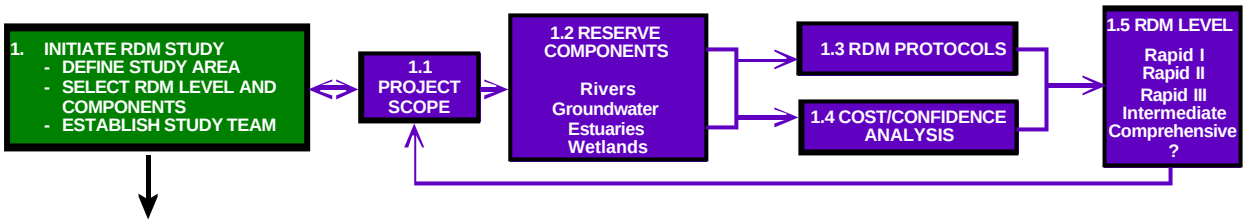
3. PROJECT SCOPE *(1)*



Resources required to determine project scope

DWAF RDM personnel
DWAF personnel from the planning departments
Instream specialists

Approximate time required

Collation of background information	1 day
Scoping meeting and minutes	1 day

3.1 RESERVE COMPONENTS *(1.2)*

During the process when the Project scope is addressed, the relevant components of the study area must be identified. These components can be the following:
Rivers Quantity
Rivers Quality
Estuary (quantity and quality)
Wetlands (quantity and quality)
Groundwater

The importance of a freshwater requirement of the marine environment has also been identified as a potential Reserve component.

3.2 REQUIREMENTS FOR DIFFERENT LEVELS OF RESERVE DETERMINATION

It became apparent within the RDM project that different levels of Reserve determination will be required to address the time and budget constraints associated with setting Reserves on numerous rivers in the immediate future.

Apart from this, the necessity of addressing all components at a comprehensive level must also be investigated. In situations where groundwater for example does not play a role in providing base flows in rivers, the groundwater component of the Ecological Reserve does not need to be addressed. Another example is where a license application for a river abstraction with no quality problems requires evaluation. The quality component might only require a rapid evaluation whereas the quantity evaluation could be at a different level.

Constraints regarding existing information and potential for collecting required information also play a role in defining which level of Reserve is possible and cost-effective, irrespective of what the required level might be required. (3.3 below).

3.3 DETERMINING REQUIRED LEVEL

3.3.1 RDM protocols *(1.3)*

Only a summary of rules for the selection of the appropriate level of Reserve determination is provided in the existing RDM documents (DWAF 99, volume 1). The issues that are considered are the following:

- Type of proposed development (abstraction, instream dam, off channel dam, forestry etc).
- Impact of the proposed development.
- Ecological Importance and Sensitivity.
- Degree to which the catchment is already utilised.
- Regulated systems.
- Existing developments.
- Socio-economic importance.

3.3.2 Cost/benefit analysis *(1.4)*

It is an established fact that DWAF is, and will be into the future, under a great deal of pressure to establish Ecological Reserves for many rivers, while it is also recognised that determinations can be expensive in time and money. It has also become clear that the confidence that can be expressed in the results of a Reserve determination is variable and depend to a certain extent on the existing available information, the time allocated to carry out new surveys or data analyses, as well as some of the physical and biological characteristics of the river (in that some rivers are more difficult to analyse and assess than others). An Ecological Reserve determination process is largely about relating ecological functioning, through the channel hydraulics and geomorphology, to the hydrological regime (natural and modified). If those relationships cannot be satisfactorily defined, then any Reserve determination method will return information that is of relatively low confidence.

Section 3.2 refers to the different levels of Ecological Reserve determination that have been developed and it was originally conceived that these represent progressively higher degrees of confidence in the results (from rapid through to comprehensive), commensurate with the additional time and costs allowed for. However, it has become apparent that this is not always a simple relationship and that, in certain circumstances, the highest degree of confidence is achieved in, for example, an intermediate determination. The Water Research Commission programme of research on Reserve developments is addressing these issues through the development of a decision support system to determine the most cost effective Reserve determination method based on the following four steps:

G Define the time and activity limitations for five generic methods; Rapid I, II and

III, Intermediate and Comprehensive. The three Rapid levels have been used because it was considered that there was too great a gap between the original Rapid approach and the Intermediate.

- **G** Define the costs (in terms of person-days) for each method and each speciality employed (i.e. hydrology, hydraulics, fish, riparian vegetation, etc.).
- **G** Define a set of questions (using simple yes/no answers) for each specialisation that allows the level of confidence that can be achieved at specific sites to be estimated. The questions should be answerable without any detailed studies being undertaken (i.e. at no cost) as the whole point is to be able to design a project using these answers.
- **G** Define the way in which the costs and confidence scores are combined to assess the cost-effectiveness of each method for each specialisation and to quantify specialisation weightings that will permit an overall cost-effectiveness score to be derived.

Two examples of the type of questions that have been defined are given below, for one of the physical driver variable (hydrology) and for one of the ecological response variables (invertebrates). The scoring system uses values between 0 (very low confidence) and 5 (highest confidence). Base scores are those that apply if all the questions are answered negatively.

For hydrology (base scores for all the methods are the same and equal to 1):

- **G** Are WR90 simulated monthly flows reasonably representative of natural baseflow conditions (if yes, Rapid 1 and above confidence improved)?
- **G** Are higher confidence (than WR90 data) simulated monthly flows available (if yes, Rapid 1 confidence improved)?
- **G** Is there a good quality gauging station (with 10+ years of daily flow data) available on the river and near the site (if yes, Rapid 2 and above confidence improved)?
- **G** Is the information on upstream water use and streamflow reduction activities adequate and available (if yes, Rapid 3 and above confidence improved)?
- **G** Are there enough gauging stations, representative of natural conditions, available for spatial extrapolation (if yes, Rapid 3 and above confidence improved)?
- **G** Are there sufficient 'calibration' (hydromet and catchment) data for a daily rainfall-runoff model to be setup (if yes, Comprehensive confidence improved)?

For invertebrate biology (base scores vary from 0.5 for all rapids to 2 and 2.25 for intermediate and comprehensive, respectively):

- **G** Do the sites contain diverse habitat types (if yes, all levels of confidence are improved quite a lot)?
- **G** Are biomonitoring SASS survey data already available (if yes, Rapid I confidence improved, while data assumed to be collected for other levels)?
- **G** Are historical (pre-development) SASS data already available (if yes, all levels of confidence are improved)?
- **G** Are species level samples available (if yes, Rapid I to III confidence improved, while these data are assumed to be collected at other levels)?
- **G** Have studies of hydraulic habitat requirements been carried out (if yes, all levels

of confidence are improved)?

- **G** Are flow dependent target species present (if yes, Rapid I confidence improved a bit and higher levels improved even more so)?
- **G** Is the relative abundance of different taxa already known (if yes, Rapid I confidence improved a bit and Rapid I I & I I I confidences improved even more so)?
- **G** Are there seasonal data already available (if yes, confidence levels up to Intermediate are improved - data are collected at the comprehensive level)?

The result is a matrix of scores, which can be used to assess the likely confidence that will result from the different determination methods for each method. These scores are then weighted in recognition of the fact that high confidence in some areas (most of the ecological consequence specialisations) will be less relevant if there is lower confidence in the results of some of the other specialisations (hydrology and hydraulics, for example). The weighted scores are then combined with generic cost estimates to develop a cost/confidence matrix and a final cost/confidence value for each method.

The Institute for Water Research at Rhodes University are developing software to support this process under the Water Research Commission's Reserve Development programme. This software is expected to be available for distribution during 2002.

3.3.3 Integration

Sections 3.3.1 and 3.3.2 above address linked, but somewhat separate, elements of a Reserve project scope design. The RDM protocols refer mainly to policy issues that are defined by DWAF and the requirements of the National Water Act. Section 3.3.2 refers to what is scientifically achievable given various constraints of time and available information. The final decision about which method (or integration of different determination levels for each specialisation) to use should be based on a consistent and repeatable approach. The integration of these two decision frameworks will go a long way toward providing that approach. For example, the RDM protocols alone may suggest that a comprehensive determination should be undertaken, while the cost/confidence analysis may indicate that the confidence achieved is unlikely to be better than for an intermediate determination. Similarly, there may be situations where a catchment falls into the intermediate determination category on the basis of the current level of water resource stress, but the confidence achieved through a comprehensive determination may be so much better. The comprehensive may then be chosen to provide a more confident result that has a longer 'life-span' that will still be applicable when the catchment becomes more stressed in the future.

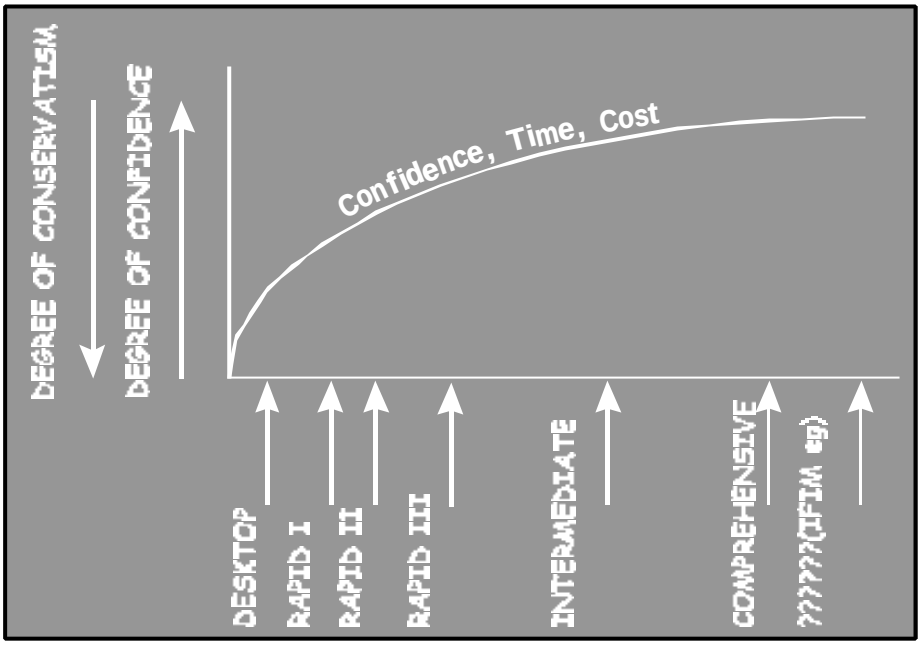
The examples provided above are very simplistic and there is no doubt that additional thought is required to understand how best to combine these decision making elements into a robust and effective Reserve project scope design tool.

3.4 SUMMERY OF METHODS FOR DIFFERENT LEVELS *(1.5)*

A suite of methods to determine the Reserve exists, each method associated with a different level of confidence as described previously. The first, and simplest, method of Reserve determination is the Rapid Ecological Reserve Methodology (RERM). The second

and third method for determining the Reserve are the Intermediate Ecological Reserve Method (IERM) and the Comprehensive Ecological Reserve Method (CERM) respectively. The IERM and CERM use increasingly comprehensive and detailed information bases, take more time and cost more than the RERM, but have the advantage of increased levels of confidence in the results arising from their use. This relationship between the different levels, cost and confidence are described in the Figure 2.3.

Fig 3.1 Relationship between different levels, cost and confidence



All the methods follow the Reserve procedure as described in Figure 2.2. The different methods are summarised below.

3.4.1 Rapid Ecological Reserve Methodology

The original criteria for the formulation of this method was that it should take two days to complete. The two days would exclude technical reporting.

The Desktop Model (Appendix C) forms the basis of the rapid methodologies. The Desktop Model provides a low confidence estimate of IFRs linked to different Ecological Reserve Categories (ERCs), i.e. different ecological states. The model is based on a hydrological extrapolation from existing medium and high confidence IFR results. The major difference between the rapid methods and the more detailed methods are that the IFRs are estimated using the Desktop Model (Appendix C) and then tested for adequacy by one or more instream specialists. Due to the limited information available during the rapid applications, the test for adequacy and any motivated adjustments are focused on assessing whether the Desktop estimate is too low (i.e. requires increase), rather than decreasing the results. During the application of the more detailed methods, the IFR requirements are determined (rather than an estimate being checked) with input of the full suite of multi-disciplinary specialists required.

Through application of the RERM, it was decided that the gap in confidence between the results of the RERM and the IERM is to large. Three rapid methods were therefore developed (RERM I, II and III) with the RERM III being the most frequently applied.

The steps for each method are summarised in Table 3.1.

Table 3.1 : Summary comparison of different levels of RERMs

RERM I	RERM II	RERM III
Determine Resource Unit.	Determine Resource Unit.	Determine Resource Unit.
Obtain most up to date hydrology and set up Desktop Model.	Obtain most up to date hydrology and set up Desktop Model.	Obtain most up to date hydrology and set up Desktop Model.
Obtain any relevant existing biophysical information.	Obtain any relevant existing biophysical information.	Obtain any relevant existing biophysical information.
Undertake site visit with following minimum specialists present: • IFR coordinator (can operate Desktop model) • Instream specialist	Undertake site visit with following minimum specialists present: • IFR coordinator (can operate Desktop model) • Instream specialist (One of the specialists must be able to undertake and calculate a flow measurement)	Undertake site visit with following minimum specialists present: • IFR coordinator (can operate Desktop model) • Instream specialist • Hydraulic engineer
Use existing information and on site information to determine the PES, EIS and derive the ERC.	Select an IFR site.	Select an IFR site.
Adjust Desktop Model output to provide site specific output and generate results for the recommended ERC or ERCs.	Use existing information and on site information to determine the PES, EIS and derive the ERC.	Use existing information and on site information to determine the PES, EIS and derive the ERC.
Provide a technical report.	Adjust Desktop Model output to provide site specific output.	Adjust Desktop Model output to provide site specific output.
	Undertake a flow measurement.	Undertake a cross-sectional survey, a flow and water level measurement and a rapid hydraulic modelling exercise to produce a rating relationship.

RERM I	RERM II	RERM III
	Evaluate the Desktop output based on the measured flow and the recommended Desktop flow for the specific month.	Evaluate the Desktop output based on the conversion of the Desktop recommended flows to hydraulic parameters such as depth, velocity, wetted perimeter.
	Adjust and motivate Desktop output if flows are deemed to low.	Adjust and motivate Desktop output if flows are deemed to low.
	Generate results for the recommended ERC or ERCs.	Generate results for the recommended ERC or ERCs.
	Produce technical report.	Produce technical report.

The rapid methodologies have not been documented and a specialist appendix (Appendix H) describing the RERM III has been produced. This is the most frequently applied rapid methodology and as it covers all the steps of the RERM I and II, specific documents on those methods are not required.

3.4.2 Intermediate and Comprehensive Ecological Reserve Methodology

The IERM and CERM use increasingly comprehensive and detailed information bases, take more time and cost more than the RERM, but have the advantage of increased levels of confidence in the results arising from their use. The IERM is a scaled down version of the more detailed comprehensive method. All the same steps are followed and the output is the same. The major differences between the CERM and the IERM procedures are the following:

- The level of information used in the IERM is based on available information and not on any extensive additional field collections. The IERM is therefore based on a much more limited information base than the CERM.
- The CERM focuses on indicator species in the system. Due to the lack of information of species occurring in the rivers, the IERM focuses on sensitive and critical habitats in the river, rather than species.
- The CERM is based on expert input and judgement. As the IERM is based on less information than the CERM, the dependence on expert judgement increases considerably.
- The confidence in the results of the CERM should be high compared to the IERM in which confidence is described as 'medium'.
- The IERM costs are approximately one third of the CERM.
- The IERM follows a similar stepwise procedure to the CERM, although at a much scaled-down version.

The IERM and CERM are discussed in chapter 6.