MONITORING SYSTEMS DESIGN APPROACH

1. Background

One of the constraints to effective management of water resources is often the timeous availability of information on the status of these resources and the implications this has for the fitness for use and the sustainability of the resource. Despite the fact that large amounts of money and other resources are often allocated to water resources monitoring programmes, too many of them produce little or no information which can be used in effective management. Such programmes are said to be suffering from the "data-rich but information-poor" syndrome, usually as the result of being "data collection" orientated, rather than goal-orientated.

To either avoid or overcome these problems an approach has been developed to design water resources monitoring systems as *management information systems*. Such an approach is being used to design the DWAF's programme to monitor aquatic ecosystem health, otherwise known as its "biomonitoring" programme, and is briefly summarised below.

2. The Components of a Monitoring System

A monitoring system consists of several components, i.e.:

- sample collection;
- laboratory or field analysis;
- data handling;
- data analysis;
- reporting;
- information utilization.

Because most monitoring programmes view the production of data as the end point, only the first three components, i.e. the data generation portion, are usually considered in the design of the system. The approach of designing monitoring programmes as management information systems recognizes that the ultimate purpose of the monitoring programme is to produce information which is used to manage water resources and therefore gives equal weight to the last three components, namely the information generation portion of the monitoring system.

3. The Design Process

The generic process used to design monitoring programmes as management information systems are made up of the following steps:

Step 1: Define information needs of management

    !   identify information needs of management policies, decisions, systems and operational practices;

    !   summarize information needs of agency

    !   relate information needs to a monitoring strategy;

    !   define reporting and information utilization procedures desired by management;

    !   determine appropriate statistical means for producing the desired information.

Step 2: Define information that can be produced by monitoring

    !   statistically characterize the "population" to be sampled;

    !   review statistical methods applicable for generating the desired information, including their data requirements;

    !   state what information can be produced;

    !   compare information sought with information that can be produced.

Step 3: Design monitoring network

    !   document sampling locations;

    !   determine what constituents to measure;

    !   compute sampling frequency.

Step 4: Document data collection procedures

    !   field sampling operations and procedures;

    !   laboratory analysis methods and operations;

    !   data storage and retrieval system.

Step 5: Document information generation and reporting procedures

    !   data analysis hardware and software;

    !   reporting formats and frequency;

    !   information utilization procedures.

4. Role Players in the Design of a Monitoring Programme

The design approach described above requires that water resource managers as information users, those who will be responsible for producing the information and the monitoring systems designers should be working in close collaboration. Their respective roles are the following:

Water resource managers as information users:

These are the principle clients for the information being produced and should be closely involved, particularly in the first and second steps of the design process:

! As part of the first step they must use their knowledge and experience of water resources management policies, decision-making, and operational requirements to help the monitoring systems designers specify the information expectations to be satisfied by the monitoring programme and the preferred way that information has to be reported are determined.

! As part of the second step they must participate in making the trade-offs between the desired information and the information that can realistically be produced by a monitoring programme.

Monitoring Systems Designers

These people are responsible for the overall design framework, the process required to complete the design of the monitoring programme and the project management aspects.

! Their involvement is intensive during steps one and two during which they are responsible for the final design specification which forms the conclusion of these steps.

! During the remaining steps their functions are mainly that of project management and quality control to ensure that the actual design is completed according to the design specifications.

Technical Specialists

These people have a thorough knowledge of, and experience in, the various scientific and technical disciplines required to design and implement a monitoring programme.
! Their role starts during step two where they have to assess to what extent it is scientifically and/or technologically feasible for a monitoring programme to provide the information required by water resources managers. If it is not feasible they must participate in discussions with managers to find acceptable trade-offs.

! During steps three to five they are the principle people responsible for the detailed design work.