European Topic Centre on Inland Waters

SURFACE WATER QUANTITY MONITORING

by

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June 1996

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EXECUTIVE SUMMARY

This report documents the surface water quantity aspects of a survey undertaken by the European Topic Centre for Inland Water (ETC/IW) on freshwater monitoring procedures in Europe. The monitoring of surface water quantity is carried out at gauging stations {measurement stations) which record level (stage) only or discharge (usually derived from a relationship between level and discharge known as the rating curve or stagedischarge relationship); Many of the Stations provide automatic measurement of level at varying time inter-vals, typically 15 minutes or 1 hour, while some are read manually on a daily or weekly basis.

The survey was conducted by issuing a validated questionnaire to hydrometric agencies in each of the 18 countries of the European Environment Agency (EEA) area. Belgium, Luxembourg and Iceland, were the only countries not to respond. The survey sought information on a variety of issues including the administrative set-up in each country, methods used for monitoring, the frequency of sampling, data quality control, data storage and the dissemination of data. In addition, twelve of the countries provided an inventory of their gauging station network in computer readable form. The questionnaire information provided was collated and loaded, together with details of over 15,000 gauging stations, onto a relational database management system to form the EEA Surface Water Quantity Monitoring Database. Copies of the database were subsequently distributed to members of the Topic Centre involved in the network design activities of the ETC/IW workplan.

This document is a synthesis of the information provided in thè completed questionnaires. For each country, textual descriptions are given of: the characteristics of inland surface waters; the administration of surface water quantity monitoring; and the monitoring practices. Where possible, maps showing the extent of the monitoring networks have been produced. The questionnaire data are also summarised in a series of tables which allow a direct comparison of the procedures in different countries. A technical description of the database is provided including a list of the tables that constitute the database and an entity diagram showing how each table is related.

The report observes that there is a significant amount of commonality between monitoring programmes in different countries. It concludes that the EEA aim of- establishing a Pan-European network on surface water quantity monitoring can be realised relatively easily and quickly , at low cost. The following set of recommendations are then, finally , proffered as a means of harmonising hydrometric practices in Europe:

- All monitoring should be carried out in full compliance with inteinationally recognised standards.

- Methods used for calibrating the relationship between water level and discharge at gauging stations should be consistent and should be carried out over the full range of flow conditions.

- The stagedischarge relation should be systematically archived on computer, together with its period of applicability.

- For stations with automatic recording of level, the time resolution of the readings should be sufficient to accurately identify the temporal variability of flow.

- Data quality control procedures, including methods of dealing with missing values, should be harmonised.

- Regular (e.g. annual) hydrometric audits should be undertaken where the performance of gauging stations and the quality of the associated flow data are critically reviewed in a systematic manner.

- All gauged data should be available for public dissemination within a specified period (e.g. 6 months) of the readings being taken.

- Constraints on the availability and use of data should be kept to a minimum and should be applied universally.

- A global numbering scheme should be designed in order to uniquely identify every gauging station in Europe.

- Station details, such as geographic location, altitude, catchment area, method of measurement, etc., should be available for every gauging station.

- Standard file formats should be used to enable the easy transfer of data between countries.

- Standard software should be developed and should be generally available for the processing of rating curves, quality control analysis and presentation of data.

- An EEA determinand dictionary should be developed.

- The EEA should actively promote greater technical cooperation between hydrometric agencies in the EEA area.

The authors gratefully acknowledge the National Focal Points and other members of the European Topic Centre for Inland Water for their contributions to this report.

1. INTRODUCTION

To achieve the European Environment Agency's (EEA's) aim of establishing a surface water monitoring network for Europe, it is essential that the current status of monitoring is understood. Although the basic reasons for monitoring are broadly similar throughout the region, practices can differ significantly from country to country according to national priorities, circumstances and tradition. As the EEA's network would be required to produce comparable and consistent results between countries, it is important that such differences are highlighted and ways of overcoming them are implemented.

.The results presented in this report provide an indication of the status of surface water quantity monitoring in Europe. The report is a contribution to project MW2 of the multiannual work-programme of the European Topic Centre for Inland Water(ETC/IW) and relates specifically to Task 4e (Collect and collate, into database, information on surface quantity monitoring) of activity MW2-1 (Produce inventories of current and planned water resources monitoring procedures). The stated objectives of the Task (WRc, 1994) were to:

- identify present and planned water resource (quantity) monitoring in EU member states, Norway and Iceland, in particular: sampling strategies (frequency, number of sites, methods of sampling), analytical procedures and the dissemination of results;
- review national and international quality control procedures (and to identify the extent to which they are applied in each member state);
- determine the extent to which the monitoring procedures applied by the Member States, Norway and Iceland vary;
- judge the extent to which States have instigated measures to harmonise their water resource monitoring strategies and, where possible, to identify possible routes to harmonisation and the practical barriers and solutions for greater harmonisation on a European Union level.

The survey of monitoring practices was conducted by use of a questionnaire which was issued to key individuals and organisations in each of the countries concerned. The design of the questionnaire was the responsibility of the Danish National Environmental Research Institute who developed it in collaboration with the Institute of Hydrology (IH) and the Austrian Working Group on Water (AWW). The questionnaire comprised four sections. The first section asked for an outline description of monitoring activities at country level while Sections II,. III and IV addressed the details of monitoring surface water quantity, groundwater quality and groundwater quantity respectively . This report deals only the responses relating to the surface water quantity aspects of the questionnaire. Prior to distribution, the questionnaire was validated by the ETC/IW consortium and the EEA. Copies. of the validated questionnaire were distributed, via the designated ETC/IW members, to the National Focal Point (NFP) of each country. The NFPs, in tum, were responsible for identifying key contacts within their country who would be required to complete and retum the questionnaire.

As well as describing their national monitoring, programme, respondents were asked to provide an inventory, in electronic form, of the monitoring stations (gauging stations) in their country. This was considered an important feature of the survey as it would provide an input for the network design activities of MW3. The level of response to this request is illustrated in Figure 1.1. It should be noted, however, that although some countries failed to provide station inventories, some did manage to provide textual information on the monitoring practices in the questionnaires. A summary of all responses is given in Table 1.1 below.

The information supplied on the completed questionnaires was loaded manually on to an ORACLE database using an screen-based forms interface (a technical description of the database is given later in Chapter 3 of this report). Irregular answers caused the most difficulties in the loading process with seemingly simple. questions open to a variety of interpretations.

Table 1.1 *Questionnaire Retums*

COUNTRY	QUESTIONNAIRE		STATION INVENTORY
	section 1'	Section II	
Austria	Y	Y	Y
Belgium	N	N	N
Denmark	Y	Y	Y
Finland	Y	Y	Y
France	Y	Y	Y
Germany	Y	N	Y
Greece	Y	N	N
Iceland	N	N	N
Ireland	Y	Y	Y
Italy	Y	Y	Y
Luxembourg	N	N	N
The Netherlands	Y	Y	N
Norway	N	N	Y
Portugal	Y	Y	Y
Spain	Y	Y	Y
Sweden	Y	Y	Y
United Kingdom	Y	Y	Y

Y = Yes; N = No

The station inventories provided details of over 15,000 gauging stations in 12 countries. In most cases, the loading of the inventories was relatively straightforward. Data files were restructured into a standard format using especially developed software and loaded onto the database using the ORACLE data loading facility (SQL*Loader). A Geographical Information System (Arc/Info) was then used to check the location of the stations.

The remainder of this document details the status of surface water quantity monitoring in each country of the EEA region based on the completed questionnaires. For those countries who failed to respond, relevant sections of the report are simply left blank. The report is structured as follows: in Chapter 2, the approach to monitoring is described on an individual country basis; in Chapter 3, a technical description of the database is given; in Chapter 4, a series of tables are presented summarising the information supplied which provide a means of comparing between countries; observations and concluding remarks are given in Chapters 5 and 6 respectively. Supplementary information is given in the various annexes.

6. CONCLUSIONS

This survey has shown that surface water quantity monitoring is well established in most, if not all, European countries, and although the individual networks may have evolved separately there is a significant amount of commonality between them. The centralised coordination of national monitoring programmes together with the widespread adoption of continuously recording equipment and the availability of data on largely compatible computer databases encourages the transfer of data between countries and would suggest that the aim of establishing a Pan-European network for surface water quantity monitoring can be realised easily and quickly at relatively low cost.

Although establishing the network may be achievable in the short-term, the EEA's ultimate goal should be to harmonise the monitoring practices between countries to ensure that the network provides comparable and consistent flow data for the whole of Europe. The following recommendations outline some of the issues that would need to be addressed:

- All monitoring should carried out in full compliance with intemationally recognised standards. A consensus will need to be reached between all countries on the most appropriate standards to use.

- Methods used for calibrating the relationship between water level and discharge at gauging stations should be consistent and carried out over the full range of flow conditions. Similarly, the required frequency of calibration should conform to guidelines defmed through international consensus.

- The stage-discharge relationship should be systematically archived on computer, together with its period of applicability. Data users should have ready access to calibration information.

- For stations with automatic recording of level, the time resolution of the readings should be sufficient to accurately identify the temporal variability of flow.

- Data quality control procedures, including methods of dealing with missing values, should be harmonised. Much work remains to be done in developing practical validation techniques which are capable of widespread application and there is considerable scope for international cooperation on this topic.

- Regular (e.g. annual) hydrometric audits should be undertaken where the performance of gauging stations and the quality of the associated flow data are critically reviewed in a systematic manner. This could, for example, usefully precede the publication of an EEA Yearbook or the fmal endorsement of data suitable for dissemination

- All gauged data should be available for public dissemination within a specified period (e.g 6 months) of the readings being taken.

- Constraints on the availability and use of data should be kept to a minimum and should be applied universally.

- A global numbering scheme should be designed in order to uniquely identify every gauging station in Europe. The scheme should be designed in such a way as to reflect the general location of the station.

- Station details should be available for every gauging station.. Each set of details should include the following: global station number, national number, river name, site name, geographic location, altitude, catchment area, catchment average annual runoff and method of measurement. A statement of the factors influencing the flow regime should also be provided. The same geographical coordinate system should be used throughout (e.g. Universal Transverse Mecator (UTM)) to describe the geographical location of each station.

- Standard file formats should be used to enable the easy transfer of data. between countries.

- Standard software should be developed and should be generally available for the processing of rating curves, quality control analysis and presentation of data.

- An EEA determinand dictionary should be developed to help ensure that variables such as "monthly mean flow" are not confused with the "mean monthly flow".

- The EEA should actively promote greater technical cooperation between countries in the EEA area. This would provide an obvious means of generally raising hydrometric capabilities, from the wider use of ultrasonic and dilution gauging techniques to the appropriate "tuning" of quality assurance packages.

In practical terms, some of the above recommendations may be difficult to achieve in the short or medium term, and, consequently, the EEA should also consider methods of maximising the utility of the flow data collected. For many EEA countries, this would be a more cost-effective means of upgrading hydrological information than the more ambitious measures of restructuring networks and standardising hydrometric practices according to perceived design objectives. These options are discussed further in the Topic Centre documents relating to "Network Design".