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EXECUTIVE SUMMARY

Rationale

A version of core functions for water resource management arising from the National Water Act (Act 36 of 1998) (the Act) can be summarised as:

- develop a vision for sustainably using South African water resources,
- set resource quality objectives,
- develop strategic and operational plans to achieve those objectives,
- implement those plans and
- close the loop by monitoring achievement of the objectives.

Effective monitoring and assessment to obtain reliable strategic and operational management information on the status of the resource itself, and other ancillary information, is a prerequisite for performing the core functions of water resources management.

Why now

Several recent and ongoing events make this an opportune time to review and realign current water resources and related monitoring activities. For example:

- Legislative requirements to provide access to information.
- The Act requires revision of water resources management functions.
- Significant advancements in information technology (IT).
- DWAF has embarked on a process to substantially improve the governance of its IT infrastructure and support.
- Key stakeholders in DWAF agree that it is critical to address the effectiveness of monitoring and assessment.
- DWAF has embarked on a process of restructuring

Process

The process was initiated with a workshop of primarily DWAF stakeholders in monitoring and assessment. A key recommendation from the workshop was for DWAF to develop a strategy to improve the current status of monitoring and assessment.

In order to give effect to the requirement for a strategy, the Department launched this project to deliver, by the end of March 2000 a strategy for:

> **Establishing monitoring and assessment information systems that meet the information requirements of the Department's water resource management functions. Significant interfaces with the monitoring and assessment requirements of the Department's water services provision functions should also be addressed.**

The proposed strategy was developed in two phases, namely:

- An analysis of the current status of water resources monitoring and assessment from an effective management information delivery perspective.

- Development of a strategy for establishing monitoring and assessment information systems that meet the information requirements of the Department's water resource management functions and address issues raised in the analysis phase.

Both phases used a process of wide consultation - in the form of interviews, workshops and presentations - with stakeholders representing the core water resources management functions and incorporation of their views and recommendations in the proposed strategy. Those who participated in the process expressed significant buy-in for the proposed strategy.

Analysis

The output of the analysis was a statement of the information required to perform a set of core functions of water resources management, accompanied by an analysis of the adequacy with which these requirements are currently met. Detailed statements of issues and recommendations were compiled, but a set of overarching issues emerged from the process that combined many of the detailed issues. The proposed strategy was designed to address the overarching issues, which are:

- Problems with quality of data and information,
- Problems with access to data and information,
- Ineffective corporate governance of monitoring and assessment,
- Commonality between data requirements of different core functions; unique requirements are the exception rather than the rule. However, data analysis or information requirements may be quite specific.
- Major shortage in skilled people needed to develop, maintain, and support monitoring and assessment systems

Proposed strategy

The strategy is presented in two steps, namely a conceptual model of a water resources monitoring and assessment information system (WRMAIS) followed by the four necessary conditions for making this model a reality. Two prerequisites, which are beyond the control of this project, were also identified as critical to successful implementation but are not described in detail because they are dealt with by others.

The proposed conceptual model for DWAF's Water Resources Monitoring and Assessment Information System provides a foundation for the strategy. The proposed model is shown below.

Its main features are the following:

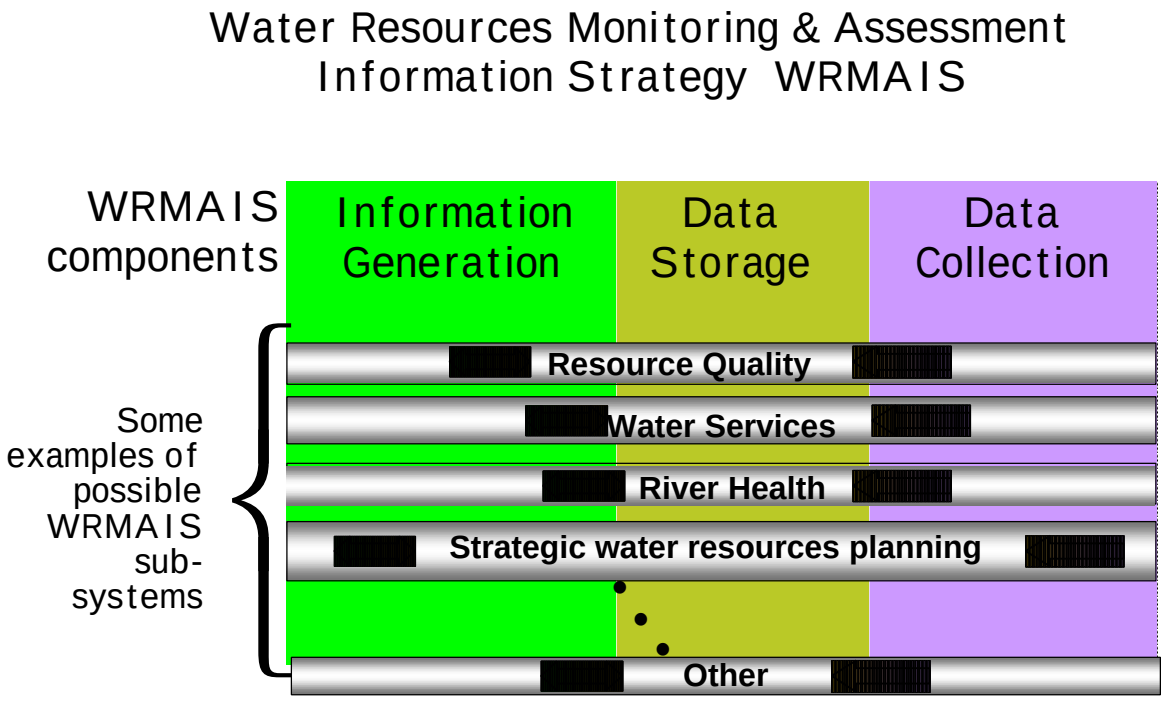
- It consists of a number of sub-systems, examples of which might be:
    - Resource Quality Objectives Monitoring and Assessment Sub-system;
    - Water Services Sub-system;

- River Health Sub-system;
- Strategic Water Resources Planning Sub-system; etc.

The sub-systems are combined as a coherent portfolio into a corporate WRMAIS.

It is recommended that Water Services is not dealt with as a separate system, but is incorporated as a sub-system in WRMAIS.

- Each sub-system contains three key functional components, namely:
  - Data collection, which can occur within DWAF or in another organisation,
  - Data storage, maintenance and dissemination, and
  - Information generation, reporting, and delivery.



Conceptual model of the WRMAIS system

Some of the implications of the model are that there will be significant sharing of logistics and infrastructure, particularly with respect to the data collection and data storage components and that there will be adherence to common guidelines and standards.

A key recommendation is:

DWAF combines all the existing and new water resources monitoring and assessment sub-systems into a coherent Water Resources Monitoring and Assessment Information System (WRMAIS) backed by a strong level of governance both within and external to DWAF.

The four necessary conditions for establishing the proposed WRMAIS are described in the following sections.

Condition 1 – Effective governance

1 A key element of the proposed strategy for effective water resources monitoring and assessment is that it should be established and managed as a corporate system within DWAF and a co-operative system with other organisations. Effective governance of such a WRMAIS is essential. The specifications for the proposed governance of the WRMAIS are:

a) A corporate management capacity for the WRMAIS within DWAF, which establishes a single point of accountability for WRMAIS, exists.
b) A master plan exists for establishing and maintaining sub-systems making up the WRMAIS. It is used to fund, manage, monitor, and control execution of the plan. Migration of the current disparate sub-systems to the WRMAIS is addressed in the master plan.
c) Commercial and other models and/or agreements exist for accessing and delivering water resources data and information from and to organisations external to DWAF.
d) A process for establishing standards exists.
e) Ongoing evaluation and improvement of the WRMAIS to keep it aligned with user expectations takes place.
f) Compliance with statutory and corporate requirements is ensured.

Condition 2 – Effective sub-systems

2 Effective WRMAIS sub-systems exist. The requirements for establishing and maintaining a typical sub-system are summarised below:

a) Effective governance for the sub-system exists (ownership of the sub-system / roles and responsibilities of stakeholders in the sub-system, service level and contractual agreements, ongoing evaluation and control, policies and procedures).
b) A portfolio of sub-systems has been selected on the basis of business analysis of the core functions of water resources management required by the Act.
c) Systems are properly designed and documented according to the WRMAIS standardised design process.
d) Adequate financing for the sub-system exists.
e) Access to adequate infrastructure (logistics, hardware, software, networks, applications, and other physical infrastructure) required to establish and maintain the sub-system exists.

f) Access to skilled human resources required to establish and maintain the sub-system exists.
g) Quality assurance is operational.
h) Effective interfaces with users are maintained.

Condition 3 – Effective client interfaces

3 Effective interfaces with clients of the proposed WRMAIS exist. User interfaces have to be maintained at two levels within a WRMAIS, namely at strategic and operational levels.

a) Strategic interfaces would be handled at the level responsible for corporate governance of the WRMAIS. The strategic interfaces would typically address policy on the establishment and use of the WRMAIS; agreements with local and international external organisations, agreements with the Chief Information Officer (CIO) on the required IT infrastructure and service levels, etc.
b) The operational interfaces would be handled at the level of individual sub-systems. The operational interfaces would typically address users' specific information requirements in the design of sub-systems, training users to use the sub-systems and interpret the information provided, etc. It would also regularly assess how well user requirements are being met and make the necessary adjustments to the sub-systems in light of such assessments.

Condition 4 – Information Technology Support

4 The WRMAIS is supported by a stable, reliable IT platform and supporting IT infrastructure.

a) The establishment of the required IT platform and supporting infrastructure is the function of the Department's Chief Information Officer (CIO) supported by the IT Integrator. However, a key requirement of corporate governance of the proposed WRMAIS is to ensure that the CIO establishes and maintains the required IT platform and supporting infrastructure. Effective participation by the WRMAIS owner and sub-system owners in the structures and mechanisms currently being established to manage IT infrastructure in the Department is essential.

Prerequisites

The prerequisites for establishing the proposed WRMAIS are that:

- Effective corporate governance of IT within DWAF exists, and
- DWAF's mandate and core functions are reflected in its business processes and structure.

Achievement of these falls outside the scope of establishing a WRMAIS. It is proposed that these be dealt with in subsequent phases WRMAIS establishment through developing and maintaining effective interfaces with the corporate governance of IT project and the re-structuring of water resources management functions project.

The way forward

The proposed strategy concludes with a brief outline of the way forward, assuming the strategy for establishing a WRMAIS is accepted by DWAF. The road map for

implementation starts with the proposed strategy and proceeds through the stages of approving the strategy, establishing the infrastructure for governance, setting up a project to develop the master plan to initiate the WRMAIS and its sub-systems, and launching a portfolio of projects to implement the plan. A critical requirement is to establish effective interfaces with two other strategic initiatives in DWAF, namely the IT governance initiative and the restructuring of the Department's water resources management functions. A probable time line for completing the establishment of the WRMAIS indicates that the full system can be operational by April 2004. However, significant interim results would be achieved during that period as individual sub-systems are developed and/or migrated to the WRMAIS.

1 INTRODUCTION

1.1 Preamble

Measurements of the quantity and quality of the water resource are the source of information regarding the effectiveness of the Department of Water Affairs and Forestry's (DWAF) policies. Only by measuring and comparing to agreed criteria can DWAF ensure the results of the current implementation of policies has been successful in attaining sustainable, equitable, and beneficial use of the resource. Because the information is essential and collecting it requires considerable effort, it is necessary to provide the most cost-efficient and effective monitoring programmes possible.

Water resource monitoring programmes produce data that are processed and analysed to create information that is used for, among other things, assessment of the resource quantity and quality. This monitoring, assessment, and information link forms a key part of strategic and operational water resources management. It is used to establish the status of the resource, estimate its current and future demands, assess the sustainability of its use, obtain information for operations, and assess the effectiveness of management practices. In recognition of this, DWAF and its predecessors have been monitoring and assessing since the late nineteenth century.

This project results from DWAF's desire to maximise the benefit from its monitoring, assessment, and information programmes and fulfil its mandate for effective water resource management. This is not the first initiative to attempt to improve monitoring and assessment and the question may then be asked as to how another initiative can make a difference. The difference is a particular window of opportunity open now through:

- South Africa's Constitution and several acts in response to the Constitution, such as the National Water Act (Act 36 of 1998) (the Act) and the Administrative Justice Act, introduce some very specific requirements for providing information and access to it.
- The Act requires significant revision of many water resources management functions and the addition of new ones. Therefore, information flow necessary for performing water resources management functions has changed significantly.
- It is probably the first time that all the key stakeholders in monitoring and assessment required for water resources management agreed to join forces in addressing the obstacles to improving the effectiveness of the monitoring and assessment information systems.
- There have been significant advancements in information technology (IT) - a key enabling technology for monitoring and assessment - that open up many new possibilities for cost-effective storage, analysis, and access to information.
- DWAF has recently out-sourced the management of its IT infrastructure and modified the organisational structure to enhance the support available for IT.

- DWAF is presently engaged in an investigation to define an appropriate structure for its water resources management function.

Now is, therefore, an opportune time to take a fresh look at water resources monitoring and assessment and to develop strategies for improving both its alignment to new requirements and its efficiency. An inclusive effort now to integrate delivery of the range of water resources management information will reduce the potential for a proliferation of disparate systems developed in response to pressure to deliver new kinds of information and make new decisions.

1.2 Background and goals for this project

Chapter 14 of the Act places the duty on the Minister of Water Affairs and Forestry to establish national monitoring and information systems as soon as is practical to do so. As a preliminary step in establishing these systems, a workshop involving a representative group of stakeholders in water resources management, monitoring, and assessment was held in September 1999. At this workshop, the participants agreed on an overarching objective, namely:

> **DWAF has led the development of easily accessible information and knowledge systems to support wise decision making for sustainable water use at all levels.**

A set of issues was identified that currently constrains the development of the envisioned information and knowledge systems and the monitoring programmes that support them. It was proposed that a strategy be developed and implemented to achieve the overarching objective by addressing these constraints. Appendix 1 contains the proceedings of the September 1999 MAIS Workshop.

The Department launched this project (see Appendix 2 for the Terms of Reference) to give effect to the requirement for a strategy. As required, it delivered, by the end of March 2000:

> **A strategy for establishing monitoring and assessment information systems that meet the information requirements of the Department's water resource management functions. Significant interfaces with the monitoring and assessment requirements of the Department's water services provision functions should also be addressed.**

The strategy addresses the following at a general level:

- Brief description of a "working version" of the core functions for water resources management;
- Description of the types of information required by each of the core functions;
- Description of current information sources and formats, and the degree to which the information requirements are being met;

- Identification of information requirements and potential information sources common across more than one of the main water resource management functions;
- Recommendations in the form of a strategy for addressing the identified gaps, inefficiencies, and requirements for coordination or integration and for addressing inconsistencies in meeting common information requirements

The recommended strategy identifies the need to produce proposals to design and develop new information systems, redesign and adapt existing systems, or establish co-operation with other organisations to provide information. Identification of the needs for the establishment of policies, financial and contractual support, IT architecture, and standards are also included. The recommended strategy accounts for current or planned initiatives.The strategy incorporates input from key role players involved in the Department's water resources management functions. The recommended strategy has been tested with these key role players and, where possible, buy-in obtained from them.

Although the strategy is focussed on the monitoring and assessment requirements of the Department's water resource management process, the Department's water services provision process has significant monitoring and assessment interfaces with water resources management. These interfaces are not specifically addressed as part of the strategy, but are incorporated into the broader principles of the strategy.

2 DESCRIPTION OF THE CORE FUNCTIONS OF THE WATER RESOURCES MANAGEMENT PROCESS

The Act provides for an integrated, adaptive process of water resource management. The various provisions of the Act can be arranged in a number of ways. A "working version" of one perspective of DWAF's core functions in managing water resources was adapted for use in this project from a similar perspective taken by a group in the Department determining Resource Directed Measures. The working version of the core functions is shown schematically in Figure 1. A business analysis of the implications of requirements of the Act is likely to produce a modified version of the details of the core functions. The highly integrated version used in this project is intended to be generic enough to allow for considerable modifications at the detailed level.

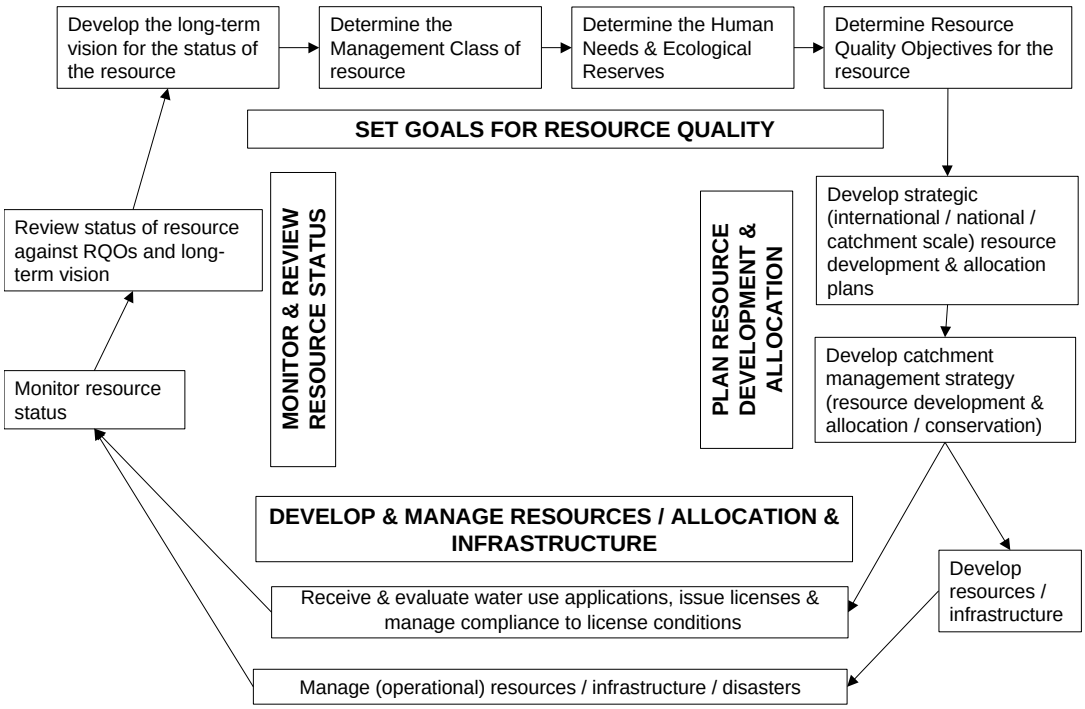


Figure 1 A set of core functions of water resource management in DWAF

The core functions of water management, as well as the current lead agents in DWAF responsible for performing them, are summarised in the table below.

Water Management Functions	Lead Agent
Set goals for resource quality	CD: Scientific Services
Develop strategic (international / national / catchment scale) resource development & allocation plans	CD: Planning
Develop catchment management strategy (resource development, allocation, conservation)	CD: Regions, CMAs
Develop resources and infrastructure	CD: Planning, CD: Regions, CMAs
Receive & evaluate water use applications, issue licenses; manage compliance to license conditions	CD: Water Use and Conservation, CD: Regions, CMAs
Manage (operational) resources / infrastructure / disasters	CD: Water Use and Conservation, CD: Regions, CMAs CD: Planning; CD: Scientific Services; CD: Regions
Monitor resource status	CD: Scientific Services, CD: Regions, CMAs, CD: Water Use and Conservation
Review status of resource against RQOs and long term vision	CD: Scientific Services; CD: Planning, CD: Regions, CD: Water Use and Conservation
Provision of water services	CD: Water Services

3 INFORMATION REQUIREMENTS

Performance of the core functions for water resources management requires many different types of information, for example:

- Resource status, including hydrology, geo-hydrology, chemical characteristics of water, aquatic health, etc;
- Water demands, including current and projected water requirements;
- Water use, including existing legitimate water use, licence conditions, estimated impact of proposed water use, etc;
- Legislation and policies affecting water and related issues;
- Infrastructure, for water, transportation, communication, etc;
- Information on past, current, and planned DWAF initiatives and those of other organisations related to water resource management.

Different types of information typically have to be obtained from separate information sources, with sources often housed on different IT platforms and using different architectures.

Almost all water management functions require information on resource quality. This information is currently obtained from various sources both inside and outside DWAF. For example, within DWAF, resource quality information is available in the Hydrological Information System (hydrological information), Water Management System (chemical / biological / microbiological quality), and the National Groundwater Data Base (geohydrological information). Outside DWAF, for example, information on rainfall and evaporation is available from Weather Bureau, land cover information from Agricultural Research Council, etc.

In DWAF, each of the sources of resource quality information is maintained through its own monitoring and assessment management process and each makes decisions about its IT platform and architecture. In addition, there are differences in the degree to which each of these sources meets the new information requirements dictated by the Act.

An analysis of the information requirements for water resources management was conducted as part of this project. The analysis process and its conclusions are summarised below.

3.1 Analysis Process

The survey of information required for decision support for each of the core functions for water resource management and an analysis of the effectiveness of current systems to meet the requirements was conducted by personal interviews with practitioners from each of the functions. Participants included both information users and data providers. Interviews were also conducted with people involved in support functions, for example, the IT Integrator and consultants currently advising on restructuring of the water resources management functions in DWAF. A list of people interviewed, workshop participants, and those to whom a separate presentation was made is given in Appendix 3.

In addition to the interviews, documents such as the Act and others were used. Appendix 4 contains a list of documents used. DWAF's Legal Services Directorate

addressed implications of recent legislation related to information provision. A summary of the background legal information is given in Appendix 5

Transcripts of the interviews and other supporting documentation were used to collate and summarise the range of information required to perform core functions for water resources management and to analyse the adequacy with which these requirements are met.

A draft report on the analysis of information requirements and their adequacy was shared with stakeholders at a workshop on 24 February 2000. Stakeholders had the opportunity, during the workshop and afterwards, to verify and add to the information presented. Their input was included in a summary table of information requirements, gaps, and recommendations (shown in Appendix 6). A preliminary list of detailed data and information requirements for water resources management was compiled and is shown in Appendix 7.

3.2 Overarching Issues that Emerged from the Analysis of Information Requirements

The analysis identified several issues that affect all the core functions and the types of information used in water resources management, namely:

- Problems with quality of data and information
  - Geographic reference is not consistent;
  - Little evidence of adherence to data collection and storage standards;
- Problems with access to data and information
  - Little evidence of regular assessment and reporting based on data being collected;
  - No comprehensive, generally accessible directory of available data and information in DWAF and other organisations;
  - Difficulty in accessing or integrating data and information available on disparate IT platforms;
  - Many current monitoring and assessment programmes are perceived to be poorly aligned to the information needs of the core functions of water resource management– particularly new needs that arise from the Act;
  - Large number of other organisations produce data and require water resource information, including large water boards and local government;
  - Security issues constrain access of data through central government's computer system firewall;
- Ineffective corporate governance of monitoring and assessment
  - Corporate IT initiatives in DWAF have a bad reputation for meeting user needs;
  - Too many "spaza shop" monitoring and assessment systems; in other words, independent systems often running on IT platforms that do not adhere to the corporate IT architecture, data standards, design requirements, etc. The information generated through these systems is often accessible only to the people who develop and maintain them;
  - Lack of flexibility and creativity in accepting new solutions;
  - Little evidence of coordination of monitoring and assessment initiatives;

- Commonality between data requirements of different core functions; unique requirements are the exception rather than the rule. However, data analysis or information requirements may be quite specific.
- Major shortage in skilled people needed to develop, maintain, and support monitoring and assessment systems

3.3 Process Used to Develop the Strategy

The strategy was based on established information requirements and an analysis of the adequacy with which these requirements are currently being met, in particular to the overarching issues that emerged. The results of the analysis and the draft strategy were shared with the group of key stakeholders at a workshop on 17 March 2000 and, after the workshop, with other key stakeholders who had the opportunity to verify and add to the strategy presented. Their input was incorporated in the strategy.

4 RECOMMENDED STRATEGY

4.1 Conceptual Model for DWAF's Water Resources Monitoring and Assessment Information System

A conceptual model for DWAF's Water Resources Monitoring and Assessment Information System provides a foundation for the strategy. The proposed model is shown in Figure 2.

Its main features are the following:

- It consists of a number of sub-systems, examples of which might be:
    - Resource Quality Objectives Monitoring and Assessment Sub-system;
    - River Health Sub-system;
    - Strategic Water Resources Planning Sub-system; etc.

The sub-systems are combined as a coherent portfolio into a corporate WRMAIS. It is recommended that Water Services is not dealt with as a separate system, but is incorporated as a sub-system in WRMAIS.

- Each sub-system contains three key functional components, namely:
    - Data collection, which can occur within DWAF or in another organisation,
    - Data storage, maintenance and dissemination, and
    - Information generation, reporting, and delivery.

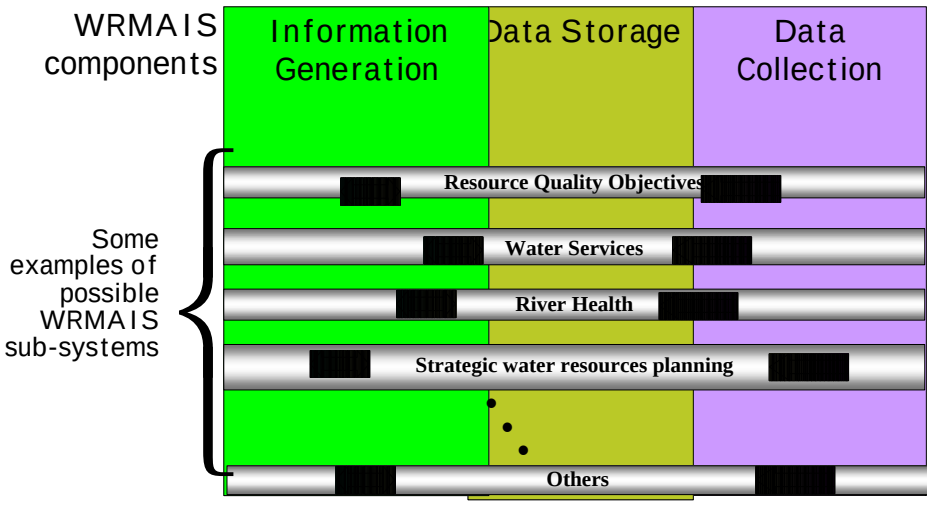


Figure 2 Conceptual model of the Water Resources Monitoring and Assessment Information System

The data collection component includes all the activities of monitoring that are conducted by DWAF in addition to obtaining data sets collected by other organisations. Liaison with other organisations to influence their monitoring standards or their data transfer standards would be included as part of the data collection activities.

Data storage is primarily an information technology function that includes specification of data formats, provision of access through whichever media is most appropriate, preparation and delivery of standard reports on a regular basis, and other similar activities.

The information generation component includes all the analysis of data activities. Models, statistical analysis, and patching of missing data are some examples of information generation activities. These activities would access data available through the “data storage” component and process the data in some way. The results of the processing would typically have more value than the original data sets. In some cases, the processed results would also be stored and available for later retrieval. The double-headed arrows in Figure 2 between Information Generation and Data Storage are intended to denote this exchange.

An important implication of this model is that different sub-systems would be able to share and benefit from certain functional components. For example, it is anticipated that almost all the sub-systems in the WRMAIS would share the same IT platform and infrastructure for their data storage activities. Sub-systems might be able to share the same logistics and part of the technical infrastructure required for data collection. The same monitoring and assessment system-design principles and data and information standards would apply across all sub-systems. One would expect more sub-system-specific requirements to exist around information generation,

reporting, and delivery, because this is where matching with specific user requirements occurs.

However these benefits and overall coherence will only be achieved if the following recommendation is executed:

DWAF combines all the existing and new water resources monitoring and assessment sub-systems into a coherent Water Resources Monitoring and Assessment Information System (WRMAIS) backed by a strong level of governance both within and external to DWAF.

Where appropriate, existing systems would continue to function until they were replaced by or incorporated into sub-systems of the WRMAIS. Necessary conditions for success of the WRMAIS are described in the following sections.

4.2 Objective of the WRMAIS

The proposed target or overall objective for the WRMAIS is:

> **By April 2004 a Water Resources Monitoring & Assessment System exists that delivers water resources related information that is effectively used.**

Although the principal clients will be people in organisations and institutions involved in or with water resources management, the same information products delivered through the proposed WRMAIS would also benefit a wide range of other parties, including the general public, interested in and affected by water resources management. While the system's features are dictated primarily by information requirements of principal clients, all clients will be provided with access to and encouraged to use the information contained in the WRMAIS.

A reasonable target date for completely achieving this objective is April 2004. However, as soon as it is agreed to establish a WRMAIS and migration of sub-systems to the integrated system begins, the objective will be partially achieved.

4.3 Necessary conditions for Establishing a WRMAIS

Four conditions, shown in Figure 3, were identified as necessary for the successful establishment of the WRMAIS. They are:

- Effective corporate-level governance of water resources monitoring and assessment exists, both within and external to DWAF.
- A portfolio of effective sub-systems exists for collecting data, storing and maintaining data and information, and generating, reporting, and delivering the required water resources information and assessment tools to users through appropriate media (hard copy, electronic files, Web pages etc.)

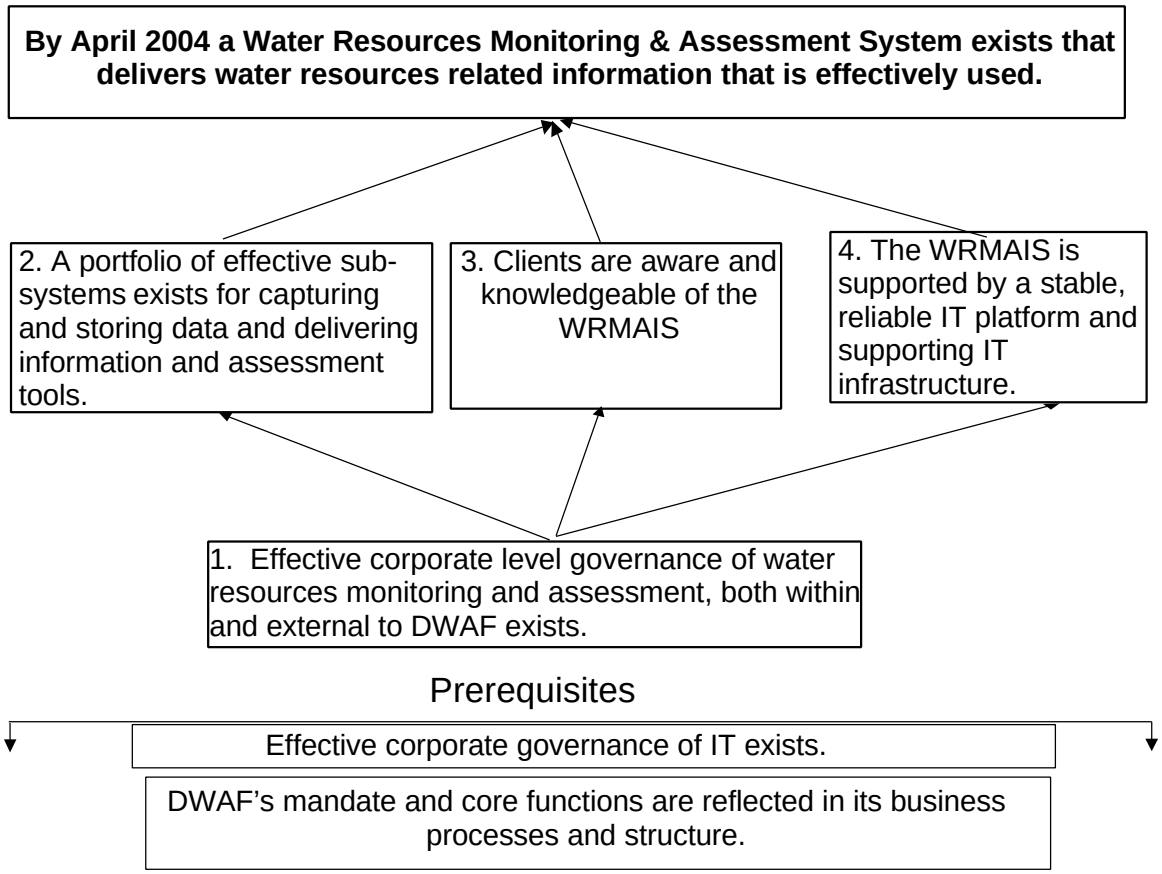


Figure 3 Necessary conditions for the proposed Water Resources Monitoring and Assessment Information System and two prerequisites that are dealt with outside this strategy

- Clients are aware of the WRMAIS, the requirement to use the information delivered through this system in their decision-making, and they have access to the necessary skills required to use the system and interpret the information.
- The WRMAIS is supported by a stable, reliable, IT platform and supporting IT infrastructure.

More detailed specifications for each of the four necessary conditions for achieving the objective of the WRMAIS are outlined in the following sections.

Achievement of two prerequisites, namely, "effective corporate governance of IT exists," and "DWAF's mandate and core functions are reflected in its business processes and structure" fall outside the scope of establishing a strategy for the WRMAIS. It is proposed that these be dealt with in subsequent phases of WRMAIS through developing effective interfaces with the Corporate Governance of IT project and the Re-structuring of Water Resources Functions project.

4.3.1 Effective Corporate Governance of WRMAIS

A key element of the proposed strategy for effective water resources monitoring and assessment is that it should be established and managed as a corporate system within DWAF and a co-operative system with other organisations. Effective governance of such a water resources monitoring and assessment system is essential. The specifications (and verifiable features) for the proposed governance of the Water Resources Monitoring and Assessment Information System are:

a) A corporate management capacity for the WRMAIS within DWAF exists, for example:
   - A single point of accountability for corporate WRMAIS is established – recommended for senior management level within water resources management.
   - The overall objectives of the WRMAIS and of all its sub-systems are clearly defined.
   - Roles and responsibilities of all the key role players, both within and external to DWAF, such as CMAs and water boards, in the WRMAIS are defined.
   - A small, but appropriate, infrastructure (for example, a project manager, the secretariat role, and a WRMAIS projects office) to support governance of WRMAIS within and external to DWAF exists.
   - Policies and resulting procedures exist that require data collection, data storage, and use of integrated water resource information delivered through the WRMAIS for water management decision-making.
   - Funds are allocated to all the required elements of the WRMAIS, including funding agreements with external partners.
   - A strategic human resources development plan for sustaining the WRMAIS exists.
   - A strategic technology plan for the WRMAIS exists. As a result of the convergence of monitoring technologies and information technologies, there must be integration of the Information technology plan and the Monitoring and Assessment technology plan.

b) A master plan exists for:
   - Designing the WRMAIS, including evaluation of current systems like the Water Management System (WMS), Hydrological Information System (HIS), etc.
   - Creating or migrating sub-systems making up the WRMAIS.
   - Funding, management, monitoring, and controlling execution of the plan (for example, project plans, status reports, performance agreements, etc.).
   - Existing systems would continue to function until evaluation and/or migration into the integrated system.

c) A process exists, and is applied, for the analysis, design, implementation, and ongoing evaluation of each of the WRMAIS sub-systems. The process would be applied by techniques such as the following:
   - Guidelines and standards for data analysis and assessment methodologies, including models,
   - Standards, guidelines and processes for application design,

- Standards, guidelines and processes for storage and maintenance of electronic and non-electronic data.
- Standards, guidelines, and procedures for data exchange,
- Standards, guidelines, and procedures for meta-data, and
- Standards, guidelines, and procedures for data collection aligned with national and international standards.

d) Commercial and other models and/or agreements exist for accessing and delivering water resources data and information from and to organisations external to DWAF.

e) Ongoing evaluation and improvement of the WRMAIS takes place. For example:
   - The degree to which the WRMAIS meets the expectations of its key stakeholders is measured and remedial actions taken,
   - Effective use of the WRMAIS is evaluated and remedial actions taken, and
   - The WRMAIS is continuously improved in terms of its effectiveness and efficiency, using benchmarks where appropriate.

f) Compliance with statutory and corporate requirements is ensured. For example:
   - Compliance with corporate IT architecture
   - Compliance with statutory requirements, and
   - Compliance to corporate standards, guidelines and procedures (for example, audit incorporation of these in tenders or contracts).

The style of governance of the WRMAIS is important. It could, for example, be done with a light hand, having few standards and more guidelines and encouraging voluntary adherence to them. It could also be more firm-handed with standards and policies clearly defined, adherence to them mandatory, and violations met with significant consequences. There is not a universal best choice of governance style; rather there are right choices for a given set of circumstances.

It is our recommendation that during the initial period of the establishment of the proposed WRMAIS the firm-handed style is adopted. The Department, in establishing a WRMAIS, would be moving from a culture where there was little adherence to standards and policies related to information systems. A firm hand in terms of governance is needed to establish a new culture of adherence to such standards and policies. Once the new culture is firmly in place a lighter hand can be used to govern the WRMAIS. Nevertheless, the WRMAIS must demonstrate a benefit to the organisation that will support its business functions and will continue to encourage individual initiative.

In setting up agreements establishing relationships with outside organisations, particularly those falling within the ambit of the Act, the Department can choose to adopt a rights-based or an interests-based approach. A rights-based approach would be one in which the Department demands certain things from, say a CMA, and it uses the powers it is given in terms of the Act to make those demands. An interests-based approach is one in which the Department would search for common interests with the other party and use that common interest as a basis for

establishing win-win agreements. Experience indicates that adopting an interests-based approach is more likely to lead to effective agreements and relationships. However, there may be cases, such as requiring water users to monitor water resources for compliance purposes, where adopting a rights-based approach may be appropriate.

It is proposed that in developing an effective WRMAIS, DWAF focus first on establishing effective corporate governance for WRMAIS within DWAF, before extending the initiative to other organisations.

4.3.2 Establish and Maintain the Sub-Systems of WRMAIS

The corporate Water Resources Monitoring and Assessment Information System will be made up of several sub-systems. Some possibilities of sub-systems are, for example, a Hydrological (water quantity) Monitoring and Assessment System, a River Health Monitoring and Assessment System, etc. Each of these sub-systems will conform to the conceptual model described in Section 4.1.

The style of sub-system governance should encourage ownership of data and information and innovation by the stakeholders.

The requirements and verifiable features for establishing and maintaining typical sub-systems are summarised below:

a) Effective governance for the sub-system exists that includes for example,
   - an identified owner of the sub-system,
   - roles and responsibilities of stakeholders in the sub-system are clearly defined and communicated,
   - service level and contractual agreements are generally used to establish delivery levels,
   - evaluation of the sub-system is continuous,
   - control activities are routinely undertaken, and
   - policies and procedures are established, documented and communicated.

b) A portfolio of sub-systems has been selected on the basis of business analysis of the core functions of water resources management required by the Act.

b) Sub-systems are properly designed and documented according to the WRMAIS standardised design process.

c) Adequate financing for the sub-system exists.

d) Access to adequate infrastructure (for example, logistics, hardware, software, networks, skills and other physical infrastructure) required to establish and maintain the sub-system exists.

e) Access to skilled human resources required to establish and maintain the sub-system exists.

f) Quality assurance is operational.

g) Effective interfaces with users are maintained. Some examples are:
   - Users are identified;
   - Sub-systems are designed and data and information is delivered in accordance with the requirements of its users (for example, in spatial and temporal scales and levels of resolution);

- Effective user support is available (for example, manuals, help desk).
- Access to data sets, assessment tools, relevant meta-data, and information products is provided in interfaces that are easy to use and media that are appropriate (for example, Internet, printed copy, information kiosk, call centres, etc);
- Users are aware of the sub-system, the requirement for them to use the information provided by the sub-system, and the functionality offered by the sub-system; and they have the skills required to use the sub-system effectively.

4.3.3 Effective Use of the Information delivered through the WRMAIS

User interfaces have to be maintained at two levels within the WRMAIS, namely at strategic and operational levels.

Strategic interfaces would be handled at the level responsible for corporate governance of the WRMAIS. The strategic interfaces typically address policy on the establishment and use of the WRMAIS, agreements with local and international external organisations, agreements with the Chief Information Officer (CIO) on the required IT infrastructure and service levels, etc.

The operational interfaces would be handled at the level of individual sub-systems. They typically address users' specific information requirements in the design of sub-systems, training users to use the sub-systems and interpret the information provided, etc. It would also regularly assess how well user requirements are being met and make the necessary adjustments to the sub-systems in light of such assessments.

More detailed specifications for maintaining effective user interfaces at the strategic and operational levels are provided as part of the specifications for corporate governance of the WRMAIS and the establishment and maintenance of its sub-systems respectively.

4.3.4 Support of WRMAIS by a stable, reliable IT platform

The establishment of the required IT platform and supporting infrastructure is the function of the Department's CIO supported by the IT Integrator. A key requirement of corporate governance of the proposed WRMAIS is to ensure that the CIO establishes and maintains the required IT platform and supporting infrastructure. Effective participation by the WRMAIS owner and sub-system owners in the structures and mechanisms currently being established to manage IT infrastructure in the Department is essential.

This topic is dealt with at length in the Department's IT Governance Model currently under development by the IT Integrator. It is, therefore, not addressed in detail in this strategy.

5 ROAD MAP FOR IMPLEMENTATION OF THE WRMAIS STRATEGY

A general roadmap for continuing the process of establishing the WRMAIS beyond the proposal stages presented in this document are shown in Figure 4.

The roadmap starts with the proposed strategy and leads through the stages of approving the strategy, establishing the infrastructure for governance, setting up a project to initiate the WRMAIS, develop the master plan for the system and its sub-systems, and launching a portfolio of projects to implement the plan. A critical requirement is to establish effective interfaces with two other strategic initiatives in DWAF, namely the IT governance initiative and the restructuring of the Department's water resources management functions. A probable time line for completing the establishment of the WRMAIS is also indicated at the right of the figure.

Figure 4 Road map for WRMAIS implementation