

Guide to

Hydrometric data management

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- Chartered Institution of Water and Environment Management
- Department of the Environment (Water and Land Directorate)
- Environment Agency
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Foreword

This British Standard has been prepared by Technical Committee CPI/113. It is intended as a guide to good practice and sets out recommended procedures for managing hydrometric data. It has been assumed that execution of the provisions of this standard is entrusted to appropriately qualified and experienced persons, for whose guidance it has been prepared. This standard should not be quoted as if it were a specification, and particular care should be taken to ensure that claims of compliance are not misleading.

Technical Committee CPI/113 wishes to acknowledge the personal contribution of Dr M J Lowing.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 26, an inside back cover and a back cover.

Introduction

Acquisition and control of hydrometric data involves a number of aspects: field procedures and instrumentation; data transmission; data processing; quality control; archiving; and dissemination. Technical issues relating to some of these are the subject of existing standards. However, the term 'management' relates to a duty of care that crosses the boundary between field and office practice, and embraces, to a greater or lesser extent, all the above aspects. It is assumed that hydrometric data have a value, and that it is the duty of the guardians of these data to maximize that value for all present and future users. Techniques of managing data to achieve this goal are outlined. Quality control and quality assurance are key factors in this.

This British Standard is concerned with general aspects of good practice in data management. Although produced in the UK, and therefore limited in terms of data types and the range of problems liable to be encountered, undue emphasis on particular UK procedures has been avoided. Where it has been believed to be relevant, such procedures are described in annex A.

The recommendations given in this British Standard are largely due to the experiences of data users. A recurring theme is the importance of describing data in terms of the conditions affecting their collection, accuracy, and limitations.

There is a clear trend for computer-held data to become more organized and accessible to a greater number of users. This British Standard is based on the assumption that this trend will continue, and, unless specifically stated otherwise, it is implicit that a computer should be available to meet the objectives and methods outlined. However, most of the principles outlined here are also relevant to data that may have been stored by other means.

Section 1. General

1.1 Scope

This British Standard provides guidance on the management of collected (and sometimes derived) data relating to: raingauge measurement of precipitation; water level; and discharge in open channels. It also covers associated descriptive, analytical and statistical material relating to sites where these data are collected. The range of sites where water levels, and sometimes flow, are measured includes: lakes, reservoirs, rivers, canals, tidal waters, sewers, wells, and boreholes.

There are other data (e.g. evaporation, soil moisture, and snow depths) that are embraced by the term 'hydrometry', as defined in this British Standard, and there are yet others (e.g. water temperature, pH, atmospheric pressure) that are peripheral. Such data may be collected by the same agencies and sensibly managed alongside the core data. These are not discussed explicitly but it is intended that the same general principles should be applied to the management of all such data.

1.2 References

1.2.1 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this British Standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

1.2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this British Standard are listed on the inside back cover, but reference should be made to the latest editions.

1.3 Definitions

For the purposes of this British Standard, the definitions given in BS 3680 : Part 1 : 1991 apply, together with the following.

1.3.1 hydrometry

Science of measurement of water, including the methods, techniques and instrumentation used.

1.3.2 precipitation

Any aqueous deposit, in liquid or solid form, derived from the atmosphere.

1.3.3 time series

Series of values arranged in order of occurrence, and normally referring to equally spaced time intervals.

1.3.4 validation

System of checking that data are numerically viable, following some process or manipulation (see 1.3.5).

1.3.5 quality control

Operational techniques and activities used to fulfil requirements for quality (see 1.3.4).

1.3.6 quality assurance

Planned, systematic actions, necessary to provide confidence that a product or service satisfies given requirements for quality.

1.3.7 data management system

Set of locations and procedures, both computerized and human-operated, that embraces all aspects of a data handling process, from the point of measurement or collection, to dissemination of the raw or derived data.

1.3.8 raw data

Output resulting directly from measurement of variables.

NOTE. This definition is given in BS 3680 : Part 1 : 1991. In the present British Standard, the term is used to define information at the lowest level of processing normally available within the data management system.

1.3.9 derived data

Information computed, or deduced, from raw data.

NOTE. These data may be modified as a result of quality control or validation.

1.3.10 event data

Data that define the time of occurrence of a change, of predetermined magnitude, in the value of a measured variable. If the value of a variable can both increase and decrease, it is recorded; if it can only increase, it is not recorded.

1.3.11 grid reference

Unique coordinate map reference to a position on the ground, given in terms of a national system.

NOTE. In the United Kingdom, the system for Great Britain is the National Grid, and for Northern Ireland, the Irish Grid.

1.3.12 geographical coordinates

International system of latitude and longitude, used for defining topographical locations.

1.3.13 geographical information system

Set of integrated techniques for collecting, storing, retrieving, transforming, and displaying spatial data analysis.

NOTE. In hydrometry, it is normal practice to use computerized maps as a means of display. Access to time series data can enhance the value of the system.

1.3.14 naturalized data

Derived discharge data that incorporate adjustments so as to estimate the behaviour of the catchment in its natural state, without the influence of man-made abstractions from, or effluent returns to, the watercourses upstream of the point of discharge determination.

1.3.15 mean discharge

Average discharge for a stated time period.

1.3.16 daily mean discharge

Mean discharge over a 24 h period.

NOTE. The term 'mean daily discharge' has no meaning and should not be used.

1.3.17 Q95

Discharge that is exceeded for 95 % of a stated time period.

NOTE. A Q95 value may be a statistical estimate based on limited raw data, when a complete set of raw data is not available for the time period under consideration.

1.3.18 flag

Within an archival system, means of alerting the user to events, criteria or values critical to a proper understanding of existing archive material and/or to processing of new material.

Section 2. Principles of data management

2.1 The value of data

Hydrometric data have been collected increasingly for at least the last 100 years, and the analyses to which they are subjected have gradually become more sophisticated. The confidence attached to such analyses depends on the quality of the data; and, in many cases, on the length of the record. In devising systems for the management of hydrometric data, emphasis should be placed on methods of describing the quality and maintaining the continuity of the record. The value of data can be significantly affected by the treatment received by the data after collection. At the very least, data collected now should be able to support today's analytical methods, and the needs of future users should be considered to the fullest possible extent.

2.2 Duty of care

2.2.1 General

The duty to manage hydrometric data should be taken to mean all such data, whether collected currently under the direct control of the responsible organization, collected by a predecessor body and inherited. Data management systems should be designed to record data description and ancillary information in sufficient detail to fully inform a completely new team of managers. Systems should also be robust enough to withstand a change of organization responsible for the data. Persons responsible for data management should be encouraged to adopt the ethos of a professional stewardship and to remember their role as guardians of an important national, and sometimes international, resource.

2.2.2 Inherited data

If the quality of inherited data is relatively poor, every effort should be made to improve it. The whereabouts and outline contents of all hardcopy files should be discovered and listed, as well as stores of charts and tapes. Special attention should be paid to current meter gauging records and details of derived rating relationships.

Inherited information should be brought into any newer computer system in use, and the details listed as described in this British Standard (see 3.1.4 and 4.3.5). Consideration should be given to processing old charts and tapes to extend the historical record of more recent water level archives. Where hardcopy records of daily mean flows are all that survive, they should be entered directly into the computer database. If it is decided that old data are completely useless, and confirmation obtained from other interested parties (e.g. national collating organizations), then the data can be withheld from the database and the facts recorded. They should not be destroyed but can be consigned to 'second class' storage (perhaps on microfilm alone).

Whatever the nature of the inherited data, they should be subjected to the same critical examination and

annotation (flags, comments, or reference documentation) as applied to current data, in line with the recommendations of this British Standard.

The task of retrospective data collation and review can be very demanding, but the resultant increase in the usefulness of the data (longer period of record, better understanding of data relevance) should not be underestimated.

2.3 The sequence of data management

In addition to the traditional sequence of field sensing and recording followed by collection, the field data record can be transmitted directly to the office, or some of the processing can be done in the field, either automatically or with portable computers. There is a variety of possible routes for data to travel from the sensor to the archive.

The processes of validation and quality control, that are central to the exercise of data management, are best seen as continuing through all stages of acquisition, from the installation of sensing devices through to publication of the finished product. Figure 1 is an example of a data management system built around the concept of several 'cycles' of data processing and quality control, each cycle progressively dealing with data from longer time periods.

Hydrometric data are of four main types:

- a) measurements of variables made either continuously or by regular sampling (e.g. water level measurements);
- b) measurements made sporadically (e.g. snow depth);
- c) data that relate to a particular period of time (e.g. mean annual flood data);
- d) site descriptive data that are sensibly constant (e.g. borehole log, spatial coordinates).

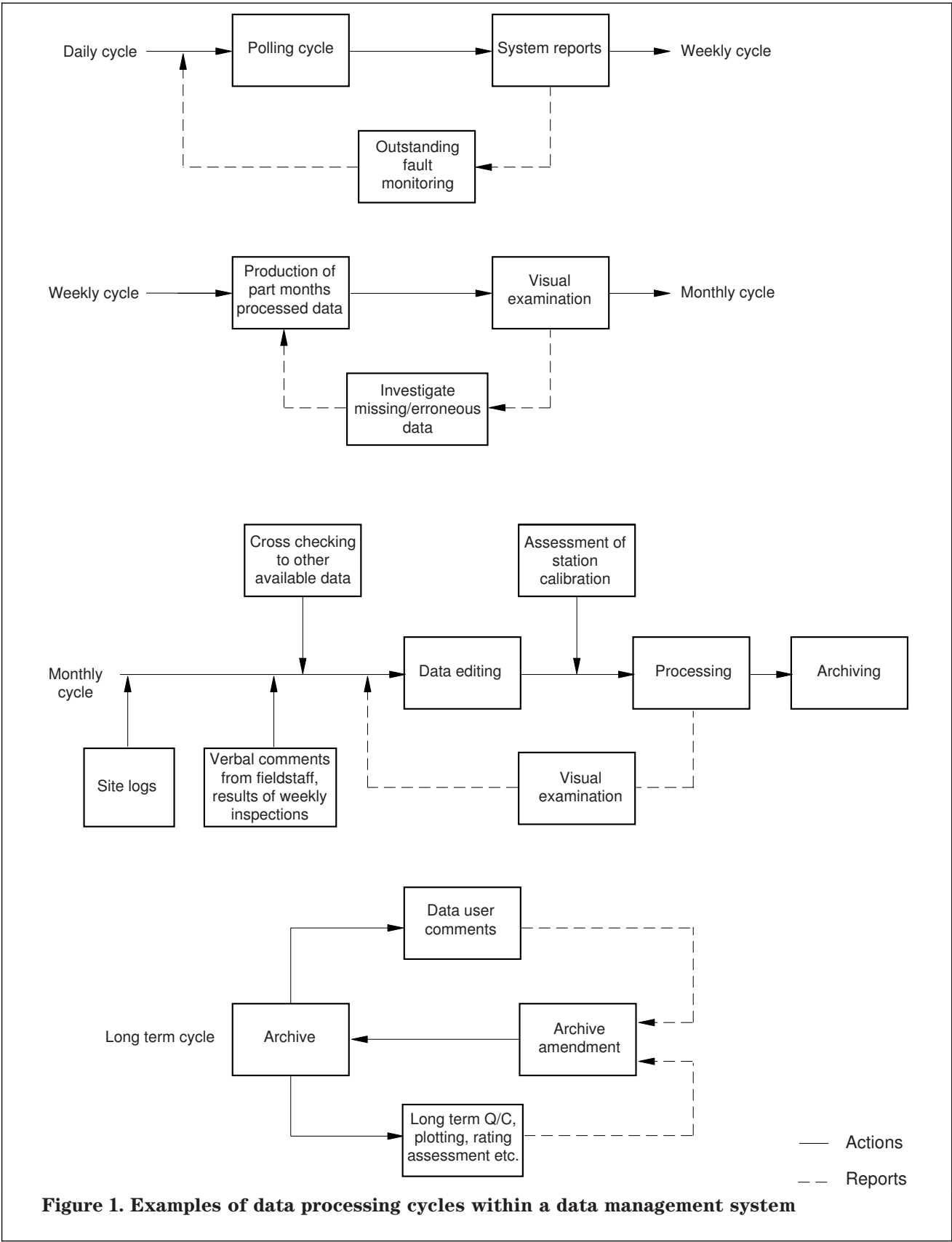
For the purposes of this British Standard, types a) to c) are classified as time series data. Site descriptive data are treated separately.

2.4 Time series data

2.4.1 Method of storing data

Raw time series data should be permanently archived. Data derived from these can either be archived or recomputed on demand. An item of time series data, which may be raw or derived, should be associated with either a single moment, or, if it is an accumulation (e.g. daily rainfall) or an integration (daily mean flow), with a certain period. There are two main methods of achieving this. Either the sequence of data items is kept with a starting time and a known interval, or a specific time is stored with each item ("event" data storage).

With either method of storage, the normal calendar conventions should apply, both to the year (1 January to 31 December) and to the day (midnight to midnight). The time standard should always be stated (i.e. GMT or local time).



Confusion has been caused in the past by adoption of the 'hydrological' year (October to September) and the 'hydrological' day (0900 - 0900 GMT in the UK). These conventions are sometimes convenient for expressing certain derived data, but they should not be used to describe any particular moment. For example, 0600 on 13 April should not be associated with 12 April, even if the rainfall at the time is subsequently allocated to the 12 April 'rainfall day', i.e. starting from 0900 on 12 April. The distinction is important: raw data should be stored only with the correct calendar date and time information; derived data can be computed in relation to any periods of time that may be required.

There are two possibilities for defining the time associated with an observation made at the instant dividing one day from the next: either it is the last moment of the previous day (2400:00), or the first of the next (0000:00). Both methods are used, and, as neither can be described as 'correct', either is acceptable. If data are stored with date and time, it does not matter which is used. If fixed interval data are stored in regular blocks, then the date and time of the first item in each block should be stated.

2.4.2 Derived data terminology

The data management system should clearly describe the periods used to accumulate or average raw data. This should be either by implication in the titles of data tables or by listing such descriptions in data dictionaries. In cases where extremes are extracted at regular intervals prior to averaging (or vice versa), care should be taken to describe the resulting item of derived data correctly. For example:

- a) maximum daily mean discharge (the maximum value of the sequence of daily mean discharges in a stated period);
- b) mean daily maximum discharge (the average value, in a stated period, of sequence of maximum instantaneous discharges recorded daily);
- c) mean discharge (the average discharge over a stated period);
- d) mean annual runoff (the average value of annual flow volume expressed in millimetres over the catchment area).

2.4.3 Precision of data storage

The number of significant figures in the data archive or its output should reflect the precision of the original measurement.

2.5 Descriptive, analytical and statistical material

Textual data can take many forms, but have two features in common: they were composed by a certain person on a certain date. As they may subsequently be revised, each piece of descriptive text should carry the name and affiliation of the original author together with the date of preparation, and there should be space left to record the same information relating to the latest amendment.

Certain items of analytical material have references to time associated with them and these references should be stored along with them. For example, the period of applicability of a particular stage-discharge relation should be stored along with the definition of the relation (see section 6).

2.6 Site references

2.6.1 Coordinate references

Raw data are usually measured at a particular location. This should be recorded using both the national standard coordinate system and, where appropriate, the international geographical system of latitude and longitude.

NOTE. See annex A for a discussion of the use of the National Grid and Irish Grid in the UK.

Latitude and longitude may be expressed as degrees, minutes and seconds, or as decimal degrees.

2.6.2 Numbering systems

Many data networks have obsolete numbering systems, and some sites may have more than one number, e.g. a local number and a national number. The data management system should allow for at least two alphanumeric references. In the case of multiple records at the same site (upstream and downstream level recorders; recording and check raingauges; separate structures for high and low flows), the local number should incorporate a system of identifying exactly which record is being described. If certain elements of raw data are combined prior to archiving, then this should be flagged through the numbering system so that future users can understand the data.

2.6.3 Site names

The name of the measurement site should be standardized and recorded in the data management system in sufficient detail to ensure unambiguity.

2.6.4 Altitude

The height above sea level should be recorded together with a reference to the appropriate datum, e.g. ODN (UK only), when using the Newlyn datum, or OD Liverpool for older sites.