Management Study of Some Aspects of Sistema de Informações Hidrológicas

by

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Introduction

The primary purpose of operating a fluviometric station is to obtain an essentially continuous record of the rate of flow, called the discharge of a stream. A reliable record of the discharge of a stream is needed to adequately design those projects using water from the stream. These include the location of dams for hydroelectric plants, municipal water supplies, irrigation projects, and flood control projects. The first step in computing the actual discharge is to obtain the gage-heights, the height of the water surface at a given time, at a given fluviometric station. A rating curve which relates gage-heights to discharge is prepared from measured values of discharge at different stages at the station. The rating table and its application to the computation of discharge from average daily gage-heights comprise the second step of the operation. However, the geometry of the channel and of the cross-section of a stream is subject to change with time and different rating tables may need to be applied for different periods of time. There may also be changes of a temporary nature which require "shifting" the rating curve up or down. These are applied by adding to or subtracting from the observed gage-heights prior to entering the rating table to obtain a discharge.

To assist in the compilation, analysis, and publication of the vast quantity of data collected for the various hydrologic Districts of the Divisão de Águas, Departamento Nacional de Águas e Energia Elétrica (DNAEE) of the Ministério das Minas e Energia (MME), a system of computer programs, Sistema de Informações Hidrologicas (SIH) has been

developed by the Departamento de Processamento de Dados (DPD) of the Companhia Auxiliar de Empresas Eletricas Brasileiras (CAEEB). The overall development and implantation of SIH is under the direction of the Supervisão do Projeto Hidrologia do DNAEE.

The system has also been designed to store and retrieve both current and historical data. Gage-heights, discharges, reservoir contents, rainfall values, suspended-sediment concentrations and loads, and water chemistry are examples of the kinds of data which may be stored in the file.

The purpose of this report is to present the results of a management study of the flow of data between the several organizations that are concerned with the collection, compilation, processing, analysis and publication of the basic hydrologic data.

Acknowledgments

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Background

There are two sources of data: historical gage-heights contained in the literature and collected for the many Districts over a long period of time; and, current data collected by the Companhia de Pesquisa de Recursos Minerais (CPRM). The historical data has been coded, punched into cards, and written onto magnetic tape by the Consórcio Nacional de Engenheiros Consultores (CNEC).

Historical Data.--Altogether there are 33,300 station-years of historical data. CAEEB in conjunction with the DNAEE Districts is now routinely processing the data. That is, average daily gage-heights are calculated and listed for a water-year (a calendar year). The listings are sent to the Districts for inspection and verification. Datum corrections and shifts, if they are required, are returned with rating curves by the Districts to CAEEB. CAEEB then corrects the average daily gage-heights, calculates daily discharges which are again sent to the Districts for inspection and analysis. With the Districts approval, a final listing of discharges is prepared by CAEEB and returned to them for publication as water bulletins. The average daily gage-heights and the discharges for that station year are copied from the current data file into the appropriate magnetic tape volume contained within the historical file.

Current Data.--CPRM observers collect and code the current data (two gage-height recordings per day per station) and send the forms to CPRM Agencies. CPRM hidrometristas survey and plot cross-sections, run levels, and measure discharges. At the agencies the data is examined by

hydrologists for consistency. If clarification of the data is required the hidrometristas are consulted. The data by station-month is routinely sent to CPRM's hydrologist in Rio de Janeiro who passes it to the Departamento de Processamento de Dados (DEPRO) for subsequent keypunching into cards, verifying the punched data, and preliminary calculating of average daily gage-height values by computer. The average daily gage-heights are stored on magnetic tape. DEPRO also calculates and stores monthly and annual minimum and maximum values and total values. Listings are returned to the Agencies for examination. If corrections are required, they are submitted to CPRM-Rio and the data reprocessed. Beginning in May 1974 the results will be checked for consistency in Rio prior to their being mailed to the Agencies. Two bulletins are sent by CPRM Agencies to the DNAEE Districts. One contains the original gage-heights and other field reports such as discharge measurements. The other contains the computer listings of calculated gage-heights. Cotagrams are produced monthly by listing daily mean gage-heights as line-bars on the printer. These are used only for verifying the observed gage-heights.

In the past CPRM has prepared, as a special project, tables of discharges for selected stations. For these studies discharge measurements were sent to CPRM's hydrologist in Rio who prepared the rating curves. The tables of discharges were verified by the Agencies.

The annual report containing calculated mean gage-heights is sent to each District. The report contains maximum values observed, minimum values observed, daily, monthly, and annual mean values, and a frequency table of the annual results. These are listed one page per station and include total figures. Cross-sections are included in the annual report;

however, unless there are changes, the cross-sections reported are reproduced from the previous year's report.

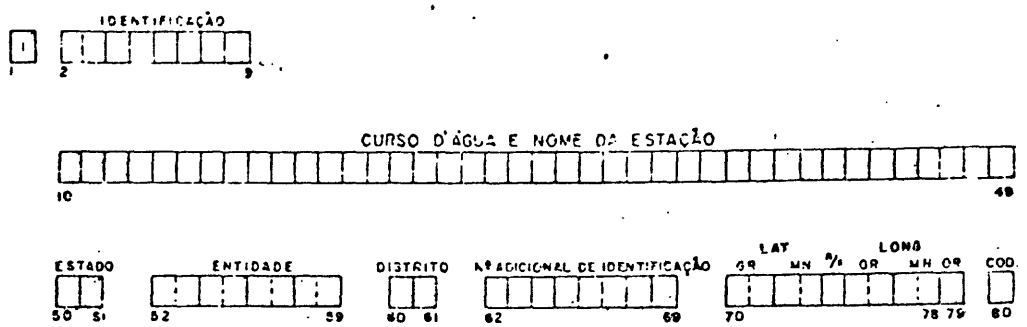
When there are periods with no readings, the gage-heights from two stations are corrected and estimated values obtained. These estimated values are listed separately in the annual report. Also, they are not stored on magnetic tape with the annual data.

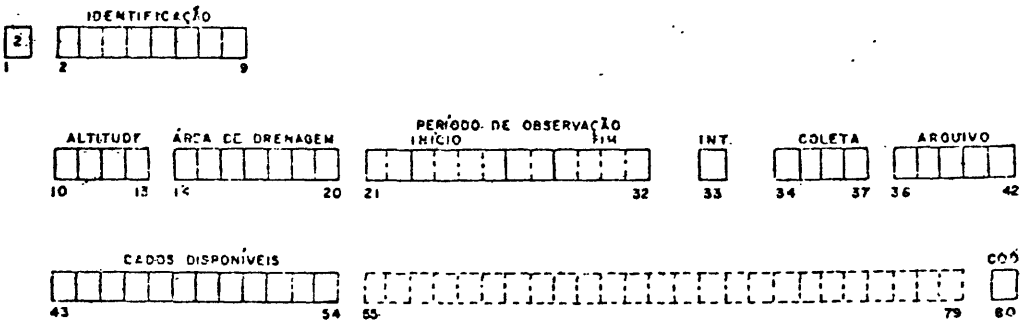
Station inventory.--The station inventory file is an auxiliary file currently being maintained by CAEEB. The information contained in this file is indicated in fig. 1, "Atualização do Inventário das Estações Hidrológicas." This file has existed for some time and current action consists of correcting erroneous information or adding new information about either new or omitted stations.

MME-DNAEE

DIVISÃO DE ÁGUAS

ATUALIZAÇÃO DO INVENTÁRIO DAS ESTAÇÕES HIDROLÓGICAS





OBSERVAÇÕES:

Preenchido por: _____ ____ DISTRITO

DATA: / /

Figure 1.--Form used for recording information for the station inventory file.

Future Plans for SIH for Hydrologic Data

Beginning in January 1975 current plans require that CPRM maintain gage-stations for DNAEE. CPRM will collect the gage-height measurements twice daily. This data will be compiled by the CPRM Agencies (see table 1) and sent to CPRM headquarters in Rio de Janeiro. Here the data will be punched into cards, the cards verified, and tables of average (mean) daily gage-heights prepared. Listings of this data together with other station information collected by CPRM Agencies such as cross-sections needed for control will be sent to the Districts of DNAEE; a magnetic tape containing the mean daily gage-heights is to be sent to CAEEB in Brasília. CAEEB has the responsibility for maintaining the hydrologic information system, SIH, and further processing of the data including hydrograph plots. The Districts have the responsibility for analyzing the data, and for preparing additional datum corrections, as necessary, rating curves, and approving and publishing the final produced tables of discharges.

In the event that CPRM has further need for either the final gage-height or discharge data they, then, become simply another user of the system. Their requests would be submitted to DNAEE Headquarters or the appropriate District for processing by CAEEB. It is recommended that the format described later in the report for use by CPRM in transmitting average daily gage-heights to CAEEB be established as a standard format for transmitting large volumes of data by magnetic tape when such requests are received by DNAEE.

Table 1.--CPRM Agencies and represented States (with codes) as of 5/10/74

Agency	States Represented (with codes)
Porto Velho	Território de Rondônia (RO)
Manáus	Acre (AC) Amazonas (AM) Território de Roraima (RR)
Belém	Pará (PA) Território do Amapá (AP)
Recife	Alagoas (AL) Ceará (CE) Maranhão (MA) Paraíba (PB) Pernambuco (PE) Piauí (PI) Rio Grande do Norte (RN) Sergipe (SE) Território de Fernando de Noronha (FN)
Salvador	Bahia (BA)
Belo Horizonte	Espírito Santo (ES) Guanabara (GB) Minas Gerais (MG) Rio de Janeiro (RJ)
São Paulo	Paraná (PR) Santa Catarina (SC) São Paulo (SP)
Porto Alegre	Rio Grande do Sul (RS)
Gioânia	Distrito Federal (DF) Goiás (GO) Mato Grosso (MT)

A Possible Scheme for Transmitting Data

One of the more critical problems will be that of maintaining a smooth flow of data between all of the concerned organizations. Probably DEPRO in CPRM and DPD in CAEEB will be most seriously affected since all data will flow through these units for computer processing in contrast with the participation of the several Agencies of CPRM and Districts of DNAEE. For them, if a logical plan is not developed it will mean that once each month they will become inundated with a mountain of data.

The scheme below will possibly alleviate this potential problem. Essentially, it will make "three smaller mountains from one colossal mountain." Table 2 lists the number of stream-gaging stations in the DNAEE network by District. The second column in the table shows the appropriate number of stations for which data will be transmitted each month by the CPRM Agencies for initial computer processing by DEPRO. Rather than reporting the data for each station every month, the data for one-third of the stations will be reported trimesterly. One advantage of the longer period is the simplification of the preparation of rating curves. Note that the definition of data for a trimester is not intended to be rigorously defined as precisely 3 calendar months of unprocessed data.

To better illustrate the scheme, let us suppose that the 46 stations for the 7th District are numbered sequentially from 1 to 46. Let us suppose that the plan has been implemented for some period of time and is operating smoothly. The flow of information is illustrated in Fig. 2 and explained in the text below. Let's examine the operation of

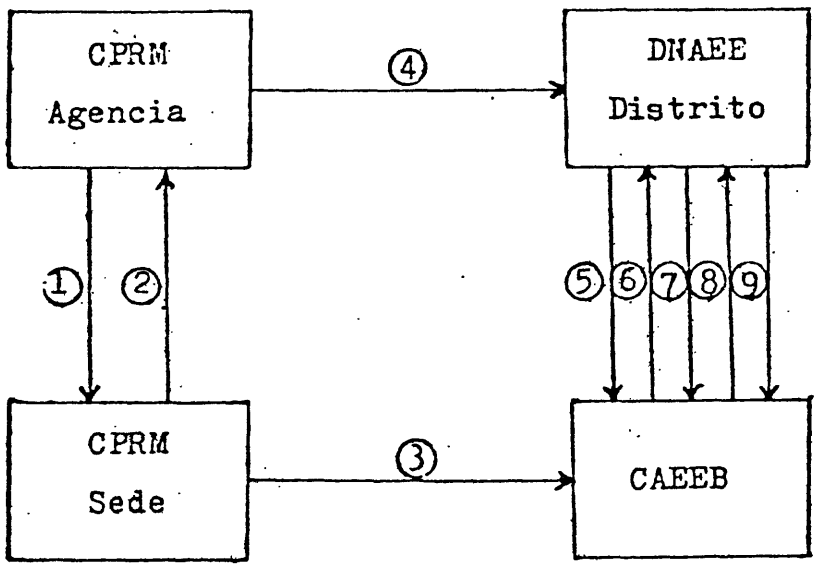


Figure 2.--Flow of data between organizations for processing current hydrologic data.

the plan for one calendar year. The plan is outlined in fig. 3. The calendar is given following table 2. Its actual use will be predicted by the scheduling of malotes (air pouches).

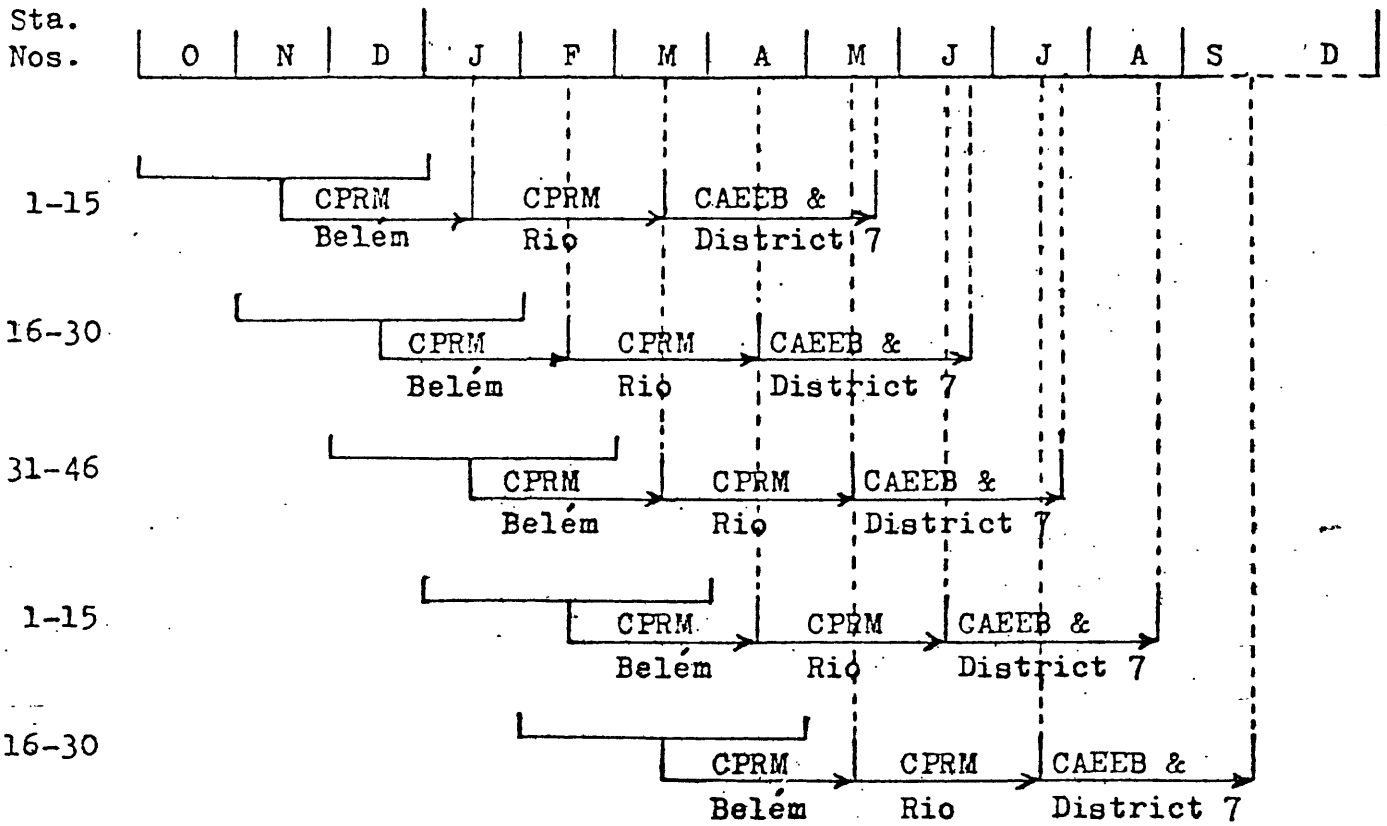


Figure 3. Calendar for processing data by trimesters.

Table 2.--Number of Stream Gaging Stations in the DNAEE network by Districts as of 5/10/74

District	Number of Stations	1/3 Station Data Transmitted Each Month
1st	144	48
2d	76	25
3d	114	38
5th	415	138
6th	247	82
7th	46	15
8th	117	39
Total	1,159	385

CPRM Agency at Belém

Action: Codes observed gage-heights (two readings/day) and forwards them to CPRM in Rio de Janeiro for processing (fig. 2, step 1).

Scedule:

Dates	Trimester of Data	Station Nos.
January 1-15	Oct., Nov., and Dec.	1 - 15
February 1-15	Nov., Dec., and Jan.	16 - 30
March 1-15	Dec., Jan., and Feb.	31 - 46
April 1-15	Jan., Feb., and Mar.	1 - 15
May 1-15	Feb., Mar., and Apr.	16 - 30
	- and so forth -	

CPRM in Rio

Action: Prepares by computer provisional tables of mean daily gage-heights. The data is recorded on magnetic tape and sent to CAEEB in Brasília for further processing (fig. 2, step 3). Simultaneously a listing of the data is returned to the CPRM Agency in Belém (fig. 2, step 2) where it is transmitted with other appropriate information such as discharge measurements and cross-sections to DNAEE 7th District in Belém (fig. 2, step 4).

Schedule:

Dates	Trimester of Data	Station Nos.
Jan. 16-Mar. 15	Oct., Nov., and Dec.*	1 - 15
Feb. 16-Apr. 15	Nov., Dec., and Jan.*	16 - 30
Mar. 16-May 15	Dec., Jan., and Feb.*	31 - 46
Apr. 16-June 15	Jan., Feb., and Mar.	1 - 15
May 16-July 15	Feb., Mar., and Apr.	16 - 30
	- and so forth -	

DNAEE 7th District and CAEEB

Action: The 7th District analyzes the listings of mean daily gage-heights received from the Belém CPRM Agency. It prepares additional datum corrections (if they are needed), rating tables, shifts, and daily discharge values (for periods when gage-height records are missing and when state-discharge relationships do not apply). These are sent to CAEEB in Brasília (fig. 2, step 5) who prepares, by computer, tables of provisory discharges and plots of hydrographs. These are returned to the 7th District inspection (fig. 2, step 6). If needed, data to update the provisory discharges are furnished by 7th District to CAEEB (fig. 2, step 4). A corrected table of discharges is produced by CAEEB for approval by the 7th District (fig. 2, step 8).

Scedule:

Dates	Trimester of Data	Station Nos.
Mar. 16-May 21	Oct., Nov., and Dec.*	1 - 15
Apr. 16-June 21	Nov., Dec., and Jan.*	16 - 30
May 16-July 21	Dec., Jan., and Feb.*	31 - 46
June 16-Aug. 21	Jan., Feb., and Mar.	1 - 15
July 16-Sept. 21	Feb., Mar., and Apr.	16 - 30

- and so forth -

*When approval is received by CAEEB from the 7th District for the discharge data for these periods, listings of the gage-heights and discharges for the appropriate stations are produced in bulletin format for the previous year. They are sent to the 7th District for publication (fig. 2, step 9).

DNAEE 7th District

Action: Following receipt of the final discharges in bulletin format after July 21 from CAEEB, the 7th District will have until September 30 to prepare accompanying manuscripts and to have the computer listings reduced for publication.

Schedule:

Dates	Annual Data	Station Nos.
July 22-Sept. 30	Jan.-Dec.	1 - 46

An allowance must be made for the possibility of having "provisional" stations in the network. Provisional stations are defined here as stations reported on a different schedule than that given above. For example, when a District is conducting a special study, it may require that gage-heights for selected stations be reported monthly by the CPRM Agency which collects its data.

It will be necessary for each District to provide DNAEE Headquarters, CAEEB, and CPRM with a schedule of stations in the order in which they want to have the data processed by trimester. To return to the example above, suppose that the 7th District wants to have the data for the 46th station processed monthly as a provisional station, then its schedule will look like this:

1st trimester: Station numbers 1-15, 46
2d trimester: Station numbers 16-30, 46
3d trimester: Station numbers 31-45, 46

Prior to January 31, 1975 each District will need to have verified the assigned code numbers and names of stations under their jurisdiction and to have completed and distributed their schedules. This will be

required because CPRM-Rio will have to completely revise their files of gage-heights data. CPRM Agencies will need the information for the data submitted by them to CPRM-Rio on February 15, 1975 for those stations reported for January 1975 (approximately one-third of the total for each District).

Future Plans for SIH for Including Other Data

The SIH is a versatile system. It has the capability of allowing the storage and retrieval of many different kinds of data. This is particularly true if the data are collected on a regular schedule causing them to be time dependent.

The kinds of data which are currently planned to be included in the storage and retrieval system may be subdivided into two classes: "on stream" and "off stream" (see fig. 4). The on-stream data will consist of gage-heights and discharges from stream-gaging stations and water chemistry from quality-of-water stations. Daily rainfall data and evaporation data are planned for inclusion in the off-stream subsystem. Each of these subsystems has an associated station inventory. Due to the large amounts of data of different varieties to be stored, retrieved, and processed by SIH, data for the on-stream subsystem should be maintained in a separate file from that to be included in the off-stream subsystem. Similarly, separate inventory files should be maintained for each subsystem.

Currently the system contains only gage-heights and discharges for one of the 33,300 station-years of historical data collected by the districts for a 30-50 year period. This data is being routinely processed by CAEEB and the Districts.

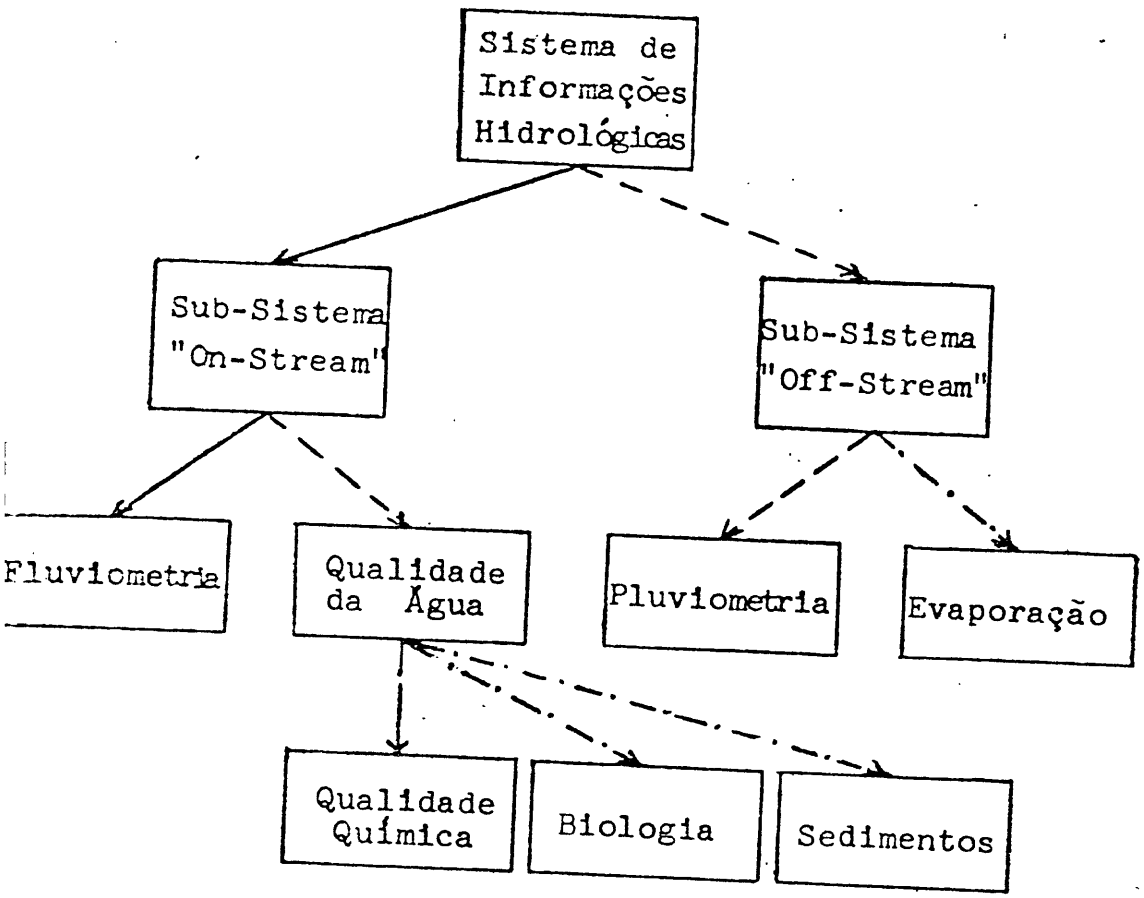
For the on-stream daily data files there are these kinds of input:

For mean daily gage heights:
- gage-heights
- gage-height corrections
- datum corrections (scaling)
- estimated gage-heights
- maximum monthly observed gage-heights

For mean daily discharges: rating tables
shift corrections
estimated discharges
corrected discharges

To obtain listings of final discharges suitable for publication as calendar-year bulletins and hydrograph plots requires the manipulation of some of these elements by each organizational entity involved. From discussions with various individuals in collecting information for this study there appears to be a large quantity of hydrologic information available from other ministries and agencies such as Superintendencia do Desenvolvimento do Nordeste (SUDENE), and Superintendencia do Vale de São Francisco (SUVALE). Probably, this data can not be published directly; however, the Districts can use it for analysis and for estimating periods of missing data.

Similarly, other data such as quality-of-water, daily rainfall, and evaporation, where it is available, can be used by the Districts when these files are organized. As an example, the Ministry of Agriculture has evaporation data for about 200-300 stations.



nvenções: ___ implantado; --- planejado —.— possível extensão

gure 4.- - Subsystems of Sistema de Informações Hidrológicas.

Requirements for Transmitting Mean Daily Gage-heights Data by CPRM

Outlined below are the requirements for transmitting data from CPRM to the DNAEE Districts and CAEEB.

Listings sent to DNAEE Districts.--Figure 5 shows the format to be used by CPRM for sending listings of average daily gage-heights to the Districts. The listing could also contain average daily gage-heights from observed data for the year-to-date. If, for example, data is being reported for the trimester June, July, and August then the listing will contain information for the period from January through August. When the trimester contains data extending into a second year, then the data for the second year will be printed separately, If, for instance, the trimester includes data for the months of November and December of 1975 and January 1976, the first page will show all the data for January through December 1975. A second page will show only data for January 1976.

For periods when there are no data available a blank field could be printed for the appropriate days. When the water surface is below the staff-gage (régua seca) the symbols "RS" could be printed. On the other hand, if the staff-gage is inundated (régua coberto) then the annotation "RC" is required.

No attempt should be made by CPRM to estimate periods of missing data. If data are not available the notations given above could be used.

Magnetic Tapes sent to CAEEB.--A method for transmitting the average daily gage-heights to CAEEB follows below. The data could be

copied onto a magnetic tape being recorded at 1,600 bytes per inch, IBM 360/370 readable. (The minimum size reel available contains 300 feet of magnetic tape. This size reel is capable of conservatively handling more than three times the amount of data represented for a trimester). The data could be stored by the data-key (see table 3). It can be written in blocks of four (4) records per block where a record represents the data for as much as a station-year. An indice from 1 to 12 will serve to locate the data for any month in the 12 x 32 matrix. For example, the data for August will be stored in the eighth (8th) row of the matrix. The format of the magnetic tape is shown in table 4.

MINISTERIO DAS MINAS E ENERGIA

D.N.A.E.E. - C.A.E.T.E.

NOME DA ESTACAO- CHOPOZINHO NO RIO CHORO N. DA ESTACAO- 35180000

LATITUDE- 01 DISTRITO- 06 AREA DE DRENAGEM (KM2)- 3929

COTAS MEDIAS DIARIAS(CM) OBSERVADAS NO ANO DE-1972

DIA	JAN.	FEV.	MAR.	ABR.	MAI.	JUN.	JUL.	AGO.	SET.	OUT.	NOV.	DEZ.
1	52	56	64	72	124	70	65	51	54	-RS-	-RS-	-RS-
2	53	58	65	69	130	80	67	49	54	-RS-	-RS-	-RS-
3	54	59	67	67	108	91	71	49	53	-RS-	-RS-	-RS-
4	54	58	70	66	102	84	63	49	51	-RS-	-RS-	-RS-
5	54	57	72	66	106	83	62	48	50	-RS-	-RS-	-RS-
6	54	60	71	64	99	81	62	48	49	-RS-	-RS-	-RS-
7	54	56	75	64	99	77	66	48	49	-RS-	-RS-	-RS-
8	53	56	74	64	95	76	65	47	48	-RS-	-RS-	-RS-
9	53	56	70	62	88	75	63	47	47	-RS-	-RS-	-RS-
10	53	58	68	62	87	73	61	47	47	-RS-	-RS-	-RS-
11	60	60	67	60	89	73	59	49	46	-RS-	-RS-	-RS-
12	54	60	65	61	79	69	70	48	46	-RS-	-RS-	-RS-
13	52	62	62	62	92	70	70	48	46	-RS-	-RS-	-RS-
14	52	67	64	62	84	70	82	51	45	-RS-	-RS-	-RS-
15	57	66	64	60	79	77	77	48	45	-RS-	-RS-	-RS-
16	53	61	65	58	76	80	73	49	45	-RS-	-RS-	-RS-
17	52	62	66	58	77	77	70	50	44	-RS-	-RS-	-RS-
18	52	64	82	58	78	78	67	49	44	-RS-	-RS-	-RS-
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20	52	78	76	58	78	77	63	48	44	-RS-	-RS-	-RS-
21	55	76	75	67	77	74	61	49	43	-RS-	-RS-	-RS-
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25	63	66	73	78	78	68	59	57	-RS-	-RS-	-RS-	-RS-
26	62	65	71	80	77	69	52	58	-RS-	-RS-	-RS-	-RS-
27	61	65	70	89	75	67	53	59	-RS-	-RS-	-RS-	-RS-
28	58	66	69	94	72	66	52	61	-RS-	-RS-	-RS-	-RS-
29	59	65	68	95	70	64	52	60	-RS-	-RS-	-RS-	-RS-
30	59		67	89	69	66	52	56	-RS-	-RS-	-RS-	-RS-
31	58		66		69		52	55				-RS-
MAXIMA MENSAL	78	83	84	96	140	92	83	64				
MINIMA MENSAL	52	56	62	58	69	64	52	47				
MEDIA MENSAL	56	64	70	68	86	74	63	51				

TOTAL ANUAL 17327 MEDIA ANUAL MAXIMA ANUAL MINIMA ANUAL

Figure 2.--- Listing showing format of mean daily gage-height data.

Table 3.--Items comprising the data-key in a magnetic tape record

Data Item	Priority
Station Identification Number	1
Cross-section Locator	2
Depth of Measurement	3
Parameter Code	4
Year	5
Statistic Code	6

When the data for a trimester extends into the following year, two records are required on magnetic tape. (See previous discussion on data listings.)

Table 4.--Contents of records for transmission of average daily gage-height data

Data Items	Storage Model*	Length in Bytes	Byte Position	Comments
Record deletion code	C	1	1	Always "blank"
Station identification number	C	15	2-16	See below
Cross-section locator	FD(6)	4	17-20	Use 7777 if the value is undefined
Depth of measurement	FD(6)	4	21-24	
Parameter code	FB(31)	4	25-28	Always use 00065
Year	FB(15)	2	29-30	See below
Statistic code	FB(15)	2	31-32	Always use 00003
No-value indicator	FD(6)	4	33-36	Always "blanks"
Mean daily gage-heights	FD(6)	1536	37-1572	A 12 x 32 matrix See discussion
Agency code	FB(15)	2	1573-1574	Always use "01"
District code	FB(15)	2	1575-1576	See table 5
Station name	C	48	1577-1624	
Drainage area	FD(6)	4	1625-1628	
Processing date	FB(31)	4	1629-1632	Year, month, and day the record was created
Account number	FB(31)	4	1633-1638	Always "blank"
State code	C	2	1637-1638	See tab e 5
Reserved space	C	45	1639-1683	Always "blank"
Control code				

*Conventions: C - Character; FD - Float Decimal; FB - Fixed Binary

The items given in table 4 - the format and contents of average daily gage-height records to be transmitted by CPRM to CAEEB - are described in more detail below.

Record deletion code.--A code to allow individual records to be deleted by CAEEB from the current file. Insertion of a "blank" character in this field by CPRM would accomplish this.

Station identification number.--A maximum of 15 digits are allowed for identifying a station. The present number system, as defined by the Divisão de Águas, requires only the last eight digits. The remaining digits allow for future expansion of the system. The eight digits, separately or combined, characterize a station. Assigning station numbers is the responsibility of DNAEE.

Cross-section locator.--This is an optional identifier that permits the identification of the horizontal distance of a station from the left bank looking downstream. If this identifier is not used, the field contains "7777."

Depth of measurement.--This is also an optional identifier. It allows the identification of the vertical position of a sampling or measuring point within a cross-section location. The field contains "7777" if there is no value.

Note: Used separately or in conjunction, the cross-section locator and depth of measurement permit the identification of more than one collection or measurement point at a single station location.

Parameter code.--This code serves to define the kind of data which the record contains. For the average daily gage-height data the code is "00065."

Year.--The calendar year for the data contained in the record. Note that two records, with consecutive years assigned, may be required on magnetic tape for trimestral data.

Statistic code.--The Statistic code is used to identify the frequency of measurement, or statistical or arithmetic reduction of the data stored in the record. A code of "00003" will always denote average daily gage-heights.

No-value indicator.--This variable is used to indicate periods of missing data within each record. Insertion of "blank" characters in this field by CPRM will accomplish this.

Mean daily gage-heights.--This is a 12 x 32 dimensioned matrix which allows a mean daily gage height value to be stored for each day of the year. The ordinal number of the month is the row indice of the matrix. In contrast the day of the month is the column indice. For days having no data these codes are used (note the included decimal point):

7777. - no measurements made
8888. - régua seca
9999. - régua coberto

The 32d column of the matrix contains the maximum observed gage-height for the month. Note that this value is not the maximum mean daily gage-height.

Agency code.--This field contains a code identifying the entity that operates the station. Since DNAEE has primary responsibility for these stations, the code "01" is used.

District code.--This is a two digit numeric code (see table 5) identifying the District of DNAEE responsible for the data pertinent to this station.

Station name.--This field describes the name of the river and the location of the station. Common names established in conjunction with DNAEE and CPRM are used.

Drainage area.--The area of the hydrographic basin, in square kilometers, whose waters contribute to the flow past the station. DNAEE established the official drainage areas to be used.

Processing date.--The year, month, and day indicating when action was last taken on this record. CPRM will report the date that this record was created on magnetic tape.

Account number.--This is, as yet, an undefined number identifying the account which will have fiscal responsibility for the station. This field is left blank by CPRM.

State code.--A two character code identifying the State in which the station is located (see table 5).

Reserved space.--This is 45 characters of space reserved for future expansion of the file. This field is left blank by CPRM.

Control code.--This 1-byte code permits deletion of designated records from the historical file. This is written as a "blank" field by CPRM.

Table 5.--DNAEE Districts; their names and codes, and represented States (with codes) as of 5/10/74

DNAEE Districts	District Headquarters (with Codes)		States represented (with Codes)	
1st	Porto Alegre	(01)	Rio Grande do Sul	(RS)
			Santa Catarina (Sul)	(SC)
2d	Curitiba	(02)	Paraná	(PR)
			Santa Catarina (Norte)	(SC)
3d	São Paulo	(03)	São Paulo	(SP)
5th	Belo Horizonte	(05)	Espírito Santo	(ES)
			Guanabara	(GB)
			Minas Gerais	(MG)
			Rio de Janeiro	(RJ)
6th	Recife	(06)	Alagoas	(AL)
			Bahia	(BA)
			Ceará	(CE)
			Maranhão	(MA)
			Paraíba	(PB)
			Pernambuco	(PE)
			Piauí	(PI)
			Rio Grande do Norte	(RN)
			Sergipe	(SE)
			Território de Fernando de Noronha	(FN)
7th	Belém	(07)	Acre	(AC)
			Amazonas	(AM)
			Pará	(PA)
			Território do Amapá	(AP)
			Rondônia	(RO)
			Roraima	(RR)
8th	Goiânia	(08)	Distrito Federal	(DF)
			Goiás	(GO)
			Mato Grosso	(MT)

Existing Data

All existing mean daily gage-height data for the transitional period 1970-74 possessed by CPRM and stored on magnetic tape needs to be converted by CPRM to the format presented above, and passed on magnetic tape to CAEEB. This can only be done after the proper codes for station numbers and names of stations have been supplied to CPRM by DNAEE Districts. Further analysis and processing of this data by the Districts and CAEEB to produce tables of discharges can follow existing procedures established for the historical data.

SIH Personnel

The successful processing of hydrologic data in Brazil depends upon the combined effort and support of the Projeto Hidrologia and CAEEB. To a large extent the future success of SIH depends upon the competent guidance of the responsible administrator of CAEEB. Ideally, of course, this supervisor would have a background in both hydrology and computer science. In practice such an individual will be difficult to find. But, the person should have experience in one area or other, preferably hydrology and then given additional training in computer science. Training in hydrology requires more training to acquire than a cursory knowledge of computer science.

There exists a need for someone within CAEEB to serve as an archivist for the SIH. Since there are only a few number of CAEEB personnel associated with the project it seems difficult to justify this position for only this project. However, there is not an equivalent position within the Divisao de Análise e Processamento within CAEEB. Organizationally, it seems logical to establish an archivist position in this Divisão under the authority of its Chief. Basically, the function of an archivist is to maintain a chronological file of all computer runs made to debug programs, all requests made for modifications of programs, all documentation of systems and related programs, and all associated correspondence.

Correspondence

To maintain an audit trail of all activity related to the computerized part of the SIH is the reason to have all requests made by either DNAEE Headquarters or its Districts in writing. A secondary purpose of requiring a formal request is that this requires the sponsor to devote thought, and some preliminary analysis, to the request. Further analysis should be conducted by CAEEB system analysts with the aim of determining the impact of this modification upon the overall system. To the greatest possible extent, SIH is to be maintained as a uniform system for use by all Districts.

Any changes to the system requested by a District which will impair the use of the system by other Districts can be answered with a formal denial for the requested modification. If necessary these communications can be made by CAEEB through DNAEE Headquarters.

Documentation

There are diverse organizations involved with the SIH. For this reason standards (padrões) need to be established for transferring information between entities and defining areas of responsibilities. They will, also, serve to create a uniformity in proceedings such as requests from individual Districts for changes to the system.

A responsibility of DNAEE Headquarters, in conjunction with its Districts, CAEEB, and CPRM, will be to define the requirements for such standards in a numbered series of documents bearing dates. In this series, for instance, instructions issued by DNAEE Headquarters to the Districts will be assigned different numbers from instructions issued by CAEEB to the Districts. The requirements for the exchange of information will be included as part of the documentation. As an example the appropriate CPRM Agency could transmit to the proper District of DNAEE the following information for a station at the same time it transmits the tables of mean daily gage-heights:

- o Discharge measurements
- o Reports of station inspections
- o Originally observed gage-heights
- o Station surveys
- o Station installation design forms
- o Cross-sections
- o Levels

Only extensive modifications to the system would be assigned supplemental numbers in the documentation. Changes affecting current operations would be issued as replacement documents for already existing documents. Suppose that a District suggests a new method of producing rating curves which is approved by DNAEE Headquarters for all Districts, then the number assigned to this document would be the same as the old number but the document would bear the annotation "revised" and contain a new date. In contrast, when the documentation for pluviometry is developed, it will be assigned a different set of conjugate numbers within the numbering system.

Incidentally, none of this has been written with the intent of downgrading existing instructions. The material thus far encountered is well written; it only appears to be scarce and difficult to locate. Neither is the discussion intended to infer that normal correspondence should be included as documentation. However, existing basic documents as "Análise Hidrológica," "Análise Preliminar de Cotas," and "Análise das Descargas Medias Diárias" ought to be included as a part of DNAEE's contribution to this numbered series.

Caeeb's responsibility will be to document the system of computer programs comprising SIH. This documentation will consist of several parts. The system will consist of several parts. The system should be documented for internal purposes of CAEEB in which the functioning of the programs is described. The organizational procedures used internatlly by DPD for physically processing the data need to be developed. Users of the system need to receive a generalized

description of the operations of the system. They also need to be given a description of the contents of various forms with instructions which provide the details for completing the forms.

Basically, a numbered series of documents will serve to enforce standards which will in turn guarantee a homogeneity in the basic hydrologic data comprising SIH. In addition a numbered series of documents, by nature, will assure that all documents are filed together.

Data Control

The chart shown in fig. 6 is used by the 1st District and some others. Since it provides exact control of all phases in the processing of the historic data it should be used routinely by all Districts. Similar charts can be prepared by both DNAEE Headquarters and CAEEB for controlling the flow of the current data.

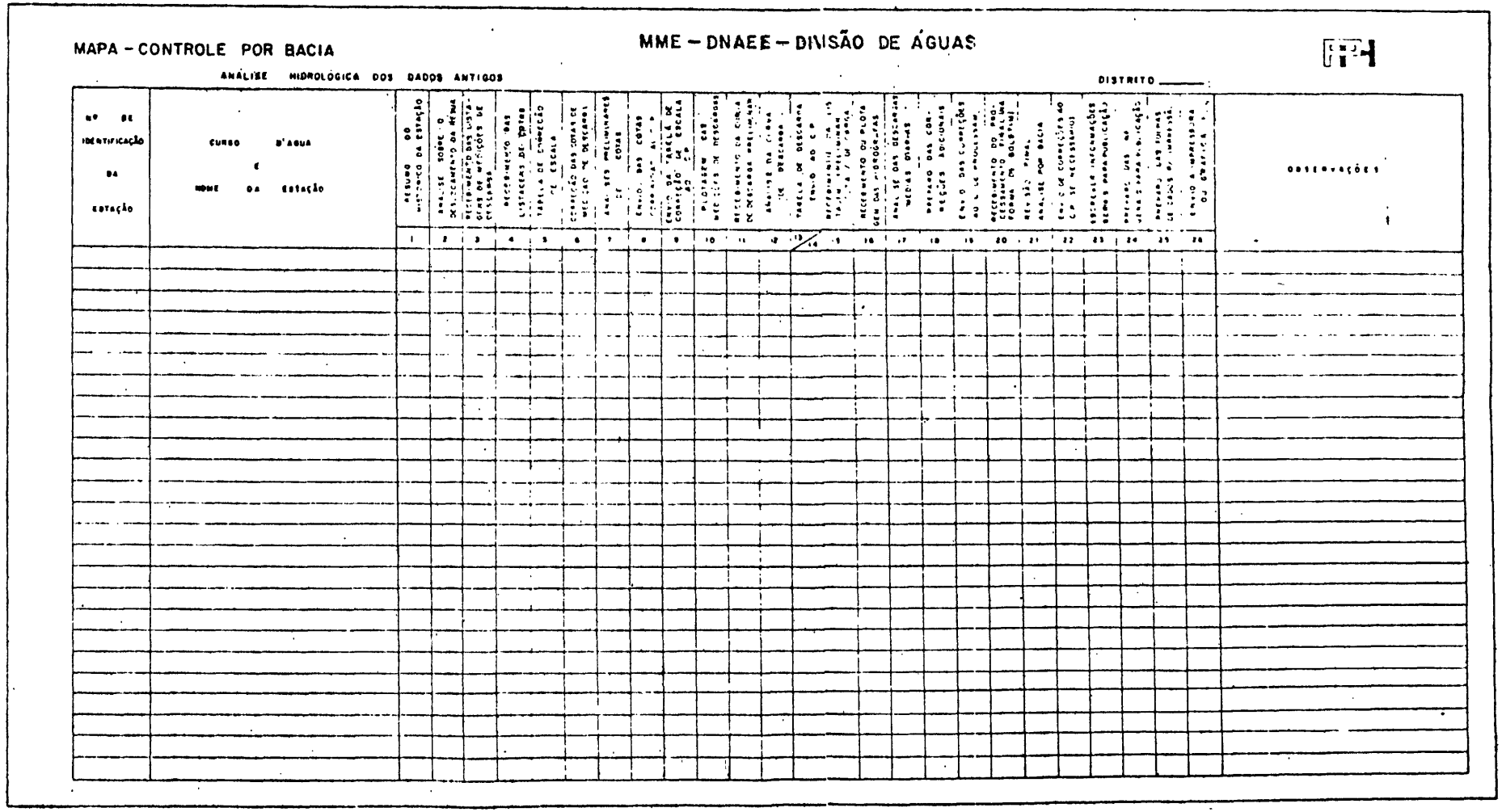

Figure 6. Chart used for maintaining control of the flow of historical data.

Summary

With its rapidly expanding population, Brazil needs the kinds of information which can be provided by the Sistema de Informações Hidrológicas. With future expansion of the system more entities will become involved in data collection, analysis, and processing. All of this activity will require close cooperation. Control of the system can best be maintained by issuing standards and requiring thorough documentation. Correspondence other than that required for the ordinary transmission of data and results can be communicated formally. The successful implementation of the basic hydrologic data subsystem of SIH will provide a firm base upon which the remainder of the system can be developed.