

823 YE90

BACKGROUND REPORT  
FOR PLANNING PURPOSES

OF  
THE NATIONAL INFORMATION CENTRE FOR WATER RESOURCES

General Department of Water Resources Studies  
Ministry of Oil and Mineral Resources  
Yemen Arab Republic

BY  
GENERAL REFERENCE TO THE  
GENERAL WATER SUPPLY AND  
SANITATION (GWS)

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## SUMMARY

The goal of this report is to be an aid for planning of time and resources within the National Information Centre for Water Resources.

First of all the framework for the Information Centre is defined, and tasks are deducted.

Task descriptions follow in detail.

This is done as general as possible but with the specific situation of the Information Centre on the background.

It is making clear what are typical database tasks and what activities carried out in the present situation are services to the other sections of the GDWRS.

However general tasks can be specified, some activities depend on the present state of the database of the Information Centre.

The present state with respect to storage systems and data processing is further evaluated.

For planning, assumptions must be made about activities to carry out, or not.

Certain assumptions were made by the author of this report in order to be able to quantify resources needed for the presentation of a 2 year time plan.

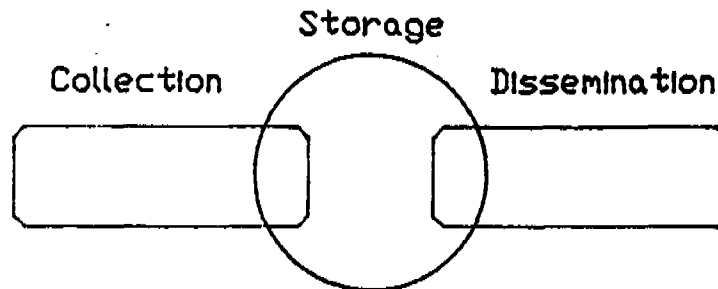
## 1. LOGICAL STRUCTURE

The National Information Centre for Water Resources can be divided into 3 characteristic parts.

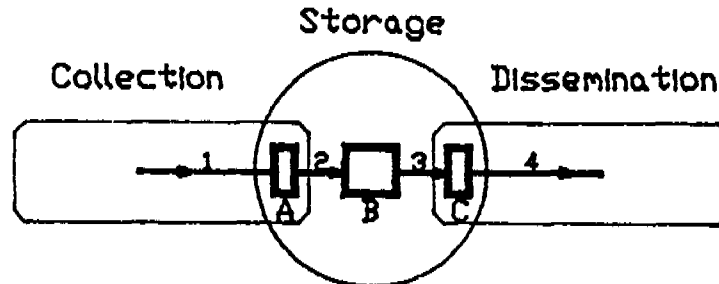
This are parts for 1) Collection  
2) Storage (database)  
3) Information providing

Part 1) and 2) are strongly depending on external relations with other organizations on one side and on the other side with the internal structure of the database.

The relation can be outlined in a figure as below.



Within the structure of the complete info centre, physical storage of information and dataflow can be distinguished (see figure below).



Main tasks can be derived from this scheme.

Some typical tasks follow from the fact that systems must be organized for physical storage, to subdivide in temporary storage (A and C) and main storage (B).

Other tasks follow from the flow of information i.e.:

- Information collection (path 1)
- Information processing (path 2)
- Information retrieval (path 3)
- Information dissemination (path 4)

Information comes in two basic forms, this is as evaluated information or as basic data. This reflects in particular the way of storage.

Evaluated information is generally stored in "libraries", while basic data is stored in (paper or computerized) files.

A library is an administrative system to describe the contents of its evaluated information (volumes).

Files do contain the content (data) itself. Besides an administrative system can be set up to describe the main characteristics of the files.

Both types of information need storage systems to be designed, computerized or not computerized.

When computerized the system and software must be designed, managed and the hardware maintained.

Finally in the Information Centre all processes need guidance and accurate control (data base management).

Above the structure of the Information Centre was described and tasks specified.

To summarize the typical tasks for the Information Centre, as will be dealt with in the next chapters are:

- 1) Information collection
- 2) Data processing
- 3) Library keeping
- 4) System and software design
- 5) System management
- 6) Hardware maintenance
- 7) Retrieval and presentation of information
- 8) Data base management

From the practice of the Information Centre, where all computerized activities of GDWRS are centralized, more tasks were always fulfilled, to subdivide in the categories:

- 9) General services as: Computerized drawing  
Secretarial work  
Stationary supplies
- 10) Technical applications for other sections

## 2. TASK DESCRIPTION

### 2.1. INFORMATION COLLECTION

#### 2.1.1. From external organizations

- Information collection in this case goes together with a continuous search for new organizations of interest, also in already existing bodies.

- With new organizations discovered general agreements must be made on data exchange. The same is valid with old organizations if no agreements yet exist.

- Define what information is of interest and how it will be transferred.

There are two options for transfer. This is physical transfer or administrative transfer. It is assumed that in general physically information will be collected, with the exception of extended (report)libraries for which administrative transfer can be considered.

In the ideal situation information will be received then automatic on a regular base.

-Regular visits are payed for reasons of maintaining good understandings and finding out new developments.

When information transfer is not running automatic, or is incomplete action should be taken.

-Specification of desired information must be prepared.

-Before visits appointments must be made and if necessary letters prepared.

-Arrangements for transfer of information must be made (copying, arranging originals). This is often a practical constraint.

-Collected or received information must be delivered at the proper place within the Information Centre.

-The different steps within the process of information collection are reported in written and systematically filed.

### 2.1.2 From the internal organization

No formal agreements on data exchange are necessary (under the present condition). Also in general all going on activities are well-known.

Physical transfer of information in this case is assumed.

For transfer there are two options:

1) Information is going through the database (directly stored there and used).

2) Information is first stored at the own section, used and later transferred to the database.

As option 1) guarantees an allways up to date database it is highly preferred.

## 2.2. INFORMATION PROCESSING

### 2.2.1. Data of external current running networks

-Data is received from the data collectors.

-Administration for received information is started and the data is checked on completeness.

-Data is prepared for data entry if necessary by specialists. Again checked on completeness and if possible on quality.

-Data is rejected, returned to the data collectors as incomplete or delivered at the data-entry section.

-Data is processed by the data-entry section

-Data is checked again on correct entry and quality.

-Data is rejected, returned to the data collectors as incomplete or "repaired" by specialists.

-If the data is accepted, final storage follows.

In the above described process of data flow, buffers of data probably need to be created as the time of passing in the different stages will vary.



#### 2.2.2. Data from internal current running networks

As under 2.1.1., except that the data-colectors probably are different persons and that, under the present situation, the other processes are deligated to the persons of the responsible sections.

#### 2.2.3. Historical data

Meant is data in files that was never processed until now. Necessity for processing must be defined. The steps for data entry are as mentioned under 2.1.1. Incomplete data can not allways be handed to the data collectors.

#### 2.2.4. Basic data included in evaluated information

Evaluated information is received in the form of reports, books, journals and geographical information (as mapsheets, aerial photographs or satelite images). Anyway this is included in the library (chapter 2.3.). If basic data can be deducted, it should be treated as such and be prepared for data entry.

### 2.3. LIBRARY KEEPING

Under a library information is stored that comes in evaluated form, such as reports, books, journals and geographic information.

Library keeping is a way of administrative storage.

The process to follow for all four is:

-Receive the volumes (originals or already copied).

-Number and label it.

-Classify as a preparation on entry.

-Fulfil administrative entry.

-Maintain certain presentation of available information if it

can not directly be retrieved from the administrative storage (e.g. geographical presentation of coverage of reports).

Besides keeping a library of evaluated information from volumes that physically are received, an administration can be kept of libraries with other organizations.

## 2.4. SYSTEM AND SOFTWARE DESIGN

This chapter gives the processes to pass through for the design of database systems in general and to be used at GDWRS Information Centre. An evaluation of the present used systems will be given in chapter 3.

### 2.4.1. For data

A system must be designed for finite storage of basic data. It can be a computerized or non-computerized system.

Tasks comprised for design are:

-Design on how to store i.e. computerized or not, or a combination of both.

To decide on this, one should divide in physical storage and administrative storage. Each of it can be computerized or not.

This gives four combinations i.e.:

- 1) Computerized administration of computerized storage.
- 2) Computerized administration of non-computerized storage.
- 3) Non-computerized administration of computerized storage.
- 4) Non-computerized administration of non-computerized storage.

Besides this the administration system can be partly computerized as well as the storage system.

It is highly recommended to have for one type of data only one of the four options (e.g. for lithology data one storage system and one administration system).

Types of data can be logically grouped (well information, meteo-data etc.). For each group, storage doesn't need to be all computerized, however it is favorable to have one type of administrative system in this case.

Using the operating system of the computer as an administrative system, is regarded as inadequate for a database administration system. (see my chapter on

criteria for a suitable administrative system).

- Design a system for physical storage.

- Define the format to store the data.

In case of a computerized system:

- Hardware must be chosen.

- Decisions taken on software to design or purchase.

- When to design it must be developed and manuals written.

- When to purchase, one has to orientate on existing software and after purchase get acquainted with it.

- Personell must be trained in the use.

In case of non-computerized storage:

- A proper way of storage must be defined an realized.

- Design an administrative system of stored data.

- Decide on what to include in an administrative system.

- Decide on computerized or not computerized.

In case of a computerized administrative system:

- Hardware probably in accordance with hardware for physical storage.

- Decide on software to purchase or to develop. This will also depend on the system for storage.

- When to design, it must be developed and manuals written.

- When to purchase, one has to orientate on existing software and after purchase get acquainted with it.

- Personell must be trained to use it.

In case of a non-computerized administrative system:

- The system must be designed and implemented.

#### 2.4.2. For evaluated information

For evaluated information a computerized or non computerized administrative system can be set up, while storage of the information as it comes will be non computerized.

For storage of the evaluated information:

- A system must be designed and implemented.

For the administrative system:

- Decide on what to include in the system.

- Decide on computerized or non computerized.

In case of a computerized system:

- Hardware must be chosen. There can be a relation with the hardware for the systems of storage and administration of basic data.

- Decide on software to design or to purchase.

- When to design, it must be developed and manuals written.

- When to purchase, one has to orientate on existing software and get acquainted with it after purchase.

- Personell must be trained to use it.

In case of a non-computerized administrative system:

- The system must be designed and implemented.

#### 2.4.3. For data entry and retrieval

Included in the design of complete database systems, also systems for data entry and retrieval must be incorporated.

For both it must be decided on what to use as a system and in case of development a whole design procedure as described with the systems for storage or administration must be followed. They should be designed as an extension of the systems for storage or administration.

Design criteria for the retrieval part will depend on the desired way of presentation (more about this in chapter 2.7. "Retrieval and presentation of information").

## 2.5. SYSTEM MANAGEMENT

This comprises set up and maintaining all database systems as designed, computerized or non-computerized. Beside this the same is valid for all software for which responsibility is awarded i.e. application software, general services.

Specific tasks for a system manager at a computerized database are:

- Install the software on the device it was designed for and for the specific peripheral devices.

- Be acquainted with the software and provide training if necessary.

- Maintain the software and data files.

- Design and maintain computer set-ups.

- Maintain the back-up system.

- As an option: maintain software for applications or general services on behalf of other sections.

- As an option: maintain database systems provided to other organizations.

Tasks for non-computerized systems:

- Maintain the system as was set-up.

## 2.6. HARDWARE MAINTENANCE

Hardware used in a database can be quite extensive, and comprises not only computer related hardware but also not computer related hardware.

From the practise of GDWRS it turns out that also not real, or not only database related equipment is maintained, as being a place were people are acquainted with modern technologies.

Hardware maintenance in this report is regarded only for the Information Centre related equipment.

General tasks for maintenance are:

-Small routine maintenance (cleaning, changing parts).

-Arrange repairs. There are several options:

1) Own technicians carry out the repair.

2) Lokal repair is arranged.

3) Repair is arranged abroad.

-Order supplies for maintenance or repairs.

Tasks for installations:

-Install new equipment when applicable within the complete set-up of a database.

-(Re)install equipment to specific wishes.

## 2.7 RETRIEVAL AND PRESENTATION OF INFORMATION

The objective of a National Information Centre is to disseminate it's information towards potential clients.

For this, public relations activities must be developed.

The information can be provided towards the clients as standard prepared summaries, or being retrieved on requests by certain specifications of the clients.

### 2.7.1. Public relations

Public relation means being the contact between (potential) clients and the available information.

The contact can start in two different ways:

1) From the Information Centre to the client. In this case all potential clients must be defined and contacted.

2) The client himself found the way to the Information Centre.

In both cases the clients must be attended. This means:

-An introduction to facilities and available information is given.

-Request made by the visitors are heard.

-The request from the visitor is taken into consideration regarding technical feasibility and timeplanning.

-Requests are put at the database.

For dissemination of information there are two options:

1) Available information is provided to the users in predefined formats (chapter 2.7.3. will deal with this)

2) A request is made by the users for special retrieval (see chapter 2.7.4.).

-Finally the information is handed over to the client.

#### 2.7.2. On request retrieved

-Requests are received.

-Depending on request:

Information can be retrieved directly.

Information must be prepared by existing means.

Information must be retrieved by means to modify or to develop.

-Information is handed over.

#### 2.7.3. Predefined formats

If it is defined to compile information in a standard predefined way, it is to consider what way's are convenient for the users.

Possible ways in an order of increasing detail are:

-Compile general information material like newsletters or leaflets.

-Compile reports of available information.

1) For basic data

-In summaries.

All basic data in water resources is bounded to locations. When information is time independent tables can be created with location of the information and some main characteristics.

When the information is time dependent (time series) the

same can be done including the time span of information available.

-In geographic presentation.

Mapsheets of certain areas with location of available information are created. The advantage is that a quick overview of available information related to location is provided, but in general not with respect to too many details of the information.

2) For evaluated information.

-In summaries.

Evaluated information like reports, books and geographical information, is in general not bounded to one location but covering area's.

Presentation of availability of this information must be done in some kind of descriptive summaries.

Accessibility of this information is improved by including standard ways of subject description.

-In geographic presentation.

It will indicate areas on a mapsheet. Reference must be made to the summaries.

-Compile databooks.

This is only applicable to basic data. One should consider if this is realistic for various types of data as it is not always necessary to go to much in detail. For example one could provide monthly data instead of daily (aggregation). To provide all data "as it is" is also quit voluminous.

Presentation of (aggregated) information can be in tables or by means of graphics.

Geographic presentation is also here an option (contouring), directly a tool for quality control.

## 2.8. DATABASE MANAGEMENT

Tasks comprise:

-Maintain all processes and realize as foreseen.

-Control if all tasks as defined are fulfilled.

-Steer if necessary, set plans for future.

-Assist / train in all tasks.



## 2.9 GENERAL SERVICES

Services that should be seen as not typical database work, but were up till now (sometimes only partly) fulfilled in GDWRS Information Centre are:

- Secretarial work.
- Computerized drawing (CAD).
- Stationary supplies for the department.
- Maintenance of general equipment (copying machines, binding facilities)
- Computer system maintenance for general services.
- Computer hardware maintenance for general services.

## 2.10. APPLICATION SERVICES

Meant are services done in cooperation with the technical sections of GDWRS, such as:

- Running special application software, install and maintain the software.
- Process data with priority, not allways in accordance with the database standards.
- Special retrievals, not foreseen in the present software.
- Computer system maintenance for applications.
- Computer hardware maintenance for applications.

EVALUATION OF PRESENT DATABASE SYSTEMS

On behalf of planning, this chapter is meant to give an overview of the present systems for storage and administration of water resources data at GDWRS Information Centre.

For basic data it is splid out by data types and logical groupes of data types.

This comprises:

Well information

- Construction details
- Well logs
- Pumping tests
- Lithological descriptions
- Groundwater levels
- Waterquality data

Climatological information

- Meteo data (Humidity,  
Temperature,  
Sunshine,  
Radiation,  
Windspeed & direction)
- Rainfall

Hydrological information

- Wadi discharge measurements
- Wadi stages
- Wadi rating curves
- Wadi discharges
- Lake levels

Geophysical measurements

- Vertical electric soundings (VES)
- Electromagnetic soundings (EM)
- Seismic
- Gravity

Systems for evaluated information exist for:

- Reports
- Journals
- Books
- Reports at other libraries
- Geographic information (mapsheets,  
aerial photographs,  
satelite images).

The tables in the next subchapters will give the present situation of the computerized systems for each type of data

and evaluated information, that means whether they are available at the Info Centre or need further development.

Signs used have the following meaning:

- + present and regarded suitable
- | present but needs modification to become suitable
- not suitable, rejected.
- <> not present

The following criteria were assumed for a computerized system when being suitable:  
(follow later)

### 3.1. WELL INFORMATION

The table below gives an overview of computerized systems at the Information Centre for well information.

	Data Storage System	Presentation Stored Data	Administr. Storage System	Presentation Administr. Information
Construction details	CL 	CL 	WRIS +	WRIS 
Well logs	ACAD +	ACAD +	WRIS +	WRIS 
Pumping tests	WHIP +	WHIP +	WRIS +	WRIS 
Lithological description	CL 	CL 	WRIS +	WRIS 
Groundwater-levels	(M) STO, WRIS + +	(M) STO, WRIS + +	WRIS +	WRIS 
Water quality	WRIS, CL + +	WRIS, CL   +	WRIS +	WRIS 

Groundwater level data is stored in three different systems, depending on the time interval:

STO : for daily levels only

MSTO : for monthly levels only

WRIS : regular and irregular intervals (by date)

For presentation of groundwater levels WRIS uses MSTO plotting facilities.

The non-computerized system contains computerized and non-computerized data.

This non computerized system exists of a drawer filed system, with one file for each well cotaining all types of data from this well. Drawers are subdivided by areas, or projects. Besides this, information is kept in reports.

### 3.2 CLIMATOLOGICAL INFORMATION

The table below gives an overview of computerized systems at the Information Centre for climatological information.

	Data Storage System	Presentation Stored Data	Administr. Storage System	Presentation Administr. Information
Daily Meteo	STO +	STO +	STO -	INFOSTO 
Daily Rainfall	STO +	STO +	STO -	INFOSTO 
Monthly Meteo	MSTO +	MSTO +	<>	<>
Monthly Rainfall	MSTO +	MSTO +	<>	<>

The non-computerized system contains computerized and non computerized data. The non-computerized system exists of files in drawers, for each station per type of data one file. Drawers are divided by meteo or by rainfall data, and by computerized or non-computerized data. Order in the drawers is on mapsheet numbers (Y.A.R. scale 1:50.000). Besides this basic data is kept in reports.

### 3.3 HYDROLOGICAL INFORMATION

The table below gives an overview of computerized systems at the Information Centre for hydrological information.

	Data Storage System	Presentation Stored Data	Administr. Storage System	Presentation Administr. Information
Discharge Measurements	SMART, HYMOS +	SMART, HYMOS + +	HYMOS 	HYMOS -
Stages	STO, HYMOS + +	STO, HYMOS + +	STO, HYMOS -	STO, HYMOS - -
Rating Curves	HYMOS +	HYMOS +	HYMOS 	HYMOS -

Discharge Timeseries	HYMOS +	HYMOS +	HYMOS 	HYMOS -
Lake Levels	STO, HYMOS + +	STO, HYMOS + +	STO, HYMOS -	STO, HYMOS - -

The non-computerized system contains computerized and non-computerized data. The non-computerized system exists of volumes for each hydrological station with all types of data.

### 3.4 GEOPHYSICAL MEASUREMENTS

The table below gives an overview of computerized systems at the Information Centre for geophysical measurements.

	Data Storage System	Presentation Stored Data	Administr. Storage System	Presentation Administr. Information
VES	VES +	VES +	DBASE 	<>
EM	EMPRO/SIP +	EMPRO/SIP +	<>	<>
Seismic	<>	<>	<>	<>
Gravity	<>	<>	<>	<>

Part of the electrical soundings were processed in the passed on non DOS compatible computers. Only for local electrical soundings a Dbase file is maintained.

The non-computerized system for VES data is drawer filed. Local electrical soundings are stored as one file for one location, ordered by mapsheet number in the drawers. Soundings for projects are banded by mapsheet number and as such drawer filed.

EM, seismic and gravity data are few and stored on adhoc basis. Besides data in files, data exist in reports.

### 3.5 EVALUATED INFORMATION

Evaluated information in general comes in volumes and the information itself is not processed except for the basic data in the volumes.

Database systems for basic data in the field of water resources at GDWRS Information Centre were discussed in the chapters 3.1 up to 3.4.

The volumes are stored in cabinets.

Information about the volumes is stored in administrative systems.

The table below gives an evaluation of the existing computerized administrative systems at the Info Centre.

	Storage	Presentation
Reports		
Journals		
Books		
Foreign libraries		
Geographic information		

Signs used have the following meaning:

| present, not 100% satisfactory

The following criteria were regarded indispensable for a computerized system in order to satisfy:

-For storage descriptors of authors, publisher, titles, area, dates, subjects and location of storage can be specified.

-Satisfying facilities for data entry.

-Satisfying facilities for selective consulting.

-For presentation of the information, that print-outs of a selection of information can be generated, that print-outs can be generated to be used in reports of availability of information and that geographical presentation of the information can be generated.

## 4. PLANNING

### 4.1. TIME PLANNING

For each of the tasks mentioned in chapter 2 a workload can be specified, making here and there assumption that tasks will be or will be not carried out.

Some activities are continuous and can be specified in man years per year (my/y).

Others are one time jobs (e.g. backlog of processing) and are estimated in man years (my).

#### 4.1.1. Information collection

Collection of information and public relation, estimated 0.75 my/y.

#### 4.1.2. Information processing

For each type of data the amount to process and the time needed is specified in tables. Included is basic data stored in files as well as in reports. The tables only give the situation for the backlog of information.

The meaning of the symbols used is:

<> no data available.

\* data available but assumed that it will not be processed.

l) software still to develop.

m) manual data entry.

a) automatic data entry.

## WELL INFORMATION

Table 4.1

Type of Data	Number of Locations	Data Storage System	Administr. Storage System	Time Data Storage [my]	Time Administr. Storage [my]
Construction		*	WRIS	*	
Well logs	200 total	*	WRIS	*	
Pump tests	200 600	*	WRIS	*	1 m)
Lithology	300 different	*	WRIS	*	
Groundwaterlv.	300	(M) STO, WRIS	WRIS	4/12 m)	
Waterquality	200	WRIS	WRIS	4/12 m)	

Conversion of the information of approximately 13000 wells stored in the well inventory program WI to WRIS will take 1/12 my.

Processing of well information when it is assumed that from 100 new wells per year data is received will take 2/12 my/y. Groundwater level data received through the year from monitored wells will be mainly processed by the geohydrological section of GDWRS.

## CLIMATOLOGICAL INFORMATION

Table 4.2

Type of Data	Number of Stations x Average Years	Data Storage System	Administr. Storage System	Time Data Storage [my]	Time Administr. Storage [my]
Daily meteo	25 x 5	STO	WRIS 1)	5/12 m)	
Daily rain	200 x 7	STO	WRIS 1)	9/12 m)	2/12 a)
Monthly meteo	30 x 7	MSTO	WRIS 1)	2/12 m)	
Monthly rain	30 x 7	MSTO	WRIS 1)	2/12 m)	

In the time for administrative storage also (administrative) processing of already stored data is included.

Data regular received from the own network will be processed by the hydrological section.

Data received every year from third parties, when assuming this will be from 30 meteo- and 100 rainfall stations will take 3/12 my/y.



### HYDROLOGICAL INFORMATION

Only 3 stations from the own organization are maintained. It is estimated that from approximately 20 other stations of third parties data is available. Some of the data from stations of third parties is present at GDWRS Information Centre, but in general the data is quite incomplete. Except for wadi stages and flood hydrographs from the own stations, no effort was made for computerized storage. It is assumed that in 6/12 my the not computerized information can be processed using HYMOS software. For yearly received data 1/12 my/y processing time is assumed. As the number of wadi stations is limited, no sophisticated administrative software needs to be developed and maintained.

### GEOPHYSICAL INFORMATION

Table 4.3

Type of Data	Number of Measurements	Data Storage System	Administr. Storage System	Time Data Storage [my]	Time Administr. Storage [my]
VES	400	VES	WRIS 1)	*	5/12 a) m)
EM	30	EMSIP/PRO	WRIS 1)	-	1/24 m)
Seismic	few	*	WRIS 1)	-	1/24 m)
Gravity	few	*	WRIS 1)	-	1/24 m)

In the time for administrative storage also the processing of already stored information is included. This mainly concerns Vertical Electrical Soundings (VES's). The approximate total number of VES's is 1000 of which 400 were never processed in the format of the GDWRS VES software. It is proposed only to put effort in having all 1000 administratively stored.

On a regular base mainly VES measurements are received (from the own department and third parties). The other type of measurements are rare. The number of VES's per year received are approximately 50 and only from the own department are processed in the GDWRS VES software. This is done by the geophysical department. Electrical soundings from third parties are drawer filed and only administrative stored. Total time for administrative storage of regular received geophysical measurements is estimated to be 1/24 my/y.

It should be realized that for all types of information

before processing can start a specialist must prepare the data for data entry and do a rough quality control. It is assumed that as an average 20% of the processing time must be added for preparation of data entry.

#### 4.1.3. Library keeping

-Reports: No backlog in present state.

When it is defined desirable to develop the system so that subject descriptors can be added in the computerized system, it is estimated that extra processing will take 3/12 my (400 volumes).

Geographic presentation of the area's the volumes deal with is another option. This will be mentioned later under system and software design.

- Geographic information: No backlog in present state.

Geographic presentation of the volumes (mapsheets) also here is an option, but is mainly to regard as a system/software to develop.

- Journals: No backlog in present state.

- Books: No backlog in present state.

- Reports at other libraries: However it is regarded desirable no realistic workload can be estimated.

Using present experience, for library keeping of regular received information, 3/12 my/y will suffice. This is including maintaining the geographic presentation of reports and geographic information.

#### 4.1.4. System and software design

Chapter 3 gives the present situation of the storage systems. Systems and software to design depend on the wish of such a system or software.

Assumptions are already made in fact in chapter 4.1.3. "Information processing" by assuming systems or software to be present for data entry.

Systems and software to design and it's workload will be dealt with below per type of information.

#### WELL INFORMATION

Only WRIS will be developed further for presentation of administrative well data. That means at present development

of printer options to be used for the compilation of reports of available information and geographic presentation of the available information.

Estimated time to develop 6/12 my.

No further data storage systems will be developed.

#### CLIMATOLOGICAL INFORMATION

A satisfactory system for administrative storage and presentation still has to be completely developed (daily as well as monthly data).

It will be less complicated to develop as the WRIS for well information.

Estimated time for development 6/12 my.

No further data storage systems will be developed.

#### HYDROLOGICAL INFORMATION

As the number of locations with this information is limited (approx. 25) it is proposed not to develop a computerized administration system.

For data storage HYMOS software can be used.

#### GEOPHYSICAL INFORMATION

The situation is the same as with climatological information. A satisfactory system for administrative storage still has to be developed, but is less complicated than the WRIS for well information.

Estimated time 6/12 my for developing.

No further data storage systems to develop.

#### LIBRARY SYSTEMS

To consider is developing the reports software so that it contains descriptors of subjects for each report, including retrieval facilities on subjects.

Probably library software with this options is for sale.

When it is purchased, development can be omitted, but then the present database must be converted to the new one

Any way for one of the to options 2/12 my is estimated.

In 4.1.3. it was already mentioned to have options for geographic presentation of reports and geographic information developed.

The idea is to present the area's covered by certain volumes on the map of Y.A.R.

At this moment this option can be automated in a higher extend for geographic information than for reports.

This is due to the fact that for geographic information the present administrative system has coordinates of the square area included.

For each of the systems it is estimated that development of the option will take 3/12 my.

For all software and systems to develop, it is assumed that an extra 20% of time is needed for system design and documentation.

4.1.5. Hardware and system maintenance

From present practise it turns out that 6/12 my/y must be accounted for.

4.1.6. Database management

Estimated 5/12 my/y.

4.1.7. Retrieval and presentation of information

Tasks described were discussed in chapter 2.7.

The workload will depend on the number of vistors in the future.

For compilation of information in predefined formats still various options are left open.

However in the light of the importance of this issue, it is recommended to reserve 1 my/y.

4.1.8. General and application services

This services are regarded as not typical Information Centre activities and for this reason left out of consideration.

4.1.9. 2 Year timeplan

For planning of resources a timespan for reaching the goals that are set must be defined.

Taking into account a total duration of WRAY-4 of 3 years and a gradual withdrawal at the end a two year timeplan will be regarded.

The total manyears (my) necessary to fulfill the tasks defined in a period of two years are summarized in table 4.4. The total workload turns out to be 15.34 my over two years.

Table 4.4

WORKLOAD FOR A TIMEPLAN OF 2 YEARS

	[my]	[y x my/y]	[my]
Information collection and PR		2 x 9/12	1.50
Processing:			
well information	21/12	+ 2 x 2/12 = 25/12	
meteo information	20/12	+ 2 x 3/12 = 26/12	
hydrol.information	6/12	+ 2 x 1/12 = 8/12	
geoph.information	13/24	+ 2 x 1/24 = 15/24	
Included preparation time (20%)		1.2 x 133/24	6.65
Library keeping	3/12	+ 2 x 3/12 = 7/12	0.75
System / software development:			
well information	6/12		
meteo information	6/12		
geoph.information	6/12		
library system	8/12		
Design + documentation (20%)	1.2 x 26/12		2.60
Hardware and system maintenance		2 x 6/12	1
Database management		2 x 5/12	0.83
Retrieval and presentation of information		2 x 12/12	2
		TOTAL	=====
			15.34

