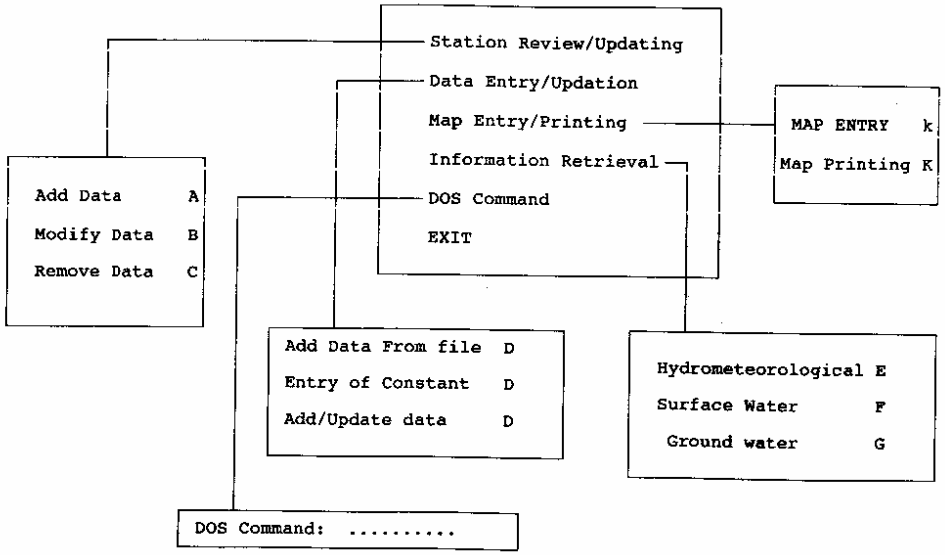
The users can have a table for such data as drawdown in pumping well and observatory well with respect to time for recovery test. This data can be supplied to the software as daily, monthly or hourly time interval.

Table 9 shows the output format of Pump Test data.

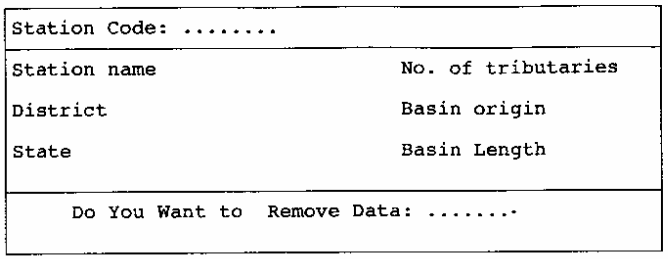
REFERENCES

- Data Storage and Retrieval System on Personal Computer (N.I.H User's Manual UM - 30).
- Data Storage, Processing and Retrieval system for hydrological data (N.I.H User's Manual UM - 47)
- Hydrological data book for Narmada basin (upto Bargi dam) 1981-90, (N.I.H. Technical Note TN - 114).
- Hydrologic data book for Punpun Subbasin (1974-90) (N.I.H Technical Report TR - 174).
- Hydrological Data Processing and Analysis by HYMOS (N.I.H Report SR-25)

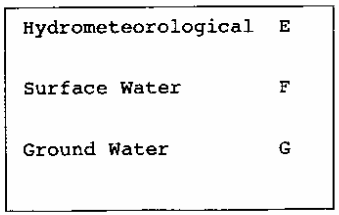
Fig. 1: Flow chart of the Software "DBOOK"



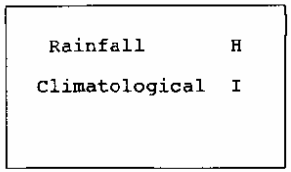
C

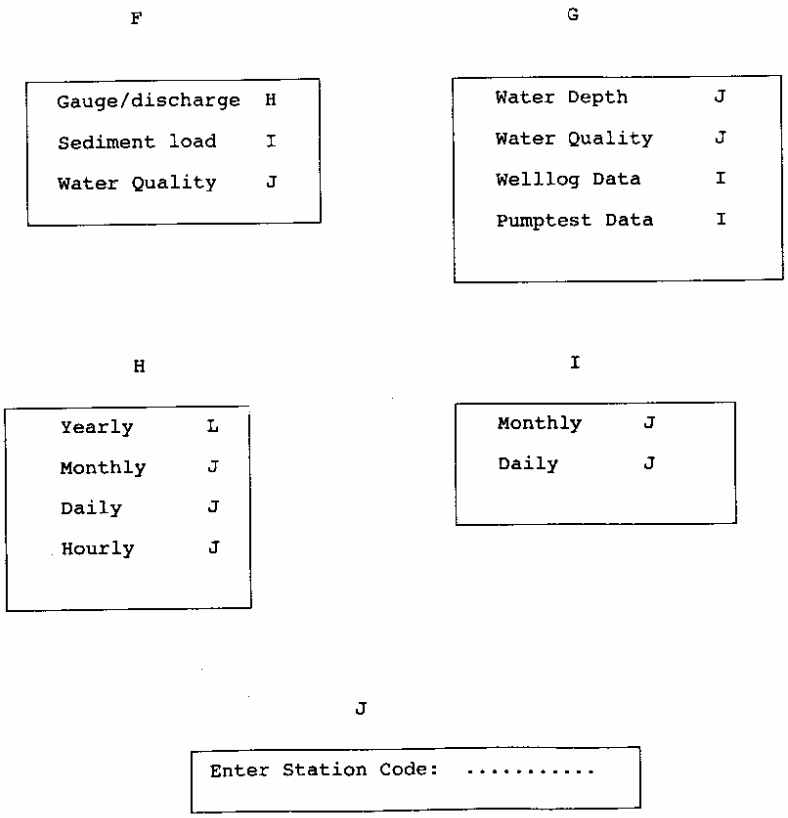

Station Code: .....
Station name
No. of tributaries
District
Basin origin
State
Basin Length
Do You Want to Remove Data: .....

D


Hydrometeorological E
Surface Water F
Ground Water G

E


Rainfall H
Climatological I


F
Gauge/discharge H
Sediment load I
Water Quality J
G
Water Depth J
Water Quality J
Welllog Data I
Pumptest Data I
H
Yearly L
Monthly J
Daily J
Hourly J
I
Monthly J
Daily J
J
Enter Station Code: .....

K

Index Msp	J
Topographical contour	J
Soil Map	J
Geological	J
Geohydrological	J
Geomorphological	J
Drainage	J
Landuse	J
Annual Isohyetal	J
Flood Inundation	J
Administrative	J
Drought Prone Area	J
Rainguage Stations	J
Observation wells	J
Gauge/Discharge sites	J

L

This option is not available.

TABLE - 1(a)

MONTHLY RAINFALL DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	MEAN	MAX	MIN

TABLE - 1(b)

DAILY RAINFALL DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

YEAR :

MONTH / DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1												
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30												
31												

TABLE - 1(c)

HOURLY RAINFALL DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

MONTH : YEAR :

HOUR / DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTAL
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TABLE - 2(a)

MONTHLY CLIMATOLOGICAL DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

YEAR :

Month	Temperature						R.Humi(%)		Wind Velocity Km/Hour	Sunshine Hours	Evaporation (mm/Day)	Vapour Pressure
	FN		AN		Max	Min	FN	AN				
	Dry	Wet	Dry	Wet								
Jan												
Feb												
Mar												
Apr												
May												
Jun												
Jul												
Aug												
Sep												
Oct												
Nov												
Dec												

TABLE - 2(b)

DAILY CLIMATOLOGICAL DATA

STATION : LATITUDE : LONGITUDE : ALTITUDE :
DISTRICT : STATE : RIVER : CATCHMENT AREA :
BASIN ORIGIN : BASIN LENGTH : BASIN WIDTH : NO. OF TRIBUTARIES :
SOIL TYPE : GEOLOGY : AGENCY : TOPOSHEET REFERENCE :

YEAR : MONTH :

Day	Temperature						R.Humi(%)		Wind Velocity Km/Hour	Sunshine Hours	Evaporation (mm/Day)	Vapour Pressure
	FN		AN		Max	Min	FN	AN				
	Dry	Wet	Dry	Wet								
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TABLE - 3(a)

MONTHLY GAUGE / DISCHARGE DATA

STATION :
DISTRICT :
BASIN ORIGIN :
SOIL TYPE :

LATITUDE
STATE :
BASIN LENGTH :
GEOLOGY :

LONGITUDE :
RIVER :
BASIN WIDTH :
AGENCY :

ALTITUDE :
CATCHMENT AREA :
NO. OF TRIBUTARIES :
TOPOSHEET REFERENCE :

YEAR	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		TOTAL	MEAN	MAX	MIN
	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D	D	D	D	D

TABLE - 3(b)

DAILY GAUGE / DISCHARGE DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

YEAR :

MONTH / DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
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TABLE - 3(c)

HOURLY GAUGE / DISCHARGE DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

MONTH : YEAR :

HOUR	1		2		3		4		5		6		7		8		9		10		11		12	
DATE	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D	G	D
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TABLE - 4(a)

MONTHLY SEDIMENT LOAD DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

YEAR :

Month	Total Runoff (m cum)	Sediment Load (Metric Tonnes)			
		Coarse	Medium	Fine	Total
Jan					
Feb					
Mar					
Apr					
May					
Jun					
Jul					
Aug					
Sep					
Oct					
Nov					
Dec					

TABLE - 4(b)

DAILY SEDIMENT LOAD DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

YEAR : MONTH :

Day	Total Runoff (m cum)	Sediment Load (Metric Tonnes)			
		Coarse	Medium	Fine	Total
1					
2					
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TABLE - 5

SURFACE WATER QUALITY DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

DATE	Q	pH	TDS	OXY	BOD	COD	HARD	TUR	CO3	HCO3	Ca++	Mg++	Fe++	F

TABLE - 6

STATIC WATER LEVEL BELOW GROUND WATER LEVEL

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

STATION	DISTRICT	WELL NO.	LATITUDE	LONGITUDE	R.LEVEL	YEAR	PREMONSOON	POSTMONSOON	FLUCTUATION

TABLE - 7

GROUND WATER QUALITY DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

DATE	Q	pH	TDS	HARD	TUR	CO3	HCO3	Ca++	Mg++	Fe++	F

TABLE - 8

WELL-LOG DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

DEPTH	RATE OF DRILLING	NATURE	TEXTURE	MINERAL COMPOSITION	DRILLING ACTION	FLUID LOSSES	CHANGES IN MUD CONSISTENCY

TABLE - 9

PUMPTEST DATA

STATION	:	LATITUDE	:	LONGITUDE	:	ALTITUDE	:
DISTRICT	:	STATE	:	RIVER	:	CATCHMENT AREA	:
BASIN ORIGIN	:	BASIN LENGTH	:	BASIN WIDTH	:	NO. OF TRIBUTARIES	:
SOIL TYPE	:	GEOLOGY	:	AGENCY	:	TOPOSHEET REFERENCE	:

OBSERVATION WELL			PUMPING WELL				
TIME	WATER LEVEL	DRAW DOWN	TIME	WATER LEVEL	DRAW DOWN	TIME	DISCHARGE RATE FLOW METER / DISCHARGE RATE

Dr. S.M. Seth

Director

Study Group

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