Hydrological Information Transfer Using HOMS

ABSTRACT

The Hydrological Operational Multipurpose Sub-programme (HOMS) scheme of the World Meteorological Organization (WMO) consists of an international network for the transfer of packages of proven hydrological know-how, with particular emphasis on helping developing countries. More than one hundred HOMS centres worldwide produce and supply information components and handle requests for components for use in their own countries. Details are presented of the organization and operation of HOMS.

UK HOMS REPRESENTATIVE:

Dr Howard R Oliver
Institute of Hydrology
Wallingford
Oxford OX10 8BB

Office Tel 01491 692393
Operator 01491 838800
Fax 01491 692424
Telex 849365 HYDROL G
Email h.oliver@ioh.ac.uk

I INTRODUCTION

This report contains a general description of the HOMS scheme together with a full listing of all available HOMS components and the HOMS National Reference Centres. It has been extracted from the HOMS manual, full copies of which are held at all HOMS Offices.

Further details of specific components, sequences etc referred to in these extracts can be provided on request.

The HOMS scheme is always very pleased to receive suggestions for possible new components and offers should please be made direct to the main UK HOMS National Reference Centre in Wallingford.

The operation of the UK National Reference Centre is funded by the Overseas Development Administration.

II Organization of HOMS

II.1 TECHNICAL STRUCTURE OF HOMS

II.1.1 Terminology and definitions

To enable a wide variety of hydrological technology to be made available for use in differing circumstances, HOMS has adopted a modular structure. The basic modules of this structure, HOMS components are the items of hydrological technology provided to HOMS by Members of WMO for transfer to other interested Members. Each component is a self-contained entity, which cannot be further subdivided without destroying its functions or usefulness, and should in general be able to work on its own to perform some specific hydrological task. Components are classified into sections dealing with the basic activities carried out by a hydrological service, viz: network design, instrumentation, data collection and transmission, data processing and storage, hydrological modelling, etc. Sections are further divided into subsections to provide a more detailed division of the subject matter of HOMS. See Part III below for a fuller description of the types of components available and of the classification system.

HOMS components are also available at different levels of complexity, ranging from simple manual techniques to those involving sophisticated computer software. In many instances, two or more alternative components are available to meet a particular need. These may be at different levels of complexity, or simply reflect different approaches to the same basic problem.

Components may be grouped into HOMS sequences: logical aggregations of HOMS components, which may be applied to meet some requirement for hydrological information. The concept of sequences is described more fully in Part IV below.

Finally, HOMS user requirements give advice to users of HOMS as to how they might fulfil their requirements for hydrological information. These include information on the components and sequences which might be applied for some major hydrological problem such as design of a reservoir spillway, or flood plain zoning, and comparative analyses of the intended fields of application of different components with similar purposes. See Part IV for a fuller description.

II.1.2 Standards and criteria

HOMS components are required to meet the standards and recommendations laid down in such WMO regulatory and guidance material as the WMO Technical Regulations, Vol. III - Hydrology, and the Guide to Hydrological Practices. In addition it is recommended that components meet other relevant standards of such bodies as the International Organization for Standardization (ISO).

II.2 ADMINISTRATION

II.2.1 General

HOMS provides an international framework for the co-ordination and promotion of technology transfer in operational hydrology between the Members of WMO. It was established as a subprogramme of the pre-existing operational Operational Hydrology Programme (OHP) of WMO by the WMO Eight Congress (1979) by its Resolution 30 (Cg-VIII). Resolution 25 (Cg-IX) lays down a plan for the second phase of HOMS (1984 to 1991). Resolution 30 (Cg-VIII) established HOMS as a co-operative effort of Members, with co-ordination of national activities through the WMO Commission for Hydrology (CHy).

II.2.2 HOMS National Reference Centres

Members of WMO which wish to participate in HOMS do so by designating a HOMS National Reference Centre. This centre, which is usually established in the national Hydrological Service, has responsibility for co-ordination of HOMS activities within the country and liaison with centres in other countries. The activities that need to be undertaken at the national level by HOMS National Reference Centres include:

- Establishment of an inventory of components which are currently available and operationally used in the country and which are considered appropriate to be proposed for inclusion in the HOMS project.

- Collection of these components, their adaptation as necessary, and transmission of their description to WMO for inclusion in the HOMS Reference Manual.

- At the request of other countries or of WMO, transmission of these components, either bilaterally or through WMO, for use and application in other countries.

- Receipt and storage of components requested and received from other countries, either directly or through WMO.

- Calling the attention of potential users in the country to the availability of HOMS components.

- Assistance in the use and application of the HOMS components, as appropriate.

The details of the organization of the National Reference Centre are of course entirely a matter for national decision, taking into account existing national practices and structures. Formally, the centre is designated by the Permanent Representative of the country with WMO who should communicate to the Secretary-General the name of the institution or service where the centre is established and the officer responsible for the centre. Annex A of this Reference Manual lists existing HNRCs.

A number of international water resources bodies have established arrangements for assisting their member countries in HOMS activities. These regional focal points are also listed in Annex A.

II.2.3 International co-ordination

As a project within the Operational Hydrology Programme, technical guidance and review of HOMS is the responsibility of the Commission for Hydrology. The Advisory Working Group of the Commission acts as Steering Committee for HOMS and rapporteurs and working groups of the Commission advise on the technical development of HOMS in the areas related to their terms of reference.

The following co-ordinating functions need to be carried out at the international level, by the Steering Committee:

- Ascertaining the needs of Members in the overall orientation of the project.
- Elaborating and distributing to Members general and specific guidance on the substance and form of HOMS components to be prepared at the national level.
- Preparing, maintaining and updating the HOMS Reference Manual and periodically distributing it to Members.
- Assisting in the technology transfer among Members, within the framework of the project.

Secretariat support is provided by the HOMS Office in the Hydrology and Water Resources Department of the WMO Secretariat. This office is responsible for:

- Keeping the HOMS Reference Manual up to date by the timely issue of supplements;
- Assisting with administrative formalities in the transfer of components, if necessary and requested;
- Arranging for assistance in the adaptation of components for use in developing countries;
- Advising on the availability of support from UNDP and VCP projects and, where appropriate, arranging for this support;
- Monitoring the operation of HOMS, including collection of statistics on transfers, assisting transfers, keeping track of unfulfilled requests, and identifying gaps in the components and sequences available;
- Requesting new components and sequences from appropriate HNRCs to cover gaps identified by the monitoring exercise, or by CHy working groups and rapporteurs;
- Publishing the HOMS Newsletter.

The Secretary-General, in co-operation with the president of CHy submits reports to the WMO Executive Council, the Commission for Hydrology and the WMO Congress on the status of HOMS together with proposals for its further development.

II.3 HOMS OPERATIONS

II.3.1 Availability and use of HOMS components

HOMS components are available to all Members of WMO, to their national services and agencies and to all international agencies for use in water resources projects requiring operational hydrology. Persons wishing to make use of the technology available through HOMS should first consult the HOMS National Reference Centre (HNRC) for their country (see Annex A). International agencies and potential users in countries without a HNRC should contact the HOMS Office in the WMO Secretariat by writing to:

The Secretary-General
World Meteorological Organization
Case postale No. 5
CH-1211 GENEVA 20
Switzerland.

The HNRCs all hold a copy of the HOMS Reference Manual and are able to advise users on the selection of components appropriate to their needs. Once a selection has been made the HNRC can obtain the required components. In the case of a commercial user, such as a firm of consulting engineers, the user may be requested to sign a simple declaration that he will not charge his clients for the component apart, of course, from such costs as salaries, materials, etc. that he incurs in obtaining and using the component on the client's behalf.

Components are normally to be obtained from the HNRC where they originated, but there are exceptions to this rule and certain components can be obtained from the HOMS Office in the WMO Secretariat (typically those developed by WMO field projects) or from some other source. Paragraph 9. Availability, of the summary description of the component, indicates where the component can be obtained. In any case, to assist monitoring of HOMS, HNRCs are asked to keep the HOMS Office informed of the components they request and, in turn, of the requests they receive.

II.3.2 Technical co-operation and training

The existence of HOMS, and the consequent availability of HOMS components, does not eliminate the need for assistance to developing countries through technical co-operation. Indeed, the need often arises for assistance or training in the use of specific HOMS components. A number of avenues exist for the provision of this assistance: UNDP has established a number of regional projects in support of HOMS; UNDP national projects in water resources can often fund assistance; as can the WMO Voluntary Co-operation Programme (VCP). In addition, a number of countries offering components are able to arrange training through bilateral aid agencies. As the situation necessarily changes from time to time, the HOMS Office in the WMO Secretariat and/or the supplier of the component should be consulted as to the availability of assistance.

It may also be noted that components can themselves be used in the training of hydrological staff. This applies not only to section Y, Training aids in operational hydrology, but to a wide range of other components as well. To assist in the use of HOMS as a source of training material the CHy rapporteur on training has developed a cross-reference between the topics in the WMO curricula for the training of personnel in operational hydrology and the subsections of HOMS. This is reproduced in Annex G to this manual.

II.3.3 Monitoring the operation of HOMS

One of the duties of the HOMS Office in the WMO Secretariat is to monitor the operation of the subprogramme, and to report on the development of HOMS to relevant WMO bodies including Congress, the Executive Council, and the Commission for Hydrology. This monitoring has two aspects: the collection of statistics on the transfer of components, and reports on the experience of using components.

For the collection of statistics, HNRCs are asked to inform the HOMS Office of the components that they request from other HNRCs, and of the components that they transfer. Perhaps the simplest method of doing this is for each HNRC to copy any correspondence with other HNRCs, concerning the transfer of HOMS components to the HOMS Office in the WMO Secretariat. Alternatively a separate report could be made. The basic information required is the number of the component, the date it was requested, and date of transfer. The HOMS Office maintains a computerized data base of transfers which can be consulted by HNRCs. Each HNRC is sent annually a copy of the information held about its transfers to ensure the accuracy and completeness of this data base.

Users of components are asked to report to the supplier on the use they make of a component and on their general experience with the component. These reports provide valuable feedback on components leading to their improvement. The HNRC supplying a component should include a report form with the component when it is transferred. The HOMS Office in the WMO Secretariat can provide a sample pro forma for these reports, but HNRCs can develop their own, if they so wish.

II.3.4 New components, sequences and user requirements

As HOMS is intended to be dynamic and evolving to meet the needs of users new components and sequences are continually required to fill gaps in the existing coverage of the field of operational hydrology, and to meet the needs of new developments. The various working groups and rapporteurs of the WMO Commission for Hydrology have as part of their terms of reference responsibility for advising on the technical content of HOMS and, in particular recommending where new components are needed. Potential users of HOMS are particularly requested to report when their needs are not adequately met by existing components.

Before inclusion in HOMS, new components are approved by the Steering Committee for HOMS, on the advice where appropriate of a relevant CHy rapporteur. This approval ensures that the technology contained in the component is within the field of interest of HOMS and that it is in accordance with WMO Technical Regulations and recommendations. The approval also ensures that the summary description, to be included in the HOMS Reference Manual, accurately describes the component.

An HNRC wishing to submit a new component should prepare a summary description and submit it to the HOMS Office. Guidelines on preparing a summary description are issued to all HNRCs and detail the information and format required. The HNRC submitting a component should advise on its classification (subsection) and level of complexity. Once the component has been approved, the summary description will be edited and published in a supplement to the HRM. It should be noted that components are to be submitted through National Reference Centres, and individuals who wish to submit components should contact their country's HNRC.

A similar procedure is followed in the approval of HOMS sequences and HOMS user requirements. HNRCs are urged when submitting a group of related components, to group them formally as a sequence and to submit the sequence together with the components. In addition, sequences and user requirements grouping existing components may also be submitted.

Part III HOMS components

III.1 TYPES OF HOMS COMPONENTS

HOMS components usually take one of the three following forms:

Instruments and equipment

HOMS components relating to instruments and equipment offer specifications or descriptions of an instrument, or instructions, including working drawings, for making an instrument, rather than the instrument itself. When a number of components relating to the same basic instrument (for example water level recorders, or current meters) are available, the components are combined into a comparative catalogue of the type of instrument concerned. These catalogues are produced with the assistance and advice of the Hydrological Services of the Members of WMO to include the makes of instrument that they themselves use in their normal operations. Each catalogue contains a description of the various instruments concerned written to a standard format, and where available, manufacturer's brochures. Once written, these catalogues replace the individual components dealing with the instruments of the given type in the HOMS Reference Manual.

Computer software

Many components consist of computer programs developed to carry out common hydrological computations. The material transferred will normally be the program itself in machine readable form, that is on cards, diskette, or magnetic tape, together with user manuals describing how to use the program. Paragraph 6, Form of presentation of the summary description will specify such details as the media (tape, diskette, etc.) on which the program can be obtained, and the computer language in which it is written. Emphasis is laid on using standard forms of such common languages as FORTRAN or BASIC in preparing components.

Technical and general guidance manuals

These describe the steps to be carried out in performing some hydrological task, or give general guidance on hydrology or water resources assessment. Examples include a manual describing how to measure the discharge of a stream using a current meter or advice on the design of networks for measuring particular hydrological elements. Some manuals describe how to perform simple hand calculations of, say, storm runoff, which at a higher level of complexity would be done by a computer program.

III.2 BASIS FOR CLASSIFICATION

Each HOMS component is given a unique component number by which it may be referenced. So that these numbers may be of help to users in locating the components they require, part of the component number is a subject classification code for the components. For the purpose of this classification the subject matter of HOMS is divided into 13 sections each designated by a letter. These sections largely follow the major sequence of activities of an operational hydrological service viz:

A	Policy, planning and organization
B	Network design
C	Instruments and equipment
D	Remote sensing
E	Methods of observation
F	Data transmission
G	Data storage, retrieval and dissemination
H	Primary data processing
I	Secondary data processing
J	Hydrological forecasting models
K	Hydrological analysis for the planning and design of engineering structures and water-resource systems
L	Groundwater
X	Mathematical and statistical computations
Y	Training aids in operational hydrology

(Sections M to W, and Z do not exist at present)

Sections are subdivided into subsections each of which is given a two digit numeric code. For example H09 denotes a subsection of section H primary data processing, and happens to contain components dealing with the primary processing of sediment transport data. Annex B part 2 contains the complete classification system, to the level of sections and subsections.

HOMS aims to provide components for users at all levels of development, therefore the components available must range from the simplest to the most complex. This range is reflected in the component number. Each component is assigned a level of complexity denoted by a single digit in the range 1 to 3. Level 1 is the lowest level of complexity and contains the simplest components. Level 3 denotes the most complex components while components with level of complexity 2 are of intermediate complexity. In certain sections this concept of level of complexity was not judged appropriate and no levels of complexity have been assigned to the components in these sections. In these cases the level of complexity is shown as zero in the component number.

The component number is completed by a two digit serial number, used only to distinguish components in the same subsection and level of complexity from each other. The complete component number is written in a form similar to the following coding:

Snn.c.xx

S represents a letter (A to L, X or Y) denoting a section, nn is a two-digit subsection number, c is a one-digit level of complexity (1, 2 or 3), xx is a two-digit serial number.

As an example note that component H09.2.10 is in section H, subsection H09 of medium complexity (level 2) and has serial number 10.

Annex B, part 1 shows a list of all the currently available components in component number order. This order is also the order of sections and subsections of the classification scheme, making it particularly simple to find the component or components intended for a particular purpose.

III.3 SUMMARY DESCRIPTIONS OF COMPONENTS

Annex C contains the summary descriptions of the currently available components. Each description is written to a standard format, and is kept to a maximum length of two pages (both sides of a sheet of paper).

The summary description includes the following ten paragraphs:

1. Purpose and objectives
2. Description
3. Input
4. Output
5. Operational requirements and restrictions
6. Form of presentation
7. Operational experience
8. Originator and technical support
9. Availability
10. Conditions on use.

HNRCs hold a copy of the Guidelines for writing a HOMS component description which gives detailed instructions as to the information to be included in each paragraph. Hydrologists wishing to submit components to HOMS should consult these guidelines.

III.4 COMPATIBILITY

HOMS has adopted a modular structure so as to be able to include a wide variety of components. On the other hand, there is a need for the components to be able to work with each other. This section of the HRM advises individuals or organizations developing potential HOMS components how they can meet this aim and ensure that the components they develop will be compatible with other HOMS components. It also advises prospective users of HOMS components how they can determine whether the components they wish to use will be compatible both with each other and with their existing procedures and equipment.

III.4.1 General principles

Compatibility between components requires, among other conditions, that they meet recognized international standards or recommendations. WMO standards and recommendations are contained in the Technical Regulations (WMO-No. 49) and the Guide to Hydrological Practices (WMO - No. 168). The International Organization for Standardization (ISO) promulgates standards in many fields and WMO collaborates with ISO in fields of common interest to ensure agreement on the standards published by the two organizations. In addition, many Members have adopted their own national standards where international standards either do not exist or must be changed to meet local circumstances. Contributors of components are encouraged to develop and present components in accordance with internationally recognized standards so that they may easily be linked with each other.

In making the sequences in Annexes E and F (see also Part IV below) attention was paid to the problem of compatibility between components and therefore by selecting sequences the user can obviate compatibility problems. In other cases the user can determine whether the components he selects will be compatible with each other from the paragraphs in the summary description dealing with input and output.

Many sequences have been submitted by Members who use them in their own operations and in these cases the components within the sequences will naturally be compatible with each other. Other sequences have been developed using components from different sources and often components may have had to be modified to ensure comptability with each other. In some cases this modification has been carried out by experts seconded from National Reference Centres to WMO to work on HOMS. In other cases users have developed compatible interfaces between components and submitted the resulting sequence.

III.4.2 Compatibility of equipment

Compatibility of instruments or equipment must satisfy two requirements: the need to interconnect instruments and the need to be able to replace an existing instrument with another either to enhance the technological level of a system or to extend its range of applicability. These two requirements may be referred to as the interfacing problem and the replacement problem, respectively.

Interfaces are particularly important with highly complex equipment such as might be used in an automatic or telemetering system where both physical (e.g. voltage levels, impedances, plug types) and logical (e.g. signalling codes, message formats) interfaces must be carefully defined. However, the problem also arises with simpler manual instruments, where such matters as units of measurement, precision, or recording chart format should be considered. Information on these points is contained in the summary description of the component under the paragraphs on input and output.

When it is necessary to replace an instrument component with another, compatibility of function will also be required. That is to say, the new instrument must carry out the same functions as the old one but perhaps at a different level of technology or perhaps with fewer restrictions on its range of application. Information on functional compatibility is given in the paragraph on description in the summary description of the component. The paragraph on operational requirements and restrictions should also be consulted to ensure that the new instrument or equipment can operate in the environment of the existing system.

III.4.3 Compatibility of software

For components consisting of computer programs, two types of compatibility must be considered: mutual compatibility between components and compatibility of the programs with the computer systems on which they will be used.

Generally, computer programs communicate with each other by means of files. A user who wishes to use together programs from two different components must ensure that the files reside on the same medium (disk, magnetic tape, etc.) and contain the information to be transferred in the same format. The paragraphs in the summary description input and output, contain the information required on these points.

In determining whether a program will operate on a particular computer system, several aspects must be considered:

- Programming language:

  Standards are defined for the common computer languages but often manufacturers will offer extensions to the standard and these may not be the same on different computers.

- Size of memory:

  That is to say, the program must be able to fit into the computer.

- Peripherals requirements:

  In addition to the usual magnetic disks or tapes, there may be a need for graph plotters or special displays.

- Speed of processing:

  Processing time is, of course, crucial for time dependent operations such as hydrological forecasting. However, it can also be important for other applications, where a program taking a long time to run may overload the user's computer system.

- The number of bits in the computer word:

  This is mainly important in its effect on the accuracy of computation, but can also cause problems with the storage of characters for titles, error messages, etc.

- Interaction with the operating system:

  Most program-system interactions will be handled by the compiler for the language used, but programs may also include system calls for such purposes as connecting to files. In addition, the methods of handling less common types of peripherals such as communication lines, digitizers or graph plotters, vary greatly from system to system.

Information on the operating system and on special characteristics of programs is given in the summary description under operational requirements and restrictions. The paragraph on operational experience may also indicate the computer systems on which the component has already been used. As components are used on new systems this paragraph is updated.

Part IV. USE OF HOMS COMPONENTS IN HYDROLOGICAL AND WATER-RESOURCE PROJECTS

IV.1 HOMS SEQUENCES AND USER REQUIREMENTS

Though the classification system (see Part III.1) provides direct access to the components dealing with any particular subjects, many users of HOMS will not wish to approach HOMS in this manner. In general users will have some requirement for hydrological information and thus need some indication as to how the components of HOMS can be used to provide the information they require. As defined in paragraph II.1.1. guidance in the selection of components is provided by HOMS sequences and user requirements.

IV.1.1 Sequences

HOMS sequences indicate components which can be used together to satisfy some user requirement for hydrological information. The components in a sequence are all mutually compatible and can thus be used in conjunction with each other. Annex F of the HRM contains the currently available sequences, while Annex E is an index of these sequences in alphabetical order. Each sequence description has two parts: the first part, description, lists each of the components in the sequence, together with brief notes on its role in the sequence, while the second part, comments, describes the purpose of the sequence - the user requirement it meets - and gives notes on the application of the sequence.

When submitting new components for inclusion in HOMS, HNRCs are urged to group them in sequences wherever possible. The inclusion of components in sequences demonstrates that they can be used together and improves the systematization of HOMS.

IV.1.2 User requirements

HOMS User Requirements represent a higher level of systematization. A variety of different types of HOMS User Requirements are included in Annex D of the Reference Manual.

One form of HOMS User Requirement indicates how HOMS can be used to provide information on major areas of activity in hydrology and water resources. Examples include: flood forecasting, reservoir design, or flood plain zoning. These user requirements list the sequences to be applied to provide the hydrological information required in these general areas. It will be seen that user requirements are very general in scope, and need to be amplified by reference to the descriptions of the sequences and components they contain.

Annex D also contains other advice on the selection and use of components, including summary tables, comparing and contrasting similar HOMS components intended for application in some particular field. One example is a tabulation of the hydrological forecasting models currently available in HOMS, showing the element forecast, data requirements, and time resolution. This allows the user to quickly make a choice of model to meet his requirements. This form of advice supplements that given in the WMO Guide to Hydrological Practices or hydrological texts and is specific to the HOMS components currently available. It is kept updated as new components are added or old ones deleted.

IV.2 SELECTION OF COMPONENTS

The HOMS Reference Manual provides three basic methods for the selection of components: Users who know exactly what they require can use the classification system to find directly the subsection of HOMS dealing with their topic, from whence they can select a component appropriate to their needs.

Users who approach HOMS with a broader problem in mind can use sequences. For example, a hydrologist establishing a hydrological data processing system would consult HOMS sequences on primary and secondary data processing to determine the components he requires. The final choice would be made on the basis of the published component descriptions, as in the first method above.

Finally, HOMS User Requirements are available to give general guidance on the use of HOMS in operational hydrology and water resources. From the user requirements the user can turn to related sequences and components to analyze his requirements in more detail.

ANNEX A

LIST OF HOMS NATIONAL REFERENCE CENTRES AND FOCAL POINTS

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Mail for the HOMS Office should be addressed to:

The Secretary General
World Meteorological Organization
P.O. Box 2300
1211 Geneva 2
Switzerland

Tel : +(41 22) 730 8111
Telex : 41 41 99 OMM CH
Cable : METEOMOND GENEVA
Telefax : +(41 22) 734 8250

ALGERIA

Institut national des ressources hydrauliques
Clairbois, Ave. Mohammedi, Bir Mourad Rais
Algiers

Mr. M.A. Demmak
Tel: +(213) 564998, 565152, 565198 or 565415
Telex: 62139 INRH DZ

ARGENTINA

Servicio Meteorológico Nacional
25 de Mayo 658
1002-Capital Federal
Buenos Aires

Sr C.A. Damboriana
Tel: +(54-1) 343-9274 or 312-4481/95
Telefax: +(54-1) 311-3968
Telex: 27040 METEO AR
Cable: METEOBAIRES

AUSTRALIA

Hydrology Program Office
Bureau of Meteorology
GPO Box 1289K
Melbourne VIC 3001

Mr Ross James
Tel: +(61 3) 669 4608
Telefax: +(61 3) 669 4725 or 669 4548
Telex: AA30434

AUSTRIA

Hydrographisches Zentralbüro
Marxergasse 2
A-1030 Wien

The Director
Tel: +(43 1) 71 100 69 42 or 32
Telefax: +(43 1) 71 100 6851
Telex: 111 145 REGGEB

BANGLADESH

Bangladesh Water Development Board
Ispahani Building (4th Floor), 14-15, Motijheel Commercial Area
Dhaka-1000

Mr A. Shamsul Hoque, Chief Engineer, Hydrology
Tel: +(880-2) 230815
Cable: HYDROCHIEF

BARBADOS

Ministry of Agriculture
P.O.Box 505, Graeme Hall
Christ Church

Mr O. Carlyle Bourne
Tel: +(809) 428-3689
Telefax: +(809) 429-4854
Telex: 2222 FOREIGN WB
Cable: AGMIN

BELGIUM

Institut Royal Météorologique
Section d'hydrologie
3, avenue Circulaire
1180 Bruxelles

Dr F. Bultot
Tel: +(32-2) 373 06 11, 373 05 45
Telefax: +(32-2) 375 12 59
Telex: 21315 METEOR B
Cable: METEOR BRUXELLES

BELIZE

Hydrology Section
National Meteorological Service
P.O Box 717
Belize International Airport

Mr A. Sanchez
Tel: +(501-2) 520 11, 520 11
Telefax: +(591-2) 520 01
Telex: 371-211 CW BOOTH BZ or CIVIL AIR 164
Cable: METOF BELIZE

BENIN

Direction de l'Hydraulique
Service de l'Hydrologie
B.P. 385 Cotonou

Tel: +(229) 31-34-87 or 31-32-98

BOLIVIA

Servicio Nacional de Meteorología y Hidrología
Avenida Camacho Esq. Bueno No. 1458, Edificio La Urbana
La Paz

Ing. José Cortéz M.
Tel: +(591-2) 32 61 65, 35 58 24
Telefax: +(591-2) 34 35 66
Cable: SENAHMI

BRAZIL

General Coordinator of Water Resources
Sgan, Quadra 603, Modulo J
1° Andar, Sala 103
70830-030 BRASILIA DF

Dr V. Fuzeira de Sá e Benevides
Tel: +(55-61) 225 57 68
Telefax: +(55-61) 224 41 90

BRITISH CARIBBEAN TERRITORIES

Caribbean Operational Hydrological Institute
Caribbean Meteorological Institute
Husbands, St James
Barbados

Tel: +(1 809) 425 13 62/63/65
Telefax: +(1 809) 424 47 33
Cable: METINST BARBADOS

BULGARIA

Institute of Meteorology and Hydrology
Blvd Trakia No. 66
Sofia 1184

Dr D.I. Dimitrov
Tel: +(359-2) 72 22 71/75
Telefax: +(359-2) 88 03 80
Telex: 22490 RTH SF/BG

BURKINA FASO

Service hydrologique
Direction de l'Inventaire des Ressources Hydrauliques
B.P. 7025
Ouagadougou 03

M. Innocent Ouedraogo
Tel: +(226) 31 28 67 or 30 80 35/36/37
Telefax: +(226) 31 15 50

BURUNDI

IGEBU
B.P. 331
Bujumbura

M. E. Sinarinzi
Tel: +(257) 040 23 18 or 040 22 48 or 231 50
Telex: 3000 GITEGA

CAMEROON

Direction de la Météorologie nationale
Service d'Hydrométéorologie
c/o UNDP
B.P. 2077
Douala

M. T. Onana Fouda

CANADA

Integrated Monitoring Branch,
Atmospheric Environment Service,
Environment Canada
373 Sussex Dr., Academy LaSalle, Room E124
Ottawa, Ontario
K1A OH3

Dr Paul J. Pilon
Tel: +(613) 992 28 74
Telefax: +(613) 992 42 88
Telex: 0533188 ENV PM HULL

CHAD

Service hydrologique
Direction des Ressources en Eau et de la Météorologie
B.P. 429
N'Djamena

M. Dj. J. Alainaye
Tel: +(235) 51 30 43
Telefax: +(235) 51 62 31
Telex: 5298 KD-ASECNA

CHILE

Dirección General de Aguas
Ministerio de Obras Públicas
Morandé 59, 8 Piso
Santiago

Ing. Humberto Peña Torrealba
Tel: +(56-2) 699 22 33 or 696 42 69
Telefax: +(56-2) 672 66 09 or 698 53 41
Telex: 24077 SETOP CL

CHINA

Ministry of Water Resources
Hydrological Forecasting and Water Control Center
Pai Kwang Road
Beijing

Mr Lu Jiu-yuan
Tel: +(86-1)36 53 31
Telefax: +(86-1)32 606 35
Telex: 22466 MWREP CN
Cable: 3048 BEIJING

COLOMBIA

Instituto Colombiano de Hidrología
Meteorología y Adecuación de Tierras
Apartado aereo 20032
Bogotá D.E. 1

Tel: +(57-1) 286 06 58
Telefax: +(57-1) 284 24 02
Telex: 44345 HIMAT CO
Cable: HIMAT BOGOTA

COMOROS

Service météorologique
B.P. 78
Moroni

Tel: +(269) 23 13 or 23 78
Telex: 241 Public KO
Cable: METEO MORONI

COSTA RICA

Departemento de Estudios Básicos
Instituto Costaricense de Electricidad
Apartado 10032
1000 San José

Lic. Sadí Laporte M.
Tel: +(506) 232 73 09 or 220 73 09
Telefax: +(506) 231 47 01 or 231 47 37
Telex: CR 2140 ICE
Cable: ICE

COTE D'IVOIRE

Sous-Direction de l'hydrologie
Direction de l'Eau
01 B.P. V 161
Abidjan

Mme Saramatou Kone
Tel: +(225) 22 15 10
Telex: 2108 MITRAV CI

CROATIA

Meteorological and Hydrological Service
Republic of Croatia
Gric 3
4100 Zagreb

Mr Dusan Trninic, M.Sc.
Tel: +(38-41) 27 56 89 or 27 50 05
Telefax: +(38-41) 27 87 03 or 27 87 03
Telex: 22233 hidro hr

CUBA

Centro Nacional de Servicio Hidrológico
Instituto Nacional de Recursos Hidráulicos
Calle Monserrate No. 213
Havana

Tel: +(537) 62 25 11 or 62 01 91 or 63 95 42
Telefax: +(537) 33 52 20 or 33 82 12/13

CYPRUS

Department of Water Development
Nicosia

Mr Dedalos Kypris
Tel: +(357-2) 40 35 21
Telex: 33 99 MINFIN CY

CZECH REPUBLIC

Czech Hydrometeorological Institute
Na Sabatce 17
143 06 Prague - Komorany

Ing. Josef Hladny, Deputy Director
Tel: +(42-2) 401 97 80 or 409 53 54
Telefax: +(42-2) 401 08 00
Telex: 123335 CHMU C
Cable: HYDROMET PRAHA

DEMOCRATIC PEOPLES' REPUBLIC OF KOREA

Hydrological Research Institute
State Hydrometeorological Administration
Oesang-dong, Central District
Pyongyang

Mr Zo Yong Chol
Telefax: +(850-2) 81 44 17
Telex: 380.18 PUBLIC 1 KP; 380.21 TST K

DENMARK

(see Sweden)

DOMINICAN REPUBLIC

División de Hidrología
Instituto Nacional de Recursos Hidráulicos
Centro de los Héroes, Apartado 1407
Santo Domingo

Ing. José Fco Febrillet
Tel: +(1-809) 533 70 00
Telefax: +(1-809) 532 43 18
Telex: 346 0559
Cable: INDHRI

ECUADOR

Instituto Nacional de Meteorología e Hidrología
Paris 207 y Gaspar de Villaroel
Quito

Ing. Gustavo Gomez A.
Tel: +(593-2) 45 30 35 or 24 82 68
Cable: DIRMETECUADOR QUITO

EGYPT

Nile Control Dept
1 Sofia Zaglool St, P.O. Box E1 DAWAWIN
Cairo

Mr Abdel Badie Abulhoda
Tel: +(20-2) 354 11 18 or 354 42 04

EL SALVADOR

Servicio de Meteorología e Hidrología
Aptdo Postal 2265
Cantón El Matasano
Soyapango

Ing. Rafael López Vides
Tel: +(503)77 06 22 ext. 56
Telefax: +(503)77 04 90
Cable: MINIAGRICULTURA

ESTONIA

Estonian Meteorological and
Hydrological Institute
Toom-Kooli 9
EE0001 Tallinn

Ms Rimma Vedom
Tel: +(372 2) 44 41 90
Telefax: +(372 2) 44 16 10 or 44 94 84

ETHIOPIA

Hydrological Service
Water Resources Development Authority
P.O.Box 5673
Addis Ababa

Tel: +(251-1) 18 29 42 or 18 31 97

FIJI

Hydrology Section (PWD)
Suva Water Supply Office
Box 3740
Samabula, Suva

Tel: +(679) 32 10 99
Telefax: +(679) 32 03 13

FINLAND

(see Sweden)

FRANCE

Ministère de l'Environnement
Direction de l'Eau
20, Avenue de Ségur
75302 Paris 07 SP

Monsieur le Directeur de l'Eau
Attention M. Michel ODIER
Tel: +(33 1) 42 19 13 11
Telefax: +(33 1) 42 19 13 33
Telex: 620602 DENVIR F

GAMBIA

Department of Water Resources
7 Marina Parade
Banjul

Mr M.M. Saho
Tel: +(220) 22 82 14 or 22 82 16
Telefax: +(220) 22 50 09
Telex: GV 2204 SG

GERMANY

IHP/OHP Secretariat - HOMS NRC
c/o Federal Institute of Hydrology (Bundesanstalt für Gewässerkunde)
Post Box 309
D-56003 Koblenz

Prof. K. Hofius
Tel: +(49 261) 130 63 13
Telefax: +(49 261) 130 64 22
Telex: 8-62 499

GHANA

Water Resources Research Institute
P.O.Box M.32
Accra

Dr Yaw. Opoku-Ankomah
Tel: +(233 21) 77 53 51/2
Telefax: +(233 21) 77 71 70
Cable: WATERSEARCH ACCRA

GREECE

Hellenic National Meteorological Service
P.O. Box 73502, GR 166 03 Hellinikon
Athens

Mr A. Niarnos
Tel: +(30 1) 962 94 15 or 962 54 79
Telefax: +(30 1) 962 89 52 or 964 96 46
Telex: 215255
Cable: METEOR ATHENS

GUATEMALA

INSIVUMEH
7a Ave 14-57, Zona 13
Guatemala

Ing. Sergio Hernández
Tel: +(502-2) 324 722 or 314 741 or 319 183
Telefax: +(502-2) 315 005
Cable: INSIVUMEH or GUATEOBS

GUYANA

Hydrometeorological Service
Ministry of Agriculture
18 Brickdam
P.O. Box 1088
Georgetown

Mrs Joylyn Jefferally
Tel: +(592-2) 614 60 or 724 63
Telefax: +(592-2) 614 60
MINFLAM

HONDURAS

Dirección de Recursos Hídricos
Servicio Hidrológico y Climatológico
Apartado Postal 1389
Tegucigalpa

Ing. Roberto Dimas Alonzo Mercado
Tel: +(504) 33 63 68 or 32 13 86 or 33 63 61 or 32 26 250
Telefax: +(504) 32 18 28

HONG KONG

Royal Observatory
134a Nathan Rd
Kowloon

Mr P. Sham, Director
Tel: +(852) 92 26 82 00
Telefax: +(852) 721 50 34
Telex: 54777 GEOPH HX
Cable: OBSERVAHKG

HUNGARY

Research Centre for Water Resources Development
(VITUKI)
H-1453 Budapest, Pf.27

Mr G. Balint
Tel: +(36 1) 215 50 01
Telefax: +(36 1) 216 15 14
Telex: 224959 H
Cable: VIZRAJZ BUDAPEST

ICELAND

(see Sweden)

INDIA

Hydrological (South) Directorate
Central Water Commission
Sewa Bhavan, Room 513 (S), R.K. Puram
New Delhi 110066

Mr P.D.H.S. Rao, Director
Tel: +(91-11) 60 68 82 or 608 88 55
Telex: 3166323 CWC IN
Cable: HYDROLOGY-I CWC NEW DELHI

INDONESIA

Institute of Hydraulic Engineering
Jln Ir. H. Juanda 193
Bandung

Tel: +(62-22) 845 53, 845 54 or 816 07
Telex: 28283 DPMA-BD
Cable: LPMA BDG

IRAN, ISLAMIC REPUBLIC OF

Ministry of Energy
Water Resources Research Organization
c/o Islamic Republic of Iran Meteorological Organisation
P.O. Box 13185-461
Tehran, Mehrabad

Dr N. Rostam Afshar
Tel: +(98-21) 89 35 66
Telex: NIRO 273672
Cable: Ministry of Energy

IRAQ

Scientific Research Council
National Committee for Hydrology
Al-Jadiria
Baghdad

IRELAND

Dept of Engineering Hydrology
University College
Galway

Prof. C. Cunnane
Tel: +(353-91) 244 11
Telefax: +(353-91) 249 13
Telex: 50023 UCG EI

ISRAEL

Hydrological Service
P.O. Box 6381
Jerusalem 91060

Tel: +(972-2) 52 62 01
Telefax: +(972-2) 52 07 04

ITALY

Institute for Hydrogeological Protection Research in Central Italy
National Research Council (IRPI/CNR)
Località Madonna Alta
06100 Perugia

Tel: +(39-75) 75 49 43/4

JAMAICA

Meteorological Service
6 Hagley Park Plaza
Kingston 7

Tel: +(1-809) 926 11 69

JAPAN

River Planning Division, River Bureau
Ministry of Construction
2-1-3 Kasumigaseki, Chiyoda-ku
Tokyo

Mr Satoshi Iyama
Tel: +(81 3) 3580 4311
Telefax: +(81 3) 5251 1942

KENYA

Water Development Department
Ministry of Water Development
P.O. Box 30521
Nairobi

Tel: +(254-2) 71 61 03-12
Cable: WATER NAIROBI

LATVIA

Hydrological Department
Hydrometeorological Agency
19, K. Valdemar St
LV-1010 Riga

Ms Inita Stikute
Tel: +(371-2)28 04 24
Telefax: +(371-2)28 67 83
Telex: 161151

LESOTHO

Dept of Water Affairs
P.O. Box 772
Maseru

S. Makhoalibe
Tel: +(266) 32 50 68
Telefax: +(266) 35 03 25
Telex: 4431 LO
Cable: HYDROMET

LIBERIA

Liberia Hydrological Service
Ministry of Lands, Mines and Energy
P.O. Box 9024
Monrovia

LITHUANIA

Lithuanian Board for
Hydrometeorology
Rudnios 6
Vilnius 2600

Mrs Ona Zukauskiené
Tel: +(370-2) 75 22 13 or 75 11 94 or 75 40 12
Telefax: +(370-2) 75 35 00
Cable: 261240 TLG SU + LITOVGIDROMET + 303337 ORAI

MADAGASCAR

Service de la Météorologie agricole et de l'Hydrologie
B.P. 1254
Antananarivo

Mme Christine Razafy
Tel: +(261-2) 402 41 ext. 208
Telefax: +(261-2) 405 81

MALAWI

Water Resources Branch
Water Department
Private Bag 390
Lilongwe 3

Mr E.Z. Laisi
Tel: +(265) 730 424 or 732 155
Telefax: +(265) 784 678
Telex: 4285 MI
Cable: WORKS

MALAYSIA

Drainage and Irrigation Department
Jalan Sultan Salahuddin
50626 Kuala Lumpur

Director General
Tel: +(60-3) 298 20 11
Telefax: +(60-3) 291 42 82
Cable: DIRRIG KUALA LUMPUR

MALI

Division Hydrologie
Direction Nationale de l'Hydraulique et de l'Energie
B.P. 66
Bamako

Tel: +(223) 22 48 77 or 22 25 88
Telex: 2406

MALTA

Institute of Water Technology
Water Services Corporation
Qormi Rd
Luqa LQA 05

Mr Antoine Riolo
Tel: +(356) 24 98 51
Telefax: +(356) 22 30 16

MAURITIUS

Meteorological Services
Vacoas

Mr S.N. Sok Appadu
Tel: +(230) 686 10 31 or 686 10 32
Telefax: +(230) 686 10 33
Cable: METOR MAURITIUS

MEXICO

Instituto Mexicano de Tecnología del Agua
Paseo Cuauhnáhuac 8532, Col. Progreso, Jiutapec
CP 62550 Morelos

Dr Javier Aparicio
Tel: +(52 73) 19 40 49
Telefax: +(52 73) 19 43 41
Telex: 49 00008981

MOROCCO

Direction de la Recherche et de la Planification de l'Eau
Administration de l'Hydraulique
B.P. Rabat-Chellah
Rabat

Mr Mohammed Jellali
Tel: +(212-7) 77 87 42
Telefax: +(212-7) 77 86 96
Telex: 32876 M

MOZAMBIQUE

National Directorate of Water
P.O. Box 1611
Maputo

Eng. A. Lopes Pereira
Tel: +(258) 42 21 91/92
Telefax: +(258) 42 14 03
Telex: 6-521 HIDR MO
Cable: HIDRAULICA Maputo

MYANMAR

Department of Meteorology and Hydrology
Mayangon Post Office, 11061
Yangon

Tel: +(95-1) 633 90
Telex: 21512 BURMET BM
Cable: BAMETEORS

NAMIBIA

Hydrology Division
Department of Water Affairs
Private Bag 13193

Mr G. van Langenhove
Tel: +(264-61) 631.41 x 2081
Telefax: +264-61) 632.22
Telex: 33.18

NEPAL

Hydrology Section
Department of Irrigation, Hydrology and Meteorology
P.O. Box 3526
Kathmandu

Mr Kiran Shankar
Tel: +(977 1) 21 21 51
Telefax: +(977 1) 52 19 82 (via GTZ office)
Cable: HYDRONEP

NEW ZEALAND

Environmental Data
National Institute of Water & Atmospheric Research Ltd
P.O. Box 3047
Wellington

General Manager
Tel: +(64 4) 472 99 66
Telefax: +(64 4) 496 94 11

NICARAGUA

Instituto Nicaraguense de Estudios Terrestres (INETER)
Apartado 2110
Managua

Ing. Claudio Gutiérrez
Tel: +(505-2) 66 60 93
Telefax: +(505-2) 66 34 16

NIGER

Service hydrologique, Direction des Ressources en Eau
Ministère de l'Hydraulique et de l'Environnement
B.P. 257
Niamey

M. Kanta Ibrahim
Tel: +(227) 72 38 89
Telefax: +(227) 73 35 88
Telex: 5509 NI

NIGERIA

Department of Hydrology and Hydrogeology
Federal Ministry of Water Resources
P.M.B. 159, Gorki
Abuja

NORWAY

(see Sweden)

PAKISTAN

Pakistan Water and Power Development Authority (WAPDA)
Hydrology and Water Management Organization
236-WAPDA House,
Sharah-e-Quaid-e-Azam
Lahore

Mr Muhammad Saleem Warsi, Chief Engineer
Tel: +(92-42) 21 26 68 or 636 69 11/22 36
Telefax: +(92-42) 41 31 60
Telex: 44869 WAPDA - PK
Cable: WAPDA LAHORE

PANAMA

Depto. de Hidrometeorología
Instituto de Recursos Hidráulicos y Electrificación
Apartado 5285
Panamá

Ing. Claudia Candanedo
Tel: +(507)62 15 84 or 62 87 70
Telefax: +(507)62 91 17 or 27 47 69
Telex: 2158 IRHE PA
Cable: IRHE

PAPUA NEW GUINEA

Bureau of Water Resources
Dept of Environment and Conservation
P.O.Box 6580
BOROKO

Tel: +(675) 21 47 08 or 21 17 47
Telex: WABPRO NE22211

PARAGUAY

Ministerio de Defensa Nacional
Servicio Nacional de Meteorología e Hidrología
Av. Mcal. López 1146, 4 Piso
Asunción

Mr Miguel A. Vázguez
Tel: +(595-21) 221 39 or 31 30 33
Telefax: +(595-21) 21 20 58
Telex: 629 Py MDN

PERU

Servicio Nacional de Meteorología e Hidrología (SENAMHI)
Direccion de Estudios Hidrológicos
Avenida República de Chile No. 295
Lima

Ing. Luis Brea Kaik
Tel: +(51-14) 32 76 24

PHILIPPINES

National Flood Forecasting Office
PAGASA
1424 Quezon Avenue, Q.C.
Metro Manila

Mr Cipriano C. Ferraris
Tel: Direct +(63-2) 921 83 13 or PABX 922 84 01 to 19
Telefax: +(63-2) 922 18 72 or 924 77 44
Telex: 42021 PAGASA PM
Cable: 66682 WXMLA

POLAND

Institute of Meteorology and Water Management
Water Management Branch
ul Podleena 61
01-673 Warsaw

Mr T. Klinski
Tel: +(48 22) 34 07 08 or 34 18 51
Telefax: +(48 22) 34 17 88 or 341 801
Telex: 814331 hm pl
Cable: CENTROHYDROMET WARSAW

PORTUGAL

Direcçáo-Geral dos Recursos e Aproveitamentos Hidráulicos
Divisão de Hidrometria
Av. Almirante Cago Coutinho, 30-13
1000 Lisboa

Ms. M.E.V. Macedo
Tel: +(351-1) 80 75 51 or 80 78 01
Telex: 15853 CHEIAS P

REPUBLIC OF KOREA

River Planning Division, Water Resources Bureau
Ministry of Construction
1, Chungang-dong, Kwacheon, Kyunggee-do 427-760
Seoul

Mr. Noh Jae Hwa
Tel: +(82-2) 593 24 47 or 503 73 72
Telex: 24755 MOCONST K

ROMANIA

Institut de météorologie et d'hydrologie
Sos. Bucuresti-Ploiesti 97
Bucarest 18

Tel: +(40-1) 193 40
Telefax: +(40-1) 312 98 43
Cable: METEO BUCAREST

RUSSIAN FEDERATION

State Hydrological Institute
Vasilievsky Island, 2 line 23
St Petersburg 199053

Tel: +(7 812) 213 3458 or 213 89 84
Telefax: +(7 812) 213 1028

SAUDI ARABIA

Hydrology Division, Dept of Water Resources Development
Ministry of Agriculture and Water
Riyadh

The Director

SENEGAL

Direction du Génie Rural et de l'Hydraulique
Ministère du Développement Rural et de l'Hydraulique
B.P. 2041
Dakar

M. Abdoulaye Séné
Tel: +(221) 32 11 18
Telefax: +(221) 32 11 16
Telex: 61 302 M HYDRO

SLOVAKIA

Slovak Hydrometeorological Institute
Jeséniova 17
833 15 Bratislava

Mr Boris Minárik
Tel: +(42-7) 37 57 30, 37 33 31
Telefax: +(42-7) 37 11 92 or 37 65 62

SLOVENIA

Ministry of the Environmental and Regional Planning
Hydrometeorological Institute of Slovenia
Vojkova 1b
61000 Ljubljana

Mr. Anton Music, B.Sc.
Tel: +(38-61) 32 74 61 or 33 60 28
Telefax: +(38-61) 32 04 66
Telex: 31620 MET LJ

SPAIN

Dirección General de Obras Hidráulicos
Ministerio de Obras Públicas, Transporte y Medio Ambiente
Paseo de la Castellana, 67
Despacho B-609
28071 Madrid

Dr Eng. Alberto Rodriguez Fontal
Tel: +(34 1) 597 7617
Telefax: +(34 1) 597 8551

SRI LANKA

Irrigation Department
P.O.Box 1138
Colombo 7

Mr G.T. Dharmasena
Tel: +(94-1) 58 16 36
Telefax: +(94-1) 58 49 84
Telex: 219.98 DIRRIG CE

SUDAN

Nile Waters Department
P.O. Box 878
Khartoum

Mr K.A. Mohamed, Director General
Tel: +(249-11) 724 09 or 788 35
Telex: 223.76 MKHNL
Cable: MOYA KHARTOUM

SURINAME

Hydraulical Research Division
Ministry of Public Works, Telecommunication and Building Industry
P.O. Box 2110
Paramaribo

Tel: +(597) 49 09 63
Telefax: +(597) 49 09 39

SWAZILAND

Water Resources Branch
Ministry of Natural Resources and Energy
P.O. Box 57
Mbabane

Mr D.M.P. Lukhele
Tel: +(268) 423 21/22/23/24
Telefax: +(268) 423 64
Telex: 2194 WD

SWEDEN

HOMS Nordic Reference Centre (for Denmark, Finland, Iceland, Norway and Sweden)
SMHI
Folkborgsvägen 1
S-601 76 Norrköping

Mrs Gunlög Wennerberg
Tel: +(46 11) 158 000
Telefax: +(46 11) 170 207
Telex: 64400 SMHI S
Cable: HYDROMETEOR

SWITZERLAND

Service hydrologique et géologique national
3003 Bern

Dr Ch. Emmenegger
Tel: +(41-31) 324 77 58
Telefax: +(41-31) 324 76 81
Telex: 912 982 LHG

SYRIA

Head, Surface Water Division
Ministry of Irrigation
P.O. Box 4451
Damascus

H. Eng. J. Jamal El-Din
Tel: +(963-11) 22 14 00
Telex: IRIGAT 441059 SY
Cable: RAY

TAJIKISTAN

Main Administration of Hydrometeorology and Environmental Monitoring
47, Shevchenko St
734025 Dushanbe

Mr Boris I. Kalontarov
Tel: +(7-3372) 21 52 91 or 21 55 22
Telefax: +(7-3372) 21 41 24
Telex: 201104 VODA
Cable: DUSHANBE GIMET

THAILAND

Meteorological Department
4353 Sukumvit Road
Bang Na, Phrakanong
Bangkok 10260

Mr Siriboon Lekplipol
Tel: +(66-2) 398 98 68
Telefax: +(66-2) 399 40 14
Telex: 72004 DEPMETE TH
Cable: METEOR BANGKOK

TRINIDAD & TOBAGO

Water Resources Agency
P.O. Box 145
Port-of Spain

The Director
Tel: +(1 809) 627 82 77 or 627 82 78
Cable: WASA

TUNISIA

Institut National de la Météorologie
Sous-Direction de la Météorologie économique
B.P. 22
2035 Tunis-Carthage

M. A. Kasaar
Tel: +(216-1) 28 74 00
Telex: 12369
Cable: METUNIS

UGANDA

Department of Meteorology
P.O. Box 7025
Kampala

Tel: +(256-41) 25 85 72 or 25 85 37 or 25 35 59
Telefax: +(256-41) 25 17 97
Telex: +61 061

UNITED KINGDOM

Institute of Hydrology
Maclean Building
Crowmarsh Gifford
Wallingford, Oxon OX10 8BB

Dr H.R. Oliver
Tel: +(441491) 83 88 00
Telefax: +(44)491 69 24 24
Telex: 849365 HYDROL G
Cable: HYCYCLE

UNITED STATES

Office of Hydrology, SSMC-2
National Weather Service, NOAA
Room 8144, 1325 East-West Highway
Silver Spring, MD 20910

Mr E.A. Stallings
Tel: +(1-301) 713 0006
Telefax: +(1-301) 713 0963
Telex: via RCA-248376 OBSWUR, via TRT-197683 KWBC UT
Cable: WNOAA WASHDC

URUGUAY

Ministerio de Transporte y Obras Públicas
Dirección Nacional de Hidrografía
Rincón 575, piso 2.
Casilla de Correo 413
Montevideo

Ing. G. Arduino
Tel: +(598-2) 96 47 84
Telefax: +(598-2) 96 46 67/2883

UZBEKISTAN

Main Administration of Hydrometeorology
72, Observatorskaya St
Tashkent 700052

Dr Anatoliy Ovchinnikov
Tel: +(7-3712) 33 61 80 or 32 07 58
Telefax: +(7-3712) 33 20 25
Telex: 116573 UZMET
Cable: TASHKENT GIMET

VANUATU

Hydrology Section
Geology, Mines and Water Resources
Private Mail Bag 1
Port Vila

Tel: +(678) 22 423 or 22 3246
Telefax: +(678) 22 213
Telex: 1040 VANGOV NH

VENEZUELA

Dirección de Hidrología y Meteorología
MARNR
Edificio Camejo, piso 5
Caracas

Ing. Claudio Caponi
Tel: +(582) 408 16 01/02 or 581 43 64
Telefax: +(582) 541 83 75 or 545 06 07
Telex: 28475 MARNR VC

VIETNAM

Service hydrométéorologique
4 Dang Thai Than St
Hanoi

Tel: +(84-4) 25 33 43 or 25 34 67
Telefax: +(84-4) 26 07 79
Cable: HYDROMETEO HANOI

YEMEN

General Directorate of Irrigation, Department of Water
Ministry of Agriculture and Fisheries
P.O. Box 2805
Sana'a

Mr Mohammed Saad Harmal

YUGOSLAVIA

Federal Hydrometeorological Institute
Bircaninova 6, P.O. Box 604
11001 Belgrade

Dr Mihailo Andjelic
Tel: +(38-11) 64 64 45 or 64 57 79
Telefax: +(38-11) 64 63 69
Telex: 11141 YU HIDRO or 12937
Cable: HYDROMETEOR BELGRAD

ZAMBIA

Water Resources Research Unit
National Council for Scientific Research
P.O. Box CH 158
Lusaka

Mr C.B. Mwasile
Tel: +(260-1) 28 10 81
Cable: NACSIR, Chelston, Lusaka

ZIMBABWE

Hydrology Branch
Division of Water Department
P Bag 7712, Causeway
Harare

Mr G. Mawere
Tel: +(263-4) 70 78 61
Telex: 22141 ZIM-GOV-ZW

HOMS REGIONAL FOCAL POINTS

AGRHYMET

Centre régional de Formation en Agrométéorologie et Hydrologie opérationnelle
B.P. 11011
Niamey
NIGER

Directeur Général
Tel: +(227) 73 31 36, 73 24 36
Telefax: +(227) 73 24 35
Cable: AGRHYMET Niamey
Telex: 5448 NI

AIT HOMS FOCAL POINT

Asian Institute of Technology
P.O. Box 22754
Bangkok
THAILAND

Dr Nicanor C. Austriaco
Tel: +(66-2) 529 01 00-13 or 529 00 91-3
Cable: AIT BANGKOK
Telex: 84276 AIT TH

ARAB STATES FOCAL POINT

The Arab Centre for the Study of Arid Zones and Dry Lands (ACSAD)
P.O. Box 2440
Damascus
SYRIAN ARAB REPUBLIC

Dr Jean Khouri
Tel: +(963-11) 75 57 13 or 75 57 14
Telefax: 963 11 755712
Cable: ACSAD
Telex: 412697 ACSAD SY

CENTRAL AMERICAN ISTHMUS FOCAL POINT

Comité Regional de Recursos Hidráulicos (CRRH)
Apartado 3514-1000
San José
COSTA RICA

Lic Eladio Zarate H.
Tel: +(506) 31 57 91
Telex: 3651 COMITE CR

COMITE INTERAFRICAIN D'ETUDES HYDRAULIQUES

01 BP 369
Ouagadougou 01
BURKINA FASO

Tel: +(226) 30 71 12 or 30 71 15
Telex: 5277 BF

EAST AFRICAN DROUGHT MONITORING PROJECT

Drought Monitoring Centre
P.O. Box 30259
Nairobi
KENYA

Mr J.M. Maina
Tel: +(254-2) 56 78 80
Cable: WEATHER NAIROBI
Telex: 22208

HYDRONIGER

Centre International de Prévision
B.P. 10377
Niamey
NIGER

Tel: (+227) 73 32.39 or 73 43 89
Telex: 5328

MEKONG HOMS FOCAL POINT

Mekong Secretariat
Kasetsuk Bridge, Rama I Road
Bangkok 10330
THAILAND

Mr Pachern Sridurongkatum, Officer-in-Charge, Hydrology Unit
Tel: +(66-2) 225 00 29
Telefax: +(66-2) 225 28 96
Cable: MEKONG BANGKOK
Telex: 21322 MEKONG TH

UPPER NILE FOCAL POINT

Hydrometeorological Survey of Lakes Victoria, Kyoga and Mobutu Sese Seko
P.O. Box 192
Entebbe
UGANDA

Eng. E.A. Oryang
Cable: HYDROMET

ANNEX B

LIST OF HOMS COMPONENTS

(Issued with Supplement No. 16 to the HRM)

Part 1 of this annex gives a classified list of currently available HOMS components by section and subsection.

Part 2 of the annex gives the complete classification scheme for HOMS components.

SECTION A POLICY, PLANNING, AND ORGANISATION.

A00.0.01 Casebook of examples of organization and operation of hydrological services
A00.0.02 Hydrologists safety manual
A00.0.03 Guide on the maintenance of streams
A00.0.04 Policy on services for communications and archiving of data from automatic stations
A00.0.06 Assessment of water resources

SECTION B NETWORK DESIGN.

B00.0.02 Rationalization of a raingauge network
B00.0.03 Reference manual on the planning of meteorological observation networks
B00.0.04 Climatological network design using optimum interpolation
B00.0.06 A hydrometrically orientated station numbering system
B00.0.07 Optimization of surface water level gauging networks

SECTION C INSTRUMENTS AND EQUIPMENT.

C00 GENERAL

C00.1.02 Hydrometric equipment handbook
C00.1.04 Manual for the design construction and inspection of hydrometric stations
C00.2.02 Reading 16 track punched tape
C00.2.03 In situ data logger
C00.2.06 Memory card type data processing and recording system
C00.3.02 Specifications for solid state memory recorders
C00.3.03 Measuring systems and interfaces for recording hydrological data
C00.3.05 Precision turbidity recording meter

C09 SEDIMENT LOAD

C09.2.01 Hydrographic data acquisition system, HYDAC

C10 SUSPENDED LOAD

C10.1.01 US DH-48 suspended sediment sampler
C10.1.02 US DH-76 suspended sediment sampler
C10.1.03 US D-74 suspended sediment sampler
C10.2.01 US P-61 suspended sediment sampler
C10.2.02 US P-63 suspended sediment sampler

C12 BED LOAD

C12.1.01 Chanjang bed-load sampler
C12.2.01 US BMH-53 bed-material sampler
C12.2.02 US BMH-60 bed material sampler
C12.2.03 US BM-54 bed-material sampler

C25 GENERAL METEOROLOGICAL DATA; CLIMATE AND WEATHER STATIONS

C25.3.03 Automatic weather station

C27 PRECIPITATION, MANUAL & STORAGE GAUGES

C27.1.02 Manual raingauge
C27.1.03 Daily rain gauge

C30 PRECIPITATION, RECORDING AND TELEMETERING GAUGES

C30.1.01 Rain gauge for mountain areas (Ombrograph)
C30.1.02 A simple low cost reliable raingauge
C30.2.01 Rainfall alarm
C30.2.04 Siphoning 31 day raingauge
C30.2.05 Long duration recording precipitation gauge
C30.2.06 180-day rainfall recorder
C30.3.01 ALERT rain gauge
C30.3.03 Rainfall intensity recording and archiving system

C33 PRECIPITATION, MEASUREMENT BY RADAR

C33.3.01 Radar raingauge system

C35 AIR TEMPERATURE

C35.1.01 Double-louvered thermometer screen

C46 EVAPORATION, PANS AND TANKS

C46.1.02 Evaporation pan
C46.1.03 Class A evaporation pan

C58 SOIL MOISTURE, NUCLEAR METHODS

C58.3.01 Neutron probe for soil moisture measurement

C60 SOIL MOISTURE, ELECTRICAL METHODS

C60.3.01 Dielectric measurement of the soil water content
C60.3.02 Capacitance probe for measuring soil moisture

C62 SOIL MOISTURE, TENSIOMETERS

C62.3.01 Pressure transducer soil tensiometer
C62.3.02 Tensiometers for measurement of soil water pressure

C65 GROUNDWATER, LEVEL

C65.2.01 Electrical contact water level gauge

C67 GROUNDWATER, BOREHOLE LOGGERS

C67.1.01 Observation well for sea water-fresh water interface

C71 WATER LEVEL OR STAGE

C71.1.02 HOMS Catalogue of water level recorders
C71.3.01 ALERT river level (float-type) station
C71.3.02 Water-level recorder with removable static memory
C71.3.03 Pressure probe for water level measurement
C71.3.08 Precision water level recording gauge

C73 STREAM DISCHARGE, FLUMES, WEIRS, ULTRASONIC, AND ELECTRO-MAGNETIC METHODS

C73.3.01 Acoustic flow meter

C79 WATER VELOCITY, CURRENT METERS OR FLOATS

C79.1.02 HOMS Catalogue of current meters

C85 RIVER GAUGING, GENERAL

C85.1.01 Gauging vehicle
C85.1.02 HOMS Catalogue of winches, cranes, cableways, and other gauging accessories

C86 RIVER GAUGING, CABLEWAYS

C86.1.01 Overhead float thrower
C86.2.01 Technical standard for measuring river flow and sediment by hydrometric cableway

C88 RIVER GAUGING, CRANES, BRIDGE FRAMES, WINCHES, AND REELS

C88.1.01 Portable river gauging winch

SECTION D REMOTE SENSING.

D00.0.01 Application of remote sensing to operational hydrology
D00.0.03 Water surface temperature mapping from satellite
D00.0.04 Assessment of snow amount on river catchments by means of satellite data
D00.0.05 Airborne radiometer temperature surveys
D00.0.07 Snow cover from multi-channel satellite data
D00.0.08 Surface water temperature from polar-orbiting satellite infrared data
D00.0.09 Photo interpretation and mapping of flood-prone areas
D00.0.10 Estimation of extent of flooding using satellite images
D00.0.11 Estimation of the polluted area of snow cover around towns using satellite images
D00.0.12 Mapping of river floods using satellite images and digital image processing
D00.0.13 Determination of icing conditions on large lakes using satellite images
D00.0.14 Satellite image interpretation system (SIADIS)

SECTION E METHODS OF OBSERVATIONS.

E00 GENERAL

E00.1.02 Hydrological observation explained in pictures

E05 WATER QUALITY

E05.1.01 Guidelines for sampling surface water quality variables
E05.1.04 Water quality sourcebook
E05.2.02 Sampling for water quality
E05.2.03 Water quality analytical methods manual 1979

E09 SEDIMENT

E09.2.01 Field methods for measurements of fluvial sediment
E09.2.02 Sediment surveys
E09.2.03 Manual on sediment transport measurements
E09.2.04 Fluvial sediment concepts

E25 METEOROLOGICAL OBSERVATIONS FOR HYDROLOGY

E25.1.01 Meteorological observations for hydrological purposes
E25.1.03 Organization of observations of evaporation on evaporimeters and evaporative reservoirs
E25.1.04 AES guidelines for co-operative climatic autostations

E53 SNOW AND ICE, GLACIOLOGY

E53.1.04 Snow survey

E55 SOIL MOISTURE

E55.2.01 Use of the neutron probe for soil moisture measurement

E65 GROUNDWATER

E65.1.01 Systematic observation of the main subsurface water characteristics
E65.1.02 Sampling groundwater for hydrogeological investigations
E65.2.01 Determination of water table depth by hammer seismic refraction

E70 SURFACE WATER, LEVEL AND FLOW

E70.1.02 Manual on procedures in operational hydrology, volume I-V
E70.1.05 Graphical ice correction
E70.1.06 The instrumentation of flat low-lying catchments
E70.2.01 General field and office procedures for indirect discharge measurements
E70.2.02 Measurement of peak discharge by the slope-area method
E70.2.03 Measurement of peak discharge at culverts by indirect methods
E70.2.04 Measurement of peak discharge at width contractions by indirect methods
E70.2.05 Circulation studies using fluorescent dyes
E70.2.06 Measurement of peak discharge at dams by indirect methods
E70.2.07 A guide to slope-area discharge gauging in mountain rivers
E70.2.08 Manual for water gauging and discharge measurement
E70.3.01 Software Q: A program package for evaluating and managing discharge data on DOS computers

E71 WATER LEVEL

E71.1.02 Measurement of stage

E73 DISCHARGE MEASUREMENT, DILUTION GAUGING

E73.2.01 Method for discharge measurement with dye tracing techniques
E73.2.02 Fluorometric procedures for dye tracing
E73.2.03 Measurement of time of travel and dispersion in streams by dye tracing
E73.2.04 Determination of stream reaeration coefficients by use of tracers
E73.2.05 Measurement of discharge using tracers

E79 VELOCITY MEASUREMENTS, USE OF CURRENT METERS

E79.1.01 Two-point method of measuring discharge velocity
E79.1.02 Correction of observed depth for angle of sounding line
E79.1.03 Technique of stream gauging by current meter
E79.2.06 Discharge measurement by moving boat method

E85 MEASUREMENT OF HYDROLOGICAL CHARACTERISTICS FROM MAPS

E85.1.01 Drainage area determination

E88 SURVEYING

E88.1.01 Levelling

SECTION F DATA TRANSMISSION.

F00.1.06 Flood warning device
F00.2.01 Telephone service water level gauge
F00.2.06 Flood warning system
F00.2.09 Satellite data collection platform
F00.2.13 Telemetering station land radio link
F00.2.15 Satellite direct readout ground stations
F00.2.17 DATAPOST - PC program for data collection
F00.3.01 Data collection and transmission system (Ott Allgomatic)
F00.3.02 River information system
F00.3.04 Automatic network for collecting real-time hydrological data
F00.3.05 ALERT data collection substation
F00.3.06 System for recording and transmitting rainfall data
F00.3.07 Modular system for recording and transmitting hydro-climatological data
F00.3.08 Telemetry system for data acquisition and flood forecasting
F00.3.09 Data collection platform (DCP) specifications
F00.3.10 The telemetry of hydrological data by satellite
F00.3.13 Telemetering system

SECTION G DATA STORAGE, RETRIEVAL AND DISSEMINATION.

G05 STANDARDS, MANUALS AND RECOMMENDATIONS

G05.2.03 Data storage, retrieval and transmission data archival formats

G06 SYSTEMS FOR STORING GENERAL HYDROLOGICAL DATA

G06.2.01 Software for archiving and retrieving time-dependent data (TIDEDA)
G06.2.03 HYDSYS - time series data management software
G06.2.04 Automatic data quality-control and analysis system (SYSCAD)
G06.3.01 Storage and file management system for hydrological data (main frame version)
G06.3.01 Database management software for hydrological data (micro computer version)
G06.3.02 HYDATA - hydrological database and analysis system
G06.3.03 Management system for field data (FIELDMAN)
G06.3.04 HYMOS: database management and processing system for hydro-meteorological quality and quantity data

G08 SURFACE WATER OR RIVER DATA STORAGE SYSTEMS

G08.2.03 Hydrometric and sediment data banks
G08.2.04 Computer storage of hydrological data from rivers
G08.2.05 Methods and software for establishing and maintaining a data base
G08.2.06 Hydrometric data base
G08.2.07 HYDROM: Hydrometric data management software
G08.3.01 Data storage and file management for mean daily discharges

G10 GROUNDWATER DATA STORAGE SYSTEMS: LEVELS, WATER CHEMISTRY, WELL YIELDS AND FLOWS

G10.3.01 Ground water information system
G10.3.02 Groundwater information processing system (GRIPS)

G12 METEOROLOGICAL DATA STORAGE SYSTEMS

G12.2.01 Synoptic data processing package
G12.2.02 PLUVIOM: Precipitation data management software

G14 WATER QUALITY DATA STORAGE SYSTEMS

G14.3.02 HYQUAL - Water quality database

G20 GENERAL HYDROLOGICAL DATA TABULATION PROGRAMS

G20.2.01 Printout of data stored in working files

G30 INFORMATION OR DATA DISSEMINATION SYSTEMS

G30.2.01 Hydroinform: minicomputer controlled automatic hydrologic information dissemination unit

G40 TRANSFER OF DATA BETWEEN AUTHORITIES, STANDARDS, RECOMMENDATIONS, MANUALS AND METHODS OF CODING

G40.2.01 Standards for interchange of water resources data

SECTION H PRIMARY DATA PROCESSING.

H00 SYSTEMS PROCESSING SEVERAL TYPES OF DATA

H00.1.02 Area, length, point location processing program records
H00.3.01 Operational hydrometeorological data processing

H05 GENERAL WATER QUALITY DATA

H05.2.01 Guidelines for the primary processing of surface water quality data

H06 WATER TEMPERATURE DATA

H06.2.02 Water temperature data processing program (analogue recording gauge)

H09 SEDIMENT TRANSPORT DATA

H09.1.01 Computation of fluvial sediment discharge
H09.1.03 Method of determining bed load runoff from available data
H09.2.01 Suspended sediment computations
H09.2.02 Analysis of suspended sediment measurements

H25 GENERAL METEOROLOGICAL DATA FOR USE IN HYDROLOGY

H25.1.02 Primary manual data processing of meteorological observations for hydrological purposes
H25.3.01 Decoding of synoptic reports to extract hydrometeorological information

H26 PRECIPITATION DATA, NON-RADAR

H26.2.01 Reduction and use of 10 minute precipitation observations
H26.2.02 Long duration recorded precipitation data processing system
H26.2.03 System for digitizing chart recorded rainfall data

H39 AIR HUMIDITY DATA

H39.2.01 Calculation of various indicators of air humidity

H55 SOIL MOISTURE DATA

H55.2.02 Soil water information processing system

H70 SURFACE WATER (LEVEL AND FLOW) GENERAL

H70.1.02 Primary manual data processing of surface water characteristics
H70.2.05 Hydrometric data processing program (manual gauge)
H70.2.06 Hydrometric data processing program (analogue recording gauge)
H70.2.07 Automatic primary processing and checking of hydrological data

H71 WATER LEVEL DATA, RIVER STAGE, LAKE OR RESERVOIR LEVELS

H71.2.04 System for digitizing analogue recorded water-stages
H71.2.06 Digitizing and computer storage of water levels in tidal areas
H71.2.07 System for digitizing hydrological recorder charts

H73 DISCHARGE DATA, ALL RANGES

H73.3.01 Flow estimation by interactive graphic and flood routing techniques
H73.3.05 Computation of discharge by the slope-area method

H76 DERIVATION OF RATING CURVES, CONVERTING STAGE TO FLOW BY MEANS OF RATING CURVES

H76.2.01 Mathematical calculation of the rating curve (stage-discharge equation)
H76.2.02 Multi-variable rating curve (QTOBBV)
H76.2.03 Determining daily mean discharges using the rate of change in stage
H76.2.04 Calculation of discharge by means of stage-discharge analytical relations (main frame version)
H76.2.04 Calculation of discharge by means of stage-discharge analytical relations (micro computer version)
H76.2.05 Discharge ratings at gauging stations
H76.2.06 Computation of continuous records of streamflow
H76.2.07 Stage-discharge relations at culverts (SWCULRAT)
H76.3.02 Analytical fitting of the stage-discharge relation (main frame version)
H76.3.02 Analytical fitting of the stage-discharge relation (micro computer version)
H76.3.03 Numerical fitting of stage/discharge and stage/slope/discharge relations: BASIC programs for a PC
H76.3.05 Rating curve computation (SCADE)
H76.3.06 Automatic processing of discharge measurements and computation of the stage-discharge equation

H79 WATER VELOCITY DATA, COMPUTING DISCHARGE FROM POINT VELOCITY MEASUREMENTS

H79.1.07 Current meter measurements of streamflow using the two point method
H79.1.08 Calculation of discharge from current-meter velocity measurements
H79.1.09 Current meter measurement of stream flow using the five point method
H79.2.02 Simplified discharge measurement and computing method
H79.2.05 Computation of discharge measurements
H79.3.01 Computer program for stream gauging data processing
H79.3.02 CUMEC - PC program for current meter measurements

H83 PROCESSING OF HISTORICAL FLOOD INFORMATION

H83.1.01 Collection and processing of historical flood data

SECTION I SECONDARY DATA PROCESSING.

I00 GENERAL

I00.1.01 Recommendations for data processing for representative basins
I00.1.02 Statistical analysis of long time series of hydrological data
I00.2.01 Statistical analysis of the monthly values of a hydrological variable (main frame version)
I00.2.01 Statistical analysis of the monthly values of an hydrological variable (micro computer version)
I00.2.02 Annual regime of a hydrological variable
I00.3.01 Hydrographical data analysis package (HYDAP)

I05 WATER QUALITY DATA

I05.2.01 Evaluation of surface water quality data and water quality maps

I09 SEDIMENT TRANSPORT DATA

I09.2.01 Calculation of the annual distribution of sediment runoff from available data
I09.3.01 The correction to the annual load of measured suspended sediment

I26 PRECIPITATION DATA

I26.1.01 Tabulation of rainfall series and selection of storms
I26.1.02 Regional distribution of point rainfall intensities
I26.1.03 Computation of rainfall return period values by Gumbel's method
I26.1.04 Rainfall probability processing program
I26.1.05 Computation of rainfall return periods by partial duration series
I26.1.06 Mean areal precipitation by triangular grids
I26.1.07 Analysis of digitized raingauge records
I26.2.01 Daily average areal precipitation by the Thiessen method (main frame version)
I26.2.01 Daily average areal precipitation by the Thiessen method (micro computer version)
I26.2.03 Storm areal averages by fitting polynomials
I26.2.05 Rainfall data processing (CORDA)
I26.3.01 Computer drawn areal rainfall and averaging
I26.3.02 Checking and areal analysis of precipitation data (SVARD)
I26.3.03 Mean areal precipitation (NWSRFS-MAP)

I36 AIRBORNE POLLUTION

I36.3.01 Precipitation chemistry - small-grid regional sulphur deposition model
I36.3.02 Regional sulphur deposition model

I45 EVAPORATION, GENERAL

I45.1.03 Computing shallow lake evaporation using Class A pan data

I50 EVAPORATION, COMPUTATION FROM METEOROLOGICAL MEASUREMENTS

I50.2.01 Calculation of free water surface evaporation by the Penman method
I50.2.02 Potential evapotranspiration from vegetation by the energy balance method
I50.2.03 Catchment potential evapotranspiration by the energy balance method
I50.2.05 Computation of actual evaporation using a composite method
I50.2.06 The heat and water balance method of calculating actual evaporation
I50.2.07 Potential evapotranspiration by Penman's method

I53 SNOW DATA

I53.2.01 Objective analysis of the water equivalent of snow cover

I60 WATER BALANCE

I60.2.01 Calculation of areal evaporation and soil moisture deficit

I73 DISCHARGE DATA

I73.1.02 Frequency curves
I73.1.03 Duration curve (CURDURA)
I73.1.04 Verification of mean discharges over the river network
I73.1.05 Verification of extreme annual discharges over the river network
I73.1.07 Discharge-duration-frequency curves
I73.1.08 Volume-discharge-frequency curves
I73.2.01 Curves of ranked discharges
I73.2.03 Secondary processing of monthly discharge series
I73.2.04 Identification of characteristic discharges (from multi-year series of daily discharges)
I73.2.05 Identification of flood (or low-flow) events and associated characteristics
I73.2.06 Statistical analysis of the duration and volume of floods (or low flows)
I73.2.08 Extending monthly flow series (EXTMIN)
I73.2.09 Annual runoff computation with or without observational data
I73.2.10 Methods for extending runoff series
I73.2.12 Model for filling and extending monthly discharge series (MCL)
I73.3.01 REMUS : Reconstitution of missing data by regression

I80 LOW FLOWS

I80.2.01 Statistical analysis of low flow periods
I80.2.02 Calculation of annual minimum discharges with given probabilities
I80.2.03 The low flow frequency analysis package (LFA)

I81 FLOODS AND FLOOD FREQUENCY ANALYSIS

I81.1.01 Program for flood peak separation
I81.1.02 Recommendation for the estimation of flood-frequencies
I81.1.04 Frequency of peak discharges in an arid river
I81.1.09 Flood frequency analysis, program FDRPFFA
I81.2.01 Statistical analysis of flood discharges
I81.2.02 The consolidated frequency analysis (CFA) package
I81.2.03 Flood flow frequency analysis
I81.2.04 Calculation of annual maximum discharges with given probabilities
I81.2.05 HFA: Hydrological frequency analysis
I81.2.08 Annual flood frequency analysis (PEAKFQ)

SECTION J HYDROLOGICAL FORECASTING MODELS.

Models and procedures whose main purpose is the operational forecasting of various hydrological elements

J04 FORECASTING STREAMFLOW FROM HYDROMETEOROLOGICAL DATA

J04.1.01 Tank model
J04.1.04 Snowmelt-runoff model (SRM)
J04.1.05 Inflow-storage-outflow (ISO) function models
J04.1.06 Micro-computer based flood forecasting system
J04.1.07 Operational estimation of snow cover development and snowmelt
J04.2.01 A conceptual watershed model for flood forecasting
J04.2.02 Conceptual watershed model (the HBV model)
J04.2.03 Model to forecast rainfall floods
J04.2.04 Model for the calculation of snow-melt and rainfall runoff
J04.2.05 Method for short-term forecasts of discharges in mountain rivers
J04.2.06 Short-term forecasts of spring inflow to reservoirs on plainland rivers
J04.2.09 NLC rainfall-runoff model
J04.2.10 The soil moisture accounting and routing model (SMAL)
J04.3.01 Sacramento soil moisture accounting model (NWSRFS-SAC-SMA)
J04.3.02 Sacramento model modified for use in the upper Nile basin project
J04.3.03 Snow accumulation and ablation model (NWSRFS-SNOW-17)
J04.3.07 Synthesized constrained linear system (SCLS)

J10 STREAMFLOW ROUTING FOR FORECASTING

J10.1.01 Flood peak forecasting by a grapho-analytic technique
J10.1.02 Gauge relations for flood peak forecasting (FLOODSYS)
J10.1.03 River station selection for forecasting
J10.2.01 Real-time adaptive hydrological prediction ("self-tuning predictor" algorithm)
J10.2.02 Method of unsteady flow calculation in braided river beds
J10.2.03 Flood routing using a discrete linear cascade model
J10.3.01 Hydrodynamical river model (DC2)
J10.3.02 Recursive river flow forecasting using a Kalman filter
J10.3.03 Flood routing by a linear systems analysis technique

J15 COMBINED STREAMFLOW FORECASTING AND ROUTING MODELS

J15.1.01 The linear perturbation model (LPM)
J15.2.01 Streamflow synthesis and reservoir regulation (SSARR)
J15.2.02 Nonlinear cascade hydrological model (NONLIN)
J15.2.03 CLSX (constrained linear system extended) model
J15.3.01 Manual calibration program (NWSRFS-MCP3)
J15.3.02 Multipurpose unsteady flow simulation system (MUFSYS 3)
J15.3.03 Real time streamflow forecasting model (MISP)
J15.3.05 Micro computer modelling package for real-time flood forecasting (MIKE 11 FF)
J15.3.07 Conceptual watershed model for real time forecasting of runoff

J22 SEASONAL FLOW FORECASTING

J22.1.01 Seasonal forecast of inflow to a lake
J22.1.02 A method to forecast the spring flood volume
J22.2.01 Forecasting inflows to a lake
J22.3.01 Kalman filter empirical fitting (KFEF)

J32 FORECASTING SOIL MOISTURE

J32.3.01 Improved irrigation efficiency using soil physical techniques

J45 ICE FORECASTS

J45.2.01 Formation and melting of ice on surface waters
J45.3.01 Numerical river ice model

J55 FORECASTING SURFACE WATER QUALITY

J55.3.01 Integrated quantity and quality snowcover formation model (ISCF)

J80 ANALYSIS OF MODEL PERFORMANCE

J80.1.01 Model result analysis by the methods of the WMO model intercomparison
J80.3.01 Statistical summary - mean daily discharges (NWSRFS-STAT-QME)

SECTION K HYDROLOGICAL ANALYSIS FOR THE PLANNING AND DESIGN OF ENGINEERING STRUCTURES AND WATER-RESOURCE SYSTEMS

Models and procedures whose main purpose is hydrological analysis for planning, development, design, and management of water-resource systems, including studies of climatic change and man's influence.

K10 REGIONAL ANALYSIS

K10.1.01 Evaluation of water resources in a country
K10.1.02 Determining surface water resources for semi-arid and arid basins without data
K10.1.03 Peak discharge frequency in an arid region
K10.2.01 Resource information and analysis using grid cell data banks
K10.2.02 Long-term mean values of watershed water balance (program "RASTER")
K10.2.03 Computer programs for evaluation of regional flood risk
K10.2.04 Regional analyses of streamflow characteristics
K10.2.05 Regionalization of flow duration curves (REGFLOW)
K10.2.06 Reservoir flood estimation

K15 SITE-SPECIFIC FLOOD STUDIES

K15.1.01 Design flood estimation using historical flood data in frequency analysis
K15.1.02 Methods for computing design floods
K15.1.04 Hydrologic and hydraulic procedures for flood plain delineation
K15.2.01 Techniques for estimation of probable maximum precipitation
K15.2.02 Expected annual flood damage computation (EAD) (761-X6-L7580)
K15.2.03 Nonlinear threshold model (NTM)
K15.3.01 Damage reach stage-damage calculation (DAMCAL)
K15.3.02 Dam-break flood model (DAMBRK)

K22 RAINFALL-RUNOFF SIMULATION MODELS

K22.1.01 Runoff calculation by the storage function method
K22.1.02 Chart method for determining peak discharge
K22.1.03 Tabular method for determining peak discharge
K22.1.04 Computer program for project formulation structure site analysis (DAMS2)
K22.1.06 Engineering field manual for soil and water conservation practices
K22.1.07 Graphical method for determining peak discharge
K22.1.08 Synthetic generation of flows for river basins without data (SOIL)
K22.1.09 Morphometric unit hydrograph (UNIMORF)
K22.1.10 The unitgraph lumped technical review and analysis model (ULTRA)

K22 RAINFALL-RUNOFF SIMULATION MODELS (Contd.)

K22.2.01 Runoff model for cultivated soils
K22.2.02 Flood hydrograph package (HEC-1)
K22.2.03 Semi-conceptual watershed model
K22.2.04 Estimation of the unit hydrograph and correction of net rainfall time distribution
K22.2.05 Rainfall-runoff model for medium-sized urban basins
K22.2.06 Hydrologic parameters (HYDPAR)
K22.2.07 Aggregated runoff from small catchments based on stochastic representation of storm events
K22.2.09 The basin storage and water balance analysis package (BSTOR)
K22.2.10 Hydrological rainfall runoff model (HYRROM)
K22.3.01 Urban rainfall-runoff model (SWMM)
K22.3.02 Computer program for project formulation - Hydrology (TR-20)
K22.3.03 General purpose rainfall/runoff model NAM
K22.3.04 Hydrological land surface and river basin model system - EGMO
K22.3.05 CAMOS for operating hydrological land surface and river models
K22.3.06 Combined simulation model for surface water and groundwater
K22.3.07 Runoff simulation model for basins containing reservoirs
K22.3.08 Programme package for hydrological model identification (PP)

K35 STREAMFLOW SIMULATION AND ROUTING

K35.1.01 Cross-section properties program (CSP)
K35.1.02 Channel routing Muskingum-Cunge method
K35.1.03 Operational calculation of the water storage in rivers from water level data
K35.1.04 Computation of water-surface profiles in open channels
K35.1.05 Numerical solution of the non-linear Muskingum method
K35.2.01 Monthly streamflow simulation (HEC-4)
K35.2.02 Multivariate streamflow generator for short and long term cyclicity
K35.2.03 Lag and K routing (NWSRFS-LAG/K)
K35.2.04 Dynamic wave operational model (DWOPER)
K35.2.05 One-dimensional hydro-dynamic modelling
K35.2.06 Water-surface profile computation model (WSPRO)
K35.2.07 Culvert hydraulic model
K35.2.08 Hydraulics graphics package (HGP)
K35.2.09 Interior drainage flood routing (INTDRA) (723-J2-L279)
K35.2.10 Hydraulic computations in channels (HIDRAC)
K35.3.01 Dynamic rating curve model (DYNMOD)
K35.3.02 Channel routing - implicit solution of full equations
K35.3.04 Stream hydraulics package (SHP)
K35.3.05 Channel network computations
K35.3.06 Water surface profiles (HEC-2)
K35.3.07 WSP2 computer program (water surface profiles)
K35.3.09 MIKE11-A one dimensional modelling system for rivers and esturies
K35.3.10 Input detection as the inverse task of forecasting
K35.3.11 Nonlinear model "RIMO/RIDO" for streamflow routing
K35.3.12 River flow computation (RIFLOW)
K35.3.13 Branch-network dynamic flow model (BRANCH)
K35.3.14 Flow model for a one dimensional system of open channels based on the diffusion analogy (DAFLOW)

For additional components modeling estuary flows with temperature and salinity distribution see also subsections K54 Water temperature studies, and K55 Water quality studies.

K45 ROUTING THROUGH RESERVOIRS AND LAKES

K45.1.01 Lake-routing using a monthly time interval
K45.1.03 Propagation of floods through reservoirs (PROPAGA)
K45.3.01 Reservoir operation model (KS2)

K54 WATER TEMPERATURE STUDIES

K54.2.03 Reservoir temperature stratification
K54.3.01 Model of thermal pollution propagation in a river (TEMPER)
K54.3.02 A computer code for forecasting heat and pollutant spreading in rivers (POLFOR)

K55 WATER QUALITY STUDIES

K55.1.01 Estimating contaminant loads in rivers
K55.2.01 Graphical and interactive software for detecting trends
K55.2.03 Longitudinal dispersion of stable pollutants in rivers (DISPER)
K55.2.04 Transport model for a one dimensional system of open channels (BLTM)
K55.3.01 Storage, treatment, overflow, runoff model (STORM)
K55.3.02 Water quality for river-reservoir systems (WQRRS)
K55.3.03 Salt wedge intrusion
K55.3.04 Mathematical model for two dimensional salinity distribution in estuaries
K55.3.05 Environmental (water quality) information software (RAISON/GEMS)

K65 SEDIMENT STUDIES

K65.2.01 Computation of reservoir sedimentation
K65.2.02 Scour and deposition in rivers and reservoirs

K70 ECONOMIC EVALUATION OF WATER-RESOURCE PROJECTS AND FLOODING

K70.1.02 Design, construction, commissioning and operation of small hydroelectric power (HEP) plants
K70.2.01 Hydropower analysis using streamflow duration procedures (HYDUR)
K70.3.01 Multipurpose river basin simulation model (MITSIM)
K70.3.04 Risk assessment of optimal firm water and energy production from hydroelectric projects (OPTWER)
K70.3.06 Interactive river system simulation program (IRIS)

K75 DESIGN AND OPERATING POLICIES OF RESERVOIRS

K75.1.01 Storage capacity of a reservoir for low-flow regulation
K75.1.02 Storage capacity of a flood-control reservoir
K75.2.01 Design of storage reservoirs by stochastic simulation
K75.2.02 Reservoir design (hydrology)
K75.2.04 Analysis of reservoir operation in the case of random drafts
K75.2.05 Operational control rules based on components
K75.3.01 Reservoir system analysis for conservation (HEC-3)
K75.3.02 Simulation of flood control and conservation systems (HEC-5)

SECTION L GROUNDWATER.

L10 ANALYSIS OF DATA FROM WELLS AND BOREHOLES

L10.1.01 Computation of sea water-fresh water interface
L10.1.02 Determination of hydraulic conductivity by test pumping with observation wells
L10.1.03 Computation of drawdown of vertical and horizontal partially penetrating wells
L10.2.01 Pumping test analysis by analytical solutions (AQ-AT)

L20 AQUIFER SIMULATION MODELS

L20.2.01 Ground water interface model
L20.2.03 Groundwater flow model (GRW2M)
L20.2.04 Modular finite-difference groundwater flow model (MODFLOW)
L20.3.01 Ground water salinity model
L20.3.02 Aquifer simulation system
L20.3.03 IDROSIM: a simulation model for flow in a coastal aquifer
L20.3.04 Multi-aquifer simulation system
L20.3.05 A model for unsaturated flow above a shallow water table (MUST)
L20.3.06 Determination of the position of a salt/fresh groundwater interface
L20.3.07 Pathlines and travel times based on analytical solutions (AQ-AS)
L20.3.08 Groundwater potential analysis based on finite element solution (AQ-FEM)
L20.3.09 Groundwater pathlines and travel times analysis based on finite element solution (AQ-EF)
L20.3.10 Groundwater head drawdowns based on analytical solutions (AQ-AP)

The International Groundwater Modelling Centre, with offices in Delft, The Netherlands, and Golden, Colorado, USA, operates a clearing house for groundwater modelling software. For further details of the services that IGWMC offers, users should contact the HOMS Office.

L30 GROUNDWATER FORECASTING

L30.3.01 Groundwater levels forecast

SECTION X MATHEMATICAL AND STATISTICAL COMPUTATIONS.

X00.1.01 Statistics of monthly data
X00.1.02 Program to fit the gamma distribution
X00.1.03 Program to fit the log-normal distribution
X00.1.04 Gumbel fitting program
X00.1.05 Fitting the truncated Gumbel distribution with a known truncation point
X00.1.06 Program to fit the Gumbel distribution
X00.1.07 Fitting the truncated normal distribution with a known truncation point
X00.1.09 Program to fit the general extreme value distribution
X00.1.10 Program for frequency analysis
X00.1.11 HYPROB: analysis of hydrological data
X00.2.01 Statistical programs for extreme value distributions
X00.2.02 Fitting of various distribution functions to a series of observations
X00.2.03 Frequency distributions for extreme value statistics
X00.2.05 Program for fitting six distributions to maximum discharge values
X00.2.06 Extreme value statistics (STATI)
X00.2.07 Computational methods in hydrology (with FORTRAN programs)
X00.3.04 UNESCO IDAMS - Internationally developed data analysis and management software

SECTION Y TRAINING AIDS IN OPERATIONAL HYDROLOGY.

Y00.0.01 Manual for training of instructors of hydrological technicians
Y00.0.02 Manual of hydrometeorological instruments
Y00.0.03 Manual of the international course on operational hydrology
Y00.0.04 Video tape on field maintenance of hydrological instruments
Y00.0.05 Statistical analysis in hydrology
Y00.0.06 On tides and storm surges
Y00.0.07 Basic hydraulic principles of open-channel flow
Y00.0.08 Study guide for beginning course in groundwater hydrology

CLASSIFICATION SCHEME FOR HOMS COMPONENTS

Section A Policy, planning, and organisation.

Section B Network design.

Section C Instruments and equipment.

C00 General
C05 Water quality, instruments monitoring several variables
C06 Water temperature
C09 Sediment Load
C10 Suspended load
C12 Bed load
C14 Wash load
C16 Chemical quality
C21 Biological quality
C25 General meteorological data; climate and weather stations
C26 Precipitation, general
C27 Precipitation, manual & storage gauges
C30 Precipitation, recording and telemetering gauges
C33 Precipitation, measurement by radar
C35 Air temperature
C37 Soil temperature
C39 Humidity
C41 Sunshine hours
C43 Solar radiation
C45 Evaporation, general
C46 Evaporation, pans and tanks
C48 Evaporation, lysimeters
C52 Wind velocity and direction
C53 Snow, depth and water equivalent
C55 Soil moisture, general
C56 Soil moisture, soil samplers
C58 Soil moisture, nuclear methods
C60 Soil moisture, electrical methods
C62 Soil moisture, tensiometers
C65 Groundwater, level
C67 Groundwater, borehole loggers
C71 Water level or stage
C73 Stream discharge, flumes, weirs, ultrasonic, and electro-magnetic methods
C79 Water velocity, current meters or floats
C85 River gauging, general
C86 River gauging, cableways
C88 River gauging, cranes, bridge frames, winches, and reels
C90 River gauging, equipment for use in boats
C92 Ice measurements

Section D Remote sensing.

Section E Methods of observations.

E00 General
E05 Water quality

E09 Sediment
E25 Meteorological observations for hydrology
E53 Snow and ice, glaciology
E55 Soil moisture
E65 Groundwater
E70 Surface water, level and flow
E71 Water level
E73 Discharge measurement, dilution gauging
E79 Velocity measurements, use of current meters
E85 Measurement of hydrological characteristics from maps
E88 Surveying

Section F Data transmission.

Section G Data storage, retrieval and dissemination.

G00 General
G05 Standards, manuals and recommendations
G06 Systems for storing general hydrological data
G08 Surface water or river data storage systems
G10 Groundwater data storage systems: levels, water chemistry, well yields and flows
G12 Meteorological data storage systems
G14 Water quality data storage systems
G20 General hydrological data tabulation programs
G25 Hydrological yearbooks
G30 Information or data dissemination systems
G40 Transfer of data between authorities, standards, recommendations, manuals and methods of coding
G42 Transfer of data between authorities, programs implementing the standards in G40

Section H Primary data processing.

H00 Systems processing several types of data
Standards, recommendations, manuals, etc. for primary data processing in general
H05 General water quality data
H06 Water temperature data
H09 Sediment transport data
H16 Chemical quality data
H21 Biological quality data
H25 General meteorological data for use in hydrology
H26 Precipitation data, non-radar
H33 Radar precipitation data, including calibration by comparison with telemetering gauges
H35 Air temperature data
H39 Air humidity data
H41 Solar data, sunshine hours or radiation
H45 Evaporation data
H52 Wind data
H53 Snow and ice data, snow cover, depth, water equivalent
H55 Soil moisture data
H65 Groundwater data
H70 Surface water (level and flow) general
H71 Water level data, river stage, lake or reservoir levels
H73 Discharge data, all ranges
H76 Derivation of rating curves, converting stage to flow by means of rating curves
H79 Water velocity data, computing discharge from point velocity measurements
H83 Processing of historical flood information

Section I Secondary data processing.

I00 General
I05 General water quality data
I06 Water temperature data (Includes ice phenomena in rivers)
I09 Sediment transport data
I25 General meteorological data for use in hydrology
I26 Precipitation data
I36 Airborne pollution
I41 Solar data, sunshine hours or radiation
I45 Evaporation, general
I50 Evaporation, computation from meteorological measurements
I53 Snow data
I55 Soil moisture data
I60 Water balance
I65 Groundwater levels
I71 Water level data
I73 Discharge data
I80 Low flows
I81 Floods and flood frequency analysis

Section J Hydrological forecasting models.

Models and procedures whose main purpose is the operational forecasting of various hydrological elements

J04 Forecasting streamflow from hydrometeorological data

Forecasting basin or catchment runoff, including urban runoff, using rainfall-runoff and/or snowmelt-runoff models.

J10 Streamflow routing for forecasting

River stage and flow forecasting using models based on hydrometric data (stage and flow) only, starting from simple empirical and regression relations or storage-discharge relations and extending to full dynamic streamflow routing models.

J15 Combined streamflow forecasting and routing models

Forecasting stage or flow in river systems using complex models which include both rainfall-runoff and/or snowmelt-runoff components as well as channel routing components.

J22 Seasonal flow forecasting

Seasonal flow forecasting, including volume of runoff, using deterministic or stochastic methods.

J28 Forecasting low flows

J32 Forecasting soil moisture

Forecasting soil moisture conditions including water demands for irrigation

J45 Ice forecasts

Forecasting ice conditions in rivers, lakes and reservoirs

J54 Forecasting surface water temperature

J55 Forecasting surface water quality

J65 Forecasting sediment yield

J80 Analysis of model performance

Methods of analyzing the performance of forecasting models

Section K Hydrological analysis for the planning and design of engineering structures and water-resource systems.

Models and procedures whose main purpose is hydrological analysis for planning, development, design, and management of water-resource systems, including studies of climatic change and man's influence.

K10 Regional analysis

Water resources inventories; regional flood flow, mean flow and low flow studies; analysis in general.

K15 Site-specific flood studies

Design floods, extent of flooding, flood plain mapping.

K22 Rainfall-runoff simulation models

Rainfall/snowmelt-runoff simulation models for the planning, development, design and management of water-resource systems. Coupled surface water/groundwater models. Models of the complete hydrological cycle.

K35 Streamflow simulation and routing

Models using only stage and flow data describing streamflow processes in rivers

K45 Routing through reservoirs and lakes

Models for routing flows through ponding areas, lakes, and reservoirs.

K54 Water temperature studies

Methods for water temperature studies, simulation and analysis in estuaries, streams, lakes and reservoirs

K55 Water quality studies

Methods for water quality studies, simulation and analysis in estuaries, streams, lakes and reservoirs

K65 Sediment studies

Methods for the simulation and analysis of sediment transport, reservoir sedimentation, scour, erosion and deposition

K70 Economic evaluation of water-resource projects and flooding

Methods for the economic evaluation of water-resource development strategies. Flood damage estimation

K75 Design and operating policies of reservoirs

Reservoirs: design, determining volume required, operating rules, coupled real time forecasting and operational systems

Section L Groundwater

Models and procedures for the simulation, analysis, assessment and forecasting of groundwater

L10 Analysis of data from wells and boreholes

Pump tests, well logging, and mapping techniques

L20 Aquifer simulation models

Models for simulation, analysis and assessment of groundwater flow, temperature, and quality

L22 Calibration and verification of groundwater models

L30 Groundwater forecasting

Section X Mathematical and statistical computations.

Section Y Training aids in operational hydrology.