National Aquatic Ecosystem Health Monitoring Programme (NAEHMP): *River Health Programme (RHP)*

Inception Phase (Reviewing the RHP Design) Record of Decision Report





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LIST OF ABBREVIATIONS

CMAs	Catchment Management Agencies
DEAT	Department of Environmental Affairs and Tourism
DSS	Decision Support System
DWAF	Department of Water Affairs and Forestry
EC	Ecological Category
EIS	Ecological Importance and Sensitivity
FAII	Fish Assemblage Integrity Index
FRAI	Fish Response Assessment Index
FROC	Fish Frequency of Occurrence
IHI	Index of Habitat Integrity
IT	Information Technology
MIRAI	Macroinvertebrate Response Assessment Index
MoU	Memorandum of Understanding
NAEBP	National Aquatic Ecosystem Biomonitoring Programme
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NWA	National Water Act
P&R	Policy and Regulation
PES	Present Ecological State
PTTs	Provincial Task Teams
QA/QC	Quality Assurance and Control
R&D	Research and Development
RDM	Resource Directed Measures
RHP	River Health Programme
RQOs	Resource Quality Objectives
RQOCMP	Resource Quality Objectives Compliance Monitoring Programme
RVI	Riparian Vegetation Index
R&D	Research and Development
RQS	Resource Quality Services
SASS5	South African Scoring System version 5
SoR	State of Rivers
TPCs	Thresholds of Probable Concerns
VEGRAI	Vegetation Response Assessment Index
WMA	Water Management Area
WMS	Water Management System
WRC	Water Research Commission

EXECUTIVE SUMMARY

The National Aquatic Ecosystem Biomonitoring Programme (NAEBP), better known for its subprogramme, the River Health Programme (RHP), was launched by the Department of Water Affairs and Forestry in 1994 to provide information on the state of aquatic ecosystems in South Africa. The NAEBP is now referred to as the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP) of which the RHP is one of several components. The other components of the NAEHMP, yet to be developed, include a wetlands, an estuarine and a groundwater dependent ecosystems programme.

The NAEHMP forms part of the portfolio of national water resource quality monitoring programmes for which DWAF's Policy and Regulation (P&R) branch assumes primary responsibility (DWAF, 2004a). In response to the Department's drive to align national water resources quality monitoring programmes with the requirements of the National Water Act (NWA) (Act 36 of 1998) (RSA, 1998), an Inception phase was initiated to revisit and review the design of the RHP component of the NAEHMP, after almost ten years of existence. The reviewing process began when the RHP Inception phase started in July 2004. The Department's Strategic Framework for National Water Resources Quality Monitoring Programmes Report serves as a basis for reviewing the design and provides generic guidelines in this regard.

The review process included a series of discussion sessions and workshops structured around the following core monitoring functions:

- Data acquisition;
- Data management and storage, and
- Information generation and dissemination.

The overall purpose of the review process was to:

- Align the design of the Programme with the requirements of DWAF's Strategic Framework for National Water Resource Quality Monitoring Programmes (DWAF, 2004b) and subsequently the National Water Act (Act 36 of 1998);
- Refine and test the suite of biological and secondary indices to be included as part of the national Programme;
- Investigate options to expand the scope of the Programme to include other aquatic ecosystems, e.g. wetlands and estuaries;
- Select national monitoring sites and develop a systematic national plan to monitor, assess and report on representative river types countrywide;
- Address priorities identified during a planning workshop in terms of Quality Assurance and Control (QA/QC), Data Management and Storage and the Biomonitoring Short Course;
- Formalise the programme as a national programme which includes how the Programme is to be governed, to make roles and responsibilities at national and provincial levels explicit as well as provide guidance on how to implement and maintain the Programme.

The Programme was reviewed through a number of focussed projects each addressing specific aspects of the Programme. The purpose of this report is to document: 1) the process that was followed, 2) the outcomes and key decisions of this process and 3) challenges and recommendations.

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SECTION 1: INTRODUCTION

1.1 Background

The National Aquatic Ecosystem Biomonitoring Programme (NAEBP) is better known for its subprogramme, the River Health Programme (RHP), which was launched by the Department of Water Affairs and Forestry in 1994. The NAEBP is now referred to as the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP) of which the RHP is one of four sub-components: rivers, wetlands, estuaries and groundwater dependent ecosystems. The wetlands, estuarine and groundwater dependent ecosystems components are all at different stages of development.

The NAEBP started in 1994, before the National Water Act (NWA) (Act 36 of 1998) (RSA, 1998) came into effect. While the overall purpose of the Programme is to provide information on the ecological integrity ofaquatic ecosystems, its long term vision is to implement, maintain, and improve biomonitoring for all inland ecosystems in South Africa and throughout the southern African region (Roux, 1997). The main objectives of the NAEHMP:RHP (Roux, 1997, Murray, 1999) are to:

- Measure, assess, and report on the ecological state of aquatic ecosystems;
- Detect and report on spatial and temporal trends in the ecological state of aquatic ecosystems;
- Identify and report on emerging problems regarding the ecological state of aquatic ecosystems;
- Ensure that all reports provide scientifically and managerially relevant information for national aquatic ecosystem management in South Africa;

The ultimate intention of the provision of such data and information is to create a level of awareness that empowers all stakeholders to participate meaningfully in integrated water resources management.

The promulgation of the NWA brought about fundamental changes in the management and protection of water resources and in water resource allocation. The NWA emphasises that reliable data and information on all aspects of water resources management are essential to ensure that informed decisions are made. Information for decision-making should reflect the integrated nature of water resources (DWAF, 2004a).

Chapter 14 of the Act (NWA, 1998), places a duty on the Minister to, "as soon as practically possible, establish national monitoring systems that would allow for the collection of appropriate data and information that is necessary to assess various aspects of aquatic resources", including the *health of aquatic ecosystems* (NWA, 1998: 137(2)(f)).

In response to these requirements, the Department is revising all its data acquisition, monitoring and information procedures to ensure that all relevant data is collected, verified and stored (DWAF, 2004b). Part of this process is the analysis of data and the way it is packaged to meet the requirements of different users. The Department has, as a result, developed an overarching Framework for National Water Resources Quality Monitoring Programmes (DWAF, 2004b) to ensure that all national water resource quality monitoring programmes comply with the requirements of the NWA and that these programmes are effectively and efficiently implemented.

The NAEHMP forms part of this portfolio of national water resource quality monitoring programmes for which DWAF's Policy and Regulation (P&R) branch assumes primary responsibility. In response to the Department's drive to align its national water resources quality monitoring

programmes with the requirements of the Act, a process was initiated to revisit and review the design of the RHP component of the NAEHMP (NAEHMP:RHP).

1.1.2 Purpose and structure of this report

The main purpose of this report is to document the Programme design review process and to capture the outcomes of the process.

This report is structured according to the following sections:

- Section 1: Introduction gives the background of the programme
- Section 2: Data acquisition discusses site selection procedures and protocols, indices and models, monitoring procedures, monitoring frequency and timing as well as quality assurance and control;
- Section 3: Data management and storage describes the Rivers Database and associated requirements;
- Section 4: Information generation and dissemination describes the information users of the programme, their information requirements as well as dissemination channels and media;
- Section 5: Governance and key strategic activities discusses how the Programme is governed as well as current key strategic activities of the Programme which are addressed in more detail in the NAEHMP:RHP Business Case.

Each of the above sections (except Section 5):

- Provides an overview of the review approach;
- Describes the outcomes and key decisions;
- Summarises the relevant documentation that is available on the enclosed CD;
- Describes key challenges and makes recommendations.

1.2 Reviewing the design

The NAEBP (now referred to as the NAEHMP) is primarily a system that provides information on the health or integrity of aquatic resources to support the management of these resources. The Programme's focus to date was largely on rivers and this sub-component is referred to as the River Health Programme (RHP). A distinction is made between the level of detail and nature of information that is required by water resource managers at a national, provincial (or catchment) and local level (Roux, 1997). The overall purpose of the NAEHMP is to provide information on a national level.

The Department has, in its quest to ensure that resource quality information for integrated water resource management is available, and that all national resource quality monitoring programmes (that either exist or are currently planned) adhere to the requirements of the NWA, developed a Strategic Framework for National Water Resource Quality Monitoring Programmes (DWAF, 2004b). As part of the Department's suite of national programmes, the RHP is also under scrutiny, hence the initiation of a process to the review the Programme's design.

This process was initiated towards the end of 2004, after the Programme was already in operation for ten years, and was completed in March 2008. It was preceded by a planning workshop which was held in February 2004 (DWAF, 2004c). The purpose of the Planning Workshop was to:

- Through the involvement and inputs of the key stakeholders in the RHP, e.g. various technical advisors, provincial champions and other key role players, identify the needs and requirements of the next phase RHP (referred to as the National Coverage Phase);
- Ensure that the planned activities of this next phase of the RHP bring it in line with DWAF's Strategic Framework for National Water Resource Quality Monitoring Programmes.

The Department's Strategic Framework for National Water Resources Quality Monitoring Programmes Report, served as a basis for reviewing the design and provided generic guidelines in this regard.

The fundamental point of departure of the Strategic Framework document is that all water resource quality monitoring should be information-centric. This implies that all water resource quality monitoring programmes must be justified and designed in manner that serves the information requirements of specific users who need the information to effectively perform their management functions (DWAF, 2004b). This framework defines three core functions of monitoring, namely:

- Data acquisition,
- Data management and storage, and
- Information generation and dissemination.

1.2.1 Purpose of the review process

The purpose of the reviewing process was to:

- Align the design of the Programme with the requirements of DWAF's Strategic Framework for National Water Resource Quality Monitoring Programmes (DWAF, 2004b) and consequently the National Water Act (Act 36 of 1998);
- Refine and test the suite of biological and secondary indices to be included as part of the national Programme;
- Investigate options to expand the scope of the Programme to include other aquatic ecosystems, e.g. wetlands and estuaries;
- Develop a systematic national plan to monitor, assess and report on representative river types countrywide;
- Address priorities identified during a planning workshop in terms of Quality Assurance and Control (QA/QC), Data Management and Storage and the Biomonitoring Short Course;
- Formalise the programme as a national programme which includes how the Programme is to be governed, to make roles and responsibilities at national and provincial levels explicit as well as provide guidance on how to implement and maintain the Programme.

1.2.2 Approach followed

The review process was addressed through a number of focussed projects:

- **The Inception Phase:** to align the NAEHMP:RHP with DWAF's Strategic Framework for National Water Resource Quality Monitoring Programmes; to formalise the Programme as a national programme; and to develop a systematic national monitoring plan.
- **The National Coverage Phase:** further develop and refine QA/QC procedures, the Rivers Database and the Biomonitoring Short Course.
- A number of **smaller projects**, funded or co-funded by DWAF and the WRC to develop a wetlands habitat integrity index and to further develop, refine and test biological and secondary indices that form part of the suite of RHP indices.

1.2.3 Outputs

The following main reports were produced:

Inception Phase

- Record of Decision Report (this report) which documents the review process;
- Implementation manual which provides guidelines on the implementation and maintenance of the NAEHMP:RHP (DWAF, 2008).

National Coverage Phase

- A Quality Assurance Report for the National Aquatic Ecosystems Health Monitoring Programme (RHP sub-component) (DWAF, 2007a);
- Rivers Database for the National Aquatic Ecosystems Health Monitoring Programme (RHP) (DWAF, 2007b);
- The Rivers Database Version 3: User Manual (DWAF, 2007d);
- Biomonitoring Short Course Report (DWAF, 2007(e)).

DWAF and WRC funded and co-funded projects

- Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types (DWAF, 2007c);
- Fish Response Assessment Index (FRAI) (Kleynhans, 2007);
- Manual for EcoStatus Determination (version 2) (Kleynhans and Louw, 2007);
- Manual for the Index of Habitat Integrity (IHI) (Kleynhans et al., 2007a);
- Reference frequency of occurrence of fish species (FROC) in South Africa (Kleynhans *et al.*, 2007b);
- Riparian Vegetation Response Assessment Index (VRAI) in River EcoClassification (Kleynhans *et al.*, 2007c).

SECTION 2: DATA ACQUISITION

2.1 Introduction

Data acquisition refers to what needs to be monitored (indicators) where (monitoring site location), how (protocols and procedures) and when / how often (frequency) in order to meet the objectives of the NAEHMP:RHP. Linked to this is quality assurance and control of these methods and procedures to ensure that data produced is reliable and scientifically valid.

The NAEHMP:RHP monitors the state of health or integrity of aquatic ecosystems in South Africa. At the national level, the Programme does not aim to monitor site-specific impacts or conditions. It is a screening-level monitoring programme that operates on a low sampling frequency and low resolution of sites (Roux, 2004).

2.2 Overview of the review process

The various data acquisition components of the Programme were reviewed and where necessary revised to ensure that it is aligned with the NWA, meets the requirements of a national programme and meets the objectives of the NAEHMP:RHP.

2.2.1 **Primary information users**

The point of departure of all DWAF's water resource quality monitoring programmes is to serve the information requirements of specific users that need the information to effectively perform their management functions. The first step in the review process of the data acquisition component was to identify existing and potential **primary stakeholders** of the RHP. The level of decision-making and information requirements of these stakeholders were discussed at a workshop held in September 2004 and were used as the basis to revisit the objectives of the Programme as well as to inform the design of the Programme.

2.2.2 Monitoring design

2.2.2.1 Indices and protocols

A "Network Design" workshop was held in October 2004. The workshop was attended by a group of specialists and practitioners who have extensive experience in biomonitoring site selection procedures and who either developed or were closely involved with the development of the RHP indices and protocols. The main purpose of this workshop was to discuss and propose:

- What attributes and indices to include in the national RHP;
- The location of monitoring sites (at a macro scale), including firm guidelines as to how to select these sites;
- How frequently data should be acquired taking account of what is important for water resources management and what is feasible in terms of resources available.

The decisions were based on the information requirements of the primary information users (outcomes of the September 2004 workshop).

2.2.2.2 National monitoring site selection

The purpose of this national site selection process was to propose the ideal number of monitoring and reference sites that represents the heterogeneity of the rivers in each Water Management Area (WMA) and nationally. Where there are currently no suitable sites, the process identified and proposed rivers or reaches of rivers where sites should be located.

This process was initiated at the beginning of 2005. Four specialist workshops were held which covered: 1) the northern Water Management Areas (WMAs), 2) the central parts of the country, 3) the eastern and south-eastern WMAs and finally 4) the western WMAs. These workshops were attended by biomonitoring specialists and practitioners as well as DWAF Regional Office staff that were working in and are knowledgeable about the respective areas.

During the regional workshops, the spread and location of the RHP sites were determined by taking into account certain key considerations which formed part of the national site selection process, namely:

- The overall objectives of the River Health Programme, which are to:
 - Measure, assess and report on the ecological state of aquatic ecosystems;
 - o Detect and report on the ecological state of aquatic ecosystems;
 - o Identify and report on emerging problems regarding aquatic ecosystems.
- All reports should provide scientifically and managerially relevant information for national, aquatic ecosystem management.
- Approximately 500 to 600 national RHP monitoring sites are required countrywide (i.e. approximately 32 sites per WMA).
- The location of other DWAF national monitoring points (e.g. chemistry, hydrology).
- Existing RHP monitoring sites or sites for which RHP data exist, as well as ecological Reserve sites.
- Where RHP sites exist, take into account the diversity of aquatic habitats present as well as their suitability for sampling fish, performing SASS and assessing the riparian vegetation.
- The Ecological Importance and Sensitivity (EIS) at a quaternary catchment scale.
- Ecoregions (preferably Level II, but at least Level I) (Kleynhans *et al.*, 2005; Kleynhans *et al.*, 2007d).
- Priority areas identified by DWAF for compulsory licensing and Reserve determinations (DWAF, 2004a).
- Catchments where water resources are stressed and other "hot spots".
- Flow modification information.
- Safety and accessibility of sites.

A further consolidation workshop was held in October 2005 during which all the proposed sites were revisited. The location of these sites and the number of sites proposed per WMA were considered and reduced where necessary.

2.2.2.3 Site verification

Sites to be verified include the proposed macro sites as well as existing sites that have not been monitored prior to, and including 2002. This will be done through a site verification exercise which entails a site visit by a RHP practitioner to confirm the locality of a site (i.e. its latitude and longitude) and its suitability as a national site (based on aspects considered in the national site selection process).

2.2.2.4 Characterising sampling sites

Site characterisation is about describing the physical structure of a site and is aimed at standardising data collected at biomonitoring sites. Data sheets and guidelines for this purpose formed part of a previously developed manual for deriving ecological reference conditions (Dallas 2000). A number of the RHP methods have since been refined, prompting a review and update of the site characterisation datasheets and guidelines. A workshop for this purpose was held in January 2005 and a number of specialists took part.

2.2.2.5 Monitoring of national sites

(i) Site prioritisation

The approach described below, was developed to prioritise the national sites to ensure systematic monitoring. A monitoring schedule per Water Management Area will be determined according the outcomes of the priorities.

Hill et al. (2008) took the following factors into account when prioritising sites:

- The compulsory licensing priority of the catchments in which these sites are located (according to the National Water Resource Strategy (DWAF, 2004a));
- The Ecological Importance and Sensitivity (EIS) rating of the quaternary catchments within the above catchments;
- The Present Ecological State (PES) category of the quaternary catchments, and finally
- The monitoring status of the national RHP sites: sites that were not monitored prior to and including 2002, including sites that have never been monitored (i.e. verified macro sites), will receive priority over sites that were monitored more recently or are monitored frequently.

Sites were prioritised on a scale from 1 to 4 where 1 is regarded as the highest priority and 4 the lowest. Monitoring of the national sites will start with the highest priority sites.

2.2.3 Quality assurance and control

An important aspect of the national RHP which is key to ensuring that it has the capacity to operate as a fully functional monitoring Programme, is quality assurance and control (QA/QC) of its methods and procedures to ensure that data produced is reliable, and information managerially relevant for the management of river systems. The River Health Programme (RHP) is all about data, the collection and reporting of data which is meaningful and accurate. RHP data tells the story of a river and highlights the stresses and strains that result from the many pressures exerted by society. The very credibility of the RHP rests on the quality of the data that is produced and it is clear that if this credibility were to be lost, then all the effort to produce and implement a river health monitoring programme would have been wasted.

Up until 2004, technical developments associated with QA have largely focused on the South African Scoring System version 5 (SASS5), primarily due to SASS's maturity and credibility within the RHP suite of methods. QA principles and procedures had to be extended to the other methods and protocols of the Programme. The Planning workshop held in February 2004 identified key QA/QC priority areas for the National Coverage Phase, including:

- Institutional support and structures
 - The establishment of institutional support and structures for the QA/QC programme, probably involving the appointment of a national QA manager who would have the overall

responsibility for co-ordinating and reporting on QA/QC activities for the programme nationally and providing the necessary direction and support where required.

- Methods
 - All methods developed for and applied in the RHP should have QA guidelines to ensure that they meet acceptable or stated criteria of method rigour.
- Personnel
 - All RHP practitioners producing data for the RHP should eventually become accredited as being competent to produce such data
- Data
 - All data generated by the RHP requires some measure of QA/QC from how data are captured to where it is stored and how it is reported on.

In order to secure the quality of data (and thus information) of the RHP suite of methods and protocols, the QA/QC component, in response to the above priorities, dealt with a number of issues. This included the biomonitoring **methods** themselves and the framework into which they fall, the **data** produced and the **people** who produce the data. Guidelines were also developed in terms of the use of the data and how to interpret that data into meaningful information which is synchronised with the legal framework for water resource management.

2.3 Outcomes and key decisions

The outcomes of this review process are discussed below.

2.3.1 Primary information users

The outcomes of this component confirmed what water resource managers had agreed on when the Programme was designed, namely that the primary focus of the national River Health Programme should remain: the state of health (and trends) of aquatic ecosystems, nationally. In other words, the RHP should provide an overview of the ecological health of the country's rivers rather than day-to-day operational answers, or exact conditions at any specific sites. Although provincial RHP monitoring activities do not form part of the Programme's design, the existence of the national programme does not in any way preclude additional monitoring activities necessary at the provincial, catchment and local levels. This higher resolution monitoring is in fact crucial for integrated water resources management purposes and complements the information derived at a national level. Table 2.1 summarises the outcomes of the workshop discussions.

DECISIONS/ ACTIONS			INFORMATION PRODUCTS		HOW FREQUENTLY (TO UPDATE INFO)		WHERE (GEOGRAPHIC COVERAGE	N VAR	MEASURES OR RIABLES (INDICES)
* *	Compare desired state with actual state Decide on management actions proactively Identify hotspots in	•	State of Rivers type of report once every 5 yrs (whole country)	•	Initially for priority catchments according to compulsory licensing priority list; rivers that are ecologically important and sensitive. Depends on response time of biota and how sensitive indices are to	•	Need a good indication of the river health of a catchment. High risk resource units.	* *	IHI FAII** (FRAI) SASS
•	Identify hotspots in catchments and rivers (where to focus attention) Where do problems originate – enough monitoring sites needed to provide these answers			*	and how sensitive indices are to factors such as droughts and floods. Licences to be reviewed on a 5yr cycle. National and catchment planning reviews every 5yrs – need good information every 5yrs (D:NWRP)*. Higher frequency may be required for important rivers. Baseline information is necessary – particularly catchments where little or no river health info is available.				

Table 2.1: Key decisions/actions of primary information users that national RHP information can support

* Does not mean that sampling should only take place once every 5 years

** The Fish Assessment Integrity Index (FAII) is now referred to as the Fish Response Assessment Index (FRAI)

2.3.2 Monitoring design

2.3.2.1 Indices, protocols and models

(i) Indices and models

Based on the status and stability of the different indices at the time (i.e. 2004), as well as the considerations in terms of the national programme context, fish (Fish Assessment Integrity Index, FAII-now referred to as the Fish Response Assessment Index, FRAI) and macroinvertebrates (SASS5) were proposed as the biological indicators, while the assessment of habitat (Index of Habitat Integrity, IHI) was proposed for inclusion as a non-biological indicator. For any of the indices to be included in the national RHP, the associated methods will be subject to accreditation.

Since that time, several developments have taken place and various methods, procedures and protocols have been tested and refined. There are now more RHP tools available for undertaking an assessment of the health or condition of aquatic resources nationally. Each of these tools uses indices or models that summarise biological response as one or more metrics (e.g. SASS5 Score, MIRAI, FRAI, EcoStatus, etc.). Currently used or proposed **Biological response** indices for EcoClassification or EcoStatus that could form part of the national suite of RHP indices are:

- Diatoms (No index developed yet)
- Aquatic macroinvertebrates SASS5 (Dickens and Graham, 2002) and MIRAI (Macroinvertebrate Response Assessment Index) (Thirion, 2007)
- Fish FRAI (Fish Response Assessment Index) (Kleynhans, 2007)
- Riparian vegetation VEGRAI (Riparian Vegetation Response Assessment Index) (Kleynhans *et al.*, 2007a)
- Habitat integrity IHI (Index of Habitat Integrity) (Kleynhans, et al., 2007c).

The latter four indices have been further developed and refined as part of a WRC funded project.

Driver indices used in EcoClassification / EcoStatus, and proposed for the RHP are listed below and provide a habitat template for the biological components:

- Hydrology HAI (Hydrological Driver Assessment Index)
- Geomorphology GAI (Geomorphology Driver Assessment Index)
- Physico-chemical PAI (Physico-chemical Driver Assessment Index).

These indices have been or are in the process of being further refined as part of a WRC funded project.

(ii) Proposed biomonitoring protocols

An approach similar to the biomonitoring protocols suggested in Roux (1997) is proposed for the national RHP where the level of detail at which to monitor is determined by:

- The completion of one full monitoring cycle;
- The Ecological Importance and Sensitivity (EIS) of the resource in question;
- The type of land use in the catchment;
- The extent to which the catchment is stressed (water quantity and quality);
- The priority of the catchment in terms of compulsory licensing and ecological Reserve determinations;
- The availability of resources (human and financial).

The level of detail at which to monitor are proposed in the following two options:

Option 1:	Site characterisation + SASS5 + IHI;
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Option 2: Site characterisation + SASS5 + FRAI + VEGRAI + IHI + (Diatoms)

2.3.2.2 National monitoring site selection

During the Network Design workshop (October 2004), the following number of national sites was proposed:

- Reference sites (for macro-invertebrates): approximately 300 sites, which represent at least each Level II Ecoregion.
- Monitoring sites: between approximately 500 and 600 sites.

These estimates are based on the number of sites currently monitored per province, and which the workshop participants believed could realistically be monitored at the frequencies proposed for each index. The final decision on the number of sites to include as part of the national Programme will depend on the availability of human and financial resources and whether this number of sites covers the river types found in the country.

At four subsequent regional workshops (22 February to 25 May 2005), regional experts from a broad range of organisations including government departments (regional and national), local authorities, Parks Board and conservation agencies, universities and the private sector, selected national sites for the RHP. They identified three types of site:

- Existing sites mostly monitoring sites that existed prior to the workshops as provincial or local monitoring sites.
- Proposed macro sites macro locations were identified at the river reach scale where no sites existed.
- Reference sites these are existing sites that represent the "least impacted" condition and which may be used to generate future reference conditions for specific ecoregions, longitudinal zones or river types.

In October 2005, during a consolidation workshop, all the sites proposed during the regional workshops were revised and reduced where necessary to come up with a total number of 639 sites. Of the 639 sites identified, 266 sites are existing sites (frequently monitored) and 373 sites have to be verified (i.e. macro sites and sites that have not been monitored since 2002) (see Table 2.2). Of the 639 sites, 122 are reference sites. An inventory of these sites (which include site attribute data for each site) as well as maps indicating the sites within each WMA are provided in Dallas (2005a, b).

WATER MANAGEMENT AREA (WMA)	EXISTING SITES	SITES TO BE VERIFIED	TOTAL NO OF SITES
WMA 1 (Limpopo)	0	36	36
WMA 2 (Luvubu and Letaba)	21	7	28
WMA 3 (Crocodile (west) and Marico)	39	9	48
WMA 4 (Olifants)	10	30	40
WMA 5 (Inkomati)	6	34	40
WMA 6 (Usutu to Mhlatuze)	14	29	43
WMA 7 (Thukela)	7	22	29
WMA 8 (Upper Vaal)	3	34	37
WMA 9 (Middle Vaal)	14	14	28
WMA 10 (Lower Vaal)	4	7	11
WMA 11 (Mvoti to Umzimkulu)	24	9	33
WMA 12 (Mzimvubu to Keiskamma)	10	28	38
WMA 13 (Upper Orange)	10	28	38
WMA 14 (Lower Orange)	1	17	18
WMA 15 (Fish to Tsitsikamma)	1	28	29
WMA 16 (Gouritz)	30	5	35
WMA 17 (Olifants / Doorn)	29	7	36
WMA 18 (Breede)	11	25	36
WMA 19 (Berg)	32	4	36
TOTAL	266	373	639

Table 2.2. National RHP sites and their status per WMA

2.3.2.3 Site verification

The site verification process will largely be coordinated by provincial champions and undertaken by Provincial Task Teams (PTTs), and where possible will be aligned with Reserve determination studies. The RHP site characterisation field data sheet (Dallas, 2005c) has been adapted for this purpose. A total of 373 sites must be verified.

Verified sites will be audited by RQS specialists for quality assurance purposes before being captured on the Rivers Database. The information regarding these sites will be captured on the Rivers Database by the RHP Manager.

2.3.2.4 Characterising sampling sites

The revised site characterisation data sheets form part of a manual which incorporates information necessary to characterise a site, to provide an indication of catchment condition and land-use, together with relevant abiotic (habitat) and biotic (invertebrates, fish, riparian vegetation) information (Dallas, 2005c).

2.3.2.5 Monitoring of national sites

(i) Site prioritisation

In table 2.3, catchments are ranked according to their compulsory licensing priority in the National Water Resource Strategy (DWAF, 2004a), from high to low.

Table	2.3:	Catchments	ranked	according	to	their	national	compulsory	licensing	priority
(DWAI	F, 20	04a)		-					_	

PRIORITY CATCHMENT		WMA NO.	WMA NAME
1	Mhlatuze	6	Usutu to Mhlatuze
2	Olifants	4	Olifants
2	Above Vaal Dam	8	Upper Vaal
2	Berg & CT (G22)	19	Berg
3	Letaba	2	Luvuvhu and Letaba
3	Crocodile	3	Crocodile (west) and Marico
3	Komati	5	Inkomati
3	Seekoei / Krom	15	Fish to Tsitsikamma
3	Olifants	16	Gouritz
3	Olifants/Doring	17	Olifants / Doorn
4	Vaal main stem	9	Middle Vaal
5	Palmiet / Breede	18	Breede
6	Mogalakwena	1	Limpopo
	Mkuze, Ppongola, Usutu, Sibayi		
7	& other	6	Usutu to Mhlatuze
7	Мооі	7	Thukela
8	Vaal main stem	10	Lower Vaal
8	Mgeni	11	Mvoti to Umzimkulu
8	Buffalo	12	Mzimvubu to Keiskamma
	Below Vaal Dam,		
0	Liebenbergsvlei, Mooi, Wilge and	0	
9	Nip	0	
10	Lupper Melone, Flande, Anice	2	
10	Pienaars & others	3	Crocodile (west) and Marico
10	Crocodile	5	Inkomati
	Swartkops Kouga Albany Coast		
11	Gamtoos & other	15	Fish to Tsitsikamma
11	Sandveld, Leeu	17	Olifants/Doorn
12	Steelpoort	16	Gouritz
	Mokolo, Nzhelele, Sand, Limpopo		
13	& other	1	Limpopo
	Buffalo, Tugela, Sundays &		
13	Boesmans	7	Thukela
14	Riviersonderend & others	18	Breede
15	Modder / Riet	13	Upper Orange
	Skoonspruit, Sand/Vet,		
16	Khenoster & Vals	9	Middle Vaal
16	Harts & Molopo	10	Lower Vaal
16	Mvoti, Mlazi, Lovu & others	11	Mvoti to Umzimkulu

PRIORITY	CATCHMENT	WMA NO.	WMA NAME
17	Kei, Mtata & others	12	Mzimvubu to Keiskamma
18	Orange	14	Lower Orange
19	Diep	19	Berg
20	Caledon & Kraai	13	Upper Orange
21	Sak and other	14	Lower Orange
22	Sabie & Nuanetsi	5	Inkomati
23	Goukou	16	Gouritz
23	Sout	17	Olifants/Doorn

Table 2.3. continue

National RHP sites are prioritised on a scale from 1 to 3 (highest to lowest) within each Water Management Area (Hill *et al.*, 2008). Monitoring will commence with high priority sites in the high priority catchments.

(ii) Frequency of monitoring

Monitoring frequency depends on various factors, including the characteristics and ecological status of the aquatic resource, the type of indices assessed, the primary objective of the monitoring programme and the resources available. These factors were mostly taken into account in the monitoring site prioritisation process - a process developed to systematically cover the whole country by monitoring the highest priority sites first. The frequency of monitoring at national sites will be linked to their monitoring priority (DWAF, 2008).

Table 2.4 lists the proposed sampling frequencies of indices at national reference and monitoring sites for **baseline** purposes. Sampling must occur in the same season, e.g. autumn, to minimise effects of year-to-year (seasonal) variability, and to ensure that data is comparable. Once sufficient data is available per national site to detect a baseline, monitoring frequencies can be adjusted for routine monitoring as proposed in table 2.5.

INDEX	MONITORING FREQUENCY			
	REFERENCE SITES	MONITORING SITES		
Site characterisation	Once every 5 years	Once every 5 years		
SASS5	Twice per year / 3-4 times a year initially	Twice per year / once per year		
FRAI	Once per year (during low flows)	Once per year (during low flows) / twice per year initially		
IHI-Riparian Zone	Review annually	Review annually (if a change is detected, assess more)		
IHI-Instream	Review annually	Review annually (if a change is detected, assess more)		

Table 2.4.	Proposed	monitoring f	requency f	or recommend	ed indices
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Table 2.5. Typical (i.e. for general river health assessment) and proposed NAEHMP: RHP monitoring frequencies for biomonitoring indices (adapted from Murray, 1999) monitored routinely (Note: proposed frequencies take into account monitoring priorities).

INDEX	TYPICAL FREQUENCY	NAEHMP: RHP FREQUENCY*	TIMING
Diatoms# (not yet accredited)	Once a year	To be specified	During low-flow conditions.
Macroinvertebrates (SASS5)	2-3 times a year	Existing high priority (Category 1) and new sites** at least once a year; Existing medium priority sites (Category 2), at least every 2 years; Existing low priority sites (Category 3 and 4 sites), at least every 3 years.	Optimally during the dry season, at the end of the dry season and at the end of the wet season. The high flow period, when floods are likely, should be avoided.
Fish (FRAI)	Every 3 years	Existing high priority (Category 1) and new sites at least every three years; Existing medium to low priorities (Category 2-4), every five years	During low flow conditions.
Riparian vegetation (VEGRAI)	Every 3 years	Existing high priority (Category 1) and new sites at least every three years; Existing medium to low priorities (Category 2-4), every five years	At any time of year, although may be best during the growth season.
Habitat Integrity (IHI)	Every 3 to 5 years	Existing high priority (Category 1) and new sites at least every three years; Existing medium to low priorities (Category 2-4), every five years	At any time of year.

#Diatoms: an index to monitor diatoms in South Africa has not yet been developed and the frequency is thus for collection of diatoms.

*First 5 year cycle of monitoring

**New sites: sites not monitored before or for longer than 5 years and that have been verified

2.3.3 Quality assurance and control¹

2.3.3.1 Methods

SASS accreditation procedure

- The SASS accreditation procedure has been developed and is operational.
- Provincial auditing of SASS practitioners is ongoing.
- The authority of auditing rests with the RQS.

FRAI accreditation procedure²

- A method for accreditation has been proposed, but is based on an incomplete FRAI method. Variations are therefore possible.
- The FRAI is neither complete nor published so it is also difficult to hold field testing of accreditation as this requires candidates to know the method.
- It was not possible to document common errors in the field accreditation as a result.

¹ The outcomes of this project described in the text, are based on the progress report of December 2007, by C Dickens.

² At the time the QA/QC project came to an end, the FRAI method was not yet complete.

- A report was written on the adherence of the FRAI method (in development) to the Guidelines for RHP methods. There remain many details to flesh out in the FRAI method.
- Invitations have been sent out to Provincial Champions to nominate FRAI auditors. This process is incomplete.
- No trial of the field accreditation has been done.
- No National or Provincial Auditors have been appointed nor the process of implementation initiated.

IHI accreditation procedure³

- A method for accreditation was proposed, but it is based on an incomplete IHI method. Variations will therefore be possible.
- The IHI is neither complete nor published so field testing of accreditation is difficult as this requires candidates to know the method.
- It was as a result not possible to document common errors in the field accreditation.
- It was not possible to determine the adherence of the IHI method (in development) to the Guidelines for RHP methods. There remain many details to flesh out in the IHI method.
- Invitations have been sent out to Provincial Champions to nominate IHI auditors. This process is incomplete.
- No trial of the field accreditation has been done.
- No National or Provincial Auditors have been appointed nor the process of implementation initiated

Guide for RHP method development

This guide was produced and has been used in the development of the diatom method and possibly the IHI and FRAI methods. The latter two are not yet compliant.

2.3.3.2 Personnel

 Christa Thirion (RQS) has been appointed as national auditor for SASS, while provincial SASS auditors have been appointed in most of the nine provinces (see <u>http://www.csir.co.za/rhp/</u> for an update)

2.3.3.3 Data

Data handling

• A guide to the handling of data and the archiving of field sheets, etc. has been produced. This relates closely to the Rivers Database and should possibly become part of the responsibility of the administrator.

Use of RHP data for water resource management

• It has transpired from initial meetings with DWAF operational staff that this is a very broad subject. What has been inserted in the final QA/QC document is the potential scope of such a

³ At the time the QA/QC project came to an end, the IHI method was not yet complete

project which brings in both DWAF and DEAT requirements for biological monitoring. It would be crucial to synchronise these to ensure efficiency.

2.4 Documentation and reports

The following are available on the CD:

- Agenda and minutes of the Stakeholder workshop held on 30 September 2005
- Agenda and notes of the Network Design Workshop held on 19 and 20 October 2004
- Agenda and minutes of a progress meeting held on 1 December 2004
- Revised RHP Site Characterisation field manual and field data sheets (Dallas, 2005c)
- Inventory of National River Health Programme Monitoring Sites, Volume 1 and 2 (Dallas, 2005a, b)
- Guidelines to verify macro sites
- Monitoring prioritisation procedure for the national RHP sites
- Spreadsheet in which the national sites are prioritised.
- NAEHMP:RHP Quality Assurance Report (DWAF, 2007a)

2.5 Challenges and recommendations

This section outlines the challenges and recommendations for aspects related to monitoring design and for each biotic component and QA/QC procedure currently in the NAEHMP: RHP.

2.5.1 Monitoring design

2.5.1.1 Analysis of RHP monitoring surveys

It is strongly recommended that the results of the RHP monitoring surveys be analyzed through a generic Decision Support System (DSS). Such a system should be based on the principles of Adaptive Environmental Assessment and Management. For this purpose Thresholds of Probable Concern (TPCs) (Rogers and Bestbier, 1997) need to be set based on the best available knowledge on the functioning of a system and its response to disturbances. Such an approach operates on the principle that knowledge about the response of a system is incomplete and that TPCs are fundamentally hypotheses of how a system would react to disturbances. When a TPC is exceeded, additional effort is required to investigate the reasons for this. Such investigation may indicate that a TPC limit was either false (i.e. too low or too high) or correct. A "learning by doing" approach is followed by building such knowledge into the DSS. Such a system would allow the results of RHP monitoring to be carried over to managers of the programme as well as resource managers to make decisions and management of the resource more effective.

2.5.1.2 Verification of national sites

It is important that the macro sites be verified in the field. Experience has shown that in some instances, even the existing sites have changed and are no longer suitable for use as national sites. Reference sites should also be confirmed. Once these sites have been verified and the verification audited, it should all be entered into or updated in the Rivers database.

2.5.1.3 Site characterisation

Many existing RHP sites have not been adequately characterised using the required method (Dallas, 2005c). All existing RHP sites (national, provincial and local) should be characterised and updated on the Rivers Database. Consideration should be given to developing a training course for this as experience has shown that RHP practitioners do not always complete the required forms correctly.

2.5.1.4 Reference sites and condition

It is important that reference sites be identified and verified within each spatial unit (e.g. ecoregion combined with geomorphological zone). Ideally more than one reference site should be identified per spatial unit, although it is acknowledged that this is not always possible. It is only through the routine monitoring of such sites that natural trends in physical, chemical and biological characteristics of a site, reach (or river) within a spatial unit can be established.

- Reference conditions need to be derived for aquatic macroinvertebrates this is scheduled to begin in 2008.
- Reference conditions for riparian vegetation need to be established.
- Reference conditions for habitat integrity need to be established.

2.5.1.5 Diatoms

Although diatom indices developed in Europe have in most cases proved adequate to indicate water quality in South Africa (see section 2.1.4.1), there are a number of challenges to be faced when using these indices without modification. A small number of diatom species encountered in South Africa are possibly endemic and when these species are found as the dominant in any given diatom assemblage it becomes problematic to use an index which does not include these species (Taylor *et al.,* 2007b).

For this reason the Water Research Commission has funded a project to examine and document diatom communities around South Africa. Dr. W. R. Harding of DH Environmental Consulting is leading this project in collaboration with the North-West University. The aim is to produce and validate a unique diatom index for use in South Africa. The index will also be aligned to the categories used in EcoStatus Classification and is due for completion at the end of 2009. The project will produce additional educational material and identification guides and provide training of students and field operators in diatom-based water quality assessment.

2.5.1.6 Aquatic invertebrates

(i) SASS

SASS has undergone considerable validation and verification. An aspect that has in the past been lacking is a standardised method for interpreting SASS data that takes account of natural spatial variation. The recently published report (Dallas, 2007) provides a preliminary set of guidelines that are currently being tested. It is essential that these guidelines be refined after RHP practitioners have applied them and once additional SASS data become available. To this end, all practitioners are encouraged to test the guidelines, record any issues that arise and communicate these issues to Dr H. Dallas (Helen.Dallas@uct.ac.za). They should also contribute their data to the Rivers Database.

(ii) MIRAI

The following needs to be done:

- Develop a database of reference taxa including their frequency of occurrence for each of the National RHP sites.
- Validate the weightings given to invertebrate taxa and test the regional applicability of the method.
- Train more SASS practitioners in the MIRAI method.
- Expose managers to the advantages of MIRAI: cause/effect rather than only SASS scores.
- For both SASS and MIRAI, it would be useful to investigate the potential to include reference scores and reference taxa into the Rivers Database.

2.5.1.7 Fish

(i) FROC

It is envisaged that the reference FROC for each National RHP site will be built into customised versions of the FRAI for each WMA. This will simplify the assessment of the fish assemblage integrity for assessors.

Models will be developed that predict the presence of fish species under reference conditions. These models will be based on intolerances and preferences of fish species and their association with physical environmental attributes. The ultimate purpose is to predict the reference fish assemblage in any reach of a river.

(ii) FRAI

- Update and refine the fish intolerance and preference database.
- Investigate a version of FRAI that makes provision for low species richness situations. The use of age and length classes as metrics will be addressed.
- The use of fish health indices in situations where more resolution on the fish assemblage integrity is needed.

2.5.1.8 Riparian vegetation

(i) VEGRAI

- Design training courses.
- Design an accreditation procedure.
- Set reference conditions for riparian vegetation for all the National RHP sites.

2.5.1.9 Habitat Integrity

(i) IHI

- Design training courses.
- Develop approaches to specify reference conditions.

2.5.1.10 EcoStatus

- Design training courses to ensure that aquatic ecologists running the EcoStatus models are adequately trained.
- Design an accreditation procedure.

2.5.2 Quality Assurance and Control

The greatest challenge to the implementing of quality assurance in any programme is to maintain the level of attention that is needed to keep the system going. It is easy for lethargy to seep into the minds of managers and RHP practitioners so that things begin to crumble and quality falls away. There are some important steps to be taken to ensure that this does not take place.

- Formalise the systems for quality assurance as much as possible.
- Include the requirements for quality assurance into Standard Operating Procedures within any organisation especially within DWAF, CMAs, water utilities, etc. Build this into the job description of personnel responsible for implementation.
- Make it a requirement that government agencies (especially DWAF) will only consult with practitioners who are accredited according to this programme.
- Make it a requirement within government agencies that staff who are engaged to do river health monitoring are accredited. Build this into conditions of service.
- Continue to ensure that all methods used by the RHP have quality assurance systems in place with an emphasis on accreditation of practitioners. Procedures will have to be developed for new methods as they are developed.
- Ensure that all other methods that are linked to RHP methods (e.g. the EcoStatus suite of methods) follow similar procedures and requirements.
- DWAF will need to commit to the maintenance of the Rivers Database. This will prove to be
 most challenging if not given due attention as the Rivers Database is dependent on a great
 number of practitioners, many with unrelated allegiance, who will be collecting river health data
 and can only be encouraged, not compelled, to contribute this data to the database. This will
 require a deliberate and conscious effort on the part of DWAF. This responsibility should be
 incorporated into the job description of a single person.

SECTION 3: DATA MANAGEMENT AND Storage

3.1 Introduction

The efficient management and safe storage of data is a prerequisite for a successful NAEHMP:RHP. The Rivers Database is the national biomonitoring database that stores the Programme's data. The database is an interim measure to secure the data gathered through the RHP with DWAF as custodian of river health data and is a gateway to the eventual migration of data to DWAF's Water Management System (WMS).

3.2 Overview of the review process

Revision of the Rivers Database was part of the RHP National Coverage Phase. This included training and support to biomonitoring practitioners in the use of the database, data capture and assistance as well as administrational and technical support. It follows on a RHP Planning Workshop which was held in February 2004 and during which the following aspects, relating to the Rivers Database were identified as issues to be addressed:

- Capturing of existing RHP data. The RQS is investigating the establishment and mobilisation of a data capture group, which could greatly advance our efforts to get the vast backlog of biological data on the Rivers Database. The long-term allocation of resources to capture data needs to be investigated as well as the institutionalisation of data capturing procedures;
- Reference and monitoring sites country wide have to be registered and mapped to identify gaps.
- Technical development
- Web-based data capturing, importing current and future Excel data and the development of simple transfer specific subsets of data need to be addressed;
- Compatibility of the Rivers Database and various networks needs to be improved;
- Procedures for ensuring data integrity need to be developed and instituted;
- The data query system has to be updated.
- Development of a module for incorporation of reference conditions for SASS and assess the inclusion of such a module for the other indices.
- Capacity building, which includes the training of RHP practitioners to operate the database and training to capture biomonitoring data.
- Administrational and technical support by a Database Administrator who would oversee the central database management and maintenance, the registration of new users, and provide overall technical support.
- Development of links to associated information such as mini-SASS data and other databases of relevance.
- Management: integration of the Rivers Database with DWAF's WMS is a long term objective which must be catered for and which requires close liaison and ongoing consultation with the members of the WMS project team.

3.3. Outcomes and key decisions

- Training and support
 - A questionnaire was sent out to all registered Rivers Database Users with regards to the database to gain insight regarding the extent to which the Rivers Database is being used; problems associated with its usage, and reasons for its non-use. The response was limited.
 - Ad hoc and formal regional training workshops were held countrywide.
- Data capture and assistance
 - Hard copy and electronic RHP data was gathered countrywide and captured into the Rivers Database.
- Quality Control
 - The process of data management comprises the field collection of data, the post-field handling of data in the office, the quality checking of data, and the capturing of data into a database, i.e. data storage. Consideration has been given to these aspects within the Quality Control component of the RHP, with guideline documents produced to assist RHP practitioners in data handling, data entry and data validity checking (DWAF, 2007a).
- WMS linking
 - A decision was taken to no longer transfer the Rivers Database data to the WMS as part of the National Coverage Phase.
- Technical development / enhancement of the Rivers Database
 - The structure of the database has been adjusted and simplified to meet the changes in the field datasheets as well as the process of keeping core tables up to date on individual offline databases;
 - A detailed Software Requirements Specification was produced to guide the coding work on the Data Transfer functions, and upgrading the forms to more closely match the redesigned field datasheets utility and index management system;
 - o Database conversion and transformation scripts were created;
 - o Testing of web-based functionality and the Rivers Database took place;
 - 1: 500 000 rivers for the entire country were matched with the rivers in the Database.
- Administrational and technical support
 - Technical support has been provided to Users on an *ad hoc* basis.

3.4 Documentation and reports

The following are available on the CD:

- Department of Water Affairs and Forestry. 2007(b). Rivers Database for the National Aquatic Ecosystems Health Monitoring Programme (RHP), prepared by The Freshwater Consulting Group, Cape Town, Pretoria, South Africa.
- Department of Water Affairs and Forestry. 2007(d). Rivers Database Version 3: User Manual. Report for the Department of Water Affairs and Forestry River Health Programme. Prepared by The Freshwater Consulting Group in association with Soft Craft Systems. 71pp.

3.5 Challenges and recommendations

The key challenge to the ongoing success and utility of the Rivers Database is to convince RHP practitioners to contribute their data to the database. While the will or desire to do this is often present, time constraints, capacity, technical problems, and lack of training often hinder this process. The potential for catastrophic data loss exists if practitioners do not store all RHP data electronically in the central national database. RHP practitioners more commonly use data from the database than contribute to it, indicating that they are well aware of the value of a database of this nature to their work and to the management of aquatic resources in South Africa. The following issues need to be considered:

(i) Commitment by DWAF to the maintenance of the Rivers database

This will prove to be most challenging if not given due attention as the Rivers Database is dependent on a great number of practitioners, many with unrelated allegiance, who will be collecting river health data and can only be encouraged to voluntarily contribute this data to the database. This will require a deliberate and conscious effort on the part of DWAF.

- For any database to remain "relevant" and "useful" it needs to:
 - o be widely available,
 - o continually evolve to meet users' needs,
 - o be maintained, and
 - be updated to ensure it is current.

(ii) Training of RHP practitioners to use the database

Further training courses on the use of the Rivers Database are needed. While more than 80 practitioners have received training, there is a need to accommodate new users, and those users that need a refresher course, in the use of the River Database. This will also encourage new and old users to contribute their data to the database.

(iii) Technical enhancements

New methods are being developed (and existing methods modified). Provision for future technical enhancements of the database, and the development of new modules, should be a priority. This will ensure that the database is always up-to-date and relevant. Incorporation of new methods will also expose the database to a wider audience.

(iv) Identified future refinements and additional components

During the training workshops, participants identified several issues that would be useful to modify or add to the Rivers Database. These were outside of the scope of the current Data Management and Storage phase, and were therefore held over for a later stage. Issues identified include:

- Enhancement of the Rivers Client: to allow for confidential sites, site type (e.g. national, provincial) tool tips, etc.
- Spatial interface for viewing sites, such as GIS or Google Earth.
- Fish import template for importing fish data that resides in Microsoft Excel.
- "Results" pages for additional EcoStatus components e.g. MIRAI.

- Functionality to incorporate Reference conditions for fish, invertebrates, and possible other components.
- Incorporation of new components e.g. diatoms, riparian vegetation.
- Investigate the feasibility of including all calculations in the database when the methods are stable (e.g. IHI).

(v) Information Technology (IT) risks

Like much of the River Health Programme, the success of the Rivers Database has been largely the result of a pragmatic, goodwill approach by all partners. Formalising this process too rigidly would carry the risk of bringing development and maintenance to a complete halt. Two serious problems are:

- The government network firewall severely restricts the type of data that can pass in and out of the DWAF network. For this reason, the database currently resides on a private server, with the risk that the site owner could unilaterally withdraw support.
- DWAF could technically insist that the developers hand over all software code to the department's official outsourced IT developers for support and development. This would destroy any trust between the developers and DWAF and in practice terminate further development and support for the Rivers Database.

The DWAF NAEHMP team has the long-term view that the RHP data will eventually reside on DWAF's own WMS database. However, until the WMS is ready to accommodate the storage and retrieval procedures currently performed by the Rivers Database, the RHP managers need to avoid precipitating the events mentioned above.

SECTION 4: INFORMATION GENERATION AND DISSEMINATION

4.1 Introduction

As a management information system, the overall purpose of the RHP is to generate information on the state of health of aquatic ecosystems to support the management of these resources at a national level (Roux 1997).

The ultimate test of the success of a programme will be in the use of the information that is produced through it. For the RHP to be sustainable, a prerequisite would therefore be that the information resulting from it must become part of the decision-making process in water resources management. In other words, the RHP must become an essential tool in achieving better understanding and management of river ecosystems. To achieve this, it is necessary to have a very good understanding of the information requirements of the Programme's different information users. This includes what information they would like to receive (format), when (frequency), and how (distribution).

A broad range of stakeholders make use of the information generated by the NAEHMP:RHP, ranging from the scientific community to water resources managers and planners, politicians and the general public. Each of these user groups has unique information requirements and one of the key challenges of the Programme is to communicate technical information in an effective and creative manner to its wide audience (Roux, 1997).

DWAF's Strategic Framework for National Water Resource Quality Monitoring Programmes (DWAF, 2004a), distinguishes between two types of information users, namely:

- **Primary information users**, those who are directly affected by the information that they receive. They meet one or more of the following selection criteria:
 - They perform a DWAF Policy and Regulation function.
 - Their function cannot be performed adequately without having access to the information products that are produced by the relevant national monitoring programme.
- **Secondary information users** are those who are indirectly affected by the information they receive and include the general public, learners and students at tertiary education institutions that could benefit from having the information available.

4.2 Overview of the review process

4.2.1 Identify information requirements and needs of primary users

The data and information requirements of the primary users were revisited as part of the task to review the Information Generation Dissemination component of the RHP. Primary information users of the NAEHMP include: the Department of Environmental Affairs and Tourism (DEAT), the Water Research Commission (WRC), conservation agencies and provincial departments of the environment. Within DWAF include: the Minister (including the relevant parliamentary portfolio committees), RQS, D: National Water Resources Planning, D: Resource Directed Measures (RDM), D: Water Use, and DWAF Regional Offices.

The overall purpose of this task was to review the current information generation and dissemination strategy of the RHP, which includes reporting formats, and to align it with the information requirements of the primary information users of the Programme.

4.2.1.1 Interviews with primary stakeholders

Primary stakeholders of the RHP, identified during the data acquisition phase of the project, were approached and interviewed or communicated with during February and March 2007. A questionnaire (Strydom and Hill, 2007) was developed for this purpose and questions were structured around the purpose of this task, namely: to develop an in-depth understanding of the roles and day-to-day responsibilities of the Programme's primary information users; their information requirements (e.g. technical, medium or low level); preferred method of packaging and distribution (e.g. hard copy, electronic, presentation, etc); as well as frequency at which information is required (e.g. biannually, annually, less frequent). It was also used to identify current gaps and shortcomings in RHP data and information which they receive. A qualitative method was used, mainly comprising open-ended questions. Where possible three (but at least two) interviewers worked as a team to ensure quick and accurate capturing of data. Immediate capturing ensured that instantaneous follow-up questions could be formulated where gaps were identified during the capturing process.

Although the RHP, and subsequently the review of its design, focuses on the information requirements of the Programme's primary information users, the Programme has a key role in environmental awareness creation and education regarding water resource management and protection, and has to date supported various related initiatives. It will continue to fulfil this role.

4.2.1.2 Use of biomonitoring requirements in licensing conditions

Further to identifying the data/information requirements of the RHP's primary stakeholders, the RHP or biomonitoring data/information requirements of DWAF Regional Office water resource managers who have a water use licensing function to fulfil, also had to be specified. Biomonitoring, which includes the use of RHP indices, are used at a provincial/regional level to support DWAF regulatory functions such as water use licensing. RHP specialists, mainly at Resource Quality Services (RQS) have to date played a key role to support and advise Regional Offices in the use of biomonitoring (as it relates to the RHP) in licensing conditions. This includes biomonitoring site selection, which indices to use when, frequency of monitoring and to review biomonitoring reports produced by water use licence holders. A need was identified to develop guidelines that would support DWAF Regional Offices and licensing authorities (who mainly have a water quality background) in the use of biomonitoring in licensing conditions in a consistent manner. As a first step, a workshop was held in March 2007 between RHP specialists, selected Regional Office representatives and representatives from DWAF Head Office (e.g. RDM, Resource Protection & Waste, Water Abstraction & Instream Use, Stream Flow Reduction Activities) that provide support in terms of water use license evaluations and guidelines to develop conditions for different Section 21 water uses. The main purpose of this workshop was to establish what the RHP and biomonitoring data/information requirements of DWAF Regional Offices are, and to identify key issues and challenges in the use of biomonitoring in licensing conditions.

4.2.1.3 Reporting of RHP data/information

A workshop was held on 25 and 26 April 2007 as part of the task to review the RHP's current data/information reporting formats and to recommend the most appropriate for different purposes, namely:

- State-of-Rivers (SoR) reporting,
- technical reports (graphics, stats etc),

- where there is ecoregion information,
- where there is historical information,
- where there is no background information, and
- links to EcoStatus.

4.3 Outcomes and key decisions

4.3.1 Information requirements and needs of primary users

The outcomes of this review process are discussed below.

4.3.1.1 Interviews with primary stakeholders

Specific RHP information needs identified during interviews and personal communications with the primary stakeholders, are summarised below:

- The present ecological state of health of aquatic ecosystems countrywide;
- The desired ecological health of aquatic ecosystems countrywide;
- Trends in the health of these aquatic ecosystems, i.e. is there any change, improvement, deterioration, etc.;
- An indication of the ecological importance and sensitivity of a system;
- In terms of resource planning, to provide information on the ecological state of aquatic ecosystems in parts of the country that are not prioritized for high confidence (comprehensive) ecological Reserve determinations;
- Biological and ecological baseline data in catchments that are being prioritized for ecological Reserve determinations;
- RHP information to set specific objectives for rivers;
- A screening programme that would identify problem areas (hot spots) where management intervention is required;
- Identify potential management actions.

Table 4.1 provides an overall summary of the information that is required by the primary stakeholders as well as preferences regarding how the information must be disseminated. It includes a summary of the following:

- the context within which NAEHMP:RHP information is most likely to be used;
- the level (advanced, intermediate, basic) at which NAEHMP:RHP information is most likely to be used;
- how frequently information is required, and
- how the information should preferably be packaged and distributed (this largely reflects the preferences of the person that was interviewed).

Note that not all NAEHMP:RHP stakeholder information requirements can be met, since no monitoring programme can address all the information requirements of all its stakeholders (Roux, 1997). The data to support many of these information requirements would have to be generated at a more detailed level and could typically be supported by routine provincial or catchment level monitoring programmes.

Table 4.1. Information and dissemination requirements of primary information users					
STAKEHOLDER	FOR WHAT	NAEHMP:RHP			
	NAEHMP:RHP DATA / INFORMATION IS REQUIRED	LEVEL (ADVANCED / INTERMEDIATE / BASIC)	FREQUENCY	SUITABLE INFORMATION PRODUCTS	DISSEMINATION MEDIA
		NATIO	ONAL		
DEAT	State-of- Environment Reporting	Intermediate to advanced	5 yrs	National State-of-the Rivers Report; access to technical reports if required	Email, hand deliver hardcopy; website
WRC	Research to inform policy development & implementation	Intermediate	Quarterly	Provincial State-of- Rivers Reports; Electronic newsletter	Email, website
DWAF				-	-
D:Integrated Studies	DWAF Annual Status of Resources Report	Intermediate	Annually	Provincial State-of- Rivers Reports	Mail hardcopy report
D:National Water Resources Planning	Planning; policy and strategy development; Integrated Strategic Plans	Intermediate	When red flags appear	National State-of-the Rivers Report; provincial State-of- Rivers Reports; one pager reports	Mail hardcopy report; Presentation
D:Strategy and Policy Coordination	National Water Resources Strategy; DWAF Annual Report	Intermediate to advanced	Biannually	Provincial State-of- Rivers Reports; one pager reports; national State-of-the Rivers Report	Email, hand deliver hardcopy
D:Water abstraction & instream use	Policy development and guidelines to Regional Offices	Intermediate to advanced	biannually	Provincial State-of- Rivers Reports; technical reports	Mail hardcopy report; website; presentation
D:RDM	Reserve determinations, Classification	Intermediate to advanced	Quarterly	Electronic newsletter; provincial State-of- Rivers reports; technical reports; national State-of-the Rivers Report	Email; hand deliver hardcopy; website
D:Communications	Media releases; National Water Week; Information to the Minister and parliament	Basic	Quarterly	Electronic newsletter; national and provincial State-of-the Rivers Reports	Email; mail hardcopy

PROVINCIAL AND LOCAL					
DWAF Regions	Water use licensing; Targets; RQOs	Intermediate to advanced	Quarterly	Electronic newsletter; provincial State-of- Rivers Reports; technical reports; national State-of-the Rivers Report	Mail hardcopy report; website; presentation
Conservation agencies	Conservation Management Plans;	Intermediate to advanced	Quarterly	Electronic newsletter; provincial State-of- Rivers Reports; technical reports; one pager	Email; hardcopy report; website
Environmental departments	Conservation Management plans; State-of-the- Environment reporting; EIAs	Intermediate to advanced	Quarterly	Electronic newsletter; provincial State-of- Rivers Reports; technical reports	Email; hardcopy report; website
CMAs	Catchment Management Strategy; Targets, RQOs	Intermediate to advanced	Quarterly	Electronic newsletter; provincial State-of- Rivers Reports; technical reports; one pager reports	Email; hardcopy report; website; presentation
Municipalities	Integrated development plans	Intermediate	Quarterly	Electronic newsletter; provincial State-of- Rivers reports; one pager reports	Email; mail hardcopy report; website

table 4.1 continue

Although the RHP, and subsequently the review process, focuses on the information requirements of its primary information users, the Programme has a key role to play in environmental awareness creation and education and has to date supported various related initiatives. The information products used by these so-called secondary stakeholders include published material such as non-verbal posters, colouring books and pamphlets. These are distributed at schools, to communities and at water related events such as conferences and symposia, information days and Water Week. In table 4.2 the information requirements of these stakeholders, are summarised.

Table 4.2. Information and dissemination requirements of secondary information users

STAKEHOLDER	FOR WHAT NAEHMP:RHP DATA / INFORMATION IS REQUIRED	NAEHMP:RHP INFORMATION REQUIREMENTS			
		LEVEL	FREQUENCY	SUITABLE INFORMATION PRODUCTS	DISSEMINATION MEDIA
General public	General information; educational	Basic to intermediate	Regularly	Brochures, general newsletters; one- pager reports; posters; State-of- Rivers reports	Website; popular press
Learners and students	Educational	Basic	Regularly	Brochures, videos; colouring books, posters	Website; popular press; videos

4.3.1.2 Use of biomonitoring in licensing conditions

A number of issues where identified during the workshop which was held with a small group of DWAF Regional Office and Head Office representatives. From discussions during the workshop and the several issues identified, it became clear that this task is much more extensive than originally anticipated and that it goes beyond the scope of the overall project. It was hence decided that a separate project in this regard must be initiated and that task would no longer be addressed as part of this Inception phase.

4.3.1.3 Reporting of RHP data/information

Section 4 in the RHP implementation manual provides an overview of the interpretation and reporting of RHP data/information (DWAF, 2008). It includes suggestions for how to report to different target audiences ranging from lay to specialist. It is envisaged that the interpretation provided (especially for SASS as the EcoStatus interpretation is provided elsewhere) will become the definitive interpretation and should remove much of the uncertainty surrounding this issue. The RHP Ecological Categories were also revised as part of this task and the present state categories and colour coding proposed for use in RHP reporting are as follows:

ECOLOGICAL CATEGORY	EC NAME	ECOSTATUS NAME = EC	COLOUR
А	Natural	Unmodified natural	Blue
В	Good	Largely natural with few modifications	Green
С	Fair	Moderately modified	Yellow
D	Poor	Largely modified	Red
E	Seriously modified	Seriously modified	Purple
F	Critically modified	Critically or extremely modified	Black

Table 4.3. of Ecological Categories (EC) and EcoStatus name

The main changes include the shift in colour scheme so that red reflects the worst of the acceptable management categories and also an alignment of naming convention.

4.4 Documentation and reports

The following are available on the CD:

- Questionnaire designed to establish primary RHP users' information needs and requirements (Strydom and Hill, 2007);
- Agenda of a workshop held in March 2007 regarding the development of guidelines to support the use of biomonitoring in licensing conditions as well as issues raised by the Regional Office representatives as well as issues identified.

4.5 Challenges and recommendations

4.5.1 RHP data/information reporting

(i) Interpretation of SASS data

As noted by Dallas (2007), some ecoregions had inadequate data to develop Ecological Categories. This situation may be rectified in the future as more biomonitoring takes place within these regions and a greater understanding of the condition and tolerance of these systems grows. Furthermore, some modifications to the Ecological Categories may prove necessary once the system has been properly tested. The reader is referred to the RHP web site where updates of ecological categories per ecoregion will be maintained.

(ii) National vs provincial and local requirements

Clear links and feedback loops should be established between the more detailed provincial monitoring and national monitoring sites. Especially in instances where deterioration or problems are detected at national sites, a process should be initiated where more detailed surveys are undertaken at a provincial level. This process could typically be addressed in a Decision Support System (see 2.5.1.1).

(iii) Use of biomonitoring in licensing conditions

The use of biomonitoring in a regulatory framework is something that needs to be addressed as a matter of urgency. Biomonitoring is presently used by some DWAF Regional Offices in water use licensing conditions in the absence of proper guidelines. There is as a result no consistency in the approach followed and concerns have been raised about the legality thereof. Guidelines have to be developed that would be useful to both DWAF Regional Offices that currently have a responsibility to issue and monitor water use licenses as well as various DWAF Head Office directorates that have a responsibility to evaluate and recommend these license applications. It is therefore important that all the important role players in water use licensing are involved in such a project.

(iv) Electronic mailing list

An electronic mailing list with key stakeholders of the RHP was updated and maintained by the Programme's secretariat in the past. This mailing list needs to be restored and updated with key stakeholders at local, provincial, national as well as international level to ensure that relevant RHP information and reports are distributed widely and to the right audience.

SECTION 5: GOVERNANCE AND KEY STRATEGIC ACTIVITIES

5.1 Introduction

Governance has not really featured as an explicit concept during the first 10 years (1994-2004) of the RHP's existence. However, the institutional and collaborative models that emerged during the various design and implementation phases have attracted significant attention (Roux, 2005). From the start of the Programme a combination of a highly diverse and specialised cluster of skills which cross the mandates of a number of sectors and spheres of government, have been involved in the Programme, but mostly on a voluntary basis. The sustainability of the Programme hinges on how well the Programme is governed and whether the necessary capacity and expertise are available to implement and maintain the Programme both nationally and provincially. Other key aspects that contribute to the Programme's sustainability include an effective Research & Development (R&D) programme to promote the continuous development of scientific credibility of the RHP and links with other key initiatives within the Department and externally.

5.2 Programme governance

While the design, development, and standardisation (concepts, methods, processes) of the NAEHMP: RHP are coordinated at a national level, implementation activities largely take place at the provincial level (Figure 5.1). "This model of implementation has to date, relied strongly on voluntary participation, informal arrangements and a fair amount of flexibility that caters for the diversity of resource realities (both human and financial) across the country" (Roux, 2004). Although this approach has proved to be very successful, having to rely on the commitment of individuals leaves the Programme very vulnerable. The effectiveness of ongoing development and the sustainability of implementing and maintaining the NAEHMP:RHP, will therefore be determined by the way in which the overall process is governed. Governance is essentially about the rules of resource allocation, use and management, the entities (individuals and institutions) that set, apply, change and manage these rules, and the relationships among and between these entities. Roux (2005) provides a historic overview of how the RHP has been governed since its initiation in 1994 and proposes certain aspects to be addressed in terms of the Programme's governance in future.

A key aspect of governing the RHP is to maintain and strengthen continued support for the Programme. This would require formalising relationships and partnerships (through for example Memoranda of Understanding) and defining roles and responsibilities that support action for and commitment to the Programme. These aspects have been addressed in the Inception Phase. The roles and responsibilities of the different stakeholders at national, provincial and local level have been set out in the RHP Implementation Manual (DWAF, 2008) and the RHP Business Case. Much progress has also been made with regards to formalising the responsibilities of provincial partners in terms of implementing and managing the RHP at a regional level; notably the proposed contractual agreement between DWAF:RQS and Emzemvelo KZN Wildlife to manage and maintain the RHP in KwaZulu Natal. The contract is in the process of being finalised.



Figure 5.1: NAEHMP:RHP governance model

A generic Memorandum of Understanding (MoU) is in the process of being developed. In the RHP context, a signed memorandum of (co-operative) understanding between key government departments and other collaborating organisations within the PTT, would clearly spell out the roles, functions and responsibilities that each organisation agree to undertake. It is therefore a useful document to contribute to the successful implementation and maintenance of the Programme. It also assists these government departments in justifying their RHP expenditure to top management and even their auditors.

5.3 Capacity building and training

Within the context of water resource quality monitoring, capacity building is generally defined as a range of activities by which individuals, groups and organisations enhance their human potential by improving their skills and knowledge (individually and collectively) to perform functions, solve problems and set and achieve objectives in order to achieve sustainable water resource management (DWAF, 2004a). A key challenge of the NAEHMP:RHP remains to build and sustain a critical capacity to implement and maintain the Programme both nationally and at provincial levels. For the sustainability of the NAEHMP:RHP, capacity building should go beyond the traditional top down approach of enhancing skills and knowledge through training. It should focus on enhancing true engagement of partner organisations in all facets of the Programme.

Initiatives to enhance and build capacity within the RHP context either take place through a formal process, or on an ad hoc basis as the need arises, and include the following:

- Ongoing "hands-on" training of RHP practitioners in the operation of the Rivers Database (both one-to-one assistance and group training courses) as well as focused training of person(s) responsible for data capture (locally, provincially and/or nationally) have been addressed as part of the National Coverage Phase;
- RHP indices and specialist training provided to RHP technicians and practitioners include for example SASS5, fish identification and training in the application of the EcoStatus models;
- All personnel producing data for the RHP should at some stage become accredited (certified) as being competent to produce such data. Accredited (certified) practitioners are publicly listed (on the RHP website);
- Field days and biomonitoring information sessions give implementers, resource managers and support staff the exposure and insight into the workings of the Programme and provides an opportunity to share experiences, exchange ideas and develop an understanding of each other's day-to-day challenges;
- Mentorship;
- Presentations at forums, workshops, symposia and meetings; and
- Field demonstrations and presentations to learners and other water users such as farmers, the mining sector and industry.

The Biomonitoring Short Course has been reviewed as part of the National Coverage Phase. The objective was to revise and update the biomonitoring course in line with the latest requirements of the NWA, such as:

- The implications of the Resource Quality Objectives (RQOs) to a status and trends monitoring programme;
- The role of the RHP in Ecological Reserve compliance (to license conditions) monitoring;
- Linking with training institutions, such as universities, to ensure a broad capacity building drive.

The main product is an updated short course that can be used to train RHP practitioners and a basic document to drive the most needed capacity building, particularly when CMAs take responsibility for their roles in biological monitoring activities.

Capacity building is a continuing learning and changing process.

5.4 Research and development

An effective R&D programme would promote the continuous development of scientific credibility of the RHP. Such a programme should be more than a mere collection of independent R&D projects, and must cater for learning interdependence among multiple components. By following a learningby-doing approach, an R&D programme would facilitate a partnership between those involved with development of new concepts and those responsible for operational application of those concepts (Roux, 2005).

5.4.1 RHP indices and methods

Although the Water Research Commission as a national custodian of the RHP has a mandate to support water research and development as well as the building of a sustainable water research capacity in South Africa, DWAF, through its D:RQS, has played a key role in the development and refinement of various RHP and related indices. This is usually done by working in close collaboration with ecological specialists across the country. Recent developments include the EcoStatus and related models (FRAI, VEGRAI, MIRAI) (Kleynhans, 2007; Kleynhans et al., 2007c; Thirion, 2007), and the Fish Frequency of Occurrence (FROC) project (Kleynhans *et al.*, 2007b).

Most of these projects were co-funded by the WRC. Diatoms have been identified as an indicator to be included in the national RHP suite of indices. The development of the Diatom Assessment Programme (funded by the WRC) is currently being addressed in three phases (Phase I and II are complete), and is undertaken by the North West University (Jonathan Taylor, under the leadership of Dr Bill Harding) (Taylor *et al.*, 2007a). Discussions are being held regarding the development of a diatom index which follows the EcoStatus approach.

5.4.2 Wetlands

Although the NAEHMP has to date focussed largely on river ecosystems, the wetlands and estuarine component of the Programme is steadily gaining momentum. The Wetland Index of Habitat Integrity (WETLAND-IHI) (DWAF, 2007c) is a tool that was developed for use in the NAEHMP. The WETLAND-IHI method assesses floodplain and channelled valley bottom wetland types. Derived monitoring data will be incorporated into the national monitoring programme. The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories, and provide a score of the Present Ecological State of the habitat integrity of the wetland system being examined. The model is composed of four modules. The "Hydrology", "Geomorphology" and "Water Quality" modules all assess the contemporary driving processes behind wetland formation and maintenance. The last module, "Vegetation Alteration", provides an indication of the intensity of human land use activities on the wetland surface itself and how these may have modified the condition of the wetland. The integration of the scores from these 4 modules provides an overall PES score for the wetland system being examined. This project is the first phase of wetland habitat assessment methods to be developed by DWAF. During Phase II, similar wetland habitat assessment methods will be developed for pans, seepage wetlands and unchannelled valley bottom wetland types. The Wetland IHI is a DWAF funded project.

5.4.3 Estuaries

Much work has already gone into the development of estuarine indices and methodologies that would be suitable for the estuarine health programme (see van Niekerk and Taljaard, 2005). Discussions are currently being held with estuarine specialists as part of the process to initiate and develop an estuarine health programme by DWAF:RQS.

5.4.4 Maintaining an R&D Programme

Who should ultimately be responsible for maintaining an R&D programme for the RHP is an open question. One can argue that DWAF, as a leading partner, and the Water Research Commission have a clear mandate for supporting such a programme. Involving a few additional partners could support the objective of creating learning interdependency among key partners. Care should however be taken to ensure appropriate support, communication channels, and distribution of risk and benefits (Roux, 2005).

5.5 Establishing links with other DWAF initiatives

It is important that links are established with other initiatives that may benefit from the NAEHMP:RHP. In Roux (1997) various programmes and initiatives are mentioned which can benefit from the extensive knowledge and experience gained in the RHP as well as the information generated through the development and implementation of the Programme. Informal links have been established in some instances, but a more formal approach towards collaboration is required. In addition to the initiatives and programmes mentioned in Roux (1997) links should also be established with the following:

NAEHMP: RHP Record of Decision Report

- Resource Directed Measures (RDM), with specific links to the Resource Quality Objectives Compliance Monitoring Programme which is in the process of being designed. The RHP produces quantitative information regarding a "pre-disturbance" reference state (biological integrity) as well as the current ecological state of a river, which is interpreted in terms of the response of the biota. These two states are key benchmarks in implementing RDM. With the RHP's focus on the ecological state and responses of aquatic ecosystems, it would make sense to optimise the alignment between the RHP and the monitoring needs of RDM. One of the aspects that form part of the RDM is the ecological Reserve. The determination of the ecological Reserve is based on the EcoStatus approach which is interpreted through the integration of the PES of the system drivers (geomorphology, hydrology and water quality), the resulting habitat integrity in terms of specific biological groups (fish, macro-invertebrates and riparian vegetation) and the biological responses of these biological groups. The ecosystem drivers required by ecological reserve determinations are not specifically considered in river health determinations, so the IHI (which provides a broad qualitative approximation of instream habitat and riparian zone habitat conditions) is used as a surrogate indicator. The response of the biotic groups is therefore interpreted in terms of habitat integrity (Kleynhans, et al., 2007a). The EcoStatus approach within the context of the RHP is particularly useful in instances where catchments are not prioritised for high confidence ecological Reserve determinations, since it would permit the formulation of resource quality objectives applicable to an ecological monitoring programme, with an emphasis on biomonitoring and resource management (Kleynhans and Louw, 2007).
- Freshwater Conservation Planning (Development of a policy and a planning tool for the conservation of river biodiversity in SA) Neither the National Water Policy nor the National Water Act (Act 36 of 1998) deals with the setting of national conservation targets. There is thus no explicit guidance regarding the overall level of protection that is desirable. The Freshwater Conservation project developed a systematic planning tool to assist resource planners in answering questions such as "How many rivers should reflect a high level of protection in order to say that South Africa's collective network of rivers is healthy?" and "Which rivers should be protected in order to claim that a representative mosaic of rivers (and riverine biodiversity) is protected or conserved?." This project has direct relevance to the National RHP and its outputs.

5.6 Documentation and reports

The following are available on the CD:

- Governance of the South African River Health Programme (Roux, 2005);
- Towards a national estuarine health programme (van Niekerk and Taljaardt, 2005)

5.7 Challenges and recommendations

Governance

- Roles and responsibilities of key stakeholders must be agreed upon and relationships formalised through MoUs.
- It is important that DWAF knows exactly where they would like to be in terms of technical competencies, where they are at present, and what needs to be done to close any gaps. An assessment of the current as well as desired competencies within each of the participating

organisations is a basic prerequisite for effective participation. This could be achieved through the development of a fairly simple skills matrix.

Capacity building and training

- The revised biomonitoring short course must be presented during 2008.
- Other (specialist) training needs must be identified, for example to use the EcoStatus models, fish species identification and using the Rivers Database. Training schedules must be developed accordingly.

R&D Programme

- The wetlands IHI needs to be expanded to include pans, seepage wetlands and unchannelled valley bottom wetland types.
- The development of the estuarine health programme must follow a phased approach and must be pilot tested before full-scale implementation commences.

Establishing links with key DWAF initiatives

 The RHP has much to offer. It is therefore important to establish formal links with the DWAF initiatives mentioned above as well as any other initiatives which may benefit from the extensive knowledge base of the RHP and insight gained over the past almost fifteen years since the Programme was initiated.

5.8 Conclusion

The success of the NAEHMP:RHP and its implementation as a nationwide monitoring programme, that complies with the requirements of the NWA, ultimately hinges on the way the Programme is governed. Institutional responsibilities must be explicit and roles and responsibilities must be clearly defined and accepted, though not so rigid as to stifle enthusiasm. Equally important is ongoing development and improvement of the Programme's components (e.g. refinement of indices, further development and testing of quality assurance procedures, etc.) to ensure continuous improvement and relevance of the programme. Within this context, there are various challenges to face and carefully thought-through procedures required to ensure that the Programme is successfully implemented.

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