Guidelines on the Role, Operation and Management of National Hydrological Services

Operational Hydrology Report No. 49

World Meteorological Organization
Weather • Climate • Water

WMO - No. 1003

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FOREWORD

Recent years have seen a worldwide trend towards a widening of the mandate of National Hydrological Services (NHSs), beyond their traditional operational hydrology responsibilities. The scope of the responsibilities of NHSs now encompasses issues relating to environmental aspects and contributes to the integrated management of water resources, as a necessary step towards sustainable development. All of this comes with a backdrop where public organizations are typically requested to reduce their operational costs and their spendings. It is no longer good enough to claim that an NHS should be the exception to the rule in view of the uniqueness of its activities and the long-term benefits provided to the society through its public services. Numerous examples demonstrate that the political establishments are not inclined to accept this line of thought.

Under the situation described above, even the best trained managers would be under stress to meet the expectations from their services. Realizing that in most cases, managers of NHSs are technical people (that is, hydrologists) promoted to a managerial responsibility on the strength of their brilliant technical career, but with little or no managerial training, it is evident why an increasing number of NHSs have requested the World Meteorological Organization to issue some guidance material to assist senior officials in managerial capacities to fulfil their responsibilities.

Acknowledging this request, the Executive Council, at its fifty-second session, requested the assistance of the Commission for Hydrology to prepare a set of guidelines on the role and operation of NHSs. The Commission, with the assistance of an external consultant, took on this responsibility with enthusiasm and produced the present report, which, to some extent, goes beyond the mandate given by the Executive Council, as it also covers managerial aspects.

I would like to place on record the gratitude of the World Meteorological Organization to its Commission for Hydrology for the time and efforts dedicated to the conception, preparation and review of this valuable report.

(M. Jarraud)
Secretary-General

PREFACE

The publication of this document brings to a conclusion the significant efforts of a number of representatives from the global hydrological community. It was only after embarking on the project that it was realized how difficult it is to tackle managerial issues in a major sector such as water resources management. Such issues are influenced by cultural, social and economic settings in any given country. It requires a high level of understanding and comprehension to write a publication that is relevant to the wide spectrum of NHSs that make up the membership of the Commission for Hydrology (CHy).

First of all, I would like to acknowledge the excellent contribution of Paul Mosley (New Zealand) to the preparation of this document. Mr Mosley undertook the difficult task of consolidating a remarkable synthesis of ideas from a large number of experts into the first draft. It is primarily due to his efforts that this draft made it through several review processes and maintained a clearness of concepts and effectiveness of language that exemplifies his style.

Let me also thank the experts who participated in the various meetings held on the subject, the Regional Hydrological Advisers and members of the Advisory Working Group to CHy for their constructive reviews, as well as the members of the Executive Council Advisory Group on the Role and Operation of National Meteorological and Hydrological Services for their support and encouragement.

Finally, I take this opportunity to request the assistance of the hydrological community in providing further guidance in a world in which the institutional situations are evolving quite rapidly. As new ideas are constantly emerging in this field, these guidelines are just a first step. CHy is committed to review and continuously update this material, and will be very pleased to receive any comments aimed at improving future versions.

B. Stewart
President of CHy

SUMMARY

The main objective of these guidelines is to provide guidance to the senior managers of Hydrological Services, on the key issues that they might face, as they lead, manage and administer their Services.

Chapter 1 sets the scene, as it summarizes recent trends in hydrology and water resources management and makes the point that, even though in most cases NHS are public organizations, they still must be run in a business-like manner in order to be effective.

This is followed by an overview of the responsibilities and functions of NHSs, which, while recognizing the different institutional arrangements that may be encountered in different regions, tries to define typical products and services as well as the activities normally undertaken by NHSs. Several possible arrangements for the legal framework and institutional arrangements are mentioned.

Chapters 3 to 9 review in more detail the different aspects of management, such as strategic planning, human resources management, financial management, marketing, asset management, process and quality management, and relationships with other institutions. Without being prescriptive, emphasis is made on the issues that must be taken into consideration in each particular case.

Finally, in the Annexes a variety of material is presented as examples for some of the concepts described in the main text. In Annex 1, the organizational arrangements of two NHS is examined, only in as much as they represent typical cases, and not trying at all to have a geographical balance, as they are not representative of any region in particular. Annex 2 gives an example of an Interview Form, which could be used to compare candidates for a job position, while Annex 3 provides a sample employment contract which could be used as the basis for preparing contractual arrangements for NHSs that need to do so, and Annex 4 contains a form that could be used in a performance appraisal exercise.

RÉSUMÉ

Le principal objectif de ces *Directives* est d'aider les administrateurs des Services hydrologiques à surmonter les principales difficultés qu'ils peuvent rencontrer pour diriger, organiser et administrer leurs services.

Le chapitre 1 expose le contexte; il résume les dernières tendances en matière d'hydrologie et de gestion des ressources en eau et souligne que même si les Services hydrologiques nationaux (SHN) sont le plus souvent des organismes publics, ils doivent être gérés comme une entreprise privée pour être efficaces.

Le chapitre suivant traite du rôle et des fonctions des SHN. Tout en prenant acte des différents dispositifs institutionnels qui existent dans l'ensemble des régions, les auteurs tentent de définir les produits et les services typiques ainsi que les activités normalement entreprises par les SHN. Plusieurs possibilités d'organisation du cadre juridique et de la structure institutionnelle sont mentionnées.

Les chapitres 3 à 9 abordent les différents aspects de la gestion de façon plus approfondie (planification stratégique, ressources humaines, gestion financière, commercialisation, gestion de patrimoine, processus et gestion de la qualité, relations avec d'autres institutions). Sans être contraignantes, ces directives mettent l'accent sur les questions qu'il convient de prendre en considération à chaque fois.

Enfin, les annexes présentent divers éléments qui illustrent certains des concepts mentionnés dans le texte de base. L'annexe 1 est une analyse de l'organigramme de deux SHN, lesquels ne sont présentés que comme des cas typiques; la représentation géographique n'est pas prise en compte et ces SHN ne sont pas représentatifs d'une région particulière. L'annexe 2 est un exemple de formulaire d'entretien, qui peut être utilisé pour évaluer des candidats à un emploi, l'annexe 3 un modèle de contrat d'emploi dont les SHN peuvent éventuellement s'inspirer pour élaborer des arrangements contractuels et l'annexe 4 un formulaire qui peut servir pour une évaluation des résultats.

РЕЗЮМЕ

*с*новная цель настоящих Руководящих принципов – предоставить старшим руководителям гидрологических служб методический материал, касающийся ключевых проблем, с которыми они могут столкнуться как руководители, управляющие и администраторы этих служб.

*у*ществующая ситуация описывается в главе 1: в ней резюмируются недавно появившиеся тенденции в области гидрологии и управления водными ресурсами, а также особо подчеркивается то обстоятельство, что даже если в большинстве случаев НГС являются государственными организациями, то для их эффективности ими все же необходимо управлять, используя методики, применяемые в бизнесе.

*а*тем следует глава с обзором обязанностей и функций НГС, в которой наряду с признанием различий в институциональных аспектах, встречающихся в различных регионах, предпринимается попытка определить типичные виды продукции и услуг, а также виды деятельности, обычно осуществляемые НГС. Упоминаются несколько возможных вариантов организации правовых и институциональных структур.

главах с 3 по 9 более подробно рассматриваются различные аспекты управления, такие как стратегическое планирование, управление людскими ресурсами, финансовое управление, маркетинг, управление материальными и финансовыми ресурсами, управление процессами и качеством, а также взаимоотношения с другими учреждениями. Без установления каких-либо норм основное внимание уделяется проблемам, которые должны быть учтены в каждом конкретном случае.

наконец, в приложениях представлены разнообразные материалы, иллюстрирующие некоторые из концепций, описанных в основном тексте. В приложении 1 рассматриваются организационные структуры двух НГС. Они представляются только в качестве типичных примеров; никакого географического баланса не предусматривается, и они не являются представителями какого-либо конкретного региона. В приложении 2 содержится пример формы для проведения интервью, которая могла бы быть использована для сравнения кандидатов на должность. В приложении 3 предоставлен пример контракта о найме на работу, который можно было бы использовать, при необходимости, в качестве основы для подготовки мероприятий по заключению контрактов в НГС. В приложении 4 содержится форма, которая могла бы быть использована при оценке качества работы.

SUMARIO

La finalidad principal de estas *Directrices* es proporcionar orientación al personal directivo superior de los Servicios Hidrológicos acerca de las cuestiones fundamentales que pueden tener que abordar al dirigir, gestionar y administrar sus Servicios.

En el capítulo 1 se presenta la situación general: se resumen las tendencias recientes en los ámbitos de la hidrología y la ordenación de los recursos hídricos y se argumenta que, aunque en la mayoría de los casos los SHN son organizaciones públicas, es necesario que su gestión se asimile a la gestión empresarial para asegurar su eficacia.

A continuación se describen a grandes rasgos las responsabilidades y las funciones de los SHN. En esta sección, al tiempo que se reconocen los diferentes mecanismos institucionales que pueden adoptar distintas regiones, se tratan de definir los productos y servicios habituales de los SHN, así como las actividades que normalmente realizan. Se mencionan varios mecanismos posibles respecto del marco jurídico y la estructura institucional de esos Servicios.

En los capítulos 3 y 9 se examinan más detalladamente diferentes aspectos de la gestión, como la planificación estratégica, la gestión de los recursos humanos, la gestión financiera, la comercialización, la gestión de activos, la gestión de procesos y la gestión de la calidad, y las relaciones con otras instituciones. Sin tratar de imponer preceptos, se insiste en las cuestiones que es preciso tomar en consideración en cada caso particular.

Por último, en los anexos se ilustran de diversas maneras algunos de los conceptos que se describen en el texto principal. En el anexo 1, se examina la estructura organizativa de dos SHN. Esos dos casos se presentan únicamente como estructuras típicas, y no pretenden representar un equilibrio geográfico o a una región en particular. En el anexo 2 se ofrece el ejemplo de una entrevista que podría utilizarse en la comparación de los candidatos que aspiran a un trabajo determinado, en el anexo 3 figura una muestra de un contrato de empleo que podría servir de base para los SHN que han de preparar acuerdos contractuales, y en el anexo 4 se reproduce un formulario que podría usarse para la evaluación del rendimiento.

CHAPTER 1

INTRODUCTION

These *Guidelines on the role, operation and management of National Hydrological Services*[1] have been prepared on behalf of the Commission for Hydrology, and at the request of the Executive Council of the World Meteorological Organization (WMO). It complements the *National Meteorological and Hydrometeorological Services for Sustainable Development: Guidelines for Management* that were released by WMO in 1999.

The *Guidelines* will, we hope, be updated and improved periodically. The science and practice of both hydrology and management are developing rapidly, as are the issues that face water resources specialists. Hence, these *Guidelines*, too, must evolve, if they are to remain useful. Suggestions for improvements and additions will be welcomed by the WMO Secretariat.[2]

1.1 PURPOSE AND INTENDED AUDIENCE OF THE GUIDELINES

Our purpose is to provide guidance to the senior managers of Hydrological Services on the key issues that they might face as they lead, manage and administer their Services. "Senior managers" are taken to mean the Director[3] and the staff that report to the Director. It is anticipated that the *Guidelines* will have particular application to small Services, and/or those in developing countries, which have a limited number of staff able to take on management responsibilities.

In general terms, a Hydrological Service is defined here as an institution whose business is information about the water cycle (the hydrological cycle), and which may provide services relating to such information. This definition is enlarged and explored in later pages.

Socio-economic conditions, needs for water-related information, and organizational arrangements for Hydrological Services differ widely among countries. So, therefore, do the issues that face the managers of Hydrological Services. These *Guidelines* focus on issues that were raised and discussed by participants in an expert meeting on the Management of NHSs, organized by WMO and the Government of South Africa in August 2002. It is not practicable to provide a comprehensive manual or textbook of management that can be applied in any Service. Neither is it necessary, since there are hundreds of textbooks on all aspects of managing businesses, in both the private sector and the public sector.[4] There are dozens of courses in management, many of which can be taken by correspondence. Many governmental services offer training in management and administration through staff colleges, while others have no access to management training. Directors of Hydrological Services will increasingly find that well-developed management skills — obtained through learning from experience, and supported by wide reading and formal training — are essential, if they are to assure the future success of their Services.

1.2 RECENT TRENDS IN HYDROLOGY AND WATER RESOURCES MANAGEMENT

The environment in which Hydrological Services operate is changing rapidly. Most Hydrological Services are within the public sector, and therefore are particularly influenced by trends in government policies and practices. Key areas of change experienced during recent years include the following:

(*a*) A growing global commitment to sustainable management, or stewardship, of natural resources and the environment, in conjunction with efforts to improve living conditions for the poor, who commonly are most closely dependent on natural resources.

(*b*) A strong emphasis on poverty alleviation in developing countries and among international funding agencies.

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1 Abbreviations used hereinafter are NHS: National Hydrological Service; NMS: National Meteorological or Hydrometeorological Service; NMHS: National Meteorological and Hydrological Service. In general, the term "Hydrological Service" is used in this publication, because in many countries there are several organizations whose functions include hydrology, and there is no single agency that can be regarded as the National Service.

2 Any suggestions for improvement of this document should be sent to the Director of the Hydrology and Water Resources Department, WMO Secretariat, Geneva.

3 The title "Director" is used in this publication, but other titles such as General Manager or Chief Executive may denote the most senior official in a given service.

4 For example, the American Management Association publishes a wide range of instructional material, such as *The Project Management Workshop* (Taylor, 2000) and *The team building workshop* (Payne 2001). Visit www.amanet.org and www.amacombooks.org. McGraw-Hill provides a complete set of textbooks on different aspects of management (www.mhhe.com), and other publishers similarly have assembled sets of texts that provide a comprehensive introduction to management disciplines.

(*c*) A growing emphasis on the need for Integrated Water Resources Management (IWRM), as pressure on the world's water and other natural resources brings general recognition that resources must be developed and managed in a sustainable way.

(*d*) A seemingly inexorable increase in the impact of natural disasters, particularly floods and droughts, which sometimes could be defined as man-made accidents, as people settle in more risky areas, as the value of "at-risk" capital assets increases, and perhaps as the effects of global environmental change become increasingly visible. At the same time, the discipline of risk management is becoming more widely adopted. Taken together, these trends increase public and governmental expectations that Hydrological Services — in cooperation with National Meteorological Services — will be able to make a major contribution to disaster mitigation and avoidance.

(*e*) Rapid developments in technology, that enable Hydrological Services to offer much improved or completely new products, but usually at the cost of much increased investment in capital assets and staff retraining.

(*f*) A growing expectation that public services (that is, government agencies) should be responsive to the public at large and to elected representatives, and should conduct their affairs with efficiency, effectiveness and economy. This expectation has gone hand in hand with a growing threat of litigation, when the general public estimates that government agencies have failed to do their work properly.

(*g*) Increasing competition for resources in the public sector, as governments seek to reduce taxation burdens while meeting growing public expectations, particularly in the areas of health, education, and social services.

(*h*) The growing impacts of globalization and internationalism, which are felt both indirectly and directly by individual Hydrological Services. Indirect impacts include those on the general economic, social and political environment in which a Service operates. Direct impacts include, for example, wide adoption of international standards such as the ISO 9000 series, increasing technological dependence (in computing, instrumentation, data transmission, etc.) and the need for cooperative action between NHSs in managing transboundary river basins and aquifers. This demands a good appreciation of the potential effects of outside influences.

(*i*) The effects of general social trends on the day-to-day operations of Hydrological Services, such as the increasing role of women in professional activities, or the ever growing use of the Internet and web-based delivery of hydrological data and products.

Agencies must be able to demonstrate that their activities contribute directly or indirectly to poverty alleviation goals, or they will find resources difficult to obtain and find themselves marginalized.

Effective resource management requires accurate information — the traditional key product of a Hydrological Service — as a basis for planning, operational activities, monitoring the condition and trend of the resource, and for many other purposes. However, many parts of the information base required for IWRM are outside the areas in which Hydrological Services traditionally have tended to work. This implies that a National Hydrology Service (NHS) needs proper institutional development to meet new challenges and must develop new capabilities and/or establish partnerships or "strategic alliances" with complementary agencies, or become increasingly marginalized.

A "client focus", increased accountability (especially in the financial area), an improved service delivery system, and a requirement for comprehensive reporting on activities and outputs are just some aspects of a more demanding public sector environment. Public agencies are required to "do more with less", and in many cases are required to recover some part of the costs of their operations, and/or to seek commercially profitable work in order to reduce their cost to the taxpayer.

Many trends will continue into the future, although their exact path may be difficult to forecast, and continual monitoring and response is necessary. Other present-day trends may be phases or fashions, such as the enthusiasm in the 1990s for privatization of government agencies, which in some instances at least seems to have gone too far. It is essential that the Director of a Hydrological Service continually monitors the areas of change listed above — and others — in order to be able to respond appropriately.

1.3 HYDROLOGY AS A BUSINESS

A basic tenet of these *Guidelines* is that a Hydrological Service is a business, and should be run in a business-like way. This does not imply that a Hydrological Service must become a profit-making business, or that it may ignore its public service responsibilities. It does imply, though, that managers of Hydrological Services should:

- Recognize that their prime reason for existence is to serve their many clients;
- Adopt or develop (within the constraints set by their parent organization or government policy) administrative, management and leadership practices that produce the best possible results, in terms of efficiency, effectiveness, and responsiveness to their clients;
- Aim to ensure that their Service is a growing concern, whose assets are not depreciating and

whose prospects for future business are expanding rather than contracting.

It is often said that, because of the diversity of NHSs, "one size shoe can never fit all" (a common claim in any industry). Nevertheless, it is possible to describe the key attributes of an idealized world-class organization, adapt these attributes to the settings of the given NHS, compare one's own organization with those attributes, and identify areas for change and improvement. This process has been made very easy in recent years by the creation (by the US National Institute of Standards and Technology (NIST)) of the Baldrige National Quality Program,[5] which has been modified and adopted in a number of other countries. These programmes define criteria for performance excellence in business as well as the health and education sectors, and provide a procedure for self-assessment and follow-up action. They are fully applicable to a Hydrological Service, although the process of self-assessment is almost certain to be, in the beginning, severely challenging.

[5] Documentation for the NIST Program is available on http://www.quality.nist.gov/. Other countries have similar sources.

CHAPTER 2

THE RESPONSIBILITIES AND FUNCTIONS OF HYDROLOGICAL SERVICES

2.1 INTRODUCTION

Perhaps the best way of learning about the responsibilities and functions of Hydrological Services is to study the practice of some real Services. Annex 1 provides case studies of two very different Services, provided by participants in the expert meeting on the management of NHSs. Mosley (1994 and 2001a) provides additional, brief case study material.

2.2 THE NATURE OF A HYDROLOGICAL SERVICE'S PRODUCTS AND SERVICES

It bears repeating that the prime reason for the existence of a Hydrological Service is to serve its clients. Managers of a Hydrological Service must view their Service not only through their own eyes, as skilled technical people, but also through their clients' eyes, as people who have limited knowledge of hydrology but have water-related problems that they need help in solving.

As the products and services offered by a Hydrological Service have value, they are, therefore, economic goods, and is helpful to understand the characteristics of different types of good. A "public good" is one that is not appropriable (one person cannot appropriate the good for his[6] own sole use), not excludable (once the good is made available to one person, no one else can be prevented from using it), and is not depletable (use by one person does not "use up" the good as far as others are concerned). A "private good" has opposite characteristics. Public goods cannot be provided on a cost-recoverable or profit-making basis, because the provider cannot prevent the public at large from enjoying the good, and cannot easily charge all users. On the other hand, it is possible to restrict access to a private good, and to prevent anyone from enjoying it, unless they are prepared to pay for it. It is not necessary for public goods to be provided by public sector agencies, nor for private goods to be provided only by private companies.

The boundary between public goods and private goods is not always clearly defined or firmly fixed. Information systems are often regarded as a public good. Increasingly, however, they are managed as a private good, as copyright and contract law enforcement improves, and information technology develops. A Hydrological Service may choose to manage some information as a public good, making it accessible on the Internet, for instance, which places it irrevocably in the public domain — and to manage other information as a private good — only releasing it to selected clients, for instance, under strict contractual conditions regarding its subsequent release. Services, such as issuing warnings to a factory if its water quality compliance conditions are not being observed at a wastewater outfall, are likely to be private goods.

A "merit good" or "social good" may be either a public or a private good. It has the particular characteristic of being regarded as having significant value to society at large; provision of flood warnings is a good example. A government therefore may decide that there is merit in providing such a good to everyone, for reasons of social progress or equity (everyone should be able to enjoy it, regardless of whether they can afford it or not).

The implications for Hydrological Service managers of the differences between such goods are that:

- Products or services that are truly public goods can be provided only with public funding, because the Hydrological Service cannot easily recover their costs from the beneficiaries;
- Products or services that are private goods can be provided on the basis of profitability or recovery of costs from the beneficiaries. Authority to operate in this way may be required, and accepted accounting practices, financial transparency and fair charging regimes will be expected;
- The boundaries between public, private and merit goods may shift, as a result of evolving technology, contractual arrangements, public information, etc. A Hydrological Service may influence these boundaries, if it is in the national interest;
- To obtain or sustain funding from government sources for the provision of both public and private goods, it is necessary to demonstrate their value (merit) to society. If it is not possible to demonstrate that a product or service is truly a merit good, then funding is at risk, and the Hydrological Service should question whether it should be creating the good;
- Managers should appraise objectively the nature of each of their products and services, current and proposed, as a starting point for determining whether they are consistent with their mandate, and for identifying clients and ascertaining appropriate sources of funding.

[6] Throughout this document, where "he","him" or "his" is used for brevity, it is intended to mean "he or she", "him or her" or "his or her".

2.3 HYDROLOGICAL PRODUCTS AND SERVICES

The basic product of a Hydrological Service is commonly considered to be water-related data and information. Data and information are of value when they are used to make a decision — either a better decision than would have been made otherwise, or a decision that is made with a greater level of confidence than otherwise would have been possible. Hence, a Hydrological Service might be seen as providing increased confidence or reduced risk to its clients as they make water-related decisions.

There is a continuum in the products that a Service might provide, such as:

- A **monitoring** service, designed to provide very specific data or information at a particular location for a particular client, e.g. to warn if the dissolved oxygen concentration downstream from an outfall falls below a specified minimum value;
- Water-related **data and observations** obtained from an observing network. Although "raw" data (e.g. daily rainfall totals) are often supplied, hydrological database management systems make it possible to provide basic statistics such as daily, monthly, seasonal and annual means or maxima, whichever are more useful to clients;
- Water-related **information**, such as a comprehensive assessment of national water resources, the statistics of the magnitude, frequency and duration characteristics of flood events, or maps of spatial/temporal trends in groundwater quality. Increasingly sophisticated hydrological database management systems, which generally include time series analyses and other capabilities, Geographical Information Systems (GISs), and hydrological modelling technology, are continually extending the boundaries, in terms of the information that a Hydrological Service can provide;
- **Knowledge and understanding** of water-related phenomena and water resources, based on innovative research;
- **Advice and decision support**, where information and knowledge are turned into recommendations for a response to conditions. This might include, for instance, advice on appropriate responses to a contaminant spill on a major river, or on how to respond to an evolving drought.

In general, the greater the intellectual effort required to create the product, the greater is its value and the price that it commands. The management of a Hydrological Service should seek to develop such "added value" products and services, and to move out of the "data trap", in which they merely provide data from which other people extract value. Capacity-building, in terms of staff skills, information management technology, quality assurance and marketing will often be necessary, as well as possible changes to institutional arrangements (e.g. to permit a Service to retain revenue).

It is becoming increasingly important for Hydrological Service staff to learn to package their products to meet the needs of particular clients and thus add value. They also should recognize that client needs and expectations are changing continually, as the decisions that clients make become more complex and risky.

2.4 CLIENTS FOR HYDROLOGICAL PRODUCTS AND SERVICES

Who are the clients of a Hydrological Service? A "sectoral Hydrological Service" (see section 2.6) may have very specific clients, such as the staff of other divisions within their parent organization, who are "internal clients" for the Service's products. For an NHS or a National Meteorological and Hydrological Service (NMHS), however, the question is less easy to answer. In principle, for an NHS the ultimate clients are the general public, through their elected representatives at national, state/provincial, and more local levels. This includes the general public of the future, who will be beneficiaries of hydrological work that is being done today to assemble high quality data and information bases required for the analysis of trends, time series statistics, and so forth.

The fundamental influence on an NHS is government policies and national development goals, and the information that may be needed to support them. For example, in many developing countries the turn of the century has seen a growing national emphasis on poverty alleviation. To an extent, this has replaced the "environmentally sustainable socio-economic development" that was the emphasis in the early to mid-1990s, under the influence of Agenda 21 of the United Nations Conference on Environment and Development. The management of a Hydrological Service should, in any case, monitor government policies and analyse their implications for their own Service. What products and services will the Hydrological Service need to provide in order to support national policies and goals? Do all of the Service's current activities make a demonstrable contribution to achieving national goals? In other words, the management should ensure that their products and services have the greatest possible value. This is best done objectively, using benefit-cost analysis, cost-effectiveness analysis, poverty analysis, etc. New skills will be needed, either in-house or through arrangement or contract with outside organizations.

The interests of the public can be looked after in many ways, so that a Hydrological Service may have a variety of clients in addition to the "traditional" ones.

In seeking to extend the Service's client base, a Director may, for example, consider:

- A national disaster management agency with responsibility for issuing flood warnings and managing disaster response;
- A land-use planning agency, responsible for identifying flood-prone areas and developing regulations for controlling occupation;
- A consulting engineer contracted by government to build an irrigation scheme, highway bridge or other infrastructure that relates in some way to water;
- A municipal waste water treatment plant operator, that must ensure that its effluent stays within limits set by regulations;
- An environmental agency responsible for maintaining, inter alia, the biodiversity of aquatic ecosystems;
- An agriculture department, which needs information on flood or drought statistics or seasonal warnings of extreme conditions, with which to help farmers to plan operations.

Later sections examine in more detail the functional relationships (e.g. contractual agreements to supply particular services) between a Hydrological Service and its public sector clients.

A Hydrological Service may also be able to offer private goods to clients who are prepared to pay for them. The range of such clients will vary from country to country, depending on the nature of the national economy. They might include:

- Private electricity companies seeking to develop new resources, or find a more economical way of providing operational data;
- Private manufacturing companies that must provide evidence that their abstractions from, or their waste water discharges to, natural water bodies comply with regulations;
- Farmers' organizations contemplating communal irrigation, that require information on water availability and supply security;
- A mining company requiring an abundant water supply for processing, as well as advice on safe disposal of waste water;
- Insurance companies that require information on the changing risks of flood, drought or other insurable event.

The above lists are not exhaustive. The management of a particular Hydrological Service must carry out frequent surveys to identify potential clients, being careful to look beyond the traditional and the obvious. They should continually monitor trends in demand for water, national and state/provincial policies and development goals, political manifestos, trends and events in various economic sectors, international agreements, agreements with "donor agencies" and other sources of development finance, even down to reports of plans for new factories. Sources of information are diverse, ranging from international and national television news channels, public service circulars, professional networks, local newspaper reports, down to personal contacts with local business people. To identify the Service's clients and their evolving information needs is a fundamental task of management.

Having identified the clients, it is necessary to specify the products and services that they need, identify the form in which products and services should be presented in order to provide the greatest possible value, and create or strengthen a service-oriented mentality among the staff. More on these can be found in Chapter 7, "Marketing".

2.5 FUNCTIONS AND ACTIVITIES OF A HYDROLOGICAL SERVICE

The particular functions of a Hydrological Service should reflect the products and service required by the client. The core function of a Hydrological Service might be regarded as "operational hydrology", which comprises, according to WMO's General Regulations:

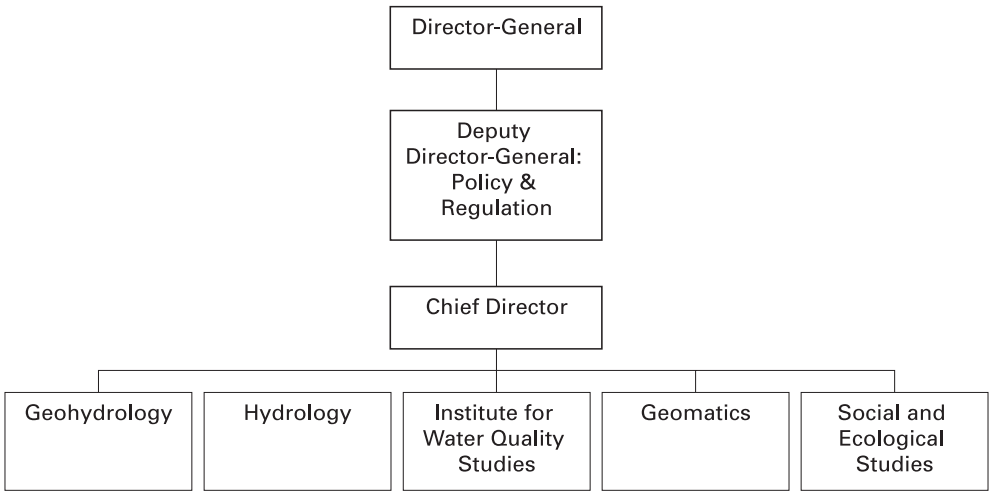
(*a*) The measurement of basic hydrological elements from networks of meteorological and hydrological stations: collection, transmission, processing, storage, retrieval, and publication of basic hydrological data;
(*b*) Hydrological forecasting;
(*c*) The development and improvement of relevant methods, procedures, and techniques in:
  (i) Network design;
  (ii) Specification of instruments;
  (iii) Standardization of instruments and methods of observation;
  (iv) Data transmission and processing;
  (v) Supplying meteorological and hydrological data for design purposes;
  (vi) Hydrological forecasting.

Traditionally, operational hydrology has had a strong focus on surface water quantity and river basin (catchment) hydrology, although WMO's *Guide to Hydrological Practices* (1994) comments that "hydrological data here are taken to include data on the quantity and quality of both surface water and groundwater". In many countries undergoing development, information needs for the economical and safe design of infrastructure have related primarily to surface water resources availability, reliability of supply, and magnitude-frequency characteristics of extreme events. In many countries there also has been a need for monitoring extreme events, particularly floods, in real time, for warning purposes. However, hydrologists increasingly need a much broader view of hydrology, extending even to the

Box 1. The functions of a Hydrology Directorate

(Illustration taken in 2002 from the Department of Water Affairs and Forestry of the Government of South Africa)

The Hydrology Directorate is part of the Scientific Services Branch of the Department of Water Affairs and Forestry, and has responsibility for data on surface water resources. Other Directorates deal with geohydrology, water quality, information, and social/ecological studies.



The Hydrology Directorate's functions are distributed among Head Office and five Regional Offices. Head Office has six functional departments:

Head Office: main functions

- Hydrometry: training of technicians, standardization of hydrometric techniques, instrumentation procurement
- Engineering services: design, construction supervision, calibration of spillways, flood management, field support for ecological compliance monitoring
- Data quality: processing standards and data validation, network planning, calibration, regular bulletins on storage and flow, utilization of reservoirs as gauging structures
- Data management: archiving of source data documents, maintenance of Hydrological Information System, data supply and map services
- Water resources studies: hydrology of basins for planning and design, Yield Risk Analyses, reservoir system operation, drought studies
- Flood studies: design flood determination, documentation of major floods, creation and maintenance of flood observation network.

The organizational structures in the regions are all different, with operational hydrology carried out by regional hydrology offices variously termed sub-directorates, divisions, sub-divisions, or sections. A matrix management system is used. The regional hydrology offices are administered and funded by regional directors, and are professionally and technically controlled by the Director of Hydrology in Head Office.

Regional Offices: main functions

- Construction of new and maintenance of existing gauging structures
- Monitoring (hydrology, geohydrology, water quality)
- Calibration of gauging sites (with Head Office)
- Hydrometric processing (rivers and reservoirs)
- Archiving of data
- Network planning in collaboration with Head Office.

ecological, biological and human use aspects of the aquatic system. The activities of many Hydrological Services are accordingly becoming increasingly diverse, as they deal with different types of data and information. Managers of Hydrological Services should continually monitor evolving demands for novel types of water-related data, information and advice, so that they can allocate resources appropriately. An early start is always desirable, because for many purposes baseline measurements and trend information will be required in the future.

Many authors have listed the basic activities of a typical Hydrological Service. The Service may:

- Establish the requirements of existing or possible future users of water-related information;
- Define and disseminate national standards for water-related data and information;
- Conduct hydrological research and develop technology (instrumentation, analytical tools, media for information transfer, etc.) required to support other activities and assist users to derive the greatest benefit from the Service's products;
- Design, operate and maintain monitoring, data transmission and data processing facilities;
- Gather, transmit, control the quality of and securely archive hydrological data and metadata;
- Assemble data about aspects of the biophysical and human environment that are needed to develop an understanding of hydrological processes — topography, lithology, land use, climate, water use and discharge, etc;
- Analyse hydrological and related data, using hydrological models of various types, to generate information about the nature, condition and trend of water resources (time series statistics, spatial distributions, etc.);
- Disseminate data and information to prospective users in appropriate forms — computer files of raw data, hydrological statistics for particular locations or areas subject to resource development, annual statistical summaries in yearbook form, national hydrological atlases, contributions to national state of the environment reports, etc;
- Disseminate (usually to the national disaster management agency) forecasts and warnings of extreme events — floods, droughts, ice dam breaks, pollution events, algal blooms, sea water intrusion, falling aquifer levels, etc;
- Provide advice on water-related matters to other government and non-government organizations;
- Ensure coordination with and among other agencies with water-related responsibilities and hydrological programmes;
- Represent national interests in international organizations with water-related mandates;
- Market hydrological products and services, and the Hydrological Service itself.

Particular national circumstances might require additional basic activities, such as the monitoring of river channel erosion and migration, or reservoir sedimentation.

A Hydrological Service's functions and activities are not fixed in time, but are able to change in response to the evolving needs and expectations of society, as well as to technological developments. The management of a Hydrological Service should continually monitor changes in its functional environment, and assess their implications for the Service's functions and activities. It is difficult to provide comprehensive guidance on what should be monitored, or on the sources that might be used. For example, in recent years the activities of some Hydrological Services have changed significantly in response to the following factors:

- Recognition of the hydrological significance of climate changes, bringing a new emphasis on drought monitoring, forecasting of extreme events, and time series analysis;
- The near-universal adoption of computer database management systems, occasioning a move away from publication of hydrological yearbooks in paper form to dissemination of hydrological data and products in electronic form;
- Cooperative agreements among the riparian states in transboundary river basins;
- Adoption of regional political agreements, with the consequent changes and adaptations of standards, regulations and directives, to which participating countries must abide, such as the European Union Water Framework Directive 2000/60/EC, which has brought considerable changes to Hydrological Services in both the EU and prospective applicant countries.

In the past, the fundamental activity of a Hydrological Service has often been to design and operate a basic network of observing stations. A basic network enables a national assessment of water resources, and meets unforeseeable future needs for data at locations or for purposes that individually might not justify special purpose observations. In the latter case, the technical capacity to extrapolate may be necessary in order to provide estimates at locations for which there are no data at all.

It is becoming difficult to sustain the concept of a basic national network in many countries; the promotion of integrated water resources management on a river basin basis can encourage monitoring networks that focus on particular applications of data, and on river basins rather than the whole territory. Even where this is not the case, Hydrological Services are required to justify all their activities in terms of specific results or simply receive reduced allocations. Individual monitoring stations must be justified in terms of specific objectives, for example, to provide a long-term record of environmental change, to provide a high quality record in a river basin that might in future years be subject to multiple purpose development, or to demonstrate compliance with international obligations. This is a subtly different approach to planning and operating a basic network. The management of the Hydrological Service should consider client requirements for information in the future, as well as technical matters. Of these, perhaps the most important is assuring coverage of distinct hydrological regions, and of the national territory as a whole, so that the essential purposes of a national basic network can be achieved. Managers should analyse the uses to which data from each of a network of stations might

reasonably be put in the future (not forgetting that observations at new locations might be required). At best, this provides the grounds for justifying continued station operation, and for adding new stations where there are information gaps. At worst, it provides the ability to rank stations, and to suspend those with the weakest justification. Statistically based network design procedures such as HYNET (the WMO Project on Intercomparison of Operational Hydrological Network Design Techniques) can assist considerably in such analyses, because they show which stations produce the greatest information return on additional investment.

In addition to the above public good activities, a Hydrological Service also may engage in other activities of a private good nature. Examples include:

- Groundwater bore monitoring for a water supply authority;
- Regulatory compliance monitoring of receiving water quality below a waste water outfall, for a factory;
- Monitoring of reservoir inflows and power station outflows for a hydropower company;
- Water-related data required for environmental impact assessment by a consultant;
- Provision of design information for a private irrigation company.

These may require the establishment of "special purpose networks" or "project networks" (or individual stations), to meet the specific needs of the client. The costs would be met by the client and the products owned by the client, and archived or disseminated only at the client's instruction. Management of a Hydrological Service should look out for such opportunities and should certainly respond positively if approached by potential clients. Special projects have many benefits for a Hydrological Service, including increased revenue, spreading overhead costs across a wider range of clients, the opportunity to develop new skills, heightened profile and support, and the creation of a positive atmosphere of innovation.

2.6 LEGAL BASIS FOR OPERATIONS

Almost all countries have Hydrological Services that have been explicitly established by some form of legal instrument; or carry out functions that are provided for or enabled by legislation, although the legislation does not establish a specific agency; or are part of a government agency that requires hydrological information in the process of discharging its responsibilities. Their authority comes from an annual appropriation of funds, with hydrology not necessarily mentioned in the parent organization's establishment law.

A great variety of legal or quasi-legal instruments is possible; these give varying degrees of authority — a national water policy, statute or law, "water code", decree, order, inter-ministerial agreement, and so on, depending on the system of government. Mosley (1994) provides a number of case studies that show the diverse arrangements that are possible. In many countries, water resources are now managed under the authority of a water law, a law to establish a water sector apex body (e.g. a national water resources council), a law on environmental protection, a law on natural resources management, or similar statute (examples are shown in box 2). In these cases, the emphasis of the law is on aspects of resource management such as allocation, resource pricing, administration of permits, etc. Hydrology may receive only a passing reference, perhaps in terms of assigning a duty to collect appropriate information.

A number of countries are devolving governmental functions to local levels; natural resources management can often be among these functions, on the principle that local interests are better able to manage — and benefit from — natural resources than national interests. Such a trend has significant implications for hydrology, and particularly for an NHS, as transboundary, sub-national issues arise regarding the management of water and water-related information. With devolution to sub-national level, the need for a national "apex body" has been recognized, to oversee national interests and to harmonize matters such as standards and regulations.

The increasing complexity of the decision-making process in the water sector, with a variety of stakeholders and actors, often with conflicting interests, necessitates a clear definition of the roles and responsibilities of each player. Furthermore, the participatory nature of the IWRM process calls for a variety of data and information to be available to all the participants. Such an arrangement is feasible under an appropriate legal framework. Therefore, some form of legal instrument is desirable, to provide a basis for a Hydrological Service's operations. In particular, it may be needed to provide authority for activities or functions such as:

- Crossing private property for the purpose of maintaining a monitoring station;
- Charging fees for products or services delivered;
- Requiring other organizations (including the private sector) to provide copies of their data for addition to a national archive;
- Transnational activities or liaison.

If water-related or natural resource-related law is being revised, managers should seek to participate in the drafting process. In particular, they should try to draw on the experiences of other countries regarding successful arrangements, and attempt to introduce these into their national legislation. Personal contact with other Services, e.g. in the context of WMO Regional Association Working Groups, will provide

useful ideas. WMO publications also provide a certain amount of guidance (WMO, 1994; Mosley, 2001a).

A legal instrument that is detailed or prescriptive may not be desirable, because it prevents a Hydrological Service from responding promptly to changing demands. For example, if responsibilities and/or organizational structure are precisely defined in terms of "traditional" operational hydrology, then there may be difficulty in starting new activities.

The management of a Hydrological Service often has limited influence on the legal basis of the Service, because it is defined by national practice for the public sector as a whole, and not for their parent organization. The functions of a Hydrological Service are often organized in one of the following forms:

- As a National Hydrological Service;
- As part of a National Hydrometeorological Service or National Hydrological and Meteorological Service;
- As one of the main sectoral Hydrological Services;
- As a federal Hydrological Service with many state/regional Hydrological Services.

Only a minority of countries have a single NHS whose principal role is operational hydrology. Several have a national or federal organization principally responsible for research, but not for the full range of functions included in operational hydrology. In many countries listed as having an NHS, the agency has a broad range of functions, only one of which is operational hydrology. Common links are with public works, environment, or water resources management. In many cases, operational hydrology functions are located in several agencies, each of which require hydrological information in support of their principal responsibilities of irrigation management, power generation, etc. One of these may be the "lead agency". In some countries, the lead agency assists or coordinates regional/provincial agencies that carry out operational hydrology in their jurisdictions.

Water is important in many areas of the economy and society, and information about water is required by many organizations. For this reason, in any one country several organizations (usually government ministries) may possess some form of "sectoral Hydrological Service", whose business is to provide water-related information relevant to the parent organizations' sectoral responsibilities. Commonly, such information is needed for the design, construction and operation of infrastructure relating to irrigation and drainage, water supply, transportation, flood and river management, and/or electricity generation. A sectoral Hydrological Service's principal clients therefore are well known, and usually the clients know what hydrological information they need. The Hydrological Service's products and services may also, of course, have value to other, external users.

Often, a particular "sectoral Hydrological Service" is larger than the others, and may be designated or accepted as the National Hydrological Service.

In many countries, water-related information is provided principally by a division of an NMHS or a specially established NHS; such a Service is largely independent of sectoral interests (such as hydropower) although it may be a part of an environmental

Box 2. The legal basis for hydrology in New Zealand

New Zealand is one of many countries in which hydrology is carried out under environmental legislation, and in which the legislation does not explicitly name hydrological activities or the types of data that are to be acquired. Environmental management is carried out largely at sub-national (regional, district) level, and there is no provision for a national Hydrological Service, nor for a water sector "apex body". The Resource Management Act contains a section (Section 35) entitled "Duty to gather information, monitor, and keep records", which enables but does not require operational hydrology. Its provisions that are relevant are:

1. Every local authority shall gather such information, and undertake or commission such research, as is necessary to carry out effectively its functions under this Act.
2. Every local authority shall monitor:
   (*a*) the state of the whole or any part of the environment of its region or district to the extent that is appropriate to enable the local authority to effectively carry out its functions under this Act; and
   (*b*) the efficiency and effectiveness of policies, rules, or other methods in its policy statement or its plan and its statement or plan for its region or district;
   (*c*) the exercise of any functions, powers, or duties delegated or transferred by it; and
   (*d*) the exercise of the resource consents that have effect in its region or district, as the case may be; and take appropriate action … where this is shown to be necessary.
3. Every local authority shall keep reasonably available, at its principal office, information which is relevant to the administration of policy statements and plans, the monitoring of resource consents, and current issues relating to the environment of the area, to enable the public:
   (*a*) to be better informed of their duties and of the functions, powers, and duties of the local authority; and
   (*b*) to participate effectively under this Act.

or natural resource management agency. For such a Service, the identity of clients is much less obvious, and their need for water-related information products and services may be unclear or unrecognized by them. Hence, the Hydrological Service must itself identify its clients and help them define their needs.

There is a strong trend towards establishing river basin agencies that have comprehensive responsibilities for water management, including the provision of water-related information. Such agencies can now be found on every continent. In many cases, these river basins and their agencies are transnational, like the Zambesi River Authority in Southern Africa. Some countries have complete coverage by river basin agencies, others have agencies only in the principal river basins. Management of water resources by river basin agencies, or by subnational civil administrations, introduces a need to harmonize standards, coordinate data exchange, avoid duplication, assure the national interest, etc. These tasks may be allocated to a national apex body and carried out by its secretariat; the secretariat may be provided by the NHS, or be completely separate. Inter-agency coordination and liaison are usually agreed to be desirable. In practice they are usually difficult to carry out, because their cost (especially in terms of time) is a lot more evident to the participants than are their benefits. Informal contacts between peers are, in any case, a very effective and economical means of maintaining liaison among agencies. Managers of Hydrological Services should give very serious consideration to the costs and benefits of inter-agency liaison, to ensure that they and their staff allocate the optimum amount of time to this activity.

In several countries, operational hydrology is the responsibility of a state-owned corporation, responsible under statute to a particular minister. It is required to operate on a commercial basis, possibly providing a dividend to its minister as well as providing services under contract to its public and private sector clients. Frequently, such a corporation is a former government department whose functions are seen as more appropriate to a commercial environment.

In a survey of 67 countries carried out in 1991 (Mosley, 1994), four principal models were found for organizing Hydrological Services at the national level:

(*a*) National hydrological or hydrometeorological agency/agencies only: 51 per cent;
(*b*) Regional (subnational) hydrological or hydrometeorological agencies only: 1 per cent;
(*c*) Both national and regional hydrological or hydrometeorological agencies: 42 per cent;
(*d*) Neither national nor regional hydrological or hydrometeorological agencies: 6 per cent.

There is a great diversity in the organizational arrangements for Hydrological Services, and arrangements are also undergoing change in many countries. No common relationships with a legal system, governmental system, language, or stage of economic development are evident. However, apparently successful examples of each model can be seen, which suggests that effective operational hydrology can be achieved in a variety of circumstances. Managers of a Hydrological Service may have limited influence on organizational arrangements at the level of the country as a whole. Nevertheless, it is important for them to take every opportunity to participate in organizational restructuring, and to draw on the experience of Hydrological Service managers in other countries in their region, in order to propose changes that will assist their Service to perform as well as possible.

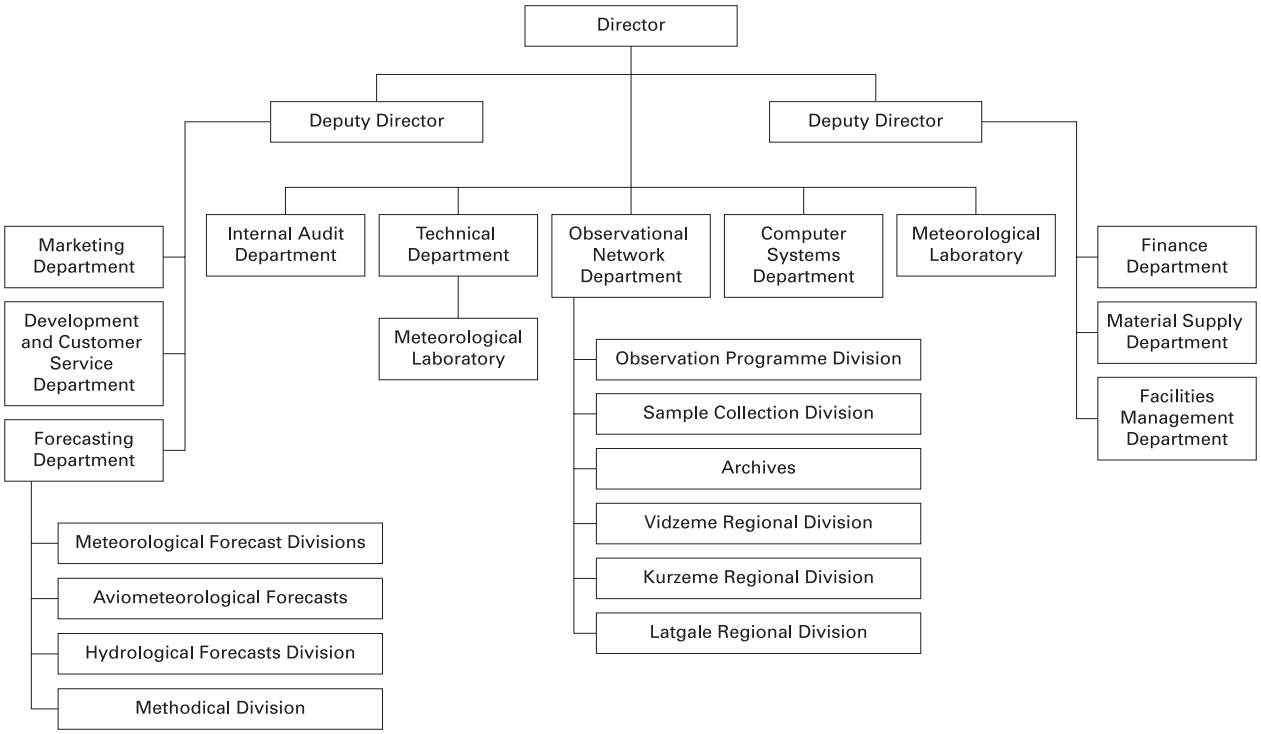
2.7 ORGANIZATIONAL ARRANGEMENT

At the level of an individual Hydrological Service the organizational structure will largely depend on the Service's functions, products, and activities; since these are evolving, the structure may also need to evolve. Organizational arrangements can therefore be diverse (see annex A). In some countries, the organizational structure is specified in law, which is a rather undesirable situation because it reduces the flexibility to respond to changing needs. In principle, the goal of establishing an organizational structure is to maximize the ability of staff to collaborate and communicate both within and between units, and to facilitate the creation and delivery of the product. It should also enable clients and stakeholders to identify appropriate contact points. The way the organization conducts its business may have a substantial effect on organizational arrangements. For example, a decision to outsource a particular activity may eliminate an entire section but increase the need for contract management and quality control. A decision to expand into new business areas may lead to the establishment of a marketing department.

Managers of a Hydrological Service should draw on the experience of other Services when considering appropriate organizational structures (see box 3). The literature on organizational behaviour and management also provides extensive guidance on the relative merits of different organizational models, and explains changing management fashions — "pyramidal structures", "flat structures", and so forth.

Box 3. The Latvian Hydrometeorological Agency

The Latvian Hydrometeorological Agency works under the Ministry of Environment and Regional Development. It has a sophisticated structure of departments that are responsible for a full range of functions, from operation of observing stations through to marketing.



CHAPTER 3

PLANNING AND STRATEGY

Perhaps a Director's most important responsibility is to lead the Hydrological Service's planning and strategy development. To successfully respond to changing conditions and demands, a Service needs a Director with vision and the ability to set a direction. Planning and strategy development imply that change will result; few people enjoy change, especially when it is imposed on them, and the managers of a Hydrological Service need special skills to manage this aspect. In particular, the organizational culture of many Services may need to shift from one that has a technical focus, to one that focuses first and foremost on the clients. Cultural change always takes time and is often difficult.

3.1 INTRODUCTION TO PLANNING

Managers of a Hydrological Service need to prepare plans and strategies that ensure that the Service allocates its resources in a way that will achieve the most important outputs and outcomes. Different types of plans may be prepared, for different purposes and for different durations. A strategic plan or long-term plan will provide a view of the overall direction of the Service during a period of, say, five years. In times of rapid change, it is difficult to look even five years ahead, so a strategic plan may be updated on a "rolling" basis, perhaps biannually. An annual plan sets out the specific intentions and desired results to be achieved during a single year of operation; it is usually associated with a budget. A development plan focuses particularly on the process of building the Service's capacity to carry on its business, and may consider a time period of ten years or more. In addition, there may be plans for particular aspects of the Service's operations, such as a staff training plan.

3.2 THE ELEMENTS OF A PLAN

A comprehensive plan is likely to include some or most of the following elements:

- Vision
- Mission
- Principles or values
- Review of achievements during the last planning period
- Analysis of strengths, weaknesses, opportunities and threats (SWOT)
- Goals and desired outcomes
- Objectives and desired outputs
- Actions
- Financial budget
- Performance criteria and indicators.

A strategic or long-term plan would probably not specify actions and might include only an indicative budget. An annual plan, on the other hand, might briefly summarize many sections from an existing strategic plan, and place more emphasis on defining the proposed actions and associated budget. Box 4 provides short informal definitions of the elements of a strategic plan and examples taken from international water-related literature.

The above list commences with the "high level" statement of vision and mission, passes to an appraisal of how the Service has performed, an honest evaluation of its condition (strengths and weaknesses of the Service) and of its business environment (opportunities for new business, and threats from competitors or adverse changes in the environment), and then moves down to specification of actions and the means of measuring whether they have been successful. It is easy to obtain plans from other agencies in order to get ideas about appropriate approaches and formats. The WMO Long-term Plan should, for example, be available to a Hydrological Service Director, either from his opposite number in the National Meteorological or Hydrometeorological Service (NMS) or from the WMO Secretariat. Other services in the WMO "family" are an obvious source of guidance; for instance, the Australian Bureau of Meteorology has plans on a range of time scales, which might provide useful examples to other services.

A Hydrological Service that is a component of a parent organization may have the format and process of its planning and budgeting strictly defined, and managers will follow that process. However, where there is more freedom, managers should take the need for planning very seriously. Sometimes, where resources are lacking and the Service seems to receive no recognition or encouragement, planning may seem like a pointless exercise. However, it is perhaps under these conditions that planning is most necessary, so that positive direction and an impetus for change can be developed.

A plan is not solely an internal document, but is commonly used to promote the Service, and as the basis for a performance agreement or contract between the Director and the more senior official to whom

he reports. In this case, the plan will be negotiated with the senior official, as well as among the Service's staff.

3.3 PROCEDURES FOR STRATEGIC AND ANNUAL PLANNING

Planning procedures form an essential component of management, and are dealt with in many text-books and all tertiary-level business management programmes. Hydrological Service managers should make planning an early part of their business management studies, preferably using a hands-on, real-world exercise relevant to their own Service.

Planning need not be technical or time-consuming, although it can use techniques such as discounted cash flow analysis to select the most promising of several alternative courses of action. It is, perhaps, most important to effectively involve stakeholders in the process — not just senior management, but all the staff of the Service, as well as clients and potential collaborators. A mix of top-down and bottom-up generation of ideas is desirable, facilitated by consultation with clients and other stakeholders. The Director and senior management should set the overall direction of the Service, on the basis of their understanding of the wider business and political environment. Other staff may have a more hands-on perspective on strengths and weaknesses, and personal links with clients and collaborators. Commonly, individual departments will make proposals for components of the plan, which will be incorporated, modified, or omitted according to the chosen selection procedure (see below).

A useful starting point for appraising the present condition of a Hydrological Service is the WMO/UNESCO publication of 1977, *Water Resources Assessment: Handbook for Review of National Capabilities*.

In every Service, managers will need to choose between proposed goals and objectives, and alternative means of achieving them. Comparison of alternatives may require formal financial analysis using discounted cash flow analysis or benefit-cost analysis. This is particularly the case for proposals that are in the form of specific projects, such as the upgrading of a flood forecasting system or introduction of a compliance monitoring system for a paying client. Assistance from trained accountants may be necessary, if there are none in-house.

Financial analysis is not the only means of evaluating, ranking and selecting activities or projects, although it might seem to be the most objective. Selection of performance criteria and indicators may consider matters other than financial performance, for example, contribution to national economic development goals, consistency with the legal mandate of the Service, or optimum use of the existing staff complement. Sometimes it may be desirable to hire social scientists and economists to help assess the socio-economic benefits of certain services and how they could be made more useful. Criteria for selecting activities or projects should be developed at an early

Box 4. Elements of a strategic plan — some definitions and illustrations

- **Vision — how we want our world to be**
  "All people have access to safe and sufficient water resources to meet their needs, including food, in ways that maintain the integrity of freshwater ecosystems" (World Water Vision).
- **Mission — our reason for existence**
  "The Service provides scientifically based warnings, predictions and data on weather, climate, water and air quality, to ensure safety, well-being and property of all citizens, and sustainable economic development" (example NMS mission statement in WMO/TD-No. 947).
- **Principles or values — our fundamental and unchanging beliefs**
  "To have a multi-disciplinary team approach in all work, and to continually explore ways to enhance and improve cross-discipline integration" (Mekong River Commission *Strategic Plan* 2001 to 2005).
- **Goals and desired outcomes — broad statements of what and how we want to change**
  "Allocations from major aquifers and linked surface waters do not exceed the sustainable yield" (*National agenda for sustainable water management action plan*, New Zealand).
- **Objectives and desired outputs — specific targets: measurable results, standards, and time frame**
  Maintain River Murray salinity at less than 800 EC for 95% of the time, at Morgan, for the next 15 years (*Basin Salinity Management Strategy*, Murray-Darling Basin Commission).
- **Actions — specific actions or tasks that, together, will be used to achieve our objectives**
  "The Federal Government will develop, with provincial governments, Canadian Water Quality Guidelines that are relevant to Canadian environmental conditions and encourage a uniform approach to establishing water quality objectives across Canada for the preservation of water quality" (*Federal Water Policy*, Canada).
- **Performance criteria and indicators — the measures that we will use to check progress and show when we are achieving our mission, goals, and objectives**
  For performance indicator "utilization of resource", the measurement is "volume delivered to clients is greater than 75% of volume diverted from rivers" (*Goulburn-Murray Water Corporate Plan 2000–2005*).

stage in the planning process, to ensure that they are used objectively and not retrospectively, and should be developed in consultation with relevant stakeholders. One of the emerging performance management tools that might be considered is the Balanced Scorecard method, which provides a framework for assessing the ability of an organization to reach its objectives, and developing strategic objectives that are expressed in terms of measurable parameters ("metrics") of performance. Two developers of the method, David Norton and Robert Kaplan, indicated that the metrics of performance fall generally into four core groups:

- Financial measures
- Customer measures
- Internal business process measures
- Learning and growth measures.

These core groups can be broken down into subsets, an essential principle that allows the Balanced Scorecard concept to work, because it enables the "cascading" of strategic objectives into definable operational targets and objectives that can be communicated to lower levels in the organization. The core groups and subsets of parameters can vary from organization to organization; in the case of the Australian Bureau of Meteorology, the four corporate goals ("scorecard metrics") are operational excellence, user satisfaction, staff motivation and development, and sound financial planning and management.

3.4 USE OF THE LOGICAL FRAMEWORK (LOGFRAME) IN PLANNING

A tool that is widely used in planning and designing international development projects is the project logical framework. This provides a structured approach to project design that helps to ensure that project components and outputs achieve the intended purpose of the project, and in turn contribute to achieving desired outcomes in the sector. The approach also requires targets and performance indicators for each project component to be defined, mechanisms for monitoring performance to be specified, and assumptions and risks that might contribute to project failure to be identified and addressed.

A logframe analysis should, properly, be carried out at the earliest stage of project development, to ensure that the project concept is logically structured and actually will achieve the outcomes sought. In practice, it is sometimes the last step to be taken, often because the project designer does not understand the benefits of such an analysis. Even then it can be very valuable, if the designer recognizes and addresses deficiencies in the original design.

International funding agencies commonly require that a logical framework be prepared and followed for any project. Therefore, managers of a Hydrological Service that works with such agencies should be familiar with the principles of logframe analysis and use — indeed, any manager is likely to find the analytical skills involved are well worth developing. Funding agencies provide guidance on the particular form of analysis that they favour; for example, Ausaid[7] has prepared very useful resource material on the topic.

3.5 MATTERS TO CONSIDER IN PLANNING

A wide range of matters should be addressed by managers during the planning process. These may include:

- Government policy and national goals, including those that do not seem to have an obvious direct link with hydrology, such as poverty alleviation, food security, or employment creation;
- Changing social patterns, needs and expectations, such as trends in settlement patterns (e.g. into more flood-prone areas) or growing public concern for environmental matters;
- Expressed client needs, as well as the Service's appraisal of the needs of future beneficiaries;
- The existing capabilities of the Service, and the feasibility of building capacity in particular areas of need;
- The implications of technological developments for levels of service, training, operating costs, etc;
- The activities of potential competitors;
- The interests of potential collaborators, and opportunities for cost sharing, strategic alliances to offer new or improved products, etc;
- The resources that are reasonably likely to be available for investment, operational purposes, etc.

As can be seen, managers need to be familiar with the external environment in which their Service operates, and which creates the pressures for change that the Service experiences. Managers cannot afford to focus on the "within-Service" matters with which they may be most familiar or comfortable, but must gather information about their business environment, analyse its implications for their own services and functions, and modify their plans for the future accordingly.

The planning process is likely to be iterative, before arriving at a balance between the cost of the proposed strategy and actions, and the resources that are likely to be available. Some components of a plan may appear to be fixed by outside circumstances, such as a government commitment to a monitoring programme as part of a transnational river basin agreement, or a

[7] www.ausaid.gov.au/ausguide/pdf/ausguidelines3.3.pdf contains a comprehensive set of guidelines on the application of logical framework analysis, which provides an excellent introduction to this tool.

requirement to maintain certain administrative practices and associated staff. Hydrological Service managers should, however, be prepared to scrutinize all components, to ensure that they really are necessary, or to explore more economical ways of carrying them out.

When selecting "optional" components of the plan, managers will need to rank them in terms of their relative contributions to the Service's mission and goals (conceptually, in terms of their relative benefits and costs), and of their total costs (other things being equal, a component with a large total cost is less attractive than one with a lesser cost, because it represents a larger risk and reduced flexibility). Managers will need to exercise judgement, because estimation of benefits is usually a great deal more difficult than estimation of costs. For example, the cost of a quality assurance programme can be readily defined in terms of the staff involved, documentation costs, third-party certification costs, etc. The financial benefits of an assured level of product quality are much more difficult to define, except in terms of commercial clients' willingness to pay for it.

3.6 IMPLEMENTATION — MANAGEMENT TO ACHIEVE RESULTS

A Hydrological Service's strategic, annual or other plan will be implemented by people, and managers must develop a clear link between the Service's plan and the responsibilities and duties of its staff. It is essential that managers focus the attention of their staff on the *results* that they are expected to achieve, and not simply on the *tasks* that they are to carry out.[8]

Management practice is, of course, a huge topic, and cannot be covered comprehensively in a document like this. There are many different approaches to management, and it is unwise to prescribe one or the other; unfortunately, management fashions and fads change rather quickly. Nevertheless, it is worth mentioning one long-established method of focusing on results, which is to use Management By Objectives (MBO), a forerunner of the Balanced Scorecard method (see section 3.3). The goals and desired outputs specified in the plan for the whole Service can be partitioned among the various departments, working together as appropriate. In turn, each department defines and allocates objectives to sub-units, teams, or individuals, as appropriate, in such a way that its contribution to the Service's goals and outputs will be achieved.

An example of an objective for the leader of a hydrometric field office might be: "To have all water level and flow gauging records for Mulembe monitoring station, for the full period of record 1952–2001, loaded to the Mbale office's local HYDRODAT database, processed according to the procedures defined in the Service's Quality Manual, and uploaded to Headquarters HYDRODAT archive by 30 June 2002".

Staff engaged in a routine and continuous function such as processing incoming reports from raingauge observers may feel that their role does not lend itself well to setting objectives or defining outputs (let alone outcomes). However, every function can be expressed in terms of one or more objectives, particularly in terms of defining the appropriate standards to be achieved. Different types of objective that are appropriate for particular circumstances or employees may be considered:

- Innovative objective: one in which a completely new result is achieved, such as to have prepared a final report on a project to document bed level changes in a defined reach of river during a particular time period;
- Remedial objective: one in which some deficiency is remedied, such as to have a non-functional observing station returned to a fully operational state;
- Ongoing or "commitment" objective: one that provides a firm commitment to carry out an ongoing task to a satisfactory standard. An example might be: "To have all incoming water level

[8] Various terms are used (often inconsistently) by managers, which are related to "results". These terms include "objectives", "outputs", "deliverables" and "outcomes". They are appropriate for different types of staff, who have different levels of ability to influence the work environment. *Objectives* are defined in terms of the desired and measurable result to be achieved, the particular verifiable standard to be achieved, the time frame (e.g. completion date), and sometimes the permissible expenditure (in person-hours, money spent on consumables, etc.). *Outputs* are commonly defined in terms of the products or services that staff members are responsible for providing, often in the form of a "*deliverable*" like a report or a data file. *Outcomes* are normally regarded as the ultimate benefit of the staff member's work, when the *outputs* have been taken and applied to bring about some change. To the extent that outcomes often depend on someone else using the results of a person's work, their achievement may be beyond the direct control of that person. Thus, for example, a technical officer may be responsible for the following: *Objective:* to have completed and presented a comprehensive analysis of the surface water resources of the Waipara River, to the satisfaction of the District Planning Officer, by 30 June 2003, within a total budget of $12 000; *Outputs:* (a) compiled and quality-assured data files of all available hydrometric data for the Waipara River system; (b) a report presenting hydrological statistics and appraisals of water resources availability and reliability; (c) seminar to District Planning staff on water resources of the Waipara River; (d) public meeting at Waipara township to present the study findings; *Deliverable: Report on the Water Resources of the Waipara River; Outcome:* District Planning Office staff are equipped with the best available water resources information, as a basis for planning water resources development and allocation in the Waipara River basin.

recorder charts digitized within one week of receipt, and with all digitized hourly water levels within ± 3 mm of the correct level, as demonstrated by independent re-digitizing of a 5 per cent sample of charts".

Defining objectives might seem to be a rather inflexible or impersonal method of managing an organization. This approach has not always succeeded, particularly in organizations which implemented MBO in a mechanistic fashion, without understanding that the "human factor" is in fact central to any management approach. A valuable complement to defining objectives is the practice of MBWA — "management by wandering about" — in which the Hydrological Service manager maintains frequent and regular contact with staff, to monitor their progress and assist if necessary with resolving difficulties. MBWA has many other advantages, such as helping the manager to quickly find out about potential business opportunities, the activities of collaborators, and so forth.

3.7 APPRAISAL AND RESPONSE

An essential aspect of planning is appraisal of past performance. In many countries, government agencies are required to provide an annual report to the national assembly of elected representatives, and this provides the ultimate in performance appraisal. Even where they are not required to do so, Directors of Hydrological Services should review at least annually their Services' activities, achievements, and changing environment. The findings might be presented in different ways and different degrees of detail for different audiences: brief and focusing on contributions to national life for elected representatives and clients; detailed and with a focus on technical and product/service matters for staff; comprehensive, and with an analysis of deficiencies and adverse changes in the environment for management and planning staff.

Appraisal of the performance of the entire Hydrological Service provides the basis for identifying the Service's strengths and weaknesses, and for developing a plan that builds on its strengths and eliminates its weaknesses. At the level of divisions, work groups and individual staff, performance appraisal is also an essential aspect of organizational and human resources management, because it provides an objective basis for addressing shortcomings in implementation.

Managers should appraise the Service's performance in terms of the performance criteria and indicators defined in the plan, and consider how successfully the Service is achieving its vision and mission and the government's policies and goals. Feedback from clients within the public sector and from any commercial clients is an invaluable element of performance appraisal. A Service whose products are technically first class but make little contribution to achieving government goals or meeting commercial clients' needs is unlikely to receive consistent support or funds during future planning periods.

In terms of the planning cycle, appraisal of performance during a given planning period will be carried out in preparation for drafting the plan for the following period. Managers also should monitor performance more regularly, to ensure that implementation is progressing towards a fully successful result at the end of the period. For an annual plan, formal monitoring is likely to be on a monthly basis; for a strategic plan, quarterly or six-monthly monitoring is appropriate. Monthly reporting against objectives and budgets by work groups/cost centres (see section 5.3) provides a basis for rapidly assembling an appraisal of the performance of the entire Service, for the full reporting period. If MBWA is practised, informal monitoring is even more frequent, and will identify shortcomings promptly and enable them to be remedied before a formal monitoring date arrives.

Performance appraisal, in conjunction with a SWOT analysis, will enable new goals and objectives to be defined for the coming planning period. It might also lead to modifications in the Service's portfolio of products and services, and even to refining the Service's vision and mission statements.

CHAPTER 4

HUMAN RESOURCES MANAGEMENT

It is conventionally stated in most organizations that "our most important resource is our people"; managers of successful Hydrological Services act as if this were true. As the role and functions of a Hydrological Service evolve, the type of staff that the Service needs also may change, and so may the style of management that is appropriate for them. Hence, for instance, a Service that is "modernizing" or developing value-added products is likely to require more professional staff who are skilled in information technology or computer analysis, and fewer sub-professional staff with traditional field skills. Staff of this type are likely to give of their best with quite different styles and levels of supervision.

4.1 RESPONSIBILITIES OF MANAGERS

The long-term success and health of a Hydrological Service rests in the hands of the Director and managers. They require skills in a number of areas to discharge their responsibilities, and the Director should ensure that his management team together has:

- Political and administrative skills to function successfully in the public service environment, or as a state-owned company;
- The ability to monitor and understand the business environment and translate that into planning the Service's programmes;
- Skills in all areas of business management — human resources, finances, capital assets, product quality, information technology — as appropriate to the Service;
- Skills in leadership and motivation;
- Marketing and communication skills required to develop effective relationships with clients, the public and elected representatives, investors/donor agencies, and the "owner";
- The technical and scientific knowledge required to ensure that the Service has the technology it needs;
- The ability to represent the Service and the national interest in international forums.

The Director should place at least as much emphasis on management training as on technical capacity-building.

4.2 STAFF SELECTION: PERSON SPECIFICATION AND COMPETENCIES

Since an organization's most important resource is its people, managers should select their staff with great care. Managers should appoint or reassign staff to meet the demands of the Service's strategic and annual plans, so that work groups have the human resources they need to achieve the objectives that have been assigned to them. A Director should take seriously the need to ensure orderly staff succession — that is, identification and preparation of junior staff to move to progressively more responsible levels, as the most senior staff retire. A combination of experience and training will probably be needed to suitably prepare such staff.

In preparing to select a new appointee or to promote or reassign an existing staff member, a manager should prepare a "person specification" that defines the qualifications, experience, and "core competencies" that the person will need in the intended position. Competencies are the skills, personal qualities and other attributes that determine the ability of a person to successfully achieve defined objectives and standards of performance. Competencies go well beyond the technical skills that are required. They may include, for example:

- Demonstrated ability to manage projects and to lead a team;
- Demonstrated ability to interact with clients and collaborators;
- A good grasp of foreign languages, if working in a Service which shares an international river basin;
- Demonstrated ability to work without supervision and exercise initiative when working away from the home office;
- Demonstrated willingness to undergo additional training and learn new skills.

A person is normally appointed to a particular position, but in defining the competencies required, the manager should bear in mind likely future progression to other positions. The manager also should remember that a Service's staff generally must work together as a team, and that a well-balanced team requires different types of people. A degree of judgement therefore will be necessary to select a new member of a work group whose qualities will complement those of existing members.

Managers should appraise all the applicants for a particular appointment in terms of exactly the same set of competencies. Normally, the most important one or two competencies are used first to select a shortlist of five or six candidates. A useful method of comparing shortlisted applicants for an appointment is to use an interview form, in which each applicant is briefly described and ranked in terms of each specified competency (see annex 2). The rankings can then be transferred onto a matrix that includes all

applicants, for quick comparison. Summation of ranks on a numeric scale (e.g. 1 to 4, indicating the degree to which the person satisfies the competency) provides an even more rapid means of comparing people. Of course, selection of the preferred applicant requires careful assessment of the applicants' relative merits as displayed in comprehensive interviews, meetings with existing staff, and consideration of the relative weighting of the various competencies.

4.3 CONTRACTUAL ARRANGEMENTS

A contract between the Hydrological Service and an employee is an essential basis for effective and fair human resources management. Legal requirements with regard to employment contracts vary from country to country, and managers of Hydrological Services should be very familiar with the employment-related legislation under which they operate. For a Hydrological Service that is within the government, the form of contractual arrangements for employees is normally specified. There is little or no flexibility for individuals in junior, technical or sub-professional positions to negotiate contracts, although many countries now permit negotiation of individual contracts for senior managers. Parent organizations normally define conditions of employment relating to leave, disciplinary action and dismissal, redundancy and pay scales, and may also specify other matters, such as a requirement for all staff to affirm a commitment to certain standards of behaviour.

The Director of a Hydrological Service that does not have closely specified arrangements for employee contracts should seriously consider developing them. Annex 3 provides an example of a contract for a Regional Manager in a large Hydrological Service. The particular format that is appropriate in a given country may be considerably different, and legal advice is likely to be necessary. However, annex 3 might provide some ideas for Directors about the responsibilities and competencies that they expect of their senior staff.

The main benefit of a contractual agreement, for both employer and employee, is that the relationship is specific and transparent, so that any shortcomings on either side can be addressed in an objective manner. People's jobs are extremely important to them, and disagreements with the employer can become very serious matters. The manager should take all possible steps — including negotiation of an employment agreement or contract — to handle personnel matters so that disagreements do not become disputes. However, if they do, a contract provides a sound basis for dispute resolution.

An area that requires particular attention is attendance at work. Management expectations must be clearly defined in employment contracts, and must be monitored and enforced. Flexible arrangements are acceptable — indeed, they are preferred in many cases, particularly for field staff whose working days often may be very long. It is advisable for all staff to complete time-sheets that accurately record their hours of work; this is essential if they are engaged in cost recoverable or commercial work, for which a client will be charged.

An aspect of contract management that is becoming important in some Services is where some part of the work is outsourced — carried out by an outsider, working under contract. Such a contract must meet the accepted legal standards of the country, and Hydrological Service managers should take legal advice if they are not competent in this area. Outsourcing can be applied to long-term routine work (e.g. servicing one or more hydrometric stations), particular operations for which the Service does not have the capacity (e.g. processing a large backlog of unprocessed data), and, in general, work that the management calculates can be provided more economically outside the Service. Many Services have used outsourcing for decades, without applying the term, for instance by using local observers to service rain gauges and staff gauges. Outsourcing has many advantages, such as reduced overhead personnel administration and other costs; increased ability to control quality of work, through tightly specified contract conditions; access to skills that the Service could not afford to maintain in-house; and increased flexibility to manage the Service's permanent staff. There are, of course, disadvantages, not least of which is the need for hard cash to pay the contractor.

4.4 JOB DESCRIPTIONS AND OBJECTIVES

A job description for every member of staff is an essential management tool. They provide a clear statement of what the Service expects of an individual, and a basis for setting personal objectives, carrying out performance appraisals, and identifying training and personal development opportunities. Annex 3 includes an example job description, as part of a contract for the Manager of a regional office in a large Hydrological Service. Many formats of job description are possible, but they commonly include the following:

- Title and location
- Position on the employment and salary scale
- Line of reporting to senior officer
- Responsibility for more junior officers
- Functional relationships with other officers, clients, cooperating agencies, etc.
- Key result areas and principal objectives
- Key tasks and expected results.

An indicative job description will be required when appointing a new person to a position. However, the manager may wish to have the staff member revise the job description, in the light of that person's understanding of the position, as a basis for renegotiating key tasks and expected results. A job description should be reviewed annually, to ensure that the position makes the greatest possible contribution to the Service's objectives. Standard classifications of personnel, such as those promulgated by WMO, may provide some assistance in drawing up job descriptions. However, in most respects it is preferable for the person that will do the job, and the manager that must oversee it, to prepare a job description that relates to particular circumstances.

A Service's strategic, annual and other plans may be implemented by allocating objectives to departments, work units and teams, and thence to individuals (see section 3.3). Individual staff members' annual objectives should be closely related to the principal objectives and expected results defined in their job descriptions; if they are not, there is a significant risk of misunderstanding and non-performance. If objectives are allocated annually, in accordance with an annual plan, it provides an additional reason for the annual review of job descriptions at the same time that objectives are agreed.

4.5 PERFORMANCE APPRAISAL

Job descriptions and objectives provide the starting point for appraisal of staff performance, which is just as important as planning and strategy development to managers and staff of a Hydrological Service. In many organizations, performance appraisal leads on to preparation of staff development plans, for individual staff members, for work groups (e.g. a work group that is expected to take on new responsibilities), or for the entire Service. Staff development plans will, of course, be used for future appraisals of performance, in part to ensure that their proposals have actually been implemented, and to evaluate their success as tools for enhancing performance.

Various approaches to staff performance appraisal can be followed, but some key principles are that:

- The process should be consultative, with formal but unhurried meetings between employer and employee;
- The process as far as possible should provide the employee with the opportunity for self-appraisal;
- The appraisal should be based on objectives or other criteria that were agreed before the commencement of the period of employment that is being appraised;
- The appraisal should be documented in writing, and filed;
- The appraisal should be used primarily as a means of finding ways of enhancing future performance, rather than for penalizing past poor performance.

Annex 4 presents a form that could be used in a fairly thorough performance appraisal. The process would be as follows:

1. Reviewer and staff member develop a list of agreed objectives at the beginning of the period of work (section A).
2. At the end of the period of work, the staff member appraises in writing his own performance against the objectives (section B1), lists training and development that he believes is required (section C1), and outlines career development aspirations (section D1). The form is then passed to the reviewer.
3. The reviewer appraises in writing the staff member's performance against the objectives (section B2), and comments on the staff members' competencies in the position (section F). The form is then passed to the staff member.
4. Staff member and reviewer meet to discuss their appraisals. The results of their discussion are summarized during the meeting in sections C2, D2 and E.

The manager should ensure that any decisions reached, e.g. regarding training, re-assignment of duties, etc., are incorporated into the staff member's objectives prepared for the following year, and/or in a revised job description. It is worth emphasizing here that the appropriate response to shortcomings in performance or competence need not necessarily be to arrange further training. The possibility should be recognized, for instance, that a person is inherently unsuited to a particular position, and should be reassigned. Other possible reasons might be family circumstances, obstructive colleagues, defective equipment — even inadequate management. Managers should be open to considering all possible reasons for shortcomings, and the range of responses that they imply. On the other hand, they should avoid becoming involved to an inappropriate extent in staff members' affairs.

When human resource management tools such as job descriptions, setting of objectives, and performance appraisal are introduced, staff are commonly rather resistant and suspicious. However, a manager is likely to find that, with persistence over one or two years, and with sensitive and constructive use of the tools to enhance the staff members' prospects, cooperation will increase. It cannot be overemphasized that any management tools must be used with understanding, or they are likely to be of little value, if not counter-productive. This implies that the Director and

Managers of a Hydrological Service should ensure that their own performance meets the Service's needs.

4.6 TRAINING AND CONTINUING EDUCATION

The training and continuing education of staff is of critical importance to both management and staff members; everyone's goal should be for the staff to be able to make the greatest possible contribution to achieving the Service's mission. Strictly speaking, perhaps the term "training and education" is undesirable, because these are means to an end, i.e. enhanced competence and performance, rather than an end in themselves. However, the alternative term "performance enhancement" is unfamiliar and a little pretentious, so it will not be used here.

Training and education should be managed in a structured way, perhaps by preparing a training plan for the Service, or for individual staff members. They should be a response to training needs analyses that are part of the performance appraisal process (see section 4.5). Training needs analyses may also be carried out independently, for example when managers are considering new procedures, products or services, an organizational restructuring, or some other response to the changing business environment, and they need to match the competencies that will be required with those possessed by existing staff.

Managers should resist allowing their staff to participate in ad hoc training "opportunities" (e.g. the many "capacity-building" workshops and conferences organized by donors in developing countries) that do not relate to the staff's defined training needs or to their job description. It cannot be over-emphasized that the driver for training that will be provided by the Hydrological Service should be formal appraisal of job performance and competencies. The staff member's career aspirations should also be taken into account, if they are consistent with the Service's goals.

The area of education and training is extensive; much useful guidance has been provided by various WMO and UNESCO-IHP publications (see references to WMO and UNESCO publications in the bibliography), and the present *Guide* only touches some key points.

There are many different types of education and training, and the appropriate ones in any particular case should be selected to best deal with the performance shortcoming or opportunity for personal development that has been defined. A Manager should be aware of the aptitude of a particular staff member for training; realistically, for example, older staff often have difficulty in getting to grips with new technology, and may only do so (if ever) with long-continued practice under close supervision. Some of the merits of different types of training are given below.

Hands-on, on-the-job training
This is generally well suited to technical functions. It helps the employee to develop new skills in the context of familiar surroundings and work, and its relevance can be more easily grasped (this is important for the trainer, too). Hands-on training is a very effective means of learning new skills — "doing" is better than just "seeing or hearing". On-the-job training is usually more economical for the Service, because travel and accommodation costs are minimized, and several people can usually be trained at the same time. Staff with family and other responsibilities who do not wish to be away from home may prefer on-the-job training.

Training as a component of a development project
Training may be provided as a component of a development project. Water-related projects funded by international investors and donors in developing countries should include training of national counterpart staff as part of the project. Managers of Hydrological Services should do everything they can to influence investors and donors in this respect, because participation in such training is generally very beneficial. It has the same characteristics as on-the-job training noted above. It has the added advantages that it contributes to a definite national need, there is likely to be a sense of urgency, staff learn to work under pressure, more generous resources are likely to be available, and the outputs of the project (e.g. a comprehensive assessment of the water resources of a particular river basin) will make a valuable contribution to the Service's own information base. There are, it is true, drawbacks. The Service may find that its best staff are involved in special projects and that the remaining staff are unable to maintain the routine work load, and project staff may be dissatisfied with returning to normal duties and they may leave.

Job exchanges or attachments/secondments
These are a longer-term version of on-the-job-training that involves working in a different organization (or different office in the same organization). It has similar advantages to on-the-job training, with the added attribute that the participant's horizons are widened by exposure to practice in a different location. It can be rather time-consuming to organize, generally benefits only one or two people at a time, and can be costly unless *per diem* costs are tightly controlled.

It is appropriate particularly for staff with no family responsibilities.

Seminars, short courses and workshops
These are well suited to senior technical and professional functions, particularly if they contain a significant component of practical work: group analysis of an issue, role-playing, etc. They often provide an opportunity for participants to be exposed to the diverse ideas of other participants, to practice public speaking and interaction with others (especially in a second language, in the case of international events), and to hear about the latest developments in a field. They tend to become talking-shops that produce nothing other than a pile of documents; the Manager must ensure that staff permitted to attend an event have or will have responsibilities in a relevant area of work, and will use the newly gained knowledge.

Conferences
Attendance at conferences, especially international conferences, is often eagerly sought after by staff. Conferences are suitable in particular for senior professional or scientific staff who have the ability (in terms of language, personality, and knowledge) to interact effectively with other participants. The Manager should be convinced that the conference is clearly related to the staff member's duties, and that competency or motivation will be enhanced by attendance. A good way of maximizing the benefits is to require anyone attending a conference to provide a report, and preferably a seminar to other persons who might be interested.

Higher education programmes
Training courses and higher education programmes leading to some form of qualification are, perhaps, the "ultimate" in staff training and education. Because they may involve a long-term commitment of staff time, and because fees, allowances, etc. are likely to be costly, the benefit to the Service must be very clearly established. They are particularly suited to preparing a staff member for a significant change in duties, probably to a more senior or more specialized level, such as a management position. The staff member is, reasonably enough, the principal beneficiary of this form of training, and career prospects should be significantly enhanced by completing a course of tertiary study, such as a master's degree. This may result in the staff member taking other, better-paid employment. Attempting to prevent this with a condition that the staff member must remain with the Service for, say, a year after completing a course of study is unlikely to be very successful.

Self-training
Self-training, for instance by taking a correspondence course in management or participating in evening classes, can be very beneficial in equipping staff for promotion and/or for achieving their career aspirations. A manager should actively encourage and assist staff members to pursue self-training, for example by permitting use of the Service's facilities, offering study leave of a few hours per week, or assisting with fees. The Service may receive a significant benefit at little cost, although as always the manager should be satisfied that the training is relevant to present or foreseeable duties. Often, a student can use the Service's own needs as part of the coursework, for instance by preparing a marketing plan as a project in a marketing course.

Sources of education and training are, of course, different in different countries, and Hydrological Service managers should inform themselves of the opportunities offered by tertiary educational institutions and private sector providers. With the rapid growth in distance education, particularly in management and business, there are many opportunities for study with international providers, which may establish branch campuses or strategic alliances with institutions in other countries. A number of professional organizations, in business-related areas[9] and in specific disciplines such as engineering[10], also have developed extensive study syllabi and materials. They may be able to provide introductions to training institutions that use their material. For both national and international programmes, it is important to appraise the quality of instruction, the nature of the syllabus, and the acceptability of any qualifications that are offered by providers. Training for public servants in administration and management is often provided by a staff college or similar national institution.

Some agencies in the United Nations system or other international agencies provide resources to the international community as a whole. WMO provides a

[9] An example is the American Management Association, which has published guidance material such as *The Project Management Workshop* (James Taylor, 2001) and *The Team-building Workshop* (Vivette Payne, 2001). AMA websites are www.amanet.org and www.amacombooks.org. Another example is the UK Chartered Institute of Marketing, which has produced an extensive range of handbooks ("Official CIM Workbooks") for self-study; the website is www.marketingonline.co.uk.

[10] For example, Engineering Education Australia (EEA: http://www.eeaust.com.au/), a wholly-owned subsidiary of The Institution of Engineers Australia, supports the Institution's Continuing Professional Development activities, by providing opportunities for "life-long learning". It offers undergraduate and post-graduate education and training courses and services in a wide range of relevant areas, in Australia and in other countries, using distance education in association with a number of universities. Most of the distance education units are available as single unit enrolments, and unit notes are available for purchase as "do-it-yourself" guided learning packages. Other services offered by EEA include public and customized short courses, and an online searchable database of learning opportunities such as conferences, short courses, workshops, seminars, and exhibitions.

certain amount of training through the Education and Training Programme, Regional Association Working Groups on Hydrology, and Hydrological Operational Multipurpose System (HOMS) training courses. Regional Hydrological Cycle Observing System (HYCOS) projects also provide substantial training opportunities, as systems are implemented. Hydrological Service Directors and staff normally should be aware of and be involved in such opportunities in their region. Details of forthcoming events can be obtained from the WMO Secretariat or website[11] and also should be provided to each Member State's Permanent Representative and Hydrological Adviser. The UNESCO-IHP has developed a considerable amount of technical training material in the past (see references to UNESCO publications in the bibliography), but training events are uncommon nowadays. Professional and scientific staff are likely to be aware, through their personal networks, of seminars, workshops, conferences etc. that may be of interest.

An individual Hydrological Service may need to develop its own training programme, for special purposes (e.g. introduction of new procedures) or because no external providers are available. Managers with limited experience of designing, planning and running training programmes should seek professional advice or assistance, to ensure that the result meets expectations. An economical approach is to contract a consultant or academic as a part-time training officer, to design and facilitate training interventions. Hydrological Services or NMHSs in neighbouring countries also may be a source of assistance in this respect.

4.7 EMPLOYMENT CONDITIONS: HEALTH AND SAFETY

Conditions of employment are often defined in a collective employment agreement between the Hydrological Service or its parent organization and the staff organization (labour union). Where individual staff members have their own employment contracts, conditions of employment will be included.

For a Hydrological Service, workplace safety and occupational health are important issues because of the nature of the work, and are worth highlighting. Health and safety are covered in the WMO *Technical Regulations,* Volume III – *Hydrology*, and in Chapter 18 of the WMO (1994) *Guide to Hydrological Practices*. In many countries, the Ministry of Labour or some other agency also may issue guidance material on hazard management, in the context of national law. The management of a Hydrological Service should ensure that they are familiar with all this material, and have taken appropriate steps to assure occupational health and safety of staff in their Service.

The first steps are to (1) appoint a Health and Safety Officer and allocate adequate resources to carry out the task, and (2) have the Officer carry out a comprehensive appraisal of the work-related hazards to which staff are exposed. Field hydrology is inherently a dangerous occupation, with risks ranging from being involved in road traffic accidents through to contracting water-related diseases such as malaria. Office hydrology is less hazardous, but a badly managed office can still present significant risks — electric shock from faulty cables, accidents due to tripping over worn floor coverings, illness contracted because of inadequate sanitary facilities, and so forth. The Service's management has a moral, and in many countries a legal, obligation to minimize their employees' exposure to workplace hazards. A hazard appraisal provides the basis for a hazard management strategy, the design and implementation of which is the key responsibility of the Health and Safety Officer.

4.8 STAFF DISCIPLINE

Managers should deal with shortcomings in staff performance or behaviour carefully, firmly and objectively, bearing in mind the possibility that a shortcoming in staff performance may be evidence of a failure in management. They should first establish (with respect to the employee's contract, job description, and objectives) exactly what the shortcomings are, attempt to determine the causes (using the performance appraisal procedure or a similar approach if urgent action is required), then develop remedial action. Some failings may be completely unacceptable, such as theft, physical abuse of other staff, or sexual harassment, and will require immediate dismissal from the Service. Others, such as consistent failure to follow defined procedures or to observe standard work hours, may be due to employee laziness, lack of training, or inadequate supervision, and will need to be remedied in an appropriate way. The manager should provide assistance in correcting the shortcomings. Normally, one or two verbal warnings are issued, and subsequent warnings are given in writing and filed. If shortcomings persist after two written warnings and appropriate assistance, then disciplinary action should commence.

The Manager must document shortcomings and remedial actions, using either the performance appraisal system or files, and must ensure that employees are fully informed and have the opportunity to record their points of view. If the shortcomings continue, the

[11] The WMO website, at www.wmo.int, provides information about WMO publications, forthcoming events, WMO programmes (including the Voluntary Cooperation Programme, and the Hydrology and Water Resources Programme), and links to other websites.

manager will need to be able to document the "case history", because dismissal may eventually be necessary. Employees' contracts should define procedures for dismissal, such as the issuance of written warnings and instructions for remedy. They should be followed scrupulously, to ensure that the process and outcome are fair, and to avoid legal action.

There is a temptation to avoid the unpleasantness of disciplinary action, but allowing poor performance or unacceptable behaviour to continue uncorrected is likely to be demotivating for all staff. In some countries formal disciplinary action may be regarded as culturally inappropriate. The Director must be the final judge on this matter, and may prefer informal ways of encouraging a staff member to address his shortcomings or depart with dignity. The important issue is that the problem is addressed effectively, fairly and as quickly as possible.

CHAPTER 5

FINANCIAL MANAGEMENT

Financial management has come to be a basic aspect of a Director's work, as governments everywhere impose more stringent financial disciplines. Normally, financial management procedures are defined by a Hydrological Service's parent organization, with the Director and/or selected management staff receiving appropriate training in those procedures. Nevertheless, a Director should make the effort to develop a much more sophisticated grasp of financial management than the minimum required. Where resources are limited (where are they not?), skill in managing those limited resources can have a considerable influence on what can be achieved with them. Training in financial management by distance learning, attending a local business training institute, or at the very least by self-study of high quality learning materials, will almost certainly pay dividends for the Service.

5.1 ACCOUNTING PRACTICE

Accounting procedures in the public sector are generally prescribed by government, and will have to be followed by a Hydrological Service that is, or is part of, a government department or state-owned enterprise. Furthermore, accounting practice in the private sector is in many countries well defined, most likely by a National Institution of Accountants or similar professional body that is responsible for registration of practitioners and setting of national standards. Where there is not a national institution, accounting practice is likely to follow that promulgated by an institution in a larger country, or International Accounting Standards. These institutions usually provide handbooks, standards, training material and other assistance, and this may be publicly available through bookshops. A Director of a small Hydrological Service should ensure that he or a senior member of the management team understands accounting practice; a larger Service can be expected to have a qualified accountant in charge of financial affairs.

A Hydrological Service must scrupulously follow accepted accounting procedures. This is to ensure transparency and accountability: that is, to ensure that the Service's financial accounts are clear and comprehensible, resources are spent for the purposes for which they are provided, responsibilities for financial transactions can be identified, and corruption — unfortunately a fact of life in some countries — has no opportunity to siphon off funds. Transparent and accurate accounting is particularly necessary where a Service receives revenue from international organizations such as development banks or bilateral aid agencies. It is also necessary where a Service offers products and services in competition with private enterprise firms, because it must be able to demonstrate that it is operating in "competitive neutrality" — that is, it is not relying on unfair competition permitted by special advantages such as tax-free purchases of vehicle fuel, or cross-subsidization from other parts of the parent organization. Formal procedures to ensure that transparency is achieved are necessary, and their effectiveness should be reviewed regularly.

5.2 SOURCES OF REVENUE

A major concern of managers of a Hydrological Service — indeed, any organization — is the sources of income or revenue required to maintain the Service's operations and assets. In most countries, the government has been and will continue to be the predominant source.

There has been a world-wide trend for governments to require or enable public sector agencies to find sources of commercial revenue additional to allocations from the national budget. Some Services have made good progress in identifying non-governmental clients, or clients within the public sector that are willing to purchase products and services that meet their specific needs (see section 2.3). Value-added products and services are the most profitable; sales of data, an unprocessed commodity, are not. A Service should focus its energy on seeking new sources of revenue only in areas that are consistent with its primary mandate, and where a good (ie. profitable) business case can be made.

Commercial work requires a legal mandate, and the managers of Hydrological Services that engage in commercial activities should be familiar with national laws and regulations relating to commerce. Commercial work can be a real minefield for the inexperienced, particularly for public sector agencies that are competing with private sector providers. The Hydrological Service must be able to demonstrate that it is competing on a "level playing field" and does not exploit an unfair competitive advantage. An advantage could be gained, for example, from a monopoly on access to publicly funded assets such as a national database, no requirement to pay tax on profits, the ability to obtain preferential government rates for equipment and consumables, and in many other ways. These can all be addressed, for example

by charging commercially accepted rates for vehicle travel. The Hydrological Service will also need a clear policy on what is done with revenue and profit. The danger is that, on the one hand, revenue is paid into the government's consolidated fund, so that there is no benefit to the Hydrological Service, and on the other that the Service operates in a financially more favourable environment than a private sector organization.

In most countries, there are relatively few non-governmental clients for value-added products who are sources of significant commercial revenue. The effort and cost of finding them may not be justified by the returns. This is especially the case in developing countries, where the pressure on a Hydrological Service to find supplementary sources of revenue is likely to be greatest. Most of a Hydrological Service's products and services, and the databases and other assets that are needed to provide those products and services, are merit and/or public goods for which the government is the logical purchaser. A Hydrological Service nevertheless may be required to recover some of the costs of its public services and products.

Economic theory indicates that the appropriate approach to cost recovery is to charge for the direct and associated overhead costs of providing the product or service (including the administrative cost of recovering costs, as well as depreciation of the assets used). Where the product or service uses a hydrological database or other asset provided at public expense, it is economically inefficient to attempt to charge part of the cost of providing that asset. Intending clients strongly object to such charges and refuse to use the service at all — this results in under-utilization of the public asset, in the use of inferior alternatives (such as guesswork), and hence in economic inefficiency. The experience of Hydrological Services that have attempted to charge for data generally confirms this. Increasingly, it is seen as preferable to provide completely free (unrestricted, and at no charge) public access to data via the Internet. This reduces the cost of meeting data requests, and may be of value in enhancing the Service's reputation.

The information-gathering role which most Hydrological Services play is linked only indirectly to major sources of potential revenue, such as water-use fees. To direct some part of a fee collected for a particular purpose to provide funding for a Hydrological Service is likely to be regarded unfavourably as cross-subsidization. The Service may be able, however, to recover the costs of providing the information required in the process of setting water use and other fees. For example, an applicant for a permit to extract water or to discharge effluent may be required to provide the permit-granting authority with information on the likely environmental effects, and the Hydrological Service might be the logical provider. (If it is the required provider, then great care must be taken to provide an efficient service, and to not abuse the position.) Cost recovery requires legal authority, and the scale of charges must be justifiable in terms of legitimate costs.

A government may choose, as a means of imposing financial discipline and achieving maximum transparency, to administer funds in ways other than making an allocation in the national budget. These include:

- Providing funds through a quasi-non-governmental organization such as a National Research Council, which allocates funds on a competitive basis and/or in terms of defined national needs for information;
- Establishing the Hydrological Service as a state-owned enterprise, and administering public funds on the basis of a contract for defined outputs and services (if all else fails, the contract could be awarded on a competitive basis, possibly to another provider);
- Introducing a "government contract" between the appropriate Minister and/or the Minister of Finance and the Director of the Hydrological Service, to provide defined outputs and services.

The Director of a Hydrological Service is unlikely to have much influence on such a decision, which will reflect overall government policy. He should, however, seek guidance from other directors in similar circumstances, either from other organizations in the same country or from other Hydrological Services in different countries, and attempt to negotiate contractual arrangements that provide the most favourable conditions for future work.

An important source of revenue for some Services, principally in the developing world, is funds from international investors and donors to support capacity-building — institutional development, staff training, introduction of new technology (see section 9.3). The WMO's own Voluntary Cooperation Programme provides one channel for seeking specific and small-scale assistance; details of the Programme and procedures for application are available from the Secretariat or the WMO website. There is also a WMO Trust Fund for hydrology and water resources, which was set up to support projects on particular topics. WMO/TD-No. 947 lists a number of international sources of funding that may be relevant to Hydrological Services; a Director normally will be required to seek funds from such sources through the appropriate government ministry.

Finally, it is worth recalling that a way of increasing effective revenue is to reduce costs, for example by

moving from paper-based to Internet-based dissemination of information. Of course, the Service should ensure that product or service quality (from the user's perspective) is not reduced, and preferably is enhanced.

5.3 BUDGETING AND MONITORING OF FINANCIAL PERFORMANCE

Budgeting should be an integral part of annual planning. As the Hydrological Service defines its proposed programme of objectives and activities, it will need to define the associated costs, and through an iterative process revise the proposed programme so that its cost is consistent with likely revenue. Just as it is desirable for operational staff to be involved in annual planning, they should also be involved in setting the budget — they will, after all, have to work with and within it.

In Hydrological Services that are part of the public sector, budgeting procedures and timetables are normally strictly defined. The annual planning process must therefore be timetabled accordingly. The Hydrological Service will probably be required to submit its budget in a defined format to its parent organization, in terms of specified line items in a chart of accounts. The managers of the Service should ensure that the internal process of preparing a budget provides an end result that can readily be converted into the required format, but they may prefer to use a format that is more appropriate to the Service's business, or is simpler to use.

The internal budgeting process should be carried out in a very tightly prescribed way, using an absolutely fixed format. It is best to provide managers and supervisors of all work groups/cost centres[12] with a template on a spreadsheet, and a full set of definitions, instructions, and deadlines. Use of the template should be pre-tested by representative users, as well as by the accountant who prepared it. Experience shows that the slightest ambiguity in instructions will result in different interpretations and inconsistent data. The process should be started well before the Service is required to submit its consolidated budget, to provide time for clarifications, fixing errors, and revising cost estimates to achieve consistency with the annual plan and likely revenue.

The completed budget should be a key component of the annual plan, and a means of monitoring performance against the plan. To do this, all managers and supervisors with responsibility for work groups/cost centres must be provided with financial reports that relate to their cost centre. Normally, this is done monthly, and on a very tight timetable. Responsible managers and supervisors should be required to report back on the financial reports for their cost centres, using a standard format based on a spreadsheet template, and to a strictly enforced deadline. They should be required to explain significant variances between actual and budgeted figures, provide projections of future performance, provide estimates of year-end results, and comment on any other matters that might affect performance. It is preferable to request a financial report as part of a monthly report that comments on all aspects of the work group's activities and results. Again, such a narrative monthly report should be in a standard format, perhaps based on a template in a word processor package.

An important task of a Director is to report on the Service's annual financial performance, in comparison with the agreed budget. The procedure and format for doing so is normally defined by the parent organization, and normally will be in the hands of qualified accountants. However, Directors should be closely involved in the process of preparing the annual financial report, at the very least so that they are able to explain it to the person to whom they report. A financial report can, in addition, be an extremely revealing document. For example, it enables Directors to compare the costs of the various components and programmes of their Service with the contribution that each makes to the Service's outputs. Such an ability can be extremely helpful in allocating scarce resources, or in seeking cost savings in programmes that appear to be excessively costly.

5.4 ACCOUNTING FOR STAFF ENTITLEMENTS

Normally, the largest item in a Hydrological Service's budget is staff salaries. Staff are an asset to the Service, but in some circumstances they may also be a financial liability. It is often difficult, if not impossible, to dismiss staff. A Service that has surplus staff, or staff who are not able to carry out the tasks that the Service requires, may find itself with a large salary bill and an inability to provide products and services that will bring in revenue to pay it. In some governmental administrations there is an incentive to maximize the number of staff in a department, but Directors of Hydrological Services should be very careful to match the number and type of staff to the quantity and type of work that is expected in the future.

[12] A cost centre is a sub-unit within an organization for which all direct operating costs and revenues are transparently accounted. A profit centre is a sub-unit for which all aspects of financial transactions are separately and transparently accounted, so that its "bottom-line" profit or loss can be determined.

An aspect of salary payments that often receives inadequate attention from managers is the value of staff entitlements, in particular the various forms of leave, such as annual leave, sick leave, and "long service leave". Such entitlements can represent large liabilities to a Service, that must be paid for at some future time. For example, if a member of staff does not take all his annual leave in the year(s) that it is due, but accrues it (carries it over to following years), the Service in effect is indebted to that employee for the value of the leave that has not been taken. Should the employee resign before taking the leave, the Service will be obliged to pay the salary value of that leave. If, on the other hand, the employee takes accrued leave in a block (for example in order to assist a family member to build a house), the Service will be obliged to continue to pay salary while receiving no benefit (in terms of work output), and may need to employ a temporary replacement. The Director of a Hydrological Service should be familiar with the nature and implications of such financial liabilities, and should develop policies[13] to ensure that they do not threaten the Service's ability to pay for other operating costs. In some Services, the annual financial reports nowadays tabulate staff entitlements as a major component of assets and liabilities.

[13] For instance, a policy that employees are not allowed to accrue annual leave from one financial year to the next, except for a specific and agreed purpose.

CHAPTER 6

ASSET MANAGEMENT

In simple terms, the purpose of asset management is to ensure that the value of the organization's assets is maintained, and therefore that the organization continues to be a "going concern" that has the resources that it needs to do business. It is, therefore, of considerable importance to all managers and staff of a Hydrological Service. Asset management basically involves acquisition, replacement, maintenance, protection, and disposal of assets. A large Hydrological Service may consider it necessary to employ an Asset Manager, whose team may have associated responsibilities, such as occupational health and safety, vehicle maintenance, or energy management.

6.1 TYPES OF ASSET

For accounting purposes, assets are usually defined as items that have a useful life of more than one year (that is, they are not expensed in the year of purchase), and are subject to depreciation over a period of years. It is likely that the national tax authority in any country will have defined a standard period over which assets of a given type must be depreciated, for tax purposes. For example, a desk-top computer may be depreciated over a period of three years; that is, it is estimated that desk-top computers have a useful life before replacement of three years, although in practice many individual businesses (or Hydrological Services) may keep a computer for longer. A standard list is likely to be available only for common types of assets, however, and is unlikely to include, for instance, hydrometric field stations or large databases.

An alternative definition of an asset is one that has a purchase price greater than some sum, e.g. the local equivalent of US$ 250.

The Director and Finance Manager of a Hydrological Service will probably be required to follow definitions and basic asset management practices (e.g. for disposal) stipulated by the parent organization. The Director nevertheless will probably wish to have in-house definitions and practices as well, to meet the distinctive needs of the Service. The most common types of asset possessed by a Hydrological Service include:

- Field observing installations: the fixed assets (weirs, radio masts, etc.) as well as movable assets (recorders, dataloggers, solar panels, etc.);
- Mobile equipment and instruments (field radios, water quality meters, etc.);
- Vehicles;
- Buildings and other fixed assets (e.g. current meter rating tank);
- Office equipment and furniture;
- Computer equipment;
- Library and other information resources;
- Databases;
- Knowledge of the staff (intellectual capital).

It is rather more difficult, but not impossible, to place a monetary value on the last two items, but there is no question that they are very important.

An up-to-date, accurate register of assets must be maintained, preferably in a computer spreadsheet or database format. This should include such details as:

- Description;
- Asset identification number;
- Date and cost of purchase;
- Location and responsible officer or cost centre;
- Depreciated value;
- History of maintenance, damage, repair etc.;
- Date of disposal and sale price.

An asset register can serve a variety of purposes, including identification of types of asset that have excessive maintenance costs (e.g. a particular brand of vehicle), or calculation of the costs of theft in comparison with the likely cost of insurance. Maintenance of an asset register should be an important item in the job description of an officer in the accounts department, or of the Asset Manager.

6.2 CAPITAL BUDGETS

Budgeting for the acquisition and disposal of capital items, or assets, is of great importance for a Hydrological Service, and may create considerable competition among managers. Assets are, by definition, those with a high initial cost and long lifetime, so that their purchase represents a substantial commitment and a commensurate risk to the Service. (It should be noted, in passing, that an agreement for long-term lease of a large item represents a similar commitment, and normally should be treated in the same way as a capital item.)

In the capital budgeting process, formal analysis of the benefits and costs of proposed asset acquisitions is often required, so that the Hydrological Service's managers may rank competing proposals and select those that make the greatest possible contribution to

the Service's goals, and pose the least risk. The process ensures that all managers are aware of developments in other parts of the Service, assists them to identify opportunities for sharing of assets, reduces the risk that incompatible items are being purchased, and so on. Consideration of operational implications is important, for example to avoid the purchase of additional numbers of a particular type of instrument from a different manufacturer, which might increase costs of maintenance.

To assist in ranking and selection of capital items, a proponent should be required to document (in one or two pages, depending on the cost of the item):

- The proposed acquisition and its cost;
- Proposed source of funds (e.g. it may be required for and purchased by a particular project funded by a client, or it may be partially paid for by sale of another asset);
- The purpose for which it is required, and the benefits that will be gained;
- The consequences of not acquiring it, and possible alternatives (e.g. lease);
- Implications for ongoing operations and operating costs;
- Proposals for ultimate disposal.

A capital budget is likely to be prepared at the same time as the annual plan and operating budget; there are significant linkages between them in terms of operating costs, staff training, etc. Because large purchases may have significant cashflow implications, the capital budget should specify when during the financial year particular items are to be invoiced for. Normally, the Director will require specific approval to be sought to purchase a capital item, even if it has been included in the budget.

6.3 PROTECTION OF ASSETS

Different types of asset require different forms of protection to conserve their value and usefulness, and requirements will differ in different locations or countries. (For instance, a water level recording station in one country may require protection principally from vandals, and in another principally from hippopotamuses.) It is difficult to provide guidance that will cover all eventualities — by definition, risk is unpredictable — so the following comments are not exhaustive. Hydrological Service managers should take full advantage of the ideas of their staff; appointment of an Asset Manager may be warranted in a Service with significant numbers of assets, or assets at significant risk of loss or damage.

A common approach to protection of assets is insurance. Hydrological Services that are part of a government ministry may not be permitted to take out commercial insurance unless it is legally required, e.g. in the case of motor vehicle insurance against third-party risks. Hence, the Service must, so to speak, insure itself. In practice, this means that the Service must — on the basis of experience — estimate the average cost of replacing or repairing lost or damaged assets, and include that estimate in its annual operating and capital budgets. Experience also provides the basis for deciding whether commercial insurance is cost-effective, where it is permitted. This decision is only possible where experience is carefully documented, by maintaining detailed records of loss and damage in an asset register.

Irrespective of whether commercial insurance cover is obtained, managers of the Hydrological Service should require staff to take care of the assets that they use, or for which they are responsible. This is likely to involve a combination of:

- Clearly established and disseminated rules for use and maintenance of assets, including such matters as building security;
- Education and training to ensure that staff know how to use and maintain assets correctly; this is particularly important for vehicles and field equipment;
- Encouragement to take pride in assets, for example by an annual prize for the best-kept hydrological station;
- Regular monitoring of the condition of assets, to identify work groups or staff whose performance is unsatisfactory, and additional training or instruction if necessary;
- Disciplinary action where unsatisfactory performance continues or there are wholly unacceptable breaches of standards.

Many of a Hydrological Service's most important assets are sited in the field, away from the oversight of staff. They can be extremely difficult to protect fully, particularly from thieves and vandals. An approach to this issue that some Services have found to succeed is to engage local people in the protection of field installations. As a start, local people can be visited by the Service's staff, and be informed of the purpose of the work and the benefits to them. They can be encouraged to treat the installation as "theirs", and something for which they take a certain amount of responsibility. A higher level of protection is likely, however, if the people have a monetary stake in the installation, perhaps by paying a nearby village to "look after" it. Perhaps the best approach is to appoint a nearby resident as "station superintendent", with appropriate financial recompense, and defined duties such as regularly removing excessive vegetation or making check gauge readings. Such a person would require a certain level of training, depending on agreed duties. The final step is, of course, to appoint the person as a non-professional member of staff, at a suitable rate of pay, to act as a regular observer.

6.4 DATABASE SECURITY

A Hydrological Service's most important single asset is likely to be its database. Means of protecting this asset will depend on the data storage media that are used, but there is no doubt that the Director of a Service must ensure that it is protected. In a number of countries, data rescue projects have been necessary in order to gather together all data (i.e. original records, usually on paper), place them in a secure location, and convert them into an electronic format that is more manageable on a long-term basis. Such projects, admirable though they are, should be necessary only as a result of circumstances that are completely outside the control of the Hydrological Service. There can be few excuses for a Director who allows his Service's basic asset to be degraded or dissipated.

Paper media — observer's notebooks, recorder charts, machine-punched tapes, etc. — are invaluable, because usually they provide the original record that must be consulted if questions arise about data validity, or if data reprocessing is required for some reason. They should be stored in such a way that gives them maximum protection from damage by insects, water, rot, sunlight, fire, earthquake, or from simple loss. Original records should if possible be the responsibility of a single office, or at least of designated individuals if the records are stored in more than one office. In any case, the location of original documents should be carefully tracked, if, for example, they are released for reprocessing. If a Hydrological Service does not have the facilities or expertise to permanently archive its paper media, the National Archive, Museum or Library may be able to assist.

Since paper media are subject to deterioration, it is desirable that copies be made. Commonly, microfilm or microfiche copies have been made, but the obsolescence of this technology presents difficulties for the future. Electronic storage of scanned images is now an economical alternative, using CD-ROM or other even higher density media. Obsolescence is perhaps an even greater concern with this technology than with microfilm, so the Hydrological Service will need a procedure for regular migration of electronic archives onto successive generations of storage media.

The secure long-term storage of original and processed records in electronic form (e.g. incoming telemetered data) or of an entire computer database requires procedures that are not so much sophisticated as disciplined. The disciplines of making regular and frequent backups of data, rigorously following defined procedures so that data are not lost before they reach the archive, or comprehensively documenting archived data so that subsequent users can understand any alterations that have been made — all are essential, and are considered in more depth in the *Guide to Hydrological Practices* (WMO, 1994).

6.5 INTELLECTUAL CAPITAL

The knowledge and skills of staff members is a major asset for a Hydrological Service. They are handled by the human resources management procedures in place in the Service (see Chapter 4). Some Hydrological Services carry out research and development, and produce technology or knowledge of significant value. They are likely to be familiar with issues relating to the management of intellectual property, and it is unnecessary for this *Guide* to deal with them. For most Services, however, the intellectual capital possessed by their staff members is unlikely to be sufficiently innovative to warrant management as such.

6.6 DISPOSAL OF ASSETS

A Hydrological Service's capital assets are likely to have residual value, even if they are fully depreciated in the accounting sense. Their disposal must be managed carefully, for several reasons:

(*a*) The parent organization may have clear instructions on the matter;

(*b*) Capital assets are included in the balance sheet of a business, and any change to the balance sheet caused by disposal of an asset must be properly accounted for. Any revenue gained from sale could be used (if permitted by the government) to offset the cost of replacement or other assets. Revenue from sales should be treated as carefully as expenditure in the capital budget;

(*c*) Improper disposal of assets is at risk of being seen as corrupt, with possible disciplinary or legal consequences.

Assets are commonly disposed of by tender or auction, assuming that there is a market for them (there may be a limited market for obsolete water level recorders, for instance). These are transparent methods that are likely to produce the best possible return for the effort invested. A Director may choose to dispose of assets that could be of interest to staff members — e.g. surplus furniture or obsolescent computers — by ordering that staff be offered the first opportunity to purchase them. This course of action might be appreciated by staff, but the Director should be certain that the price is in line with market prices, to avoid any risk of impropriety.

CHAPTER 7

MARKETING

Client expectations of all businesses, including those in the public sector, are rising continually, and businesses must continually seek to meet or exceed client expectations. Hydrological Services are no different. To assure the future health of their Service, managers must encourage a "client focus" among their staff, and demonstrate it themselves. The single most important client is the person to whom the Director reports, the Minister of Environment, for instance. The health of a Hydrological Service depends to a considerable extent on how successfully the Director markets the Service to that person, and demonstrates how the Service assists him to meet his own responsibilities.

The discipline of marketing provides useful principles and tools for all staff. In recent years, an abundance of instructional material has become available, for instance the series of "Official CIM Workbooks" published by the Chartered Institute of Marketing, UK (www.marketingonline.co.uk), with titles like *Marketing in practice*. Managers of a Hydrological Service should be at least familiar with the principles of marketing, whether or not they themselves have regular direct contact with clients, so that they understand and are able to facilitate the relationship between the Service's staff and its clients. The Director of a medium to large Service might consider it necessary to appoint a Marketing Manager, or at least to assign responsibility for marketing to one of the management team.

7.1 THE ELEMENTS OF MARKETING

To a technical or scientific person, marketing often appears to be a somewhat imprecise activity, or one that is "obvious". The basic philosophy of marketing is to "match the client's needs with the supplier's capabilities, to the mutual advantage of both". The focus is, or should be, on the client, and on ensuring that the Hydrological Service's products and services are what the client needs, and are provided when, where, and how the client needs them. Section 2.4 considers in some detail who the clients are, and this matter has also been alluded to in section 5.2, from the perspective of revenue sources.

The elements of marketing are conventionally said to comprise the "Four P's" — Product, Place, Price, Promotion. Marketing of services includes additional "P's" — Processes and People (see box 5). The client-focused Hydrological Service will consider its products and services from their point of view. A Hydrological Service may well wish to develop a marketing strategy, as a component of or complementary to its overall strategic plan, in order to address the "P's" of marketing in a structured way. Some larger Services, or those with a mandate to operate on the basis of cost recovery and/or commercial activities, may consider it necessary to appoint an appropriately trained or experienced Marketing Manager, or even establish a marketing unit.

Box 5. The "P's" of Marketing

Product: the product or service that the client requires. The emphasis is on what the client requires, not what the supplier wants to supply, thus it is the job of the latter to determine what the client requires and work out ways of providing it.

Place: the location at which the client requires the product or service. For a Hydrological Service, alternatives might include, for example, availability of information via the Internet, a report couriered to the client's office, on-site access to the Service's files at its headquarters, or a flood warning transmitted by automatic fax to selected offices of the National Disaster Management Committee.

Price: the price that is charged for the product or service, that both gives the supplier a reasonable return on investment and meets the client's expectations of value for money.

Promotion: the means used for informing potential clients of the availability of the service's products and services, demonstrating the benefits and facilitating the process of connecting the client and the service.

People: the people who will provide the service. In professional services marketing, clients' confidence in the ability of the people that they are dealing with is often crucial to their acceptance of the product or service itself.

Process: the processes that are used to deliver a product or service often must meet particular standards — in the case of a Hydrological Service, for example, a stringent data quality assurance programme may be required by major clients.

A marketing strategy should accomplish the following:

(*a*) Identify the Hydrological Service's actual and potential **clients**, and ensure that a client database is maintained. Depending on national circumstances, clients may be internal clients (e.g. irrigation engineers within the Service's parent organization), governmental clients (e.g. natural resource policy analysts, elected representatives in electorates with severe water-related problems, officials of a national disaster management committee), external clients (e.g. consultants working for a private irrigation company, schedulers in a hydropower company, policy analysts working in an environmental non-governmental organization), and international clients (e.g. officials of the National Hydrological Service (NHS) of a neighbouring country).

(*b*) Identify the **products** and services that the clients require and that the Service may be able to provide. A long-term (5-10 years) view of this will be required, given the time series nature of a Hydrological Service's information products, and the time that is likely to be necessary to carry out supporting research and development.

(*c*) Identify the most suitable mode or **place** of delivery of the product or service to the client (e.g. use of the Internet to provide access to real-time data, automatically generated fax warnings, conventional written reports with data annexes on CD-ROM, etc.).

(*d*) Determine the **pricing** policy for different products and services, and different types of client. The Hydrological Service may have a variety of pricing arrangements, ranging from a completely free service through to full profitability (with revenue sufficient to cover cost of capital and a dividend to the minister). Pricing arrangements are likely to require a legal mandate, and to be subject to considerations of competitive neutrality, accounting transparency, etc. (see section 5.1).

(*e*) Specify the types of **people** that should be involved in delivering the product or service, and any special skills (and therefore training) or other attributes (e.g. ability to be on 24-hour call) that may be required.

(*f*) Determine particular characteristics of the **processes** of product or service delivery that may be required to meet client needs. This may include, for example, process documentation or quality assurance sufficiently stringent to be acceptable in a court of law.

(*g*) Prepare an approach to **promotion** that is suited both to the clients and to the staff of the Service itself. Staff of a technical/scientific organization like a Hydrological Service are unlikely to favour highly visible forms of promotion, and the costs of promotion must be commensurate with the likely additional revenue generated. Promotion is likely to focus on relatively low cost approaches such as maintaining regular contact with known clients, mixing with peers from client organizations at professional meetings, preparing news releases on significant water-related events, etc. There may be a case for advertising new products or services (just one aspect of promotion), but in general a Hydrological Service's potential clients can be precisely identified, and can be contacted directly.

(*h*) Define the methods of **monitoring** the degree of success achieved by marketing, in terms of numbers and size of clients, client satisfaction and recognition, product development, revenues from different products, etc.

(*i*) Present a formal marketing **budget**: estimate the costs of and likely additional revenues gained by the strategy.

It will be seen from the above that marketing can be a major exercise, involving a significant number of staff to at least some extent. However, it is one that provides a formal way for the Service to look at itself from the perspective of its clients, to the advantage of both.

7.2 MANAGING RELATIONSHIPS WITH CLIENTS

A crucial element of marketing — indeed, of simply running any business — is maintaining effective relationships with clients. Good communication with clients is essential in ensuring that they are aware of the Hydrological Service's capabilities, identifying and designing the products and services that clients might need, and obtaining honest feedback on client satisfaction with the Service's performance. The Director should show a lead to the Service's staff, by being proactive in developing effective relationships with clients.

The job description of the staff members in a Hydrological Service should specify their functional relationships both within and outside the Service, and identify clients with whom they need to interact. Each staff member's supervisor should ensure, through the performance appraisal process, that he has the necessary skills to do so, if necessary by providing training or coaching in client relations. To a considerable extent, client relations are personal relations.

The most numerous clients of a public sector Hydrological Service are the general public and their elected representatives. An essential aspect of good governance is for a publicly-funded agency to keep the public informed of its activities and outputs, and provide opportunity for feedback. It is essential for a Hydrological Service to have a high profile — to be visible, and to ensure that the public and their

representatives recognize the benefits of its work. This is an ongoing task, because memories fade quickly. Benefits need not be expressed to the public in monetary terms, as many of a Hydrological Service's benefits — such as increased security from flooding — have an important social dimension. However, a Service that has difficulty in demonstrating the benefits of its work to the public is in a weak position. Its management should seriously review its vision, mission, and goals (see section 3.1).

There are many possible means of communicating with the public, such as:

- Illustrated talks to schools or public meetings, perhaps in flood-prone locations or on matters of current interest, such as a severe drought;
- Press releases or offers of radio/TV interviews on matters of current public interest;
- Production of booklets or briefing papers that will be provided to every elected representative, perhaps in conjunction with reporting to the elected national assembly;
- Production of educational material designed to contribute to a secondary school syllabus in environmental studies;
- Sponsorship or facilitation of community events such as clean-ups of river banks;
- Preparing a display or stand at a community fair.

World Water Day (22 March of each year) provides an annual opportunity to remind the public about hydrology, although hydrologists do need to be inventive to find a hydrological perspective on some of the topics promoted by World Water Day.

Public information can be costly, and the Hydrological Service should select methods that are likely to be cost-effective and beneficial to both the public (in terms of being better informed about water-related matters) and the Service itself (in terms of achieving enhanced public awareness). It might be helpful to develop a public information or communications strategy, perhaps as an element of a marketing strategy, which would provide a structured way to:

- Survey the business environment and specify the needs for communication;
- Define the goal and objectives of the strategy;
- Specify the audience to be reached;
- Select the most cost-effective methods, and ensure that their benefits exceed the costs;
- Develop an action plan for implementing the chosen methods;
- Prepare a realistic timetable and budget;
- Allocate responsibility for implementation;
- Establish methods of monitoring and reviewing the outcomes.

A communications strategy need not be a major exercise; for a small Service, a two-page document may be quite sufficient. However, even a small amount of thought may avoid wasted effort and resources on unproductive activity.

7.3 EVALUATION OF PRODUCTS AND SERVICES

The final stage in marketing is to obtain feedback from clients on the product or service that they have received. With a product provided directly to a specific commercial client, feedback should be relatively straightforward to obtain, although it is surprising how often clients who are not wholly satisfied simply pay the bill, say nothing, and never come back. There are many ways of obtaining feedback. Perhaps the simplest is a friendly telephone call a few days after the product has been delivered, to enquire if it met expectations. More formally, clients may be asked to fill out a simple questionnaire at the time that they process the invoice. The ultimate in evaluation is, perhaps, to arrange a client satisfaction survey for a sample of the clients served during the year. The aim of such a survey is, essentially, to determine the expectations that the clients originally had, and to measure the extent to which the expectations were met. A Hydrological Service is likely to need assistance from a consultant to carry out a client satisfaction survey, at least on the first occasion.

CHAPTER 8

PROCESS AND QUALITY MANAGEMENT

The general public continually demands an ever-higher quality of consumer products, be they foodstuffs, cars or hydrological information. Hydrology, in common with meteorology, has been a leader in accepting quality management as a routine element of its business. As Hydrological Services are required to compete in the marketplace, high quality products and processes can provide a significant competitive advantage. Maintenance of verifiable standards may even be essential to survival. As a general rule, a Hydrological Service should make quality management a focal point of its business, and the Director should take ultimate responsibility for the quality of the Service's work.

8.1 STANDARDS

Defined standards are an essential basis for quality assurance of a Hydrological Service's products and services. Increasingly, clients require knowledge of the standards that are being achieved by the Service, in order to satisfy their own clients. In general, standards may be specified for the procedures that are used by the Service, and for the attributes of the products that the Service produces. It is important to remember that standards are needed not only for technical activities related to hydrometric data collection and provision of metadata,[14] but also for all other activities undertaken within the Service, such as accounting practice, performance appraisal, preparation of letters to clients, etc.

In a country with several Hydrological Services, defined standards are of particular importance in ensuring comparability of hydrological data and products, for example in preparing a national water resources assessment. A key role of the NHS or "lead" Hydrological Service may be to establish and promulgate national standards. The same could be said of an international river basin in which there are several national Hydrological Services; in this case, a key role for a river basin organization would be to promulgate standards for the whole basin, and to assist national Services to achieve them.

The WMO's *Technical Regulations,* Volume III – *Hydrology* provides a set of long-established technical standards (a new edition is expected to be released before the end of 2006). So too does the International Standards Organization's *Handbook 16* of standards relating to hydrometric data collection.

The fifth edition of the WMO *Guide to Hydrological Practices* provides guidance on "good practice", from which standards could be derived (see especially chapter 4). A sixth edition of the Guide should be published in 2007, the subject of standards being treated in Volume 1, chapter 2. In addition, various textbooks and international standards provide design guides for hydrometric structures such as weirs (see WMO-No. 168 (1994), chapters 11 and 12, and references therein). A number of Hydrological Services have published manuals of practice that, in effect, establish national standards of practice and, in some cases, product (e.g. the US Geological Survey's *Techniques in Water Resources Investigations*, or the Swiss Hydrological Service's manual on hydrometric practice). Also, WMO provides guidance through various publications, such as the *Manual on Stream Gauging* (WMO, 1980), a new edition of which is expected by 2007.

International standards or those adopted by other Hydrological Services are a suitable starting point for establishing those used by a particular Service. However, the Service should develop standards that are appropriate to its own operating conditions and especially to the needs of its clients. This provides an obvious linkage back to the Service's marketing activities; in the process of determining the products and services that are or will be in demand, the Hydrological Service should be careful to define the standards that the clients will need. Clients may not always have the technical background to understand the nature of hydrological data and standards, particularly with regard to the levels of uncertainty that are almost inevitable in making measurements. The Hydrological Service's staff should work with clients to establish their requirements, so that the Service can translate the requirements into hydrologically meaningful standards. Achieving higher standards often increases the cost, and clients may need assistance in defining the standards they are prepared to pay for. All this should be done before work starts!

The technical and other standards that are adopted by a Hydrological Service also provide an objective basis for performance monitoring and appraisal. They should be incorporated into the Service's objectives as laid out in the annual plan, and in the personal objectives of individual staff members.

[14] A review of ISO standards for metadata from a WMO perspective can be found at http://www.wmo.ch/web/www/WDM/reports/ET-IDM-2001.html.

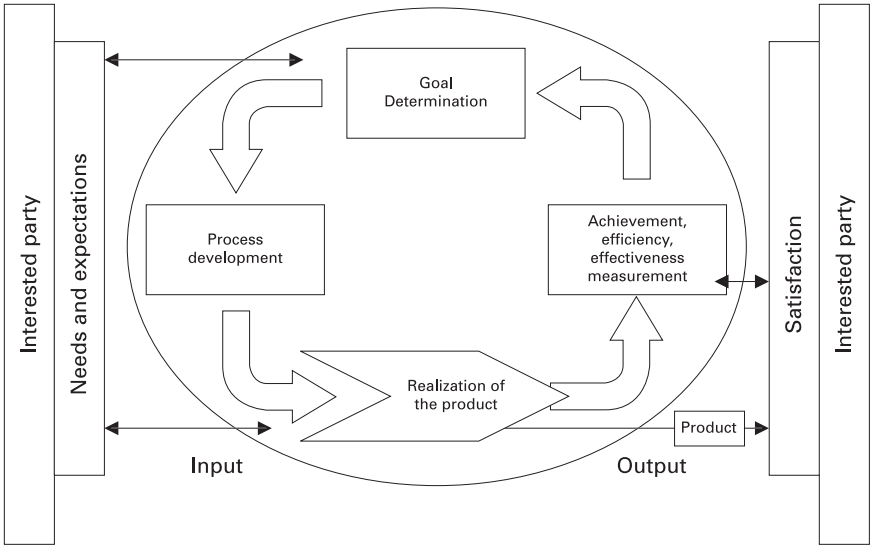


Figure 1. Quality improvement loop

8.2 QUALITY MANAGEMENT SYSTEMS

A quality management system is a management tool consisting of a set of rules to direct and control an organization with regard to quality, which is intended to assist in establishing policy and objectives and in achieving those objectives. It is not a simple set of documents but a dynamic process that brings resources, activities and behaviours together and focuses on the achievement of objectives.

Quality management is — or should be — such a pervasive aspect of running a modern Hydrological Service that it needs to be carried out in a systematic way. In other words, a Hydrological Service should have a quality management system in place that assures clients that its products and services meet the standards of quality that have been defined for them. A Service may find that operating a well-documented quality management system can be of great assistance, if for any reason it gets involved in legal proceedings relating to the veracity of its data and information products.

Modern quality management does not only control the final product, but the entire process. A basic but fundamental approach to quality is the "quality improvement loop" (see figure 1). This can be seen as containing four steps:

1. Goal determination, preparation and planning;
2. Process development and product realization;
3. Achievement-Effectiveness-Measurement (checking of the results, also in view of the client's satisfaction);
4. Reacting to this information to improve future actions.

Quality management should not be confused with quality control (which is just that part of quality management focused on fulfilling quality requirements) or quality assurance (part of quality management focused on providing confidence that quality requirements will be fulfilled), as, in fact, it consists of coordinated activities to direct and control an organization with regard to quality.

There is a huge amount of literature on quality management, and the International Organization for Standardization (ISO)[15] has developed the ISO 9000 series of standards for quality assurance systems (see box 6). The international standards tend to be most readily applied to a manufacturing enterprise. Inadequate knowledge of ISO 9001 has led in the WMO community to some misconceptions resulting, perhaps, from the fact that ISO 9001 is a generic standard applicable to any type or size of organization; rather than a limitation, this should be perceived as its main strength because it enables the organization seeking certification to define the level of complexity required for its particular situation. At any rate, businesses in both the private and public sectors, and in both manufacturing and service industries, have established quality assurance systems that are certificated against one of the ISO 9000 series. Indeed, some Hydrological Services and NMSs have implemented such systems, and have obtained certification from the

[15] The ISO website is found at www.iso.ch and provides detailed guidance on how to obtain and use standards. There is a focus on the ISO 9000 series of quality standards, and the ISO 14000 series of environmental standards, which also might be of interest to Hydrological Services. Note that ISO is only the organization that defines the standards: it does not carry out audits nor issue certificates. Certification of an organization according to the ISO 9001 standard is carried out by organizations which have themselves to be accredited as such in the first place.

relevant national authority (Mosley and McKerchar, 1989; Mosley and McMillan, 1994).

WMO is encouraging NMHSs to set up quality management systems and is working towards a Quality Management Framework for NMHSs that would eventually include and develop the following distinct though related elements:

- WMO technical standards
- Quality management systems including quality control
- Certification procedures.

The WMO Quality Management Framework should enable the provision of early and continuing relevant advice to WMO Members on developing their quality management system. A web page on the WMO Quality Management Framework has been developed and is now available under http://www.wmo.int/web/www/QMF-Web/home.html. Besides providing guidance and examples, this web page also presents information on the costs incurred by NMHSs having implemented quality management systems and reports on some of their experiences. In this context, WMO published in June 2005 the "First WMO Technical Report, Revised Edition" (WMO/TD-No. 1268).

It should be noted that the development of a WMO Quality Management Framework and the implementation of ISO 9001 are complementary and not mutually exclusive activities. Moreover, ISO 9001 certification has an element of international credibility and recognition that should not be ignored.

It is not necessary for a Service to seek certification for its quality management system, unless its major clients require it to do so. Maintaining certification can be expensive, since it requires regular visits from the national certifying authority. On the other hand, having certification, and having to maintain it, does introduce a discipline that otherwise would be missing. If a Hydrological Service is serious about having an effective quality management system, then the extra step of obtaining and maintaining certification adds a relatively small cost, in comparison with the cost of implementing the system.

Quality management systems need to be designed for each National Hydrological Service independently. Consultants can assist in the development and set-up of a quality management system, but the system has to be "owned" by the National Hydrological Service and its staff, and not by the consultant. This means, as an example, that the procedures need to be developed by the staff, so that they correspond to the work habits of the organization and its real needs. This also enables the Quality Management System to be much better accepted by the staff, and therefore more efficient.

A quality management system is an integral part of management. Full commitment of the direction is necessary in order to benefit from it; otherwise, the system will turn out to be a burden and a waste of resources for the organization.

A comprehensive quality management system is often perceived as being expensive to implement. In practice, however, a quality management system should be no different from the data/product management procedures that the Hydrological Service uses to make measurements, convey them to the office, process, archive, and transmit them to clients. To carry out these procedures in a professional way requires:

- Documented procedures for each step of the data/information flow;
- Defined standards for measurement and processing procedures, the measurements (data) themselves, and derived products;
- Staff training and oversight;
- Assigned responsibilities;
- Clear documentation of the steps that have been taken to make and process the measurements.

In fact, these elements of data management are all components of quality management. A comprehensive quality management system might include some additional components:

- Verification that standards of practice are being followed (e.g. by independent checks on flow rating curves, or on field party practices);
- Validation that archived data meet defined standards (e.g. by cross-comparison between neighbouring stations);
- Documented evidence that all aspects of the system have been consistently followed (e.g. a training record for each member of staff).

The additional components that, so to speak, convert a "data management system" into a "data quality management system" amount to a rather small increment, and one might consider that they really should be part of an acceptable data management system.

Although the "cost of quality" (implicitly, high quality) is commonly perceived to be high, the "cost of lack of quality" may well be higher. A Service that finds that the observations it has made for several years are worthless because of a hitherto unrecognized fault in an instrument, or the Service that finds that it must completely reprocess a flow record because a weir was incorrectly rated, incurs a much higher cost than would have been involved in checking the instrument or the rating. As in so many other situations, the cost of doing something now is obvious, but the long-term or future benefits are much less so. The management of a Hydrological Service should consider very carefully the Service's need for a systematic approach to product quality.

Box 6. The ISO 9000 series of quality standards

The standards, guidelines and technical reports which make up the ISO 9000 family and which are listed below are available separately, or as collections. The ISO 9000 Compendium presents the ISO 9000 family in hard copy form.

Standards and guidelines	Purpose
ISO 9000:2000, *Quality management systems — Fundamentals and vocabulary*	Establishes a starting point for understanding the standards and defines the fundamental terms and definitions used in the ISO 9000 family which you need to avoid misunderstandings in their use.
ISO 9001:2000, *Quality management systems — Requirements*	This is the requirement standard you use to assess your ability to meet customer and applicable regulatory requirements and thereby address customer satisfaction. It is now the only standard in the ISO 9000 family against which third-party certification can be carried.
ISO 9004:2000, *Quality management systems — Guidelines for performance improvements*	This guideline standard provides guidance for continual improvement of your quality management system to benefit all parties through sustained customer satisfaction.
ISO 19011, *Guidelines on Quality and Environmental Management Systems Auditing*	Provides you with guidelines for verifying the system's ability to achieve defined quality objectives. You can use this standard internally or for auditing your suppliers.
ISO 10005:1995, *Quality management — Guidelines for quality plans*	Provides guidelines to assist in the preparation, review, acceptance and revision of quality plans.
ISO 10006:1997, *Quality management — Guidelines to quality in project management*	Guidelines to help you ensure the quality of both the project processes and the project products.
ISO 10007:1995, *Quality management — Guidelines for configuration management*	Gives you guidelines to ensure that a complex product continues to function when components are changed individually.
ISO/DIS 10012, *Quality assurance requirements for measuring equipment* — Part 1: *Metrological confirmation system for measuring equipment*	Gives you guidelines on the main features of a calibration system to ensure that measurements are made with the intended accuracy.
ISO 10012-2:1997, *Quality assurance for measuring equipment* — Part 2: *Guidelines for control of measurement of processes*	Provides supplementary guidance on the application of statistical process control when this is appropriate for achieving the objectives of Part 1.
ISO 10013:1995, *Guidelines for developing quality manuals*	Provides guidelines for the development and maintenance of quality manuals, tailored to your specific needs.
ISO/TR 10014:1998, *Guidelines for managing the economics of quality*	Provides guidance on how to achieve economic benefits from the application of quality management.
ISO 10015:1999, *Quality management — Guidelines for training*	Provides guidance on the development, implementation, maintenance and improvement of strategies and systems for training that affects the quality of products.

8.3 TQM — TOTAL QUALITY MANAGEMENT AS MANAGEMENT

Quality management systems of the form promulgated by the ISO 9000 series of international standards specifically aim to assure that product quality meets defined standards. There are many other aspects of an organization's business that are not directly related to product quality, and therefore may not be covered in even a comprehensive quality management system. The concept of total quality management (TQM) extends the systematic management of product quality to all aspects of the business. Again, there are many books on TQM, and it is vigorously promoted by national associations in many countries, as part of the promotion of business excellence in general.

The most accessible introduction to total quality management (even though the term might not be used) is provided by the Malcolm Baldrige National Quality Program that is administered by the US National Institute of Standards and Technology, and the equivalent programmes established in several other countries (see section 1.3). All manner of organizations have introduced total quality management, on the "Baldrige model" or in some other form, and the approach is equally applicable to a Hydrological Service. Whether or not the Director and managers of a particular Service consider that the approach is suitable in their circumstances will depend on many factors, but perhaps most of all on whether the Service is viewed as a technical organization or as a business. In any case, Directors should familiarize themselves with total quality management principles and practices; they may decide that the cost of implementing TQM would exceed the benefits, but nevertheless may find elements that would be worth adopting.

CHAPTER 9

MANAGEMENT OF RELATIONSHIPS WITH OTHER INSTITUTIONS

The nature of Hydrological Services varies widely (see sections 2.2 and 2.7), but they all have suppliers, collaborators and clients.[16] Management of relationships with other organizations therefore is a necessary part of managing a Hydrological Service; for a Service that shares an international river basin, this responsibility could, indeed, be one of its most important responsibilities.

Everyone usually agrees that coordination, collaboration and liaison are desirable, but the reality is that such activities have an obvious cost, in terms of time commitments, whereas the benefits (or costs avoided) are less obvious. Coordination and similar activities therefore are often rather difficult to maintain on a long-term basis; Hydrological Service managers should be completely realistic in appraising these costs and benefits, particularly if they are the initiators. If a particular exercise is considered to have limited benefit relative to the effort involved, the Service should politely decline to be involved. On the other hand, if an exercise is judged to have a net benefit, then the Service should take its involvement seriously, and avoid half-hearted participation that is at the mercy of other pressing matters.

9.1 RELATIONSHIPS WITH THE "OWNER" OF THE SERVICE

As noted in the introduction to Chapter 7, the most important client of a Hydrological Service is the person to whom the Director reports, the "owner" of the Service. It is essential that the Director knows how to deal with this person (or his representative, with whom the Director normally deals), whether it is the Minister, the Chairman of the Board, the Chief Executive of the NMHS, or anyone else. To an extent, the relationship might be a matter of personal chemistry, but at a senior level it might be hoped that this can be subordinate to more objective matters. Perhaps the most important need is for the Director of the Service to understand the demands to which his superior must respond. In simple terms, the Director should see the Service's primary task as to assist his superior, as principal client, to satisfy in turn his own clients.

As a basis for an effective working relationship between the Director and superior, a contract has much merit. The contract might be the Director's personal employment contract, which defines his required outputs and responsibilities, or it might be a contract between the parent organization or Minister and the Hydrological Service as a whole (a government contract). Such a contract provides a formal and objective way of defining the owner's requirements, specifying the resources that will be made available to the Service, and appraising the Director's or Service's performance in meeting requirements. It should also include other elements, such as a statement of penalties if standards or outputs are not achieved, or provision for dispute resolution.

An important element of the relationship between Director and owner is reporting. No-one, particularly those in a political position, likes surprises (unless they are "nice surprises"), and Directors should always keep their superiors accurately and promptly informed of events and circumstances that might affect their responsibilities, particularly in a negative way. Directors should also be objective in presenting information; advocacy on behalf of their Service is likely to be resisted, unless its aim is clearly to further the interests of the owner, rather than the Service itself.

9.2 RELATIONSHIPS WITH AND AMONG NATIONAL ORGANIZATIONS

Water is important in many sectors of the economy, and many organizations, both governmental and non-governmental, are likely to have interests in water.[17] Indeed, most countries have several organizations engaged in different aspects of hydrology, with monitoring of surface water, groundwater, and water quality commonly the responsibility of different agencies. Even if there is a designated NHS or NMHS, therefore, there are likely to be complex inter-relationships among hydrological agencies. As IWRM and river basin management principles become more widely adopted, the need for effective relationships among water-related agencies can be expected to increase.

Key areas of cooperation for Hydrological Services include:

- Data and information exchange among Hydrological Services under different parent organizations, and with the NHS if there is one. Such Services might have national mandates for particular aspects of hydrology, or mandates within a

[16] Relationships with commercial clients are dealt with in Chapter 7, Marketing; client organizations considered herein are those that use a Hydrological Service's merit good or public good products and services.

[17] For example, in Thailand about 30 agencies in eight ministries have various water-related responsibilities.

single river basin or a sub-national administrative unit. In some countries, there is a legal requirement for all hydrometric data to be provided to the NHS;
- Cooperative arrangements that avoid duplication of effort or facilitate sharing of technology, e.g. through joint operation of monitoring networks, shared facilities such as instrument calibration laboratories, joint purchasing arrangements for hydrological software or instrumentation, or joint field exercises for quality assurance purposes;
- Data and information transfer to client organizations that require hydrological information for resource management, regulatory or other purposes;
- Collaboration with national disaster management agencies and the NMS, to provide forecasts and warnings of extreme hydrological events;
- Joint arrangements for research and development with universities or research institutes, in which the Service benefits from research and development outputs while the research establishment benefits from access to data, field installations, opportunities for research students to gain experience, etc.;
- Cooperation and liaison between Hydrological Services and the NMS, in terms of exchanging water-related and climate data, sharing technology for data management, and generally capitalizing on the very similar nature of meteorological and hydrological products and services.

Hydrological Service managers can arrange cooperation and liaison in many ways:
- Informal contact between peers at a technical level — "horizontal cooperation" — often is perfectly effective, and avoids the delays and overhead costs of formal contact through official channels;
- National scientific organizations often provide valuable means of arranging informal contact, at workshops and conferences, Internet-based discussion groups, or simply via the "old boy network" of contacts;
- Cooperation may be arranged, on a more formal basis, through mechanisms such as an "officials' working group", a "coordinating committee", or through a national committee for IHP and the Operational Hydrology Programme (OHP). Commonly, such arrangements are for particular purposes, such as to develop standards for a new national water quality monitoring programme;
- Formal arrangements for collaboration may be required where the value of the resources involved is considerable. This might include, for example, arrangements to exchange data between regional hydrometric agencies and the national hydrological service, in which case explicit terms and conditions would be required with regard to frequency of transfer, data quality standards, access to the national archive, scales of charges, etc. In such cases, signed agreements would be required between the Directors involved;
- As fiscal discipline increasingly is imposed on government agencies, cooperation may have to be placed onto a commercial basis, with financial arrangements being applied to, for example, cost-sharing of jointly-operated monitoring sites, or access to a current meter rating tank. In this sort of situation, the Hydrological Service managers should carefully consider all the costs and benefits — for example, the national benefit in terms of enhanced data quality of providing free access to an NHS-owned current meter rating tank by sub-national hydrometric agencies.

In many countries, cooperation in the water sector is deemed to be so important to the national interest that national arrangements have been made to facilitate it, through creation of an "apex body" such as a national water resources council. The position and authority of such bodies varies widely. In some cases they are largely advisory, with limited power. In others, they are chaired by or report directly to the prime minister, and have considerable authority. Hydrological Services will usually benefit from such arrangements, and they provide a good opportunity for Directors inter alia to draw attention to the national benefits of unhindered exchange of water-related data and information, standardization, and so forth.

9.3 INTERNATIONAL RELATIONSHIPS

Hydrological Services are not interdependent in the same way that NMSs are, since in general they do not have the same need to exchange data and forecasts on a 24-hour, continuous basis. Of course, many countries ("riparian states") share river basins with others, and the downstream countries — such as Cambodia, Bangladesh, the Gambia and Egypt — are heavily dependent on flows coming from upstream. Ideally, their national Hydrological Services need to have close working relationships with those of the upstream countries, to provide the ability to forecast flows and issue warnings (see box 7). River basin organizations such as the Mekong River Commission (www.mrcmekong.org) or the International Commission for the Protection of the Rhine (www.iksr.org) facilitate such relationships in some river basins, although this is not always so. Unquestionably, a key responsibility of the Director of a Hydrological Service in a riparian state is to maintain close working relationships with his equivalents in the other countries, either bilaterally, or in the framework of river basin agreements administered through multilateral river basin organizations.

A number of international organizations provide considerable assistance to national water resources

agencies and Hydrological Services, and Directors of Hydrological Services should be aware of their mandates and interests.

WMO, through its Commission for Hydrology (CHy), Regional Association Working Groups on Hydrology, and the Hydrology and Water Resources Department in the Secretariat, has a mandate in the United Nations system to take a leading role in the area of operational hydrology. WMO has in recent years provided valuable guidance to NMSs, NMHSs and NHSs in management-related disciplines, through global and regional conferences and workshops. The Commission for Hydrology, through its working groups, provides a wide range of research and development, advice and support for Hydrological Services, with an emphasis on technical and scientific matters. The Director of an NHS, in his capacity as the Hydrological Adviser to his country's Permanent Representative to WMO, should take full advantage of the opportunities offered by WMO, especially CHy activities. In countries where there are several Hydrological Services, the Hydrological Adviser has a responsibility to transfer to other directors the benefits of WMO membership.

A key role of WMO is to promote transnational exchange of data, information and technology. It does this through a wide range of initiatives:

- The HOMS network of HOMS National Reference Centres. This is a means of facilitating technology transfer among national Hydrological Services, with an emphasis on making available hydrological technology developed by the Services themselves, and that otherwise would not be available through commercial channels;
- Support of global data archives, such as the Global Runoff Data Centre and the Global Precipitation Data Centre. A key purpose of such archives is to provide a database that can be used in research into global environmental change, the condition of global hydrological resources, etc. WMO also supports and facilitates more short-term initiatives like the World Water Development Report;
- WHYCOS — World Hydrological Cycle Observing System — which in practice is implemented through the medium of regional HYCOSs that include the Hydrological Services of several countries. Normally, a HYCOS receives funding from one or more donors, and WMO's role is to prepare project proposals and facilitate the process of "connecting" donors and the countries that would be involved. Although the WHYCOS originally was conceived particularly in terms of providing information on global water resources, it has come to be seen more as an effective means of technology transfer and standardization;

Box 7. International relationships: the case of Canada and the United States

Canada and the USA share a number of river and lake basins along their common border, and international relationships with regard to the management of "boundary waters" are carefully regulated according to well-documented agreements. An International Joint Commission has jurisdiction, under the 1909 *Treaty between the United States and Great Britain relating to boundary waters, and questions arising between the United States and Canada*, over the use, obstruction or diversion of boundary waters. For example, it has established conditions for dams on the Kootenay, Osoyoos and Columbia rivers, has helped set rules for sharing the St Mary and Milk Rivers, sets emergency water levels for the Rainy Lake system, and plays a role in protecting the quality of the St Croix River. A detailed example of the work of the Commission with regard to regulation of, and flow forecasting in, the Souris River is provided in Annex 7 of Mosley (2001b). The Commission's rules of procedure are laid down in the *Rules of Procedure and Text of Treaty* of the International Joint Commission (April, 1980).

To enable harmonious decision-making, the two countries operate a joint system of monitoring streamflow and water levels in shared waters. It is based on "professionalism, trust and goodwill", and on a detailed *Procedural guide for international gauging stations* (Huberman et al., 1985).

This guide includes several parts that might provide guidance for other countries seeking to establish cooperative arrangements:

1. Designation of international gauging stations (definitions and procedures for selecting and suspending stations);
2. Operation of international gauging stations (operational hydrological practice), including:
   - Responsibility for ownership, operation and maintenance;
   - Scheduling of visits;
   - Field survey procedures;
   - Measurement systems;
   - Reporting systems;
   - Computation of records;
   - Review and approval of records;
   - Exchange of records for publication;
   - Storage and retrieval of computerized data;
   - Review and revision of historical records.
3. Other considerations (such as legal status of records, certification of records, reference datums, etc.).

- Support of the Working Groups on Hydrology established by each WMO Regional Association. Their activities depend on the terms of reference set by the Regional Association, but there tends to be an emphasis on technical cooperation and technology transfer.

There are a number of other international organizations whose mandates and activities relate to hydrology; the most important, perhaps, are the UNESCO International Hydrological Programme (IHP)[18] and the International Association of Hydrological Sciences (IAHS).[19] The UNESCO-IHP has in past decades made a huge contribution to operational hydrology through promotion of the international FRIEND[20] programme of scientific hydrology and the current Hydrology for the Environment, Life and Policy (HELP) programme to apply water resources science, and preparation of training materials for hydrological scientists and technicians. The IHP still provides a framework for conferences, educational programmes and training events provided by national organizations (universities, Hydrological Services, etc.) in member countries. It has tended to focus increasingly on scientific hydrology and water resources management rather than operational matters, but the Director and managers of Hydrological Services should certainly be aware of its programmes, and seek to participate where they are relevant to the Service's own mandate. The IAHS also has a scientific emphasis, but its publications and events present much knowledge, information and technology that is relevant to a Hydrological Service.

At a regional level, a number of organizations provide mechanisms for cooperation among Hydrological Services. These include:

- Regional economic groupings like the Southern African Development Community (SADC) and the Association of South-East Asian Nations (ASEAN), through which Hydrological Services may communicate and collaborate on initiatives such as a regional HYCOS;
- Regional technical and scientific bodies, such as the South Pacific Applied Geoscience Commission (SOPAC) and the African Centre of Meteorological Applications for Development (ACMAD), that have water-related programmes;[21]
- The regional development banks: Asian Development Bank, African Development Bank, Inter-American Development Bank, that may provide technical support in a variety of ways, both to individual member countries and to regional groupings.

Directors of Hydrological Services in the developing world should also be familiar with the bilateral investors and donor agencies "External Support Agencies" (ESAs) that are active in their countries. ESAs tend to concentrate on particular subject areas (e.g. environmental conservation) and regions or countries. A director considering seeking support should be sure that his project is one in which the ESA is likely to be interested. (In a sense, the director should regard ESAs as "customers" for projects that are consistent with their mandates, and recognize that he will have to market his project to the ESA.) It is often helpful to have contact with the NHS in the ESA's home country, because ESA officers commonly seek advice from appropriately qualified specialists. In most countries, direct formal approaches from a national organization to an ESA are not permitted, but must be transmitted through a coordinating ministry, which develops a list of requests for support that have priority. The director of the Hydrological Service therefore should be able to demonstrate how his project contributes to national development needs — in a sense, the coordinating ministry is also a "customer" for good projects.

9.4 DATA EXCHANGE

Arrangements for data exchange are of considerable interest to many if not most Hydrological Services, including data exchange:

- Among the NHS and "sectoral Hydrological Services" in a single country;
- Among NHSs in a transboundary river basin;
- Among NHSs in neighbouring countries, where the water resource is not shared but where data access would facilitate hydrological modelling or analysis;
- Between NHSs and international scientific users, global water resources assessment exercises, and international data archives;
- Between Hydrological Services in national users, particularly private sector users.

In response to this, the WMO Congress has adopted Resolution 25 (Cg-XIII), Exchange of hydrological data and products (see Mosley, 2001b). The Resolution

[18] The UNESCO-IHP website is at www.unesco.org/water/. It is an excellent source (through the "Water Portal" and "Water Events" facilities) of up-to-date information on coming events, and links to websites of other relevant organizations. It also, of course, provides information on the current and past phases of IHP, a hydrological publications catalogue (see also the main UNESCO site), and much other useful material.

[19] The IAHS website is at www.cig.ensmp.fr. It provides information, in particular, on IAHS events and publications (including the "Red book" series), and an alternative, electronic source of information to that in the regular IAHS bulletin.

[20] Flow Regimes from International Experimental and Network Data Sets (UNESCO).

[21] The SOPAC website is www.sopac.org.fj. SOPAC is a geosciences agency with a focus on small islands, and has had considerable involvement in small island hydrology. The ACMAD website is at www.acmad.ne.

specifically relates to international exchange of hydrological data and information products, but the basic principles are applicable at national level. As discussed in section 5.2, it is economically most efficient to transfer or exchange data under a charging regime in which only the costs of transfer are levied, and this is essentially the principle expressed in Resolution 25. A number of Hydrological Services have experimented with financial arrangements for data transfer in recent years, and the general consensus seems to be that the approach advocated by Resolution 25 is preferred. The situation is, in practice, rather more difficult in transboundary river basins, where issues of national sovereignty and national development outweigh all others. In these circumstances, the NHS can do no more than state the case for Resolution 25 to be followed.

Many Hydrological Services consider that there is merit in providing data to educational institutions and international scientific projects at no charge at all. On the other hand, if the institution or project has a research grant, or the data might subsequently be used for consulting work, there is no reason why the Hydrological Service should subsidize the ultimate client.

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ANNEX 1

CASE STUDIES OF NATIONAL HYDROLOGICAL SERVICES

(These case studies are based on information supplied in 2002 and are given here for illustration purposes only.)

BANGLADESH

INSTITUTIONAL FRAMEWORK

The National Hydrological Service of Bangladesh (NHSB) is a department of the Bangladesh Water Development Board (BWDB), which is a public statutory body constituted under an Act of Parliament (see figure A1). It is a key water sector organization responsible for the planning, design, execution, operation and maintenance of irrigation, flood control, drainage improvement, river development, land reclamation, salinity control, estuary development, etc. Along with these responsibilities, it is mandated to collect, process, store and disseminate all kinds of hydrological data. Besides all these activities, some other very important responsibilities such as flood forecasting and warning services, drought monitoring, low flow monitoring, dry period groundwater monitoring and erosion prediction and monitoring have been entrusted to BWDB, and in particular to NHSB.

BWDB is headed by a Director-General, who is the Chief Executive. Overall management and policy formulation has been entrusted to a council headed by the Minister for Water Resources and comprising another 12 members drawn from different ministries and stakeholders.

NHSB is headed by a Chief Engineer. It is organized on a functional basis, and responsibilities are assigned to four circles (Surface Water Hydrology, Groundwater, River Morphology and Research, and Processing and Flood Forecasting) and their subordinate offices (see figure A2).

The Surface Water Hydrology Circle is mainly responsible for data collection in the fields of surface water and climate. There are four field divisions, 12 sub-divisions, and 33 sections. The field divisions are mainly responsible for operation and maintenance of all surface water and climatological networks, and supervision of data collection. The Bangladesh Meteorological Department (BMD) has a limited number of climatological stations, insufficient to provide the climatological data needed for water resources planning, flood forecasting, etc., so BWDB established its own network of rainfall and evaporation stations in the early sixties.

The Groundwater Hydrology Circle is mainly responsible for collecting geohydrological data, conducting tests for aquifer characteristics and conducting field tests for groundwater quality. The staff also collect lithological borings. Supervision of all relevant field data collection is also part of their responsibilities. The circle consists of two field divisions, six sub-divisions, and six drilling teams. The River Morphology and Research Circle is mainly responsible for cross-section surveys of the river system during the pre- and post-monsoon period. It consists of three field divisions, four sub-divisions, and eight survey teams. Supervision of relevant data collection is also one of their main responsibilities.

The Processing and Flood Forecasting Circle is responsible for processing, storage and retrieval of data collected by the other circles. It is also responsible for flood forecasting and warning services, groundwater monitoring during dry months, low flow monitoring, prediction and monitoring of river erosion, etc.

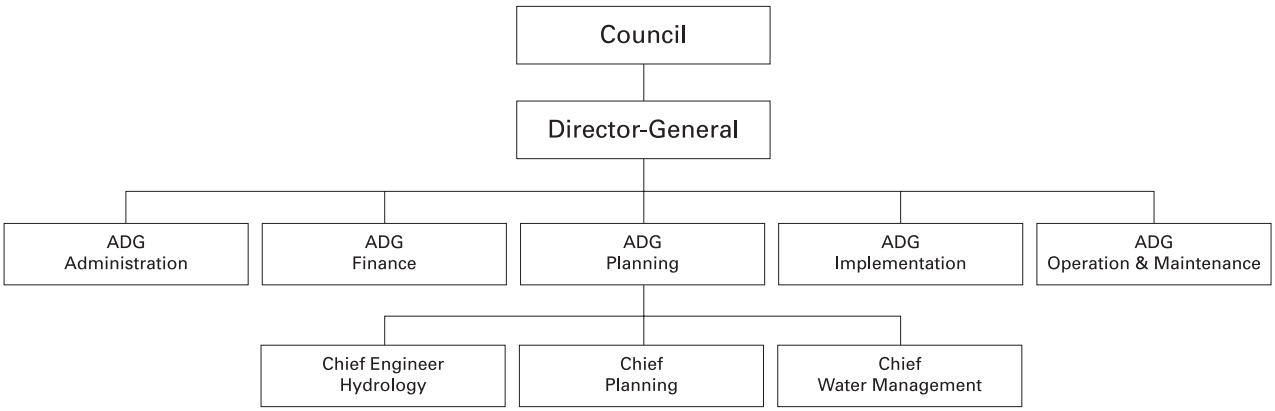

Figure A1. BWDB organization chart

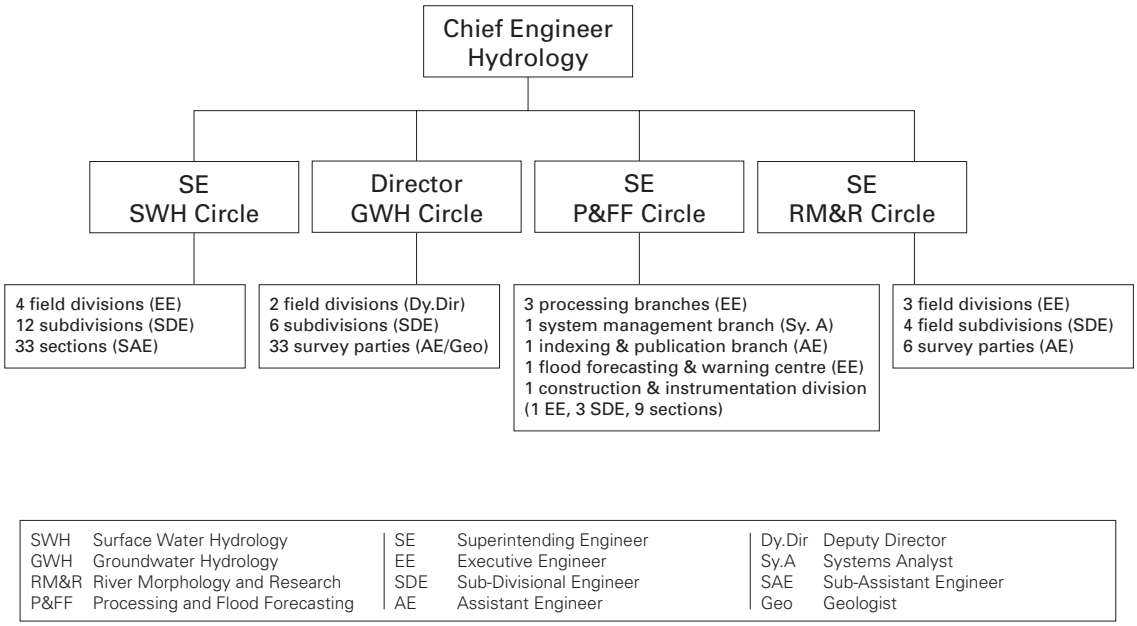

Figure A2. NHSB Hydrology Department organization chart

It is also responsible for maintenance of gauging equipment, river craft and the data communication system for flood forecasting and warning services, etc. It has three processing branches, a system management branch, an indexing and publications branch, and a construction and instrumentation division. It publishes regular and special reports on the state of water resources and floods in Bangladesh. During the monsoon it publishes a daily flood bulletin; during the dry season it publishes a weekly low flow monitoring report and a fortnightly groundwater monitoring report.

HUMAN RESOURCES

NHSB has over 1,000 staff at three levels, i.e. strategic, management, and operational levels. At the lower levels it is difficult to find suitable people, with the result that NHSB has been facing difficulties in conducting gauging work and maintaining the networks.

A separate Hydrology Training Institute was established in 1968 but closed in 1983 owing to funding shortages; hydrological training was merged with BWDB's general training activities. The priorities of NHSB have not always been reflected in these, and nowadays NHSB organizes some in-house training. It is facing difficulties in maintaining the quality of its human resources, in the face of inadequate training facilities and funding. Recent training has been tied to donor-assisted projects. Continuous professional development is strongly felt to be needed to keep pace with continuous technological development in hydrology.

NHSB conducts different types of training for the different levels of staff. Training courses include:

- General management;
- Introductory hydrology;
- Advanced hydrology;
- Refresher hydrology;
- Operation and maintenance of hydrological gauging equipment;
- Electronic equipment maintenance;
- Land and hydrographic survey;
- Observer/field supervisor training;
- Application software for data processing;
- Computer application package programmes.

BWDB conducts surveys and assessment of staff development needs periodically. NHSB also conducts its own surveys and assessments, but not on a routine basis. Staff development has been identified as a key element to improving organizational efficiency and service delivery, but it is not always pursued vigorously. It deals with many areas and hence its requirement for staff development are varied, and it cannot meet all staff development needs with existing facilities and institutional arrangements.

FUNDING

Funding of the NHSB comes from the Government of Bangladesh through two kinds of budget, namely revenue and development budgets. Most of the salary and regular operational costs come from the revenue budget. Funding is not adequate to meet all the routine jobs undertaken by the Service. Most of the funds are used for salaries, and a small portion remains for actual operations. Funding has not increased with the rate of inflation. As a result, funding is gradually

decreasing, affecting field data collection as well as processing work. Currently, all field data acquisition is carried out by departmental staff, but it is becoming prohibitively costly to continue, and the Government is considering outsourcing field data acquisition as well as data processing. Some pilot-scale activities have been undertaken in this regard recently, but it will take some time to assess the results of outsourcing. Cost recovery is minimal in relation to the costs incurred.

Allocations from the development budget are mostly relating to development projects, either donor-assisted or self-financed. Currently, NHSB has one development project for flood forecasting and warning services, with the assistance of the Danish International Development Agency (Danida). In the case of foreign technical assistance, a large portion of the assistance is spent on expatriate consultants' salaries and logistics.

COOPERATION WITH OTHER INSTITUTIONS

At the national level, different types of cooperation are in place with different government departments, statutory bodies, consulting firms, research and academic institutions. This cooperation exists for the purposes of the water sector, e.g. planning, implementation, operation and maintenance, infrastructure development, disaster management, environmental monitoring, navigation, fisheries, etc. Most of the cooperation is in supplying data, and in some cases data and experience are also shared. Cooperation with research institutions helps to bridge the knowledge gap. Details of notable collaborators are given in table A1.

Table A1. Collaborating institutions

Sector	Organization
Planning, implementation and operation and maintenance	• Bangladesh Water Development Board • Water Resources Planning Organization (WARPO) • Local Government Engineering Department
Research, water, agriculture	• River Research Institute (RRI) • Bangladesh Agricultural Research Council • Arsenic Mitigation Project • Institute of Water Modelling • Institute of Water and Flood Management
Disaster management	• Disaster Management Bureau • Bangladesh Meteorological Department • Navigation
Navigation	• Bangladesh Inland Waterways
Infrastructure development	• Local Government Engineering Department • Roads and Highways Department
Water supply and sanitation	• Department of Public Health Engineering • Dhaka and Chittagong Water Supply and Sewerage Authorities
Environment	• Department of Environment • Agriculture • Department of Agricultural Extension • Bangladesh Agricultural Development Corporation • Department of Fisheries
Municipalities	• City Corporations (Dhaka, Chittagong, etc.) • Municipalities (Comilla, Jessore, etc.) • Academic institutions
Academic institutions	• Bangladesh University of Engineering and Technology • Bangladesh Institute of Technology • Other universities

At the regional level, cooperation exists with the Central Water Commission (India) and the Department of Hydrology and Meteorology (Nepal). This mainly relates to hydrometeorological data exchange in connection with flood forecasting for a very limited period of time.

At the international level, no formal cooperation exists, except with WMO.

NHSB has no regular programme of technical exchange with other institutions, but some exchange is carried out through project activities. One such case is with the Danish Hydraulic Institute, mainly relating to development of hydrodynamic models. Some internal exchange programmes are in place with the Institute of Water Modelling and the Centre for Environmental and Geographic Information Systems. It is strongly felt that, to improve and maintain technical capabilities, exchange programmes are necessary.

PLANNING POLICY

The planning policy of NHSB mainly depends on the Government's policy in the water sector, which is formulated by the National Water Council (NWC) headed by the Prime Minister. NWC generally considers any policy or plan on the recommendation of the Executive Committee of the Council, headed by the Minister of Water Resources. Once any plan or policy is approved, execution is the responsibility of the Ministry of Water Resources and its subordinate organizations, BWDB, WARPO and RRI. The Government formulated a National Water Policy in 1999, in which the scope of the work of NHSB was mentioned. The Government has also prepared a National Water Management Plan, in which different programmes have been outlined, and many new tasks for NHSB have been enumerated. At the time of writing the plan is in the draft stage and is being debated, before being placed before NWC.

The policy and plan provide the broad policy guidelines and activities for NHSB, and NHSB then draws up its own operational policy framework. In the operational policy, the following issues are generally considered: institutional development, capacity-building, staff development, research, sustainability and funding.

UNITED REPUBLIC OF TANZANIA

INSTITUTIONAL FRAMEWORK

In the past, water resources development in the United Republic of Tanzania was managed according to sectoral, regional or district interests. This approach made it difficult to clearly understand water resources availability, and caused conflicts due to overlapping mandates. Having realized this problem, the Government has adopted the river basin as the planning unit; hence, planning, evaluation, analysis, development and management are done at the basin level.

Water resources management is governed by three Acts:

- The Water Utilization (Control and Regulation) Act No. 42 of 1974, as amended by Acts No. 10 of 1981 and No. 17 of 1989;
- The Water Laws (Miscellaneous Amendments) Act No. 8 of 1997; and
- The Water Laws (Miscellaneous Amendments) Act of 1999.

The Water Utilization (Control and Regulation) Act establishes the principles under which water resources are managed. Under Section 8 of the Act, all water is vested in the United Republic of Tanzania; the Ministry responsible for water (currently the Ministry of Water and Livestock Development, MWLD) is mandated to deal with all matters pertaining to the administration and conservation of water.

At the national level, the Ministry responsible for water is the main actor. Under the ongoing reforms in the public sector, the mandated roles of the Ministry have now been changed from being an implement to being a facilitator, regulator and promoter. Under the new organizational structure, MWLD has three technical departments, namely Water Resources, Rural Water Supply, and Urban Water Supply and Sewerage. In addition; there are two technical units, the Central Water Board (CWB), which deals with regulatory functions of water resources management and development, and the Central Water Laboratory, which deals with water quality and waste water pollution monitoring. Hydrological Services are provided by the Hydrology Section of the Department of Water Resources.

The Minister responsible for water affairs is empowered to declare any area of land to be a water basin in relation to any river, thus establishing a Basin Water Office and Board. The functions of the Basin Water Board are the same as those of the CWB in their areas of jurisdiction. Where basin water offices have not yet been established, the Ministry's Resident Water Development Officer at the regional centre is the Regional Water Officer, and is responsible for administering water rights in the region.

At basin level, the following functions are performed:

- Monitoring and regulation;
- Granting water rights and collecting water user fees;
- Collecting, analysing, storing and disseminating data;
- Creating awareness and sensitizing stakeholders;
- Identifying and involving stakeholders.

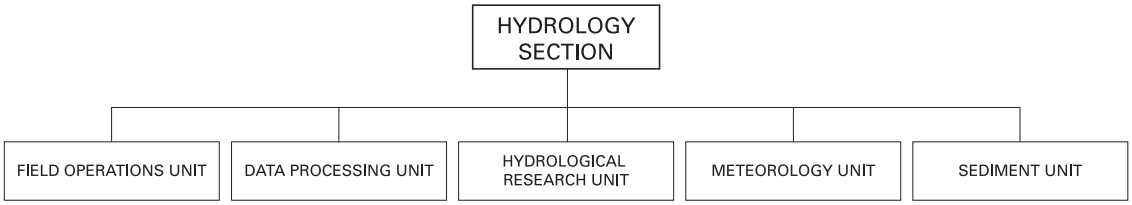

Figure A3. Composition of the Hydrology Section

At district level, the following functions are performed:
- Formulating and enforcing by-laws;
- Supervising implementation of water supply projects;
- Training and sensitizing communities;
- Soliciting funds for sector development.

At community level, the following functions are performed:
- Planning water sector activities;
- Implementing planned activities;
- Operating and maintaining water schemes.

Hydrological Services are the primary responsibility of the Hydrology Section of the Ministry responsible for water. The Section has the following principal functions:
- Establishing hydrological stations (streamflow, sediment transport, water quality, groundwater levels, rainfall, evaporation, temperatures);
- operating and maintaining hydrological stations to collect data;
- processing, compiling and storing the data.

Work is carried out at three levels:
- Head Office sets policy and standards, provides training, carries out final quality checks, processes the collected data, and builds and maintains databases;
- The regional or field office provides equipment, facilities, training, control and initial processing of the collected data;
- Field personnel actually measure and record the physical data and maintain the recording and gauging facilities in good condition.

The Head Office of the Hydrology Section has five units, dealing with field operations, data processing and archiving, hydrological research, meteorology, and sediment sampling (see figure A3). The Regional Hydrologist is accountable for all hydrological activities in the region, both administratively and technically, including setting up the field teams required.

HUMAN RESOURCES

Hydrologists and technicians carry out the work of the Hydrology Section (see table A2). At the time of writing the Hydrology Section has 29 hydrologists, 9 at Headquarters and 20 in the regions. There are 135 technicians in the Hydrology Section, of which 23 are at Headquarters.

Training plans are designed to strengthen existing human resources, and build the additional capacity needed to meet future requirements in the water sector. These plans take into account the short- and long-term training needs that are assessed for four categories of staff: professionals, technicians, craftsmen and support staff.

Currently, training is provided by the Government and by external support agencies (ESAs), which are supporting water supply and sanitation programmes in the regions in which integrated rural development programmes are being executed. The training packages offered by each ESA are not coordinated with those of other ESAs or the Ministry. The result has been a surplus of well trained personnel in some regions and a shortage in others. This approach has not been very helpful as a strategy for human resources development for the water sector as a whole.

The Ministry has a structured training programme for its professionals, which unfortunately is not implemented owing to shortage of funds. The University of Dar es Salaam has been the largest single source of professionals for the water sector. About 50 hydrologists were trained at the University between 1972 and 1980. The hydrology course and department were ultimately discontinued in 1980, but the University continued to train water resources engineers. However, the number joining the Ministry of Water has been far below that needed to meet the ever-increasing demand in the sector. Training in water-related fields is also conducted at Sokoine University of Agriculture in Morogoro, and at the Department of Environmental Engineering at the University College of Lands and Architectural Studies.

A good number of professionals were trained abroad, at world-famous institutions such as IHE Delft, Stanford University, Uppsala University, University College Galway, Free University of Brussels, University of Roorkee, US Geological Survey and VITUKI.

Item	Description	Duties of Hydrologists	Duties of Technicians
1.	Old network	Evaluation, coordination and supervision	Operation and maintenance
2.	Network design	Fully responsible	Assisting Hydrologist
3.	Additional stations	Administrative, site selection/supervision	Survey and investigation and construction
4.	Data collection, storage and retrieval	Data storage and retrieval	Data collection and storage
5.	Planning of surveys	Fully responsible	Assisting Hydrologist
6.	Data processing	Fully responsible	Assisting Hydrologist
7.	Data quality control	Fully responsible	Field activities and assisting Hydrologist
8.	Hydrological analysis	Fully responsible	Assisting Hydrologist
9.	Water resources management	Fully responsible	
10.	Staff training	Fully responsible	As may be assigned
11.	Water balance studies	Fully responsible	Assisting Hydrologist
12.	Financial control	Fully responsible	As may be assigned
13.	Equipment, stationery, stores	Fully responsible	Keeping inventory up to date
14.	Repair and service of instruments	Fully responsible	Assist Hydrologist
15.	Other duties	Fully responsible	As may be assigned

Table A2. Duties of hydrologists and technicians, Hydrology Section

Most hydrology technicians have been trained at the Rwegarulila Water Resources Institute in Dar es Salaam. The Institute was established in 1974 to train middle level technicians and craftsmen to cater for the growing needs of the sector. Up to 1997, more than 1500 technicians and 10100 craftsmen had received training at the Institute. Courses offered are:

- Full Technician Certificate Course in Water Resources Engineering
- Craftsmen Training Course at Trade Test Grades I, II and III
- General Course in Engineering for primary school leavers
- Performance Improvement Course to meet the training needs of technicians and craftsmen at regional and district levels.

Other technicians were trained at various local technical colleges and a few completed postgraduate studies abroad. The numbers of technicians graduating from the institutions are far from meeting the water sector needs.

Trained staff are key to effective hydrology and water resources development and management. However, lack of professional staff is the most serious constraint to water sector development in the United Republic of Tanzania, while shortage of technicians and craftsmen also hinders sector development. This has been caused by retrenchment, non-recruitment, and non-replacement of retiring staff, for economic reasons.

Human resources planning at organizational level involves continuous recruitment/ appointment, training, promotions and transfers. However, this has not been the case in the United Republic of Tanzania for many years. Development of technicians through

training to first degree level is at the moment non-existent. So is the recruitment of staff who have recently graduated from local institutes or abroad. ESAs mostly sponsor candidates for post-graduate and post-experience programmes, rather than for under-graduate courses. Another problem is the infrequent promotion of water sector staff. This leaves hydrologists and technicians in the same designation for a long time, which becomes a disincentive.

FUNDING

National Hydrological Services in the United Republic of Tanzania are funded mainly by the Government through the Hydrology Section. Every year, a realistic budget for carrying out hydrological investigations, hydrological research, operation and maintenance of stations, purchase of new and replacement of old and worn-out instruments and equipment, training, etc. is prepared. However, the funds actually allocated by the Government budget for these services are normally a small fraction of the budget. As a result, many Hydrological Services cannot be fully provided. One of the consequences of inadequate allocation of funds has been a continuous decline in the hydrometric, precipitation, climatic and groundwater monitoring network. Many other areas of Hydrological Services have also been affected.

As mentioned earlier, there has been cooperation between the Hydrology Section and ESAs which have funded Hydrological Services. The River Basin Management and Smallholder Irrigation Improvement Project (River Basin Management component) is a good example of external funding. This project is being implemented in the two largest river basins of the United Republic of Tanzania, the Rufiji and Pangani basins. Under the project, 71 hydrometric and 20 climatic stations have been established. Hydrologists and technicians of the Hydrology Division have been seconded to the project.

COOPERATION WITH OTHER INSTITUTIONS

The Hydrology Section cooperates with a large number of institutions at national level. These institutions include the Ministry of Agriculture, Energy and Minerals, the Ministry of Natural Resources and Tourism, the Ministry of Works, the Ministry of Science, Technology and Higher Education, the Ministry of Lands and Human Settlements Development, the Tanzania Meteorological Agency, universities, institutes, technical colleges and research centres. Cooperation is in the form of jointly executed projects and programmes, exchange of data and expertise, seminars and workshops, staff secondments and training.

There is also cooperation at international level. Tanzania is riparian to many international lakes and rivers, and therefore requires transboundary water resources management and cooperation through several river and lake basin projects/programmes and organizations. The country also participates in international data exchange and cooperates with professionals and consultants from many countries, institutions, academic and research centres. As mentioned earlier, many projects have drawn on expertise and resources from outside the country, with regard to the planning, funding and implementation of the projects. A number of Tanzanian hydrologists and water resources experts are working in other countries within and outside Africa.

Technology transfer to the National Hydrological Service of Tanzania has been mainly achieved through a large number of ESA-funded water projects. The United Republic of Tanzania has for a long time been divided administratively into twenty regions. As a prerequisite to the twenty-year Rural Water Supply Programme launched in 1971, regional Water Master Plans were prepared and implemented, with funding by different ESAs that often used different types of technology. In effect, this has provided technological exchange between the foreign experts and local hydrologists who were attached to these plans. Many other water projects have been implemented with expertise drawn from within and outside the country. These include rural and urban water supply projects, water resources projects, hydrometeorological surveys of Lakes Victoria, Kyoga and Mobutu Sese Seko, the Lake Victoria Environmental Management Project and the River Basin Management and Smallholder Irrigation Improvement Project. All these projects have brought about significant technology transfer.

PLANNING POLICY

Water resources planning, development and management is guided by the Tanzania Water Policy. Its overall objective is to provide a comprehensive framework for sustainable management of the country's water resources, and an effective legal and institutional framework for implementation. The policy, first published in 1991, states that the roles of water resource management, including standard setting and regulatory enforcement, shall be separated institutionally from service provision at all levels. It is now under review.

The draft water policy recognizes that water resources management requires an effective institutional set-up to perform core functions of water resources exploration and monitoring, assessment, water allocation, pollution control and other cross-sectoral activities such as catchment management, basin planning and development. It also emphasizes that water resources management is a multi-sectoral activity that requires effective collaboration and coordination among sectors at all levels in order to enhance information sharing.

ANNEX 2

STAFF COMPETENCIES: EXAMPLE OF AN INTERVIEW FORM

Interview form: Field Office Manager

Name of applicant:		
Attribute	**Score 1-4**	**Comment**
Track record in management		
Understanding of social / environmental issues facing the Service		
Evidence of leadership, especially in change management		
Evidence of people management skills		
Evidence of financial management skills		
Team worker? Delegator?		
Evidence of good information skills, especially relating to reporting and publicity		
Understanding of customer service		
Evidence of innovativeness		
Evidence of strategy and planning ability		
Ability to work with superior		
Evidence of negotiation / communication skills		

ANNEX 3

EXAMPLE EMPLOYMENT CONTRACT

(incorporating job description and person specification)

CONTRACT OF EMPLOYMENT

MANAGER, MOMBA HYDROLOGICAL OFFICE

1. **PARTIES TO THE CONTRACT**

The parties to this contract are:

(*a*) The Director of Hydrology and Water Resources ("the employer"); and
(*b*) Mulembe Mbale ("the employee").

2. **TERMS OF THE CONTRACT**

2.1 This contract commences on 24 May 2000, and shall remain in force until 23 May 2003, unless previously renegotiated or terminated pursuant to any provision of this contract.

3. **APPLICATION OF CONTRACT**

Entire agreement

3.1 This written contract represents the entire agreement between the employer and the employee. No change to the contract or any of the terms in it will be effective or binding on either party unless the change is made in writing and both parties have signed it. Neither party will be taken to have waived their right to insist on compliance with the terms of this contract unless that waiver is made in writing and both parties have signed it.

Subject to Federal Law

3.2 This contract is to be interpreted according to the laws of the Federation.

Commitment

3.3 The Ministry of Water Resources is a professional organization. It is expected that the employee will be loyal to the Ministry's professional ethos, and adhere to its policies, rules and procedures.

Probationary period

3.4 The employee will be appointed to the position of Manager, Momba Hydrological Office, for a probationary period of four months. During this period, the employer and the employee shall meet at the end of each month to review the employee's performance in the position. Matters to be considered are listed in Schedule C.

3.5 At the end of the probationary period the employer will review the employee's performance in the position to determine whether he is satisfactory for continued employment in the position.

3.6 If the employer considers that the employee is unlikely to be satisfactory, the employee will be given the opportunity to respond to the employer's reasons.

3.7 After considering such response as the employee may provide, the employer may:

(*a*) confirm the appointment of the employee; or
(*b*) extend the probationary period for such period as the employer may consider necessary, in which event the employer will inform the employee of the reasons for the extension; or
(*c*) subject to paragraph 3.6, terminate the employment on giving the employee such notice, being not less than two weeks, as the employer may decide.

3.8 The employer shall not exercise the power of termination under paragraph 3.7(c) unless the employer has, not less than one month before the review in paragraph 3.5, advised the employee of any improvement regarded as necessary and of the likely consequences of such improvement not being achieved before the review.

3.9 If the employer decides to extend the probationary period, the employee may be reassigned to other duties to which he appears to be better suited.

4. JOB DESCRIPTION

4.1 The employee will be employed as Manager, Momba Hydrological Office. During the term of this contract, he will honestly, diligently and to the best of his ability perform the job description set out in Schedule A, together with any other duties that the employer might reasonably require, having regard to the employee's workload, skill and training.

4.2 The job description will be reviewed annually, each June. The employee's duties may be changed from time to time by the employer following consultation.

4.3 Each June the employer will negotiate annually with the employee the performance targets for the coming year.

Performance appraisal and professional development

4.4 The Ministry of Water Resources is committed to the professional development of its employees and expects each employee to be similarly committed. Each year the employer will negotiate a professional development plan with the employee, and will pay for any necessary training.

4.5 Each June the employer will appraise the employee's performance during the preceding twelve month period, in terms of the job description set out in Schedule A and the performance targets provided for under paragraph 4.3. The employer will consult with the employee and such other persons as necessary to enable a fair and accurate appraisal.

4.6 The employer may at any time review the employee's performance in such a manner as the employer deems appropriate.

Engagement in other activities

4.7 The employee and the employer acknowledge that this is a full-time position, and the employee agrees not to accept any professional appointment outside Momba Hydrological Office, or engage in any private or commercial activity which may conflict with his duties pursuant to this contract, without the written approval of the employer.

Hours of work

4.8 The Employee is required to work a minimum of thirty seven and a half (37.5) hours per week. Standard Ministry of Water Resources hours of work are 8 am to 4.30 pm, Monday to Friday, with morning and afternoon tea breaks of ten minutes each and a one hour unpaid lunch break. When workload requires it, the employee may need to work in excess of 37.5 hours per week to complete the requirements of the position. There will be no payment for overtime work, and salary is deemed to compensate fully for all hours worked.

5. REMUNERATION

5.1 The employer will pay the employee in accordance with the provisions of Schedule B. The employer will review the salary of the employee in the manner set out in Schedule B.

6. LEAVE

Public and statutory holidays

6.1 Public holidays shall be pursuant to the Holidays Act 1981. The employee shall not be paid for any public or statutory holiday which falls on a day on which he would not otherwise have worked.

6.2 If the employee is required by the employer to work on a public holiday, he shall be paid at ordinary time rates for the hours worked on the holiday and shall be granted a day in lieu on ordinary pay to be taken at a time agreed with the employer.

Annual Leave

6.3 The employee shall be entitled for each period of twelve (12) months to twenty (20) working days in annual leave.

6.4 Annual leave shall be taken at a time agreed between the employer and the employee.

6.5 The employee shall take annual leave within 12 months from the date of entitlement or such leave will be forfeited. The employer retains the discretion to allow the employee to accumulate leave upon application.

Special leave

6.6 The employee shall be entitled for each period of twelve (12) months to ten (10) working days special leave. The employer retains the discretion to allow the employee to take additional special leave upon application.

6.7 Special leave may be taken by the employee only when:

(*a*) he is sick; or
(*b*) his spouse, dependent child, or dependent parent is sick; or
(*c*) he suffers a bereavement (as defined in Section 30A of the Holidays Act 1981).

6.8 The employee shall inform the employer as early as possible when he intends to take special leave.

6.9 Special leave may accumulate to a maximum of fifty (50) days.

6.10 Special leave shall be paid in accordance with the Holidays Act, and the provisions within this clause are inclusive of the entitlements contained in Section 30A of the Holidays Act and its amendments.

Study leave

6.11 The employee shall be entitled for each period of twelve (12) months to up to four (4) working days of study leave. Such study leave shall be taken in terms of the negotiated professional development plan provided for in paragraph 4.4.

7. TERMINATION

Notice

7.1 Either party may terminate this contract on giving three (3) months notice in writing to the other party. Where the employer terminates the contract under this clause, he may elect to pay salary in lieu of notice. Where the employee terminates the contract under this clause, he may elect to forfeit the equivalent salary in lieu of notice. No annual leave may be taken during the period of notice.

7.2 In the case of serious misconduct the employer may dismiss the employee with a lesser period of notice than specified in paragraph 7.1 or without notice.

Abandonment of employment

7.3 If the employee is absent from work for a continuous period exceeding three (3) working days without the agreement of the employer, he shall be deemed to have abandoned his or her employment.

Misconduct

7.4 The employer shall, when dealing with an allegation of misconduct involving the employee, advise him of the specific matter(s) of concern and allow him a reasonable opportunity to provide an explanation before deciding what action to take. The employer may suspend the employee from duty pending the investigation of any matter under this paragraph. In the event of a suspension, the provisions of this contract shall, subject to any necessary modification, continue to apply and to bind the employee.

Redundancy

7.5 The employer undertakes to explore all other options, including redeployment and retraining, before declaring the employee's position redundant (that is, superfluous to its needs) and deciding to terminate his employment.

7.6 In the event of redundancy, the employer shall provide at least three (3) months notice of the termination of employment.

7.7 Redundancy compensation shall be paid at the rate of one week's salary for each complete year of service, with a maximum payment of 13 weeks salary.

7.8 There will be no right to redundancy compensation where the employer:

(*a*) redeploys the employee to an alternative position on substantially the same terms and conditions of employment; or
(*b*) sells, transfers or leases a business and the employees transfer to the new employer on substantially the same terms and conditions of employment.

8. GENERAL PROVISIONS

Health and Safety

8.1 The employee agrees to work and act at all times in compliance with (a) the provisions of the Health and Safety in Employment Act 1992 concerning safety, health and welfare matters; and (b) the employer's requirements in respect of occupational health and safety.

Sexual harassment

8.2 Sexual harassment constitutes unacceptable behaviour, shall be regarded as serious misconduct, and may result in dismissal. Sexual harassment includes verbal or physical behaviour of a sexual nature that is unwelcome, embarrassing or intrusive to the receiver.

Indemnity from claims

8.3 The employee is indemnified against actions, suits, proceedings, damages, costs and expenses incurred as a result of advice or services he has given in the course of his employment and in the name of the Ministry of Water Resources provided that he has acted in good faith within the terms of his authority and has provided advice or services using the care, diligence and skill that a reasonable person in that occupation exercising best professional knowledge would have used.

Return of property

8.4 The employee agrees that when this contract comes to an end he will deliver to the employer all property (including documents and copies) belonging to the employer.

Expenses and allowances

8.5 The employer will reimburse the employee for all reasonable expenses incurred in the performance of duties under this contract, following the production of relevant invoices or receipts, provided that prior approval for incurring those expenses has been obtained from the employer.

8.6 Tax-free allowances to cover employment-related expenditure will be paid as listed in Schedule B, paragraph 4.

Service of notices

8.7 If it is necessary for the employee to serve any document or notice on the employer, this shall be done by delivering it in person to the office of the employer or by prepaid post addressed to the Director of Hydrology and Water Resources.

8.8 If it is necessary for the employer to serve any document or notice on the employee, this shall be done by delivering it in person to the employer's office at Momba Hydrological Office or by prepaid post to the employer's most recent residential address. The employee shall notify the employer of any changes of residential address.

Confidentiality

8.9 The employee agrees that during the period of employment or at any time thereafter he will in no way disclose to any unauthorized person confidential information relating to the Ministry of Water Resources. This will not include any information that may be required in the performance of duties under this contract.

8.10 This contract shall be treated by both parties as confidential and shall in no way be disclosed to any person except with the prior written agreement of both parties.

9. DISPUTES AND GRIEVANCES

9.1 A personal grievance claim brought by the employee shall be settled in accordance with the procedure prescribed in the First Schedule of the Employment Contracts Act 1991 or its amendments.

9.2 Disputes concerning the operation, interpretation or application of this contract shall be settled in accordance with the procedure prescribed in the Second Schedule of the Employment Contracts Act 1991 or its amendments.

SIGNED BY: the employee .....

In the presence of: .....

SIGNED BY: the Director,
Hydrology and Water Resources .....

In the presence of: .....

SCHEDULE A

JOB DESCRIPTION

POSITION: Manager, Momba Hydrological Office
LOCATION: Ministry of Water Resources, Momba
RESPONSIBLE TO: The Director, Hydrology and Water Resources
RESPONSIBLE FOR: Field team leaders and administration/finance staff

FUNCTIONAL RELATIONSHIPS WITH:

- Client agencies;
- Other sources of revenue;
- News media;
- Community and local government organizations; and
- Suppliers.

KEY RESULT AREAS AND PRINCIPAL OBJECTIVES

1. Ministry of Water Resources goals: Achieve the goals of the Ministry, as defined in the Water Resources Act.
2. Administration: Administer Momba Office's affairs in an efficient and business-like manner.
3. Finances and assets: Maintain the Momba Office in a financially sound state, and make the best use of the Office's physical assets.
4. Personnel: Make the best use of the abilities of the Office's employees, and create an environment in which they can extend those abilities.
5. Information: Keep the Director, staff of the Office, and other stakeholders fully informed of the Office's affairs.

Note: it is not expected that the Manager will achieve the above principal objectives on his own, but that he will work with and through other Office staff to do so.

KEY TASKS

1. Provide leadership and coordination.
2. Prepare annual business plan.
3. Prepare strategic plan.
4. Administer the Office's business affairs.
5. Develop the Office's business and income.
6. Manage the Office's financial affairs.
7. Manage the Office's physical assets.
8. Supervise Office employees who report directly to the Manager.
9. Manage the Office's staff management system and procedures.
10. Hire and dismiss Office employees.
11. Ensure that occupational health and safety requirements are observed and that the Office provides a safe workplace.
12. Prepare monthly and annual reports to the Director.
13. Publicize National Hydrological Office affairs.
14. Maintain effective communication with community interests and (potential) collaborators.

Key tasks	Expected results	Control information
Provide leadership and coordination	All the Office's staff fully understand and are committed to the goals and strategy of the National Office, and are working together, in a coordinated way, to achieve them.	Monthly reports Annual report Manager's six-monthly performance appraisal
Prepare annual business plan	A business plan (including budget), agreed with the Director, that defines the Office's goals and objectives each year, and provides objective standards against which achievement of the Office's business can be measured.	Business plan and budget, updated annually and presented to the Director one month before the start of the financial year
Prepare strategic plan	A strategic plan, agreed with the Director, that projects the Office's future business environment, and maps out the Office's future directions and strategies.	Strategic plan, prepared periodically as requested by the Director
Administer the Office's business affairs	All the Office's business and other activities are administered efficiently and in accordance with the business plan and accepted standards of business practice. An appropriate management information system is maintained in an up-to-date manner.	Monthly reports Annual report Manager's six-monthly performance appraisal Management information system
Develop the Office's business and income	Potential client organizations and other stakeholders are aware of the Office's goals, capabilities and services. Team leaders are aware of potential opportunities to tender for and supply services. The Office maintains a continuing workload, and associated income stream, that enables it to achieve the goals defined in the National Office strategic plan.	Monthly reports Annual report

Key tasks	Expected results	Control information
Manage the Office's financial affairs	The Office's financial affairs are administered efficiently and in accordance with the annual budget, and accepted standards of accounting practice. The Office remains financially sound (annually, income exceeds expenditure, unless at the direction of the Director).	Monthly financial reports Annual report Auditor's report
Manage the Office's physical assets	The Office's physical assets are appropriate to its goals and objectives, are used to the maximum sustainable level, are maintained in good order, and retain or increase in value. The Director receives good advice on the retention, acquisition or disposal of assets.	Asset register Monthly financial reports Annual report Auditor's report
Supervise Office employees who report directly to the Manager	Team leaders and administration staff are working to clear, agreed job descriptions and objectives, are enabled to carry out their duties efficiently, are motivated to make the fullest possible use of their abilities, and receive opportunities to extend their abilities according to their aspirations (consistent with Office needs).	Employees' six-monthly performance appraisals Manager's six-monthly performance appraisal (including employee feedback)
Manage the Office's staff management system and procedures	An employee database is maintained which holds up-to-date information on employees' work history, qualifications, remuneration, job descriptions, etc. Employees who do not report directly to the Manager are working to clear and agreed job descriptions and objectives, are enabled to carry out their duties efficiently, are motivated to make the fullest possible use of their abilities, and are receiving opportunities to extend their abilities according to their aspirations (consistent with Office needs).	Employee database Employees' six-monthly performance appraisals

Key tasks	Expected results	Control information
Hire and dismiss employees	The Office has a set of employees competent to carry out the duties required of them. (Note: varying the size of the salaried staff complement is subject to Director's approval.) Procedures for hiring and dismissing employees are carried out according to legal requirements.	Employee database Interview records (appointment and exit interviews)
Ensure that occupational health and safety requirements are observed and that the Office provides a safe workplace	Office employees enjoy a safe and healthy workplace in which there are no avoidable cases of lost time. Accurate and up-to-date records of incidents relating to health and safety are maintained. The Office meets legal Occupational Health and Safety requirements.	Employee database Monthly report Occupational Health and Safety Records
Prepare monthly and annual reports and attend meetings of the Hydrological Office Managers	The Director, staff, and external stakeholders (via annual report only) are informed in a timely fashion regarding all matters of Office business, and are enabled to make appropriate decisions.	Monthly reports Annual report
Publicize Office affairs	The Director, staff, and external stakeholders are kept aware of the Office's activities and achievement using informal mechanisms (the news media, periodic newsletters, personal contacts, etc).	Monthly reports
Maintain effective communication with community interests and (potential) collaborators	The Office has cordial relations with community groups and potential collaborators, who are informed of the Office's activities and plans. New opportunities are created for the Office and other groups to achieve their goals.	Monthly reports

PERSON SPECIFICATION

Qualifications and experience

- A tertiary qualification in hydrology or a related field
- A proven track record as a manager of a government office or business
- A good understanding of environmental and national development issues

Key competencies

Leadership

- Demonstrates and articulates commitment to the values and goals of the Ministry of Water Resources
- Builds commitment among Office employees
- Makes timely and firm decisions, and commits to a definite course of action
- Identifies and deals with opportunities and threats, as they occur
- Anticipates and leads change

People management

- Manages the performance and development of Office employees
- Enables employees to work together as a team
- Assists employees to establish their own "stretch goals" and objectives
- Delegates responsibilities by giving clear guidance on outcomes and allowing discretion on means
- Encourages sharing of information and experience

Service orientation

- Is committed to delivering a high quality service
- Builds a service-focused culture
- Evaluates development and environment trends relevant to the client group and the Ministry

Innovative thinking

- Identifies and acts on new opportunities
- Investigates and critically evaluates options
- Encourages and supports employees in seeking innovative options and solutions

Strategic thinking and planning

- Is able to see the broad picture, and its likely future evolution
- Translates the vision and goals of the Ministry into implementable objectives and actions
- Understands opportunities that arise from changes in society, the economy, and technology

Effective communication

- Influences others through effective arguments
- Negotiates mutually acceptable solutions
- Develops effective relationships and networks

SCHEDULE B

REMUNERATION

1. REMUNERATION

Base salary per annum: $12 500

2. REMUNERATION REVIEW

The employee's remuneration shall be reviewed at yearly intervals, having regard to:

(a) The results of the annual performance appraisal;
(b) National salary trends for comparable positions; and
(c) Changes in the scope of the position.

The first review will be made on or about the anniversary of appointment, with any adjustments arising from that review taking effect from the following 1 July. Thereafter, reviews will take place during June, with any adjustments taking effect from the following 1 July.

3. PERFORMANCE PAY

No provision is made for performance-related bonuses in this contract.

4. ALLOWANCES

The following allowances will be paid on invoice:

(a) Clothing allowance: $50 per annum
(b) Telephone allowance: $50 per annum

Invoice will be submitted monthly or quarterly by the manager, up to the annual total specified above.

SCHEDULE C

PERFORMANCE APPRAISAL, PROBATIONARY PERIOD

In appraising the employee's performance the employer shall have regard to:

(a) his efficiency, competency and effectiveness in carrying out the duties specified in Schedule A and in meeting the performance targets provided for in paragraph 4.3 of the main contract;
(b) his relationships with the customers/clients and other staff of the employer;
(c) his personal attributes, particularly those listed in the person specification in Schedule A;
(d) his efforts to develop work-related skills;
(e) any circumstances that could have influenced the employee's ability to carry out his duties.

ANNEX 4

EXAMPLE PERFORMANCE APPRAISAL FORM

PERFORMANCE PLANNING AND REVIEW FORM

CONFIDENTIAL

This form has six parts:

OBJECTIVES:

Section A: Objectives for the review period

Section B: Assessment of performance of objectives

GENERAL REVIEW:

Section C: Discussion of personal goals

Section D: Career development aspirations

Section E: Final comments

Section F: Competencies (review of the staff member's competencies)

(Note: Section A is to be completed at the beginning of the review period; all other sections are to be completed at the end of the review period.)

NAME:	**REVIEWED BY:**
REVIEW PERIOD: From	**To**

A

OBJECTIVES FOR THE REVIEW PERIOD

Notes to Section A
- This section is for objectives that have been agreed by the employer and staff member for the review period.
- This section is to be completed **at the beginning** of the review period.

1. Itemized objectives (include any required performance standards in description)

2. Objectives discussed and agreed

Signed _____ _____ _____ _____
Staff Member **Date** **Reviewer** **Date**

B

ASSESSMENT OF PERFORMANCE OF OBJECTIVES

Note: This section should be completed **at the end** of the review period

1. Staff member's assessment of performance of objectives itemised in section A

2. Reviewer's comments on staff member's assessment

3. Assessed by reviewer and discussed with staff member:

Signed _____ _____ _____ _____

Staff Member **Date** **Reviewer** **Date**

C PERSONAL DEVELOPMENT GOALS FOR NEXT REVIEW PERIOD

Note: Sections **C and D** should be completed during/after discussion between staff member and reviewer.

1. **Training and development required** (as identified by staff member)

2. **Training and development required** (as identified by reviewer)

D

CAREER DEVELOPMENT ASPIRATIONS

1. **Staff Member:**
   Comments on ambitions, career aspirations and development needs

2. **Reviewer:**
   Comments on staff member's ambitions, career aspirations and development needs

E

FINAL COMMENTS

1. Reviewer's overall comments on performance and competencies

Signed _____ _____
Reviewer **Date**

2. Staff member's overall comments on performance and competencies
(Staff member must sign this section, and can make written comments if wished)

All remarks or comments recorded regarding results achieved, performance capabilities and development during this review period have been discussed with me.
My signature, however does not necessarily imply that I agree with all aspects of the evaluation.

Signed _____ _____
Staff Member **Date**

F

COMPETENCIES

Note: competencies identify current skills and knowledge and are largely indicated by on-the-job behaviour. This section is intended as an index of current ability rather than of performance over the review period. It provides scope for identifying personal strengths and/or aspects for improvement. The reviewer should provide feedback to the staff member on his or her capabilities in relation to current competency level.

Competency (from Person Specification)	**Comments by Reviewer**
Leadership	
People management	
Service orientation	
Innovative thinking	
Strategic thinking and planning	
Effective communication	

APPENDIX

ACRONYMS AND ABBREVIATIONS

Abbreviation/Term	Definition
ACMAD	African Centre of Meteorological Applications for Development
ASEAN	Association of South-East Asian Nations
CHy	Commission for Hydrology (WMO)
ESA	External Support Agency
FRIEND(S)	Flow Regimes from International Experimental and Network Data Sets (UNESCO)
GIS	Geographical Information System
HELP	Hydrology for the Environment, Life and Policy
HOMS	Hydrological Operational Multipurpose System (a WMO sub-programme for technology transfer (part of the Operational Hydrology Programme))
HYCOS	Hydrological Cycle Observing System
HYNET	WMO Project on Intercomparison of Operational Hydrological Network Design Techniques
IAHS	International Association of Hydrological Sciences (IUGG)
IHP	International Hydrological Programme (UNESCO)
ISO	International Organization for Standardization
IWRM	Integrated Water Resources Management
MBO	Management By Objectives — a method of management that is based in setting specific objectives for each employee or workgroup
MBWA	Management By Wandering Around — a style of management in which supervisors spend significant time observing operations and maintaining close contact with employees
NHS(s)	National Hydrological Service(s)
NMHS(s)	National Meteorological and Hydrological Service(s)
NMS(s)	National Meteorological or Hydrometeorological Service(s)
OHP	Operational Hydrology Programme
SADC	Southern African Development Community
SOPAC	South Pacific Applied Geoscience Commission (a technical commission of the South Pacific Forum organization)

Abbreviation/Term	Definition
SWOT	Analysis of an organization's strengths, weaknesses, and opportunities, and the threats it faces
TQM	Total Quality Management — an approach to management that seeks to maximise the quality of every aspect of the business
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHYCOS	World Hydrological Cycle Observing System (a WMO programme, the aim of which is to promote international hydrological data collection and transfer technology)
WMO	World Meteorological Organization
WSSD	World Summit on Sustainable Development