Natural Resources
SA Murray-Darling Basin

Community Monitoring Toolkit

Information, templates and example to make your monitoring meaningful and worthwhile

2013

Government of South Australia

Where to find the Tool Kit

The Tool Kit can be viewed on or downloaded from the South Australian Murray-Darling Basin Natural Resources Management (SA MDB NRM) Board website www.samdbnrm.sa.gov.au – search for 'community monitoring' in the search bar or in the 'get Involved' section.

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Introduction

In 2005 the Community Monitoring Framework was prepared for the SA MDB NRM region. This was the first stage towards developing generic tools for adaptation and use by individual community groups aiming to contribute to greater knowledge and understanding of the changes in condition of natural resources in the region.

During the development of the Framework a review was conducted of community based monitoring in the SA MDB. This review found that monitoring contributes to awareness about the condition of the resource and impacts on resource condition. This review also highlighted that successful monitoring occurs when the monitoring process is adequately supported with both technical and planning skills and skill development and coordination.

In 2006, a second stage was initiated to develop more tools for broader community based monitoring activities. The 'Implementation' phase of the Framework involved working with four monitoring groups, as case studies, to identify group monitoring needs that require attention. This has led to the development Toolkit.

In 2012, the Toolkit was reviewed and updated. Two new sections were added, the first a summary of how to use online databases to share data collected. The second is a new set of revision decision trees for groups looking to evaluate their current monitoring program.

What is natural resources management and why does it need monitoring data?

Natural Resource Management (NRM) is a framework to assist us in looking after the environment so that there is a balance between caring for our land, water, plants, animals and sustainable production. NRM includes many activities, such as controlling weeds and animal pests, soil conservation, salinity control, conserving biodiversity, farming to land capability and the efficient management of water resources.

SA's Natural Resources Management Act was introduced in 2004 to provide a more integrated and sustainable structure for managing our States' natural assets via 8 regional NRM regions. The SA Murray-Darling Basin (SA MDB) is one of these.The SA MDB Regional NRM Plan addresses threats to natural resources by conserving and enhancing the region's unique assets.

Resource Condition Targets (RCTs) have been developed to enable the evaluation of the condition and progress towards maintaining or improving the various natural resources of the region. The RCTs are specific and long term, covering a broad range of NRM values and issues. In addition, medium term Management Action Targets (MATs) have been developed and these targets are 'stepping stones' towards achieving the long term RCTs.

In order to evaluate the condition of natural resources and progress towards RCTs and MATs, data and information is required to report against these target. Community monitoring groups are a source of data and information that may be used by the SA MDB NRM Board to evaluate the condition of natural resources or progress towards RCTs and MATs.

Purpose of the toolkit

The purpose of the Community Toolkit is to support community monitoring groups and project officers. Monitoring activities are most effective when they are clearly connected to management decisions in an adaptive management framework.

The Toolkit has a broad focus, providing information, templates and examples for all stages of the community based monitoring cycle:

- planning and coordination
- data collection and QA/QC
- data management and online databases
- analysing and interpreting results
- communicating results
- evaluating and revising.

Who is the Toolkit for?

The Community Monitoring Toolkit will be useful for:

- anyone wishing to start a community monitoring group
- anyone participating in an established community monitoring group
- project Officers, Implementation Officers and others supporting community groups
- users of data/information collected by community monitoring groups to overview the process the community group has followed.

What is monitoring?

Monitoring is the regular observation, measurement and evaluation of natural resources including, organisms and the environment that they live in. It is possible to monitor one specific parameter or a range

of parameters to detect change over time. Ongoing monitoring is often necessary as many natural resources respond to changing conditions over time.

What the Toolkit is not

The Community Monitoring Toolkit is not a prescriptive community monitoring manual nor is it intended to be the primary resource on setting up and running a community monitoring group. It seeks to address the gap in the provision of a set of guidance in one resource.

This Toolkit is not designed to replace the support of project officers or technical expertise

Community monitoring in the SA MDB NRM Region

Community monitoring in the SA MDB NRM region is substantial and covers monitoring of wetlands, surface water quality, groundwater, aquatic and terrestrial biodiversity and land condition.

If you would like to take action and join a community monitoring group or start your own visit to the SA MDB NRM website at www.samdbnrm.sa.gov.au to find your local group or local officer.

Planning and coordinating

Do you need to start a community monitoring group?

A particular issue in the community can often spark a new project. An individual or group may realise that they need more information and/or that resources are available that could be used by a community group. The first step is to do some research:

- Contact SA MDB NRM Board staff to determine if a similar community project is underway. It is possible that someone is doing something about your issue and you can link with them rather than set up another community monitoring group.
- Find out if your issue is identified in other planning exercises, such as SA MDB NRM Regional NRM Plan, Local Action Plans, Wetland Management Plans or Water Allocation Plans.
- Look at NRM reports, for example from the SA MDB NRM region – do they support the need for monitoring data about your issue

If it appears there is a good reason to set up a new community monitoring group, now is the time to do some planning. Here are some questions to help you think about planning:

- Why do you want to monitor the issue?
- Where do you plan to undertake the monitoring?
- When you are going to do the monitoring?
- Which method will you use to monitor?
- Who will be affected, who will be involved, who needs to know about the project and your results?
- What data quality do you want?
- How will the data collected be stored and managed?
- How will the collected data be analysed?
- How will you communicate your results to users?
- How do you intend to make this happen, for example funding sources, technical support, training?

You may not be able to answer all these questions straight away and this is where the Toolkit can help including getting a monitoring group established.

Your group needs a monitoring plan, primarily for itself but also for users of data/information collected by your group. Without a plan your group may:

- be less likely to go forward together as one organisation, with one vision
- be unclear about whether or not you are achieving your objective
- seem less credible to others
- run into difficulties that could have been avoided.

Tips for established groups

Your group may already be taking action and monitoring. There may be some ways that you can enhance the value of your community monitoring group, which can lead to funding, training or technical support.

You may be tackling an NRM issue identified in other planning exercises, such as SA MDB NRM Board Regional Plan, Local Action Plan, Land and Water Management Plan, Wetland Management Plan, Water Allocation Plan. Other groups may also be interested in your monitoring data for NRM condition or performance reports. If either of these situations apply then you have identified potential users of your monitoring data and they can be listed in your communication plan.

If your group does not have a monitoring plan then there is an opportunity to develop one to ensure your monitoring meets your needs. Later on in this section you will find a monitoring plan template to help you get started.

If you already have a monitoring plan then there may be value in reviewing your plan and reflecting on whether it is as effective as it can be. The Toolkit has a later on evaluating and revising your monitoring plan. This includes examples of evaluation questions and approaches you might use to answer these questions. A template is provided containing mock questions and answers, which can be incorporated into your monitoring plan. You can also use the decision trees to help determine the parts of your plan that need revising.

Remember to inform people of the results of your evaluation. For example the SA MDB NRM Board are interested in what you learn, so make sure this is included in your communication plan.

Tips for recruiting and retaining volunteers

Members of your community monitoring group may come and go. However, there are some things you can do to help recruit and retain volunteers.

Participation in an environmental monitoring program can be fun and educational. To encourage people to join in with the monitoring activities it is important to think about what makes participation easy and

worthwhile. The experience from many programs implemented by volunteers shows that there are a few fundamentals to recruiting and retaining volunteers and the key steps to recruiting and retaining volunteers in an environmental monitoring program are listed in Table 1.

Table 1 Key steps to recruiting and retaining volunteers

Step	Because volunteer members...
Identify the tasks	want to know what is required of them and what they can contribute
Make contact	need to be encouraged that they are wanted and will be valued
Match tasks to interests and motivation	will be more engaged and likely to continue if the tasks suit them well
Explain time commitments	are likely to stay involved if they can plan their time effectively
Provide training	value learning opportunities and want support to do a good job
Seek feedback & ideas	are the ones who can best advise you about the rewards and obstacles to making a voluntary contribution

Step 1: Identify the tasks

Be sure to have a description of the activities of the group and the tasks you would like new participants to join in with. Meeting the expectations of volunteers is an important part of keeping them involved so you want them to know exactly what they are being asked to do and approximately how much of their time it will take. Don't assume that volunteers will understand what is required of them if you don't define and explain it for them.

Written instructions can be helpful for both recruiting volunteers and retaining new volunteers. Without written instructions, an individual may decline to volunteer - or may volunteer to do the job, but misunderstand exactly what it is he or she agreed to do and drop out after a short time.

A task is more likely to be completed and on time when your volunteers know that their contribution is important and that others are counting on them. So let them know the importance of what they are doing and how the job fits into the groups' overall goals. The following will assist:

- Have a job description outlining the list of activities that the volunteer can get involved with (see page 10 for an example).
- Follow up verbal commitments with a thankyou note that includes a summary of the agreed activities.

Step 2: Make contact

When someone is thinking of joining your monitoring group they will also be thinking about the kinds of people they will be working with. Therefore, it is important to give them some information about the people in the group and some confidence that they will be welcomed and valued. This can best be achieved through the personal approach. Think about developing a plan for recruiting and retaining members. Recruits may come from a number of sources and it may be worth spreading your effort.

Here are a few general tips that might improve your success rate:

- Have a few members of the group working on recruitment. This will mean that you will start with a much bigger network to draw on.
- Have some information on the general activities of the group ready to give to people who show interest.
- Set a time in the year when you encourage new people to start. There may be a time that suits people in your community and potential members will be encouraged to join at the same time as others.
- Encourage new people to join with a friend and let them know there are other members new to the group.
- Reach out to as many people as possible who may be interested. You could use attendance sheets from information sessions or workshops you have conducted or results from interest surveys conducted by the group to get a starting list of names.

General or mass recruitment is useful for spreading the message about your need for volunteers as widely as possible. This form of recruitment can help to increase the numbers up but does not guarantee quality. These methods can communicate the idea that anyone can do the tasks and that new members may not be individually valued for the skills and experience can offer. Monitoring of the environment can be technical and not all people have an interest in contributing, to managing the natural environment, will want to be involved in monitoring. However, development and implementation of a successful monitoring program involves many skills such as communication and recruitment.

Recruits from general or mass campaigns should be well informed of the program of activities to avoid wasting the time and energy of the recruits and the

existing group members. Recruitment of this kind can use:

- general announcements in newsletters or meetings
- distribution of brochures or posters
- use of advertisements of stories in the mass media.

Targeted or select recruitment is a good way to enlist people with particular skills and interests that are needed or desirable. This is a more intensive recruitment effort but offers the benefit of expanding the capability of the group. It is beneficial to:

- decide what skills and interests are needed in the group/monitoring program
- identify where people with these skills and interests can be located
- find a method of approaching and encouraging the new people to join the monitoring activities of the group e.g. prepare general information on the monitoring program, prepare a specific a 'job' description and identify the benefits of participation for the individual.

The best place to start to look for people with specific skills or interests is in the 'inner circle' of people who are already connected to current members of the group. Encouraging person-to-person recruitment means everyone in the group can play a role but it also means that group members need to understand the responsibilities and processes of recruitment. When this method is the sole source of recruitment the group should be aware of the risk of becoming 'in-bred', ie. having a membership with too narrow a range of views and experience. Starting points for inner-circle recruitment are:

- current volunteers in the group or related groups
- friends and relatives of current group members
- professional staff of NRM agencies and organisations who may be happy to get involved

Step 3: Match tasks to interest and motivation

The level of motivations for participation that potential members have will depend on their current level of interest and their understanding of the responsibilities and benefits of participation. The easiest way to draw on the motivation of potential members is to understand their interests and match these with specific tasks within the group or monitoring program. Motives can vary widely and may include looking for a challenge, self-improvement, and interest in meeting new people or concern for the environment.

Take time to speak with prospective and new members about why they want to participate. This can help to identify the tasks that they may find rewarding. For example, whether people:

- prefer to work alone or in a group (people who prefer groups may enjoy field days, people who are comfortable working alone may be happy entering data etc.)
- are interested in water quality, plants and animals etc. to help to define the component of the monitoring program which may suit the volunteer
- have training or specific expertise e.g. chemistry or statistics
- are interested in getting some training in monitoring techniques.

Step 4: Explain time commitments

Volunteers are more likely to continue to participate in the activities of the monitoring program if they have a clear understanding of the commitments involved and can plan their time. It is worth explaining:

- number and dates of monitoring activities
- time taken for different monitoring and associated activities (eg. data collection, equipment maintenance, data entry)
- number and timing of other meetings and events of the group

A good monitoring program will also have clear objectives and be focussed on management decisions which need to be made in the future. Explain this to new members and provide an end-point for the current monitoring program if one can be agreed. Motivation may be higher for some people if they know there is a clear purpose and a set time for the activity they are contributing to. For example, if monitoring has been implemented to examine changes in water quality downstream of a new development, 1 or 2 years of monitoring may be enough to make reliable judgements about the impact of the development.

Time commitments can be written into the volunteer job description to ensure that everyone is clear about the expected commitments being made.

Step 5: Provide training

One of the key motivation for people to participate in community based monitoring of the environment is interest in the natural world and a desire to protect and manage it. Good quality training can contribute to the benefits and satisfaction volunteers receive from their involvement in a monitoring program. They can learn about the natural environment and also build skills and confidence in areas interest.

Training should be matched to the experience, needs and activities of the volunteer and can be supplemented by providing copies of monitoring

manuals, procedures or notes from previous monitoring events. Think about the full range of training that might help group members. Training in data collection is usually readily available with support from NRM officers but there may be opportunities to develop or access training in:

- planning
- science of the environment or monitoring
- data analysis and interpretation, or
- communication.

New members may bring specific skills which can be shared with the group through a workshop or training session and members should be canvassed to determine if such expertise is available. It may also be possible to discuss training needs with other groups with similar needs and interests and develop joint training opportunities. Also try to stage training to closely follow the recruitment program to ensure that people who need the training are fresh, involved and ready to act with their newly acquired knowledge.

The training required for new members to contribute effectively to the group's activities can be written into the volunteer's job description.

Step 6: Seek feedback and ideas

It is good to keep a continuous check on the activities and satisfaction of members. Checking on the progress of tasks can provide an opportunity for feedback: from the new members to the group/leaders and from the group/leaders to the new members. Encouraging new members can help them to see their value to the group and sustain their involvement. Checking on tasks can be a chance to identify where additional support is needed but should not be arranged to measure volunteer effort or success. Opportunities can be made to get ideas from new members on how to run the program better or refocus efforts. Remember that new members may eventually become long-term members and leaders of the group.

Above all it is important to show appreciation and recognise the efforts of volunteers. This can be difficult when all members of the group are volunteers and employed project officers might be encouraged to take on this role. Simple ways of recognising the contribution of volunteers include:

- recognising volunteers publicly in newsletters or at meetings
- setting aside some time at an annual social function of the group to recognise or award people who make a substantial contribution.

Developing a monitoring plan

A monitoring plan should outline the why, what, when, who and how of your monitoring activities. The preparation of a plan will serve as a useful exercise to clarify the intent of the monitoring and can be used as a resource for the community group to evaluate their monitoring effort. A monitoring plan template has been developed to assist your group. A completed example is provided in Appendix B.

Monitoring Methodology

The Plan requires details about the methodology used when collecting the data. If you are unsure of which methodology to use you can look at the list of monitoring methods (page 17 onwards). If you are already using a method, ensure it is documented and note where it can be located.

Purpose of monitoring

What is important it to have a clearly documented purpose for you monitoring.

There are many reasons why groups choose to monitor:

- increasing knowledge and understanding of natural resources for the community, decision makers and scientists
- influencing decision making at the local level to manage natural resources to determine appropriate management actions
- detecting change over time that may identify the requirement for changed management practices or assess effectiveness of management interventions
- contribute towards the needs of data/information users at a higher level, for example sub regional, regional, State Government, Australian Government.

Table 2 Example of a Community Monitoring Volunteer Job Description

COMPONENT	EXAMPLES
Purpose A general statement that identifies what the job is and why it is necessary.	• Monitor surface water quality to inform management of the wetland
Responsibilities List each duty and responsibility of the job. Be as specific as possible.	• Attend two field monitoring days per year • Organise other volunteers for monitoring days • Maintain the monitoring equipment • Participate in meeting about the monitoring results and future wetland management
Qualifications List the skills, knowledge and attitudes you seek. Be careful not to over-qualify the position - you could lose some excellent volunteers. This may also be an opportunity to identify training needs	• interest in wetlands and water quality • ability to communicate • ability to delegate responsibility • ability to maintain monitoring equipment
Relationships Who the volunteer reports or is accountable to.	• responsible to the wetland management group • communicate with project officer and other monitoring personnel
Time Commitment Expectations regarding time demands of the job. Be specific! i.e., weekly, monthly, long-term basis, flexible, self-determined.	• 2 field monitoring days per year • attend 2 wetland management group meetings per year
Benefits What's in it for the volunteer? What is to be gained personally by doing the job?	• increased knowledge of the wetland and knowledge and skills about for wetland monitoring • personal satisfaction • opportunity to meet new people • opportunity to effectively improve the quality and management of the wetland

Job Description: .....

COMPONENT	
Purpose	
Responsibilities	
Qualifications	
Relationships	
Time Commitment	
Benefits	

Monitoring Plan Template

1. Objective of Monitoring

Why is the monitoring being done? Is it to inform local planning, as a formal part of regional monitoring against targets, for the interest of the participants?

2. Other Related Monitoring and Associated Activity

Record other projects which may influence or interact with the monitoring activities described in this plan. This may include activities of the group, other stakeholders, and activities which are planned but not yet started.

3. Methodology Used

What methods are used, where are the methods described? How often is data collected and when, who is responsible for making sure the monitoring happens and who is willing to participate?

Use the QA/QC guidelines and quality control sampling to help complete this table and determine the quality of the data that will be collected. ?

Method	Reference (where are the methods described?)	Timing	Responsibility	QA/QC checklist

4. Location of Monitoring

Include as much detail on the location of the monitoring sites as possible, eg. GIS datum (e.g. GDA94), GPS location (or GPS points of a polygon that describes the area), map reference, diagram or map of the location

5. Data Storage

In what format will the data be stored (eg. excel spreadsheet, government or web-based database, paper-based files), what data will be stored, where will the data be stored, who is responsible for storing the data.
Refer to other sections of this toolkit including data management and contributing to online databases.

Format	Data to be stored (eg. Fields, maps, photos)	Location of data storage	Responsibility

6. Data Analysis Reporting

Who will do the analysis, what analyses will they use, how will it be presented, who will it be presented to?
Refer also to data display control plots (page XXX) and monitoring quality assurance and quality control.

Analysis tool	Responsibility	Presentation	To Whom

7. Additional Metadata

Use the categories below to record additional project metadata required for others to understand and use the data you have collected.

Refer also to data management guidelines.

Category	Element	Metadata
Dataset	Identifier	
	Title	
Custodian	Custodian	
	Jurisdiction	
Description	Abstract	
	Search Word	
	Geographic Extent Name	
Data Currency	Beginning Date	
	Ending date	
Dataset Status	Progress	
	Maintenance and Update Frequency	
Access	Stored Data Format	
	Available Format Type	
	Access Constraint	
Data Quality	Lineage	
	Positional Accuracy	
	Attribute Accuracy	
	Logical Consistency	
	Completeness	
Contact Information	Contact Organisation	
	Contact Position	
	Mail Address	
Meta-data Date	Meta-data Date	

8. Communication Plan

Who do you want to communicate your message to, how will you communicate the message most effectively, when do the different tasks of communicating need to be undertaken and who will be responsible for each?

Refer also to the communication section of the toolkit including examples of media releases and briefing papers.

Communication Objectives:			
Target Audience	**Communication Tool**	**Timing and Frequency**	**Responsibility (including deadlines)**

9. What Support is Available / Required?

What technical support resources, volunteer assistance etc is available to assist with the monitoring?

Refer also to the toolkit section on recruitment tips.

10. Evaluation and Reflection

Choose components of the project which should be reviewed and/or evaluated to ensure that the project is on track and that learning is captured. Methods for answering these questions should be chosen to be easy to implement and provide simple unambiguous answers which require minimal processing. The group should decide when the most appropriate time is to evaluate selected stages of the of the project management cycle, who should be involved and what methods will be used.

See later section more information and templates relating to evaluation and revision of your monitoring plan.

Overall Objective:				
Project Component	**Evaluation/Reflection Question**	**Timing and Frequency of Evaluation**	**Source of Information**	**Future Actions**

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Data Collection
Quality Assurance / Quality Control

When embarking on a monitoring program, it is important to identify who is going to use the data and for what purpose. Your choices of methods for monitoring should be guided by the purpose of your monitoring program and the quality of data you need. The end use of the data will determine what level of quality assurance and quality control measures should be taken to ensure data can be reliably used for its proposed purpose.

For some monitoring groups, the main objective is education for the local community or school, where the focus is on drawing awareness to an issue rather than producing high quality data. However, groups that collect data to inform local management decisions or as part of an integrated monitoring program with the local government, research organizations, regional bodies and state agencies must take measures to ensure the data are credible and reliable.

When appropriate quality assurance and quality control measures are implemented, you can be confident that management decisions are based on sound and reliable data.

Is QA/QC important for your monitoring?

There is one important question to answer to determine whether QA/QC is important for your monitoring program:

Will the results of your monitoring program be used to inform natural resource management decisions?

☐ No Quality assurance and quality control measures are not a "must" for your purposes. Your data collection can be a valuable educational exercise for raising environmental awareness and learning about the science of measuring trends in natural resource condition.

☐ Yes Fantastic! It is important that you implement a quality assurance and quality control plan. This can be added to your monitoring plan (if developed). If you implement a QA/QC plan, your data will be of a known quality and you can confidently use the data to inform management decisions

QA and QC are implemented to help you produce data of known quality and these will enhance the credibility of your group in reporting monitoring results. Implementing QA/QC measures with your community based monitoring projects will ultimately save you time and money as it will prevent collection of data that does not fit your goals. However, a good QA/QC program is only successful if all the monitoring program participants follow the QA/QC measures and if all components of your QA/QC plan are documented and available to data collectors and data users.

QA/QC Checklists

To help you produce data of known quality and enhance the credibility of your group in reporting monitoring results, QA/ QC checklists have been developed for a range of monitoring activities (see later):

- Birds, fish using nets, frogs, macro invertebrates,tortoises, small reptiles and mammals
- Groundwater and surface water
- Vegetation using line transect, photo points and weed mapping.

These checklists cover items for the overall management system of your monitoring project. There is an extensive range of items, which can be integrated over time into your project to make it manageable.

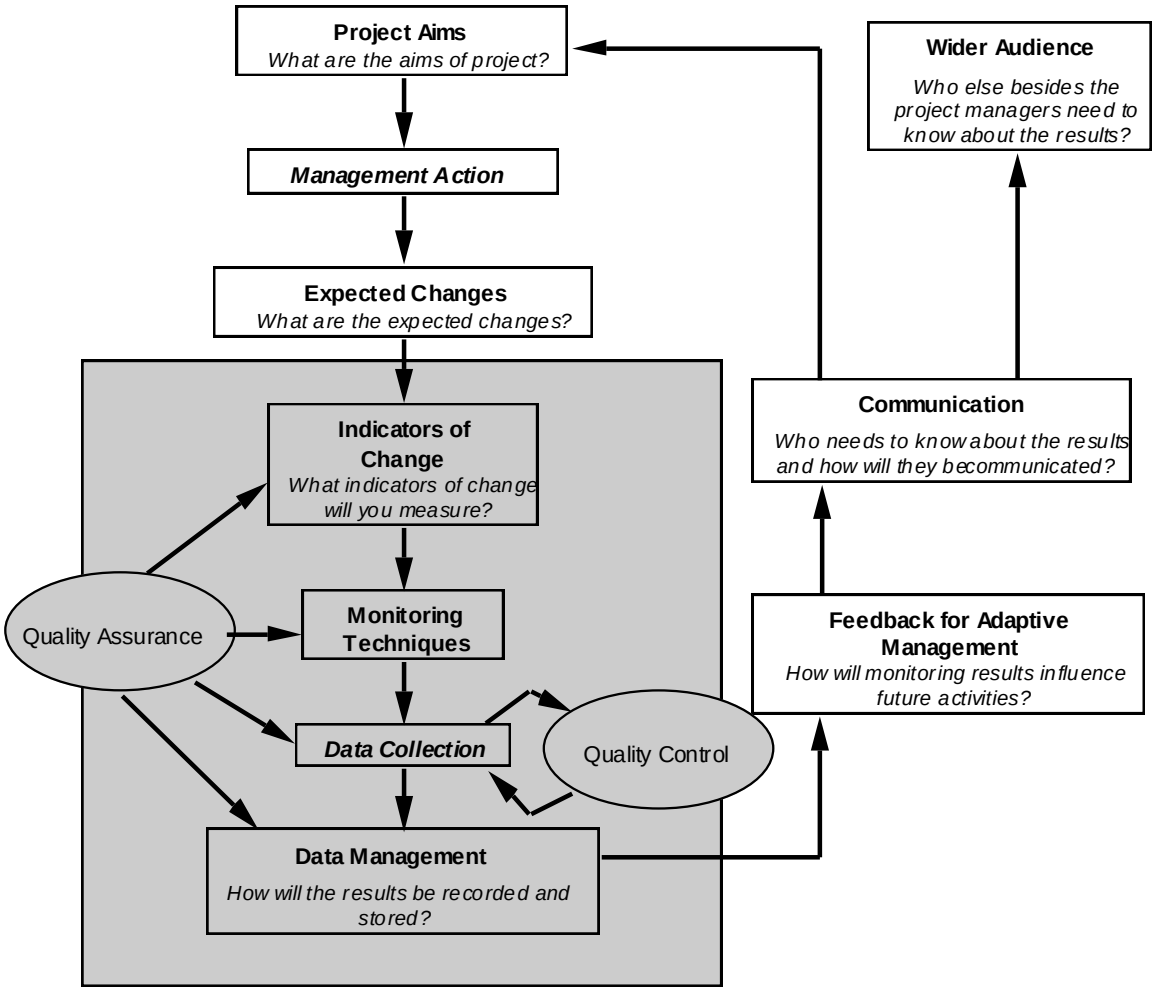
What do we mean by QA/QC?

Quality Assurance (QA) is the overall management system which includes the organization, planning, data collection, quality control, documentation, evaluation, and reporting activities of your group. QA provides the information you need to ascertain the quality of your data and whether it meets the requirements of your project. QA could also be called 'monitoring confidence'.

Quality Control (QC) is the routine technical activities that are in place to control error. Since errors can occur in either the field, the laboratory or in the office, QC must be part of each of these functions. QC should include both internal and external measures. QC could also be called 'data confidence'.

Figure 1 shows the place of QA /QC in the project management cycle.

Figure 1 The place of quality assurance and quality control in the project management cycle



Improving the quality of data

In natural systems variability is a part of the natural order of things. Changes in temperature, flow, sunlight, and many other factors affect these systems and the vegetation and animals that inhabit them. Variability in monitoring data can be a result of this natural variation but may also result from differences in the way we read, measure and interpret information. We may also apply different levels of effort to our measurement and the equipment we use may be contaminated, broken or incorrectly calibrated. These and many other differences can lead to variability in monitoring results. Measures of precision, accuracy, representativeness, comparability and sensitivity help us evaluate the sources of variability and error. Consideration of these aspects leads to increased confidence in our data. These and other key terms are described on the following pages.

Recognizing sources of variability in the data

Maintaining quality assurance requires that sources of variability in the data be identified:

- What are the causes of bias and imprecision?
- Can these be minimized?
- Can we quantify the level of bias and/or imprecision in the data?

Precision

Precision is the range of variation in repeated measurements of the same characteristic. Precision may be determined by calculating the standard deviation, or relative percent difference, among samples taken from the same place at the same time. Repeated measurements can tell you how consistent and reproducible your field or laboratory methods are by showing you how close your measurements are to each other. It does not mean that the sample results actually reflect the "true" value. By convention, 68% of measured values are within one standard deviation (see Figure 3) from the mean of all the measured values. If the standard deviation is small, most of the measured values must be close to each other.

Accuracy

Accuracy measures how close your results are to a true or expected value. For monitoring water quality this be determined by comparing your analysis of a standard or reference sample to its actual value. The smaller the difference between the measurement of a parameter and its "true" or expected value, the more accurate the measurement.

Accuracy = Average value - true value

Where the average value is the average of x replicates, and the true value is the value of standard reference sample (e.g. pH solution pH 7.0)

Increasingly, the term "bias" is being used to reflect error in the measurement system and "accuracy" is used to indicate both the degree of precision and bias (see Figure 2). For some measurements reference samples can be used to test the accuracy of your measurement. For example, the difference between an expert analyst's measurement of a "mystery sample" and your measurement indicates your ability to obtain an accurate measurement. For many parameters such as species abundance, no standard reference or performance evaluation samples exist. In these cases, the expert or trainer's results may be considered as the reference value.

Representativeness

Representativeness is the extent to which measurements actually represent the true state of the resource at the time a sample was collected. A number of factors may affect the representativeness of your data. Are your sampling/ monitoring locations indicative of the regions in your management project? For example, data collected just below a pipe outflow is not representative of an entire creek. Similarly, choosing sites that are 'hotspots' for birds will produce results that represent the chosen 'hotspots' but not other areas of management interest. These variations should be considered and their impacts minimized when developing your sampling design.

Figure 2 An illustration of the terms precision, bias and accuracy (*after Hunt* et al. *(1996)*)[1]

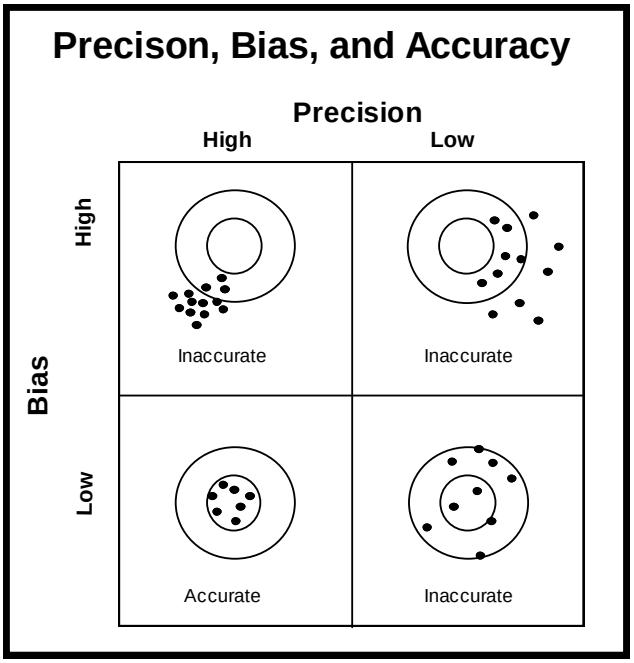


Figure 3 Explanation of standard deviation

STANDARD DEVIATION

The Volunteer Soil Monitoring Project wants to determine the precision of its soil phosphorus assessment procedure. They have taken 4 replicate samples:

Replicate 1 (X_1) = 21.1 ppm

Replicate 2 (X_2) = 21.1 ppm

Replicate 3 (X_3) = 20.5 ppm

Replicate 4 (X_4) = 20.0 ppm

To determine the Standard Deviation (s), use the following formula:

$$s = \sqrt{\sum_{i=1}^{n} \frac{(X_i - \overline{X})^2}{n-1}}$$

where X_i = measured value of the replicate, $\bar{X}$= mean of replicate measurements, n = number of replicates, Σ= the sum of the calculations for each measurement value - in this case, X_1 through X_4.

First, figure out the mean, or average of the sample measurements. Mean = (X_1 + X_2 + X_3 + X_4) ÷ 4. In this example, the mean is equal to 20.680 ppm. Then, for each sample measurement (X_1 through X_i), calculate the next part of the formula. For X_1 and X_2, the calculation would look like this:

$$\frac{(21.1-20.68)^2}{4-1} = \frac{\frac{(0.42)}{2}}{3} = \frac{0.1764}{3} = 0.0588$$

For X_3 the calculation would be 0.0108; and for X_4 it would be 0.1541

Finally, add together the calculations for each measurement and find the square root of the sum:

0.0588 + 0.0588 + 0.0108 +0.1541 = 0.2825.

The square root of 0.2825 is 0.5315.

So, the standard deviation for phosphorus is 0.532 (rounded off). That is, 68% of measured values will be within approximately 0.5 ppm of the mean value.

Comparability

Comparability is the extent to which data can be compared between sample locations or periods of time within a project, or between projects. For example, you may wish to compare two seasons of summer data from your project or compare your summer data set to one collected 10 years ago. Using standardized sampling and analytical methods, units of reporting and site selection procedures helps ensure comparability. Keeping good records about the time of year, day, weather conditions and having other monitoring activities on the same day cross-referenced for easy access will help you to judge when measurements are comparable.

Detection limit

Detection limit is a term that can apply to monitoring and analytical instruments as well as to methods. For example, detection limit is defined as the lowest concentration of a given pollutant your methods or equipment can detect and report as greater than zero.

Readings that fall below the detection limit are too unreliable to use in your data set. Furthermore, as readings approach the detection limit, i.e. as they go from higher and easy-to-detect concentrations to lower and hard-to-detect concentrations, they become less and less reliable.

Manufacturers generally provide detection limit information with high-grade monitoring equipment such as meters. Detectability is also an issue when carrying out biological surveys. If a survey fails to uncover the presence of a rare species, how many times do you have to survey before you can say that the species is truly not there?

Measurement range

Measurement range is the range of reliable measurements of an instrument or measuring device. Pre-assembled kits usually come with information indicating the measurement range that applies. For example, you might purchase a kit that is capable of detecting pH falling between 6.1 and 8.1. However, pH can theoretically range from 0.0 to 14.00. If acidic conditions (below pH 6) are a problem in the waters you are monitoring, you will need to use a kit or meter that is sensitive to the lower pH ranges Quality Control (QC) Samples.

Quality control sampling

Contamination and observer error are a common source of error in both sampling and analytical procedures. QC samples help you identify when and how contamination might occur. For most projects, there is no set number of field or laboratory QC samples or observations which must be taken. The general rule is that 10% of samples should be QC samples. This means that if 20 samples are collected, at least two additional samples must be added as a QC sample. The decision to accept data, reject it or accept only a portion of it should be made after analysis of all QC data. Quality control samples can include field blanks, equipment or solution blanks, replicate or duplicate samples, spiked samples and mystery solutions.

Quality control samples for water quality

A **field blank** is a “clean” sample, produced in the field, used to detect analytical problems during the whole process (sampling, transport, and lab analysis). To create a field blank, take a clean sampling container with "clean" water to the sampling site. Clean water is distilled or deionized water that does not contain any of the substance you are analyzing. Other sampling containers will be filled with water from the site. Except for the type of water in them, the field blank and all site samples should be handled and treated in the same way. For example, if your method calls for the addition of a preservative, this should be added to the field blank in the same manner as in the other samples. When the field blank is analyzed, it should read as analyte-free or, at a minimum, the reading should be a factor of 5 below all sample results.

An **equipment or rinsate blank** is a “clean” sample used to check the cleanliness of sample collection equipment. This type of blank is used to evaluate if there is carryover contamination from reuse of the same sampling equipment. A sample of distilled water is collected in a sample container using regular collection equipment and analyzed as a sample.

A **split sample** is one sample that is divided equally into two or more sample containers and then analyzed by different analysts or labs. Split samples are used to measure precision. Samples should be thoroughly mixed before they are divided. Large errors can occur if the analyte is not equally distributed into the two containers.

Replicate samples are obtained when two or more samples are taken from the same site, at the same time, using the same method, and independently analyzed in the same manner. Replicates (or duplicates) can be used to detect both the natural variability in the environment and the error from field sampling methods, including differences introduced by different observers.

Spiked samples are samples to which a known concentration of the analyte of interest has been added. Spiked samples are used to measure accuracy. If this is done in the field, the results reflect the effects of

preservation, shipping, laboratory preparation, and analysis. If done in the laboratory, they reflect the effects of the analysis from the point when the compound is added, e.g. just prior to the measurement step. Percent recovery of the spike material is used to calculate analytical accuracy.

Some Waterwatch groups in Australia use the terms **"mystery samples"** and **"shadow testing"** for quality control checks in their volunteer program. Volunteers are given a mystery sample to test and their results are tested for precision and accuracy, against the measurements of expert analysts. Shadow testing is where an expert tests the same field sample as you, allowing the expert to test the accuracy of the testing equipment as well as assessing technique and methodology of the monitoring participant

Quality control samples for biological surveys

It is possible to measure the precision and bias of observers using techniques for vegetation, bird, and macroinvertebrate surveys. Quality control measures include strictly following standardised protocols, including having an expert carry out the survey at the same site for comparison. Another technique is to take samples (or call recordings) and have identification verified by an expert. There are many ways in which quality assurance measures can help to increase the credibility of the data. These include measures generally applicable to most monitoring techniques, such as:

- using standardised techniques clearly documented in a handbook.
- using sites which are thoroughly characterised and documented in a site folder.
- taking adequate records in the field on standardized data sheets.
- cross-referencing for easy access to other data collected in the field at the same time.

Compiling a QA/QC plan

Just as your monitoring plan is important for your project plan, having a quality assurance and quality control plan is important for your monitoring plan. Compiling a quality assurance and quality control plan will help to ensure time and money spent on monitoring is not wasted in obtaining data of unknown quality that will not be credible enough to form the basis of decisions.

Table 3 provides some prompt questions that will guide you in compiling a sound quality assurance and quality control plan for your monitoring project.

QA/QC proformas

Different monitoring programs will have different needs for controlling and assuring quality of the program and the resulting data. Pages 33 - 43 provide example proformas for areas of QA/QC common to many programs and include:

- calibrating recording instruments
- checking that training sessions cover all the necessary topics
- recording details of volunteer training
- checking mystery samples
- checking testing protocols and equipment through shadow testing.

Table 3 Prompt questions for compiling a sound QA/QC control plan

COMPONENT	INCLUDE
List key personnel and organizations involved in your program	○ Who will verify samples/data? ○ Who will maintain/store data? ○ Who will undertake analysis and interpretation? ○ Who are the end users of the results? ○ What responsibilities do these people/organisations have?
Description of monitoring program	(from the monitoring plan)
Data quality objectives - the quantitative and qualitative terms you use to describe how good your data need to be to meet your project's objectives.	○ How precise does the data need to be ○ How accurate does the data need to be? ○ How representative of the system does the data need to be? ○ How comparable to data from other sites, times, projects does the data need to be? ○ Is the measurement range of the equipment or design adequate for the range of data to be collected?
Training requirements or certification – list training needs, how they will be met, details of training undertaken (number of participants, type of training and level)	○ Who needs what training? ○ How will the training be delivered and by whom? ○ What records of the training need to be kept (eg no. participants, date, scope), by whom, where? ○ What level of competency has been reached? ○ When will re-training or refresher training be needed?
Documentation and records - identify the field and laboratory information and records you need for this project. Copies of forms and datasheets used can be attached to the QA/QC plan.	○ What raw data will be kept? ○ What QC checks will be used? ○ What data sheets will be used? ○ What laboratory or voucher sheets will be used? ○ Where and for how long will records be kept? ○ How is the monitoring data and associated information made accessible to stakeholders and end users?
Sampling design - outline the experimental design of the project. You may refer to the relevant sections of your program's standardised procedures which detail the sampling design of the project, in place of extensive discussion.	○ What types of sampling/surveys are required? ○ How frequently will samples/surveys be undertaken? ○ How is seasonality etc being accounted for? ○ How are sample sites selected? ○ Are there any issues which may limit proposed sampling activities (eg. site access, seasonal constraints)?
Sampling methods (standard protocols can be cited)	○ What parameters will be sampled? ○ What protocols for sampling are being used? ○ What equipment is being used? ○ How are samples or vouchers preserved and stored, and what are the holding times for samples? ○ How will equipment be cleaned and decontaminated (eg. dipnets need to be thoroughly rinsed and examined for clinging organisms between sampling events)?

Table 3 continued

COMPONENT	INCLUDE
Analysis/identification methods (standard protocols can be cited)	○ What methods and equipment are needed for the analysis/identification? ○ Have any changes been made to standard protocols?
Quality control QC checks can be described narratively and if appropriate, should include discussion of replicate sample collection, cross checks by different field crews, periodic sorting checks of samples, and maintenance of voucher and reference collections.	○ What types and number of quality control samples will be collected? ○ If you are sending samples to an expert/laboratory, do you have a copy of their QA/QC plan? ○ What actions will you take if the QC samples reveal a sampling or analytical problem?
Equipment/instrument testing, inspection and maintenance	○ What is your plan for routine inspection and preventative maintenance of equipment? ○ What spare parts and replacement equipment needs to be kept on hand?
Instrument calibration	○ How, when and against what standards will you calibrate sampling and analytical instruments? ○ What records of calibration of instruments will be kept?
Inspection/acceptance of supplies	○ How will you check the quality and appropriateness of supplies such as sample bottles, nets, chemicals, equipment?
Data acquisition	○ How will you check that data you are using from other sources (eg. State government database) is quality assured?
Data management – this involves tracing the path your data takes from the field collection to analysis, storage and use. Data review, verification and validation. This can include comparing field datasheets to entered data, checking for data gaps, checking the QC documentation, checking calculations, checking for extreme values, reviewing graphs, tables and written reports.	○ How will you check for accuracy and completeness of field and laboratory datasheets and forms? ○ How will you decide when to accept, reject or qualify data? ○ How will you minimise and correct errors in data entry, calculations and reports? ○ How will data users be informed of any corrections? ○ What computer software are you going to use to store and analyse your data? ○ How will different versions of databases be managed to ensure everyone has valid data?
Evaluation and management – this component helps you to take an overview of what is working well and what needs improvement.	○ How will you evaluate the effectiveness and efficiency of field, lab and data management activities, groups and organisations (eg analysis labs) in the course of your project? ○ How will you correct any problems identified through audits or assessments (eg. it may be decided that equipment needs to be calibrated more frequently, or refresher training is required more regularly)? ○ How will positive feedback be provided to participants?
Reports	○ What type, frequency, content will reports to data users, sponsors and partner organisations take? ○ Who will reports be sent to?
Data reconciliation and usefulness	○ Does the data help us to measure progress towards the project objectives? ○ How effective is the QA/QC program in producing precise, accurate, complete, representative and comparable data? ○ What improvements can be made in the QA/QC program?

Figure 4 Calibration Record Sheet

Calibration Record (for EC or pH)

*****Record reading (measured value) before adjusting calibration*****

Group name:	**Coordinator:**
Equipment Type:	**Supplier:**
Date Purchased:	**Equipment No.**

Proposed calibration frequency:_____

The following table can be used to record up to a three-point calibration.

Date	Calibration Standard Expiry date	Calibration results					
		Expected value	Measured Value	Expected value	Measured value	Expected value	Measured value

Figure 5 Example Training Checklist

The following topics should be covered in all training sessions for each level of monitoring.

Date:……..

Trainer……

Participants: …… ……

…… ……..

…… ……...

Sampling and Storage of Samples

- ☐ Cleaning of sampling container;
- ☐ Labelling of sampling containers;
- ☐ Correct sampling procedures;
- ☐ Storage of samples not analysed in situ.

Testing Procedures

- ☐ Variety of parameters available for testing;
- ☐ Reasons for parameter selection;
- ☐ Methodologies for selected parameters;
- ☐ Safety;
- ☐ Quality control.

Equipment

- ☐ Cleaning of equipment;
- ☐ Servicing and maintenance of equipment;
- ☐ Storage of equipment;
- ☐ Limitations of equipment;
- ☐ Calibration of equipment.

Recording of Data

- ☐ Record sheets;
- ☐ Reporting units;
- ☐ Recording of equipment calibration;
- ☐ Catchment database.

Figure 6 Monitoring Training Log

Date	Name of trainer	Name of Individual	Training Aspect	Level

Figure 7 QA/QC Mystery Samples

Site: _____Date: _____

Name _____

Number of years Water Quality Monitoring experience: _____

QA/QC Code: _____

Parameter	**Equipment Type/No.**	**Mystery Sample No Sample 1**	**Mystery Sample No Sample 2**
pH			
EC (µS/cm)			
Turbidity (NTU)			
Reactive Phosphapte - as P (mg/L)			
Comments (eg. calibration notes, dilution suspect equipment)			

Return Sheet to: _____

_____

_____

_____

_____

_____

Figure 8 QA/QC Shadow Testing

Date: _____

Name of Monitor 1_____

Name of Shadow Monitor_____

Meter 1 (Monitor)		Meter 2 (Shadow tester)		Comments: (serviced, calibrated etc.)
Equipment Type and Code	Reading and unit	Equipment Type and Code	Reading and Unit	

Notes:

Return Sheet to: _____

_____

_____

_____

_____

_____

_____

QA/QC Bird Checklist
Bird Monitoring Using Fixed Area Searches

Quality Assurance

- ☐ Reasons for selecting the monitoring technique are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ If appropriate, a pilot study to identify the number and/or size of samples required has been conducted. For example this may involve plotting a species accumulation curve to identify the number or size of samples required to ensure at least 90% of the relevant species present will be detected by the monitoring technique.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.
- ☐ Monitoring participants are trained in the standardized methodology, completion and management of datasheets and species identification.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.
- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ An initial species list has been generated in consultation with a recognized expert.
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed.
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ Questionable or unknown species identifications are verified by recognized experts.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

Quality Control

- ☐ Bird identification is regularly checked with a recognised expert.
- ☐ Protocols are strictly followed. For example, do not include data collected from outside the defined survey area outside the define survey time.
- ☐ Locations of survey sites are recorded including GPS coordinates.
- ☐ Observer error is identified through comparing the results from multiple observers for the same sample, surveyed at the same time. (This may include an expert observer and less experienced project participants.)
- ☐ Entered data are cross-checked with field datasheets after data entry.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

QA/QC Fish Checklist
Fish Monitoring Using Nets

Quality Assurance

- ☐ Reasons for selecting the monitoring technique are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ If appropriate, a pilot study to identify the number and/or size of samples required has been conducted. For example this may involve plotting a species accumulation curve to identify the number or size of samples required to ensure at least 90% of the relevant species present will be detected by the monitoring technique.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.
- ☐ Monitoring participants are trained in the standardized methodology, completion and management of datasheets and species identification.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.
- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ An initial species list has been generated in consultation with a recognized expert.
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Fish are released as close as possible to the site where they were captured.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed.
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ Questionable or unknown species identifications are verified by recognized experts or the museum.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

Quality Control

- ☐ Identification of fish specimens is regularly checked with a recognised expert or the museum.
- ☐ Protocols are strictly followed.
- ☐ Observer error is identified through comparing the results from multiple observers for the same sample, surveyed at the same time. (This may include an expert observer and less experienced project participants.) *This is particularly important for taking measurements of fish, which is difficult to do accurately.*
- ☐ Entered data are cross-checked with field datasheets after data entry.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

QA/QC Frog Checklist
Frog Monitoring Using Frog Call Recordings

Quality Assurance

- ☐ Reasons for selecting the monitoring technique are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented. 🧍
- ☐ If appropriate, a pilot study to identify the number and/or size of samples required has been conducted. For example this may involve plotting a species accumulation curve to identify the number or size of samples required to ensure at least 90% of the relevant species present will be detected by the monitoring technique.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site. 🧍
- ☐ Monitoring participants are trained in the standardized methodology, completion and management of datasheets and species identification.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.
- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ An initial species list has been generated in consultation with a recognized expert. 🧍
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed. 🧍
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ Questionable or unknown species identifications are verified by recognized experts. 🧍
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

Quality Control

- ☐ Identification of frog calls regularly checked by a recognised expert. 🧍
- ☐ Protocols are strictly followed. *For example, do not include data collected from outside the defined survey time or area.*
- ☐ GPS location of survey sites are recorded.
- ☐ Observer error is identified through comparing the results from multiple observers for the same sample. (This may include an expert observer and less experienced project participants.) 🧍
- ☐ Entered data are cross-checked with field datasheets after data entry.

🧍 *indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert*

QA/QC Water Checklist
Groundwater Quality Monitoring

Quality Assurance

- ☐ Reasons for selecting the monitoring techniques are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.
- ☐ Monitoring participants are trained in the standardized methodology and completion and management of datasheets.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.
- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.

Quality Control

- ☐ Standardized equipment is used, maintained and calibrated appropriately.
- ☐ Observer error is identified through comparing the results from multiple observers for the same sample. (This may include an expert observer and less experienced project participants.)
- ☐ Bores are purged, and details of purge recorded before water quality samples are taken.
- ☐ Blanks, duplicates and spikes are used to identify errors in sampling and sample analysis. A minimum of 5% blind samples are processed by the laboratory.
- ☐ Reagents are stored and transported appropriately and replaced at appropriate intervals.
- ☐ All protocols are strictly followed.
- ☐ Locations of survey sites are permanently marked and GPS locations are recorded.
- ☐ Entered data are cross-checked with field data sheets after data entry.

- ☐ Logs are maintained for field instruments. Logs should include records of usage, dates for scheduled calibration and diagnostic tests and records of repairs and replacements.
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Chain of custody is adequately documented to identify samples and trace sample collection, transport, analysis and storage.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed.
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

QA/QC Macro Invertebrate Checklist
Macro Invertebrate Monitoring

Quality Assurance

- ☐ Reasons for selecting the monitoring technique are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ If appropriate, a pilot study to identify the number and/or size of samples required has been conducted. For example this may involve plotting a species accumulation curve to identify the number or size of samples required to ensure at least 90% of the relevant species present will be detected by the monitoring technique.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.
- ☐ Monitoring participants are trained in the standardized methodology, completion and management of datasheets and species identification.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.
- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ An initial species list has been generated in consultation with a recognized expert.
- ☐ Standard equipment is maintained and used consistently. *For example: holes in nets are repaired before sampling*
- ☐ Standardized data collection sheets are used for recording data.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed.
- ☐ Datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ Questionable or unknown species identifications are verified by recognized experts.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

Quality Control

- ☐ Identification of specimens is regularly checked with a recognised expert.
- ☐ Protocols are strictly followed. *For example, do not include data collected from outside the defined survey area or point.*
- ☐ Location of the survey site is recorded with GPS coordinates.
- ☐ Standard equipment is maintained and used consistently. *For example: holes in nets are repaired before sampling*
- ☐ Observer error is identified through comparing the results from multiple observers for the same sample. (This may include an expert observer and less experienced project participants.)
- ☐ Entered data are cross-checked with field datasheets after data entry.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

QA/QC Small Mammal & Reptile Checklist Using Pitfall & Elliott Traps

Quality Assurance

- ☐ Reasons for selecting the monitoring technique are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.
- ☐ Monitoring participants are trained in the standardized methodology, completion and management of datasheets and species identification.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.

Quality Control

- ☐ Identification of specimens is regularly checked with a recognised expert.
- ☐ Protocols are strictly followed.
- ☐ Locations of survey sites are permanently marked and GPS locations are recorded.
- ☐ Standard equipment and standard measures are used. *For example: depth of and size of pitfall traps is consistent.*
- ☐ Observer error identified through comparing the results from multiple observers for the same sample. (This may include an expert observer and less experienced project participants.)
- ☐ Entered data are cross-checked with field datasheets after data entry.

- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ An initial species list has been generated in consultation with recognized experts.
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed.
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ Questionable or unknown species identifications are verified by recognized experts or the museum.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Seasonal and sampling differences (including differences in trapping effort) are identified and separated from other differences when interpreting the data.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

QA/QC Water Checklist
Surface Water Quality Monitoring

Quality Assurance

- ☐ Reasons for selecting the monitoring techniques are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.
- ☐ Monitoring participants are trained in the standardized methodology and completion and management of datasheets.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.
- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ Logs are maintained for field instruments. Logs should include records of usage, dates for scheduled calibration and diagnostic tests and records of repairs and replacements.
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed.

Quality Control

- ☐ Standardized equipment is used, maintained and calibrated appropriately.
- ☐ Observer error is identified through comparing the results from multiple observers for the same sample. (This may include an expert observer and less experienced project participants.)
- ☐ At least one field and one transport blank are included in every sampling run.
- ☐ At least one container blank is used for every batch of containers.
- ☐ Mystery samples are tested every 6 months.
- ☐ Field replicates are tested every 10 samples.
- ☐ Spikes are used to identify error in sampling and analysing samples.
- ☐ Reagents are stored and transported appropriately and replaced at appropriate intervals.
- ☐ All protocols are strictly followed.
- ☐ Locations of survey sites are permanently marked and GPS locations are recorded.
- ☐ Entered data are cross-checked with field data sheets after data entry.

- ☐ Chain of custody is adequately documented to identify samples and trace sample collection, transport, analysis and storage.
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. Results from two different methods may not be comparable.
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

QA/QC Tortoise Checklist

Tortoise Monitoring Using Nest Counts

Quality Assurance

- ☐ Reasons for selecting the monitoring technique are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.
- ☐ Monitoring participants are trained in the standardized methodology, completion and management of datasheets and identification of nests and other signs.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.

Quality Control

- ☐ Identification of nests and other signs is regularly verified by a recognized expert.
- ☐ Protocols are strictly followed. For example, do not include data collected from outside the defined survey area.
- ☐ Locations of survey sites are permanently marked and GPS locations are recorded
- ☐ Observer error is identified through comparing the results from multiple observers for the same sample, surveyed at the same time. (This may include an expert observer and less experienced project participants.)
- ☐ Entered data are cross-checked with field datasheets after data entry.

- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed.
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ Questionable identification of nests or other signs is verified by recognized experts.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

QA/QC Vegetation Checklist

Vegetation Monitoring Using Line Transects

Quality Assurance

- ☐ Reasons for selecting the monitoring technique are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ If appropriate, a pilot study to identify the number and/or size of samples required has been conducted. For example this may involve plotting a species accumulation curve to identify the number or size of samples required to ensure at least 90% of the relevant species present will be detected by the monitoring technique.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.
- ☐ Monitoring participants are trained in the standardized methodology, completion and management of datasheets and species identification.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.

Quality Control

- ☐ Identification of plant specimens regularly checked with a recognised expert or the herbarium.
- ☐ Protocols are strictly followed. For example, do not include data collected from outside the defined survey area or point.
- ☐ Locations of transects permanently marked and GPS location and bearing of the transect recorded
- ☐ Observer error identified through comparing the results from multiple observers for the same sample/transect, surveyed at the same time. (This may include an expert observer and less experienced project participants.)
- ☐ Entered data are cross-checked with field datasheets after data entry.

- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.
- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ An initial species list has been generated in consultation with a botanist/recognized expert.
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed.
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ Questionable or unknown species identifications are verified by recognized experts or the herbarium.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

QAQC Vegetation Checklist
Vegetation Monitoring Using Photopoints

Quality Assurance

- ☐ Reasons for selecting the monitoring technique are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.

Quality Control

- ☐ Protocols are strictly followed. For example, ensure that photographs are taken so that they include the same field of view as the previous images for that site.
- ☐ Locations of photopoints are permanently marked and GPS locations and bearing are recorded.
- ☐ Entered data are cross-checked with field datasheets after data entry.

- ☐ Monitoring participants are trained in the standardized methodology, completion and management of datasheets and species identification.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.
- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ An initial species list has been generated in consultation with a botanist/recognized expert.
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Datasheets and images are checked by a monitoring coordinator after each monitoring session is completed.
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ Images are duplicated and labelled with copies stored in separate, safe and accessible storage systems.
- ☐ Questionable or unknown species identifications are verified by recognized experts or the herbarium.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Comparisons are only made between photographs of the same site. *Comparisons between different sites are of limited value.*
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

QA/QC Vegetation Checklist

Vegetation Monitoring Using Weed Mapping

Quality Assurance

- ☐ Reasons for selecting the monitoring technique are documented.
- ☐ Methods for analysing the monitoring data, including analysis tools and computer programs are selected and documented.
- ☐ Method for selecting the monitoring sites and reasons why they are representative of the project area are documented.
- ☐ If appropriate, a pilot study to identify the number and/or size of samples required has been conducted. For example this may involve plotting a species accumulation curve to identify the number or size of samples required to ensure at least 90% of the relevant species present will be detected by the monitoring technique.
- ☐ Your standardized monitoring protocol is documented and is easy to interpret and readily accessible to monitoring participants. Refer to any existing protocols and document any variation from the standard such as how to deal with the problems of using the protocol at the site.

Quality Control

- ☐ Identification of plant specimens regularly checked with a recognised expert or the herbarium.
- ☐ Protocols are strictly followed. For example, do not include data collected from outside the defined survey area.
- ☐ Standard equipment and standard measures are used. For example: GPS generated grid references using datum GDA94.
- ☐ Entered data are cross-checked with field datasheets after data entry.

- ☐ Monitoring participants are trained in the standardized methodology, completion and management of datasheets and species identification.
- ☐ Competency levels that the trainees should achieve and how these are assessed are clearly defined and documented.
- ☐ Refresher and other training sessions are held to ensure monitoring participants are trained in any new methodologies introduced to the project and to maintain standards and consistency between participants.
- ☐ Information regarding the site localities is recorded and includes directions and maps to ensure sites are easy for participants to locate.
- ☐ An initial species list has been generated in consultation with a botanist/recognized expert.
- ☐ Standardized data collection sheets are used for recording data in the field.
- ☐ Datasheets are checked by a monitoring coordinator after each monitoring session is completed.
- ☐ Field datasheets are copied, and copies are stored in safe, accessible and separate storage systems with other relevant information.
- ☐ Questionable or unknown species identifications are verified by recognized experts or the herbarium.
- ☐ The database is regularly maintained. Questionable or unreliable data are clearly identified with links to a description of the issues concerned and invalid data are removed.
- ☐ Comparisons are only made between data collected using consistent methodologies. *Results from two different methods may not be comparable.*
- ☐ Seasonal and sampling differences are identified and separated from other differences when interpreting the data.

indicates that this item involves a requirement to check decisions or information with another project participant or a recognized expert

Data Management

This section covers general information about how to organise and keep track of the data you collect including guidelines for data management and contributing to various online databases.

Guidelines for data management

It is important that you set up a data management system before you actually start your monitoring as this will avoid potential problems such as:

- eliminating or minimizing errors in recording and transferring data
- preventing data loss
- needing to trace information back to the original data sheets to address issues or questions
- making data easily accessible and easy to use once you've stored it
- formatting in a way that will be useful and acceptable to other users.

Collect data uniformly, completely and consistently

Where possible, use already developed data collection sheets and checklists for data collection. If you are planning to share your data using an online database, e.g. Atlas of Living Australia, they will most likely provide datasheet templates for you to use. Otherwise develop your own data sheets to fit your requirements and check that they are consistent with the needs of the organisation receiving your data. The aim is to ensure data are collected uniformly and completely in both the field and the laboratory. If you are working with an established organization or program e.g. NRM Board or a Waterwatch program, there may already be sheets and checklists developed for use by community groups.

Organise to check data for completeness

As you collect the data, ensure you continually review the data sheets and checklists to ensure the information is complete. You may want to appoint a team leader or third party to check and approve the data sheet, with a signature on the sheet. If any problems arise, the team leader can then contact the data collector whose field sheets contains significant errors or omissions.

Make copies of data sheets and field notes

After fieldwork, photocopy data sheets and related field notes and ensure proper storage of these copies in a project folder/binder.

Track any samples analysed by others

If you use a laboratory to analyse samples or control samples, use a Chain of Custody form (or transmittal letter) to document the transmittal of samples. Most laboratories can provide these. The laboratory should review the QA/QC parameters used and include these results with the laboratory report.

Check QA/QC for datasets

Review field and laboratory QA/QC results, for example using control charts and QA/QC checks on sample and data handling and determine if data are within data quality limits. Based on this review, you should decide whether to keep the data or not. In some cases, even though the data does not fall within QA/QC limits for a particular purpose, it may meet objectives and therefore be useable for another purpose. In such cases, data should be "flagged" to indicate how it did not meet its original QA/QC objectives. A record of failed QA/QC should enable these data to be tracked in the event that a problem becomes chronic.

Store data from different monitoring sessions in a database

Enter data that are within data quality limits into a spreadsheet or database. If you plan to send data to a central database, such as that of a regional NRM Board, find out how this organisation organizes their data, or requires you to submit your data and then it may be efficient to set up your data management system (spreadsheet or database) in a way that is compatible. They may provide data templates for this purpose. Local NRM officers can be contacted for follow-up through the SA MDB NRM Board main office on (08) 8532 9100.

> Decide whether to keep any data that did not meet QA/QC objectives. Flag any data that are kept despite not falling within QA/QC limits, and indicate how the QA/AC were not met, e.g. problem with calibrating equipment.

Validate data after it is entered into a database

Have a second individual review the entered data.

The database could be programmed to screen data for errors, or you could review the data manually by checking to see that results are within an acceptable range. For example, pH can only range from 1 to 14. For example, a pH of 17 is impossible, and you could be alerted to this entry because it is automatically highlighted red.

Be wary of releasing an electronic form of data to users before the numbers are checked and rechecked or before all data are entered.

Track versions of the dataset or database carefully

Include a field for dates and initials of the last update or approval so that it is easy to tell if you are working with the most current version.

Be attentive to potential data entry errors

Keeping the number of times data are transcribed to a minimum can minimize errors. Remember, the more times you transcribe data (from one datasheet to another; from datasheet to electronic spreadsheet), the more chance of errors. Also, watch for:

- entering data in the wrong units (e.g. entering concentrations as micrograms per litre instead of milligrams per litre)
- reversing numbers
- accidentally putting the decimal in the wrong place
- entering the data in the wrong row or column.

Make and store backup copies of data

To avoid losing your data, make a backup copy and store it at another location.

What are Metadata?

Check that Data Sent to Other Users are Complete

If your data are being used by external sources ensure you send complete information.

It is generally not sufficient to simply send the monitoring data for inclusion in a database. You must also send information about the data, such as the monitoring location, field sampling procedures, equipment used, analytical laboratory, lab methods, etc. This information is known as meta-data.

Metadata are information about data, describing the what, when, who and how of data. The following are examples of metadata and other records to maintain

General field notes

Keeping good field notes in a water resistant field notebook is highly recommended. Document information pertinent to each field site visited. Record information such as the name of the site, the date and time of day of the visit, the amount of time spent at the site, general impressions and site condition. If a site is selected for the first time, make abundant notes on the process of site selection, which ideally should have started from assessment of aerial photographs off site. Drawings and diagrams are useful. Make other notes such as wildlife sightings and stream condition that are not already part of a standardized protocol. Make copies of field notes on a regular basis and keep in a safe place like in a project folder. These notes should be cross-referenced with data records in the database and readily accessible.

Information about monitoring sites

Keep a site-folder containing a general map and address, written directions and an aerial photograph on which critical features may be highlighted. The map, description of the site and GPS coordinates could be supplied to monitoring personnel to help locate project features.

Information relating to collection of samples

Sampling date, time, site name, air and water temperature, information about sample collection instruments. It is useful to maintain a folder of information pertaining to collection instruments such as pictures of instruments, design diagrams, model name, manufacturer details and date of manufacture.

Information relating to monitoring and analytical rocedures

Keep records of calibration and measurement procedures for analytical instruments, and other miscellaneous values required to obtain measurements.

Quality Control Activities

Records should be kept of performance of all procedures prescribed in standardized protocols, routine instrument checks and maintenance, records of instrument adjustment (calibration of instruments), names of procedures and traceability of standard materials, results of duplicate analyses, assurance of the quality of reference solutions used, etc.

Contributing Data to Web-based Data Collections

Why share your data?

In addition to immediate benefits of community engagement in environmental issues, participatory monitoring is increasingly recognised as a useful tool for collection of data on environmental condition, which can have far-reaching benefits. Providing there is confidence in the data collected, participatory monitoring data can be used for planning and evaluation and for research. Researchers are using citizen science data where they can access it and modern algorithms are allowing mixing of data from different sources and protocols. At a national and global scale, researchers are using datasets from a variety of sources.

Given the range of potential users of resource condition monitoring data, easy access is critical for rapid use and for data integrity and storage. It is unreasonable to expect that all the purposes to which participatory monitoring data could be used will be met if data are not easily and cheaply available. The availability and use of web-based technology to store and share data has grown enormously and this part of the Community Monitoring Toolkit aims to provide some pointers to uploading data to online databases.

It is important that you seek advice from your project officers about appropriate data storage options for your monitoring project. For example, the SAMDB's online community monitoring database send water data through to the Bureau of Meteorology as part of a national requirement. Wetland groups may have their data added to national databases without having to directly engage with the database. In other words, communication can prevent duplicating data submissions or double handling data.

Atlas of Living Australia (ALA)

Contributing data

The Atlas of Living Australia (ALA) is an information system that aggregates data on all Australian species of flora and fauna and provides a capability to analyse the data geospatially.

The ALA is fast becoming the database for sharing data on Australian fauna and flora. It allows you to upload your data, provides various templates for data entry and uploads and allows you to edit your own data and download yours and any other data of interest. You can upload any additional data measurements and ALA will try and make these data accessible. Additionally there are a number of spatial analysis tools available for analysing the data.

You can share a wide range of information with the Atlas, including:

- information about a species (contributions to a species profile): descriptions, characteristics, groupings, measurements. The information may be separated into categories, e.g. in a spreadsheet and include a controlled vocabulary, text, numbers and static maps. Or it may be unstructured text (in a single block)
- multimedia such as photos, movies, sound recordings, which should will be georeferenced
- images (photographs, sketches, anatomical drawings, paintings etc) of specimens in a collection or in the wild ('habitus') or environments in which a species lives
- sounds made by a species
- movies of a species in its habitat or of its behaviour
- information on where species are (species occurrence data)
- individual occurrence records: observations, recordings (multimedia), specimens (preserved or living)
- species lists/checklists: expert distributions, predictive maps and models and surveys
- collections of specimens
- geospatial layers: area boundaries, definitions, types and environmental information[1]
- resources (where to go for more information): documents, websites, information systems
- activities (projects, programs), people (groups, institutions, agencies, individuals).

Before uploading data, try to identify whether you have shared your information with another organization that may already be sharing the information with the Atlas. ? Organization such as a government department or conservation agency then they may have already shared data with the Atlas ALA and will try to identify duplicate records and remove them.

Registration

To contribute data to ALA you must first register your group at https://auth.ala.org.au/emmet/selfRegister.html.

Licensing

Data that you upload to the ALA remains under your ownership. However, you need to provide a license under the Creative Commons for to enable others to use your data. Information on why you need to provide a license and the different Creative Common licensing options is provided at http://www.ala.org.au/faq/data-

[1] Taken from http://www.ala.org.au/faq/data-sharing/#t4

licensing/.

If you think that you will become a regular provider of data to the ALA, it is suggested that you fill in an ALA Data Provider Agreement (PDF) available at http://www.ala.org.au/faq/data-licensing/.

Data templates

Your data can be entered into one of a number of different data templates available at http://www.ala.org.au/get-involved/upload-data-sets/ .

- ALA occurrence data template – simple
- ALA occurrence data template – high quality
- ALA species list template
- ALA multimedia template
- ALA species profile template

Data quality

ALA has developed a data quality model to ensure the high quality of the data in the Atlas.

Information on the model can be downloaded from http://www.ala.org.au/about-the-atlas/how-we-integrate-data/data-quality-assurance/ .

- Atlas Quality Guide
- quality model

ALA perform data quality checks when data is uploaded into the Atlas[2]. For example:

- georeferences are checked, ie ensure that the latitude and longitude have not been transposed etc
- the current species name is determined and allocated to the record
- completeness of the records.

Results of these checks are published in the Atlas and full details of any changes made are viewed by clicking on the 'Original vs Processed' button on the occurrence record page; see next image.

Additional data

These templates will guide you to the data required by ALA. If you collect additional data, that the template does not cover, you can simply add additional labeled columns and upload the additional data along with the data fields required by ALA. ALA will enable access to these additional data wherever possible.

Sensitive data

ALA acknowledges that some data should not be shared. An example of such sensitive data is the location of threatened species. ALA has policy for dealing with sensitive data. For information on how ALA treats sensitive data go to http://www.ala.org.au/faq/data-sensitivity/ .

Editing your data

ALA allows you to manage your data. You can edit the location of a sighting that you have already uploaded, by following the instructions at: http://www.ala.org.au/faq/manage-your-data-2/change-location-of-a-sighting/ . Simple instructions to edit your data are as follows:

- log in to the Atlas
- click the 'My Profile' tab
- click 'View the sightings you have recorded'
- select the record you want to edit
- edit it.

Other useful tools

ALA Sandbox

ALA hosts a sandbox environment for data uploads, to allow users to view their data with ALA tools. This tool is currently an experimental feature of the Atlas. Uploaded data will be periodically cleared from the system. This tool currently only accepts comma separated values (CSV) occurrence data and is currently limited to 1000 records per upload. You simply paste your data into the rectangle provided and click 'Check data'.

Spatial Mapping and Analysis Tools

You can obtain species lists by region. Using an interactive map you can define an area for which you would like a species list. Go to http://regions.ala.org.au/ .

You can obtain species lists in a given area by providing a street address; place name; postcode; or GPS coordinates (as lat, long). You can choose to display records within 1, 5 or 10 km radius. Go to http://biocache.ala.org.au/explore/your-area#-35.017683|138.60584600000004|14|ALL_SPECIES .

You can filter records. For example you can remove all records from specific institutions or records before 1965. Simply select the facet of interest from the legend dropdown box, and tick the records that you want to retain. See http://www.ala.org.au/faq/spatial-portal/#t3.

Additionally you can use the tools to **predict** where a given species may occur but has not yet been recorded, using a number of environmental variables of your choice. There are detailed instructions on how to do this at http://www.ala.org.au/spatial-portal-

[2] Taken from http://www.ala.org.au/about-the-atlas/how-we-integrate-data/data-quality-assurance/

help/predict/ .

Retrieving Data

Atlas of Living Australia is very flexible in the ability to retrieve data. At http://www.ala.org.au/data-sets/ you can search for data on specific species. Data can be retrieved as lists, individual records or as maps. You can filter out spatially suspect records. In addition, if your group is registered as a data contributor you can access data from your group (as well as any other group) by clicking the View Datasets Icon. This will bring up an alphabetical list of contributors. After locating your group, you can click view records, which brings up a list of records. The list of records can then be viewed individually, can be refined by using the tools in the left hand column and can be downloaded by clicking 'Download'.

Atlas of Australian Birds and Birdata (Birdlife Australia)[3]

Contributing Data

Information on contributing to the Atlas of Australian Birds, or "*becoming an Atlasser*", including the aims of data collection and what the data are used for can be found at:
http://www.birdata.com.au/about_atlas.vm and
http://www.birdlife.org.au/projects/atlas-and-birdata/become-an-atlasser .

You don't need to be an expert to contribute, but you need to be familiar with the birds in the areas where you would most likely do Atlas surveys.

Data can be submitted on paper forms or through the data entry interface of Birdata. You can download "Birdata 101", from http://www.birdlife.org.au/projects/atlas-and-birdata. This outlines all you need to know about entering data into the Birdata website.

See the birdlife website for up to date information about who to contact to become an Atlasser.

Note that you can also contribute data to the Nest Record Scheme - see http://www.birdlife.org.au/projects/atlas-and-birdata/nest-record-scheme.

Group Atlas Sites- a new initiative from Birdlife Australia

Birdlife Australia is looking for Atlassers to nominate sites to be included in a network of sites to be visited by other birdwatchers who can contribute data. The aim is to address the unevenness in distribution of frequently visited sites. Available on the website are a map and list of the existing sites and the requirements for registering a new site.

See http://www.birdata.com.au/community_front.vm for details.

Retrieving Data

There is no capacity to download datasets directly from the Atlas of Australian Birds or Birdata. However, through Birdata you can access summary data in the form of species lists for particular areas. There is also the ability to purchase custom data from Birdlife Australia. Keep in mind, that the Atlas of Living Australia includes data from the Atlas of Australian Birds. These data will be periodically updated, so there may be a short delay in accessing recently submitted data. See the section on the Atlas of Living Australia for more information.

Biological Databases of South Australia (BDBSA)

Contributing Data

To contribute project or survey data to Biological Databases of South Australia (BDBSA) you must register your project using the online registration form at https://www.envapps.sa.gov.au/opinio6/s?s=905 .

Department of Environment, Water and Natural Resources (DEWNR) provide a template for data returns, available for download at the Data Sharing Website:
http://www.environment.sa.gov.au/Knowledge_Bank/Information_data/Biological_databases_of_South_Australia/Information_sharing .

Also at the above website is information to download on the minimum data standards.

Data should be entered into the data template provided and completed data spreadsheets can be returned by email to DENRBioDataSupport@sa.gov.au.

The following fact sheets are available on the Data Sharing Website:

- registering your biological project
- contributing data to BDBSA
- taking field voucher specimens (permits required).

You will also find downloadable as excel spreadsheets of currently accepted flora and fauna taxonomy and their associated metadata (as pdf), which are extremely useful. The spreadsheets can be searched and sorted and used to make taxonomically accurate species lists.

During project design and/or revision, it is worth considering some of the existing survey methodologies that are provided on the Data Sharing Website:

[3] BirdLife Australia is a relatively recent name change to reflect the merger of *Birds Australia* and *Bird Observation & Conservation Australia* (BOCA).

- Vegetation survey manual
- Vertebrate survey manual
- SA Pastoral field manual.

Also available are datasheets for collecting opportune data.

Retrieving Data from BDBSA

There is no capacity to download data directly from the BDBSA. There is the ability to purchase (payment is for data retrieval) data from BDBSA. Guidelines for requesting data include:

- data request procedure
- supertable overview
- supertable field definitions
- BDBSA data - notes and conditions of use.[4]

Keep in mind, that the Atlas of Living Australia includes data from BDBSA. These data will be periodically updated, so there may be a short delay in accessing recently submitted data.SA Frog Atlas (SA Frog Census)

Contributing Data

SA Frog Census collects digital frog mating call recordings to allow for accurate identification of species.

You need to rRegister to join the Frog Atlas. Go to http://www.frogatlas.com.au/get-involved/register.html to register.

Guidelines on contributing call data to SA Frog census can be found at http://www.frogatlas.com.au/get-involved/contributetotheatlas.html .

Data spreadsheets

Data associated with your frog call recording is entered into an Atlas datasheet. This datasheet can be downloaded from http://www.frogatlas.com.au/get-involved.html.

Editing your mating call recordings[5]

You can download a free, open source program called Audacity that allows you to edit and convert your digital recordings. It is available for Mac OS X, Microsoft Windows, GNU/Linux and other operating systems.

With this program you can crop the recording so that a short, representative sample can be uploaded. It allows you to view the spectrogram, so you can see what the calls look like.

It also will convert a variety of formats into MP3, including WAV, AIFF, AU, Ogg Vorbis, MPEG, but not priority or restricted formats such as WMA or AAC. To convert to MP3 using Audacity you will also need the LAME encoder.

Retrieving Data

There is currently no capacity to retrieve your data from the SA Frog Atlas. Information collected is fed into state fauna and environmental management databases e.g. Department for Environment, Water and Natural Resources.

A database for soils in the near future?

See https://wiki.csiro.au/display/SoilModelling/ACLEP+Soils+Data+Exchange for details.

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[4] http://www.environment.sa.gov.au/Knowledge_Bank/Information_data/Biological_databases_of_South_Australia

[5] Hints on editing your frog call recordings were taken from http://www.frogatlas.com.au/get-involved/faq.html .

Data Analysis and Interpretation

Data display – using control plots to detect potential trends

The key question for monitoring an environmental variable (or set of variables) is:

"Has a change occurred and is the change important"

To answer this question we need to be able to decide whether a measurement we observe at a given time is unusual, given what we would expect from our observations of the naturally variable system up until that time.

Traditional methods of determining if a change in an environmental parameter is significant or meaningful rely on comparing data on changes after a defined impact or intervention with data collected before the impact and with data from control sites.

Many of the monitoring programs undertaken by community groups are assessing change in systems where little background (baseline) information may be available, where the size of changes which are meaningful are not well described and where the type and rigor of monitoring methods may result in some measurement error indistinguishable from the natural variability between samples in time and space.

A good monitoring program will allow managers to confidently detect an important change but also guard against acting on changes which are detected but which are not important or are due to error in measurement or ordinary variation in the system. It would be a waste of resources to respond to a measured change if the change is not real or significant or is really an indication that some error has been made in measurement, data management or analysis. To guard against these risks it is useful to examine monitoring data with reference to the size of important expected changes and an awareness of potential errors creeping into the data collection or management program.

Control charts are one way of displaying the data from a monitoring program with a basic ability to visually detect a statistically significant change if one occurs. Control Charts are a way of simply plotting data from different monitoring events (different time).

Examples from Calperum and Taylorville Stations combines data analysis and interpretation.

The control chart is a line chart which displays the variability in the measurements over time, and allows us to consider the closeness of individual data points (or groups to expected values). If a pattern emerges in those lines, or if data points fall outside pre-specified limits, we observe that a change or trend in the condition of the resource is occurring . However, before confirming the change and looking for the cause or planning management actions, we check to make sure that there is no change or error in the measurement process or materials that has caused the observed trend. The following steps are recommended:

STEP 1: Determine the control and warning limits from known standards or previous studies to form Threshold Limits (or Biological Limits) or set as 3 and 2 standard deviations away from the mean to form Statistical Limits.

STEP 2: Plot data from a run (usually more than 10 data points are required).

STEP 3: Check the control chart for unusual data points or patterns.

STEP 4: Use the 'Rules of Thumb' for interpreting the control chart pattern.

STEP 5: Prepare a monitoring analysis summary (see example).

STEP 6: Take necessary corrective action to ensure there are no failings of quality assurance.

If QA/QC is assured, a pattern of very low or low chance likely means there may be an underlying cause leading to the observed change in system – so datapoints which have very low or low chance of occurring may mean very high or high chance that there is a special cause for the observed variation in the system. There is only one chance in twenty that a datapoint will occur more than ±2 standard deviations from the mean and only three chances in one thousand that a datapoint will occur more than ±3 standard deviations from the mean.

Control charts are not a substitute for analysis of change in relation to measured impacts or for modeling of the system but do provide an option for simple data display within a basic framework for statistical change detection. Limitations on the use of control charts are further outlined in the section on statistical validity.

'Rules of Thumb' for interpreting control chart patterns

When a sample point falls outside the control lines, it is reasonable to believe that a change has occurred which is greater than would be usually expected to occur by chance. In addition, it is necessary to look for systematic patterns of points across samples/surveys, because such patterns may indicate that the average (eg. average population density for kangaroos) has shifted.

These patterns may result from special or assignable causes (as opposed to chance or common causes) and these causes should be investigated to ensure that they are not due to quality assurance or quality control (QA/QC) failures in the monitoring program. Once QA/QC has been assured, environmental drivers for the observed change can be investigated. Table 4 provides more detail on interpreting control charts

Conditions on statistical validity of control chart use

There are several conditions on the use of control charts which should be considered when interpreting the data.

The probability of any sample mean in a control chart (one based on the population mean and standard deviation) falling above the centre line is equal to 0.5, provided that:

- the population mean is not changing (i.e., that the centre line value is equal to the population mean)
- consecutive sample means are independent (i.e. not auto-correlated)
- the distribution of means follows the normal distribution.

Simply stated, under those conditions there is a 50-50 chance that a mean will fall above or below the centre line. Thus, the probability that two consecutive means will fall above the centre line is equal to 0.5 times 0.5 = 0.25 and the probability that 9 consecutive samples (or a *run* of 9 samples) will fall on the same side of the centre line is equal to 0.5^9 = 0.00195. Note that this is approximately the probability with which a sample mean can be expected to fall outside the 3 SD control limits (3 standard deviations - given the normal distribution, and assuming no overall change in the population is occurring).

Other considerations:

- The control chart may require a number of points to establish the mean and standard deviation (a minimum of 10 data points will be adequate for most monitoring programs as long as they cover the range of conditions which are usually expected to influence the environmental variable being monitored).
- Remove data points which have been investigated and found to have unusual error due to failure in quality assurance.

Example of monitoring kangaroo density at Calperum Station

Kangaroo numbers have been monitored on Calperum Station for a number of years. Survey results indicate that the density of kangaroos has fluctuated between 2 and 11 kangaroos / km^2 between 1996 and 2002. Figure 9 shows a control chart for the kangaroo monitoring data with statistical control limits set at ±2 standard deviations from the mean (warning limit) and ±3 standard deviations from the mean (control limits).

The control chart indicates that the observed changes in kangaroo density are likely to be within expectations for measuring density in a variable population, i.e. there are no datapoints outside the warning or control limits and no established patterns in the data. This does not mean that the population is not changing or that the changes are not important, only that they are within expectations based on the entire set of monitoring data.

There is emerging evidence that the first data point in Figure 9 may have been significantly above the long-term average i.e. the last 7 datapoints have been below the cumulative average. However, 9 points in this pattern would be required to confirm this trend.

Example of monitoring surface water salinity (EC) at Paiwalla Wetland

Surface water salinity has been monitored at Paiwalla Wetland over a two year period. Salinity readings have been highly variable and fluctuated up and down over short time periods. Figure 10 shows a control chart for the salinity (EC) data with statistical control limits set at ±2 standard deviations from the mean (warning limit) and ±3 standard deviations from the mean (control limits). The control chart indicates that the observed changes in salinity are likely to be within expectations for measuring salinty in this wetland, i.e. there are no datapoints outside the warning or control limits.

There is emerging evidence that the pattern of fluctuating datapoints in Figure 10 indicates changes in salinity. These may be to filling and drying of the wetland. However, this pattern could be investigated to ensure that no systematic error in sampling or quality assurance is occurring.

Table 4 Example of a Monitoring Analysis Summary

Monitoring Parameter	Problem	Rule	Comment	Corrective Action
Example: Date: Autumn 2006 Kangaroo Numbers – Calperum Station	The data show an upward shift of about 8% in the last 6 survey periods. Results since then are on average 5% higher than before 2004.	Rule 5 There is a trend of six points in a row upward or downward	A new community group took over the kangaroo monitoring two years ago. They are very keen and diligent about recording every kangaroo they can find. Reports from around the district are that kangaroos have been moving South because of the continued dry weather. This may have resulted in an increase in numbers seeking refuge on Calperum.	Check with the monitoring group to see if they are following the protocol closely. Check if the same observers are doing it to see if they think they have become better at detecting or counting roos. Check on grazing data for palatable plant species to see if there is corroborative evidence that kangaroo impacts and numbers have increased.
Previous comments for kangaroo monitoring				
Date: Autumn 2004 **From Monitoring Summary**	Started to see an increasing number of kangaroos over the last couple of surveys, but only a few percent more.		New group doing the monitoring.	Check the new group are following the protocol

Figure 9 Calperum Station kangaroo density (Individuals/km^2)

Datapoints are from surveys between 1996 – 2002. Control limits = ±3 standard deviations; Warning limits = ±2 standard deviations.

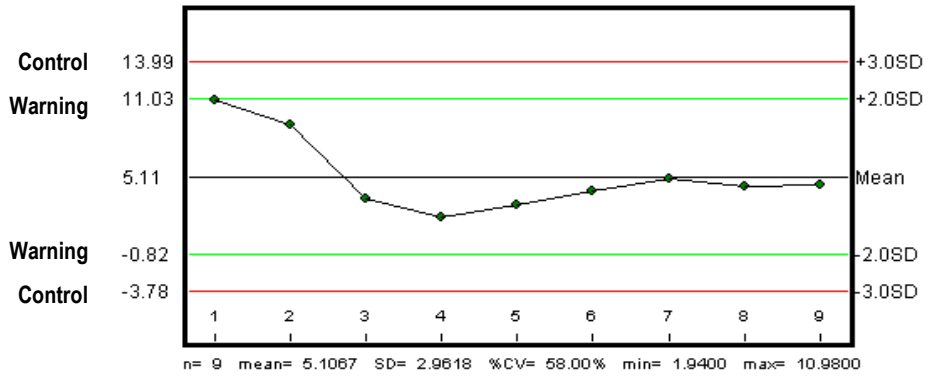


Figure 10 Paiwalla Wetland surface water salinity (EC)

Datapoints are from surveys between 2004 – 2006. Control limits = ±3 standard deviations; Warning limits = ±2 standard deviations

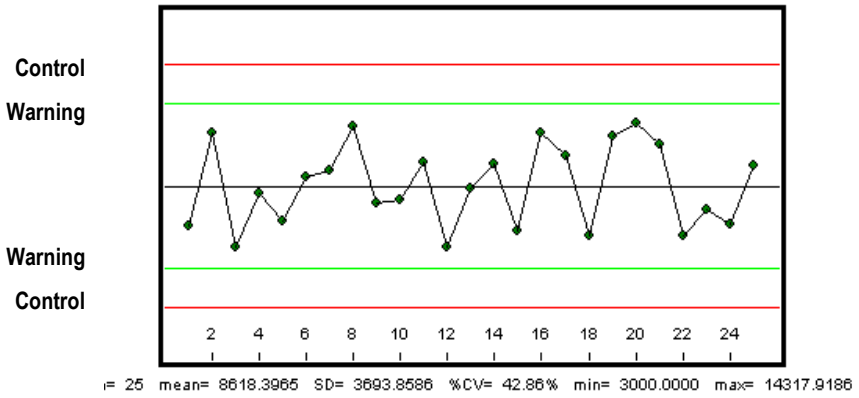


Table 5 Interpreting control chart patterns

Pattern type	Pattern indicates	Potential QA/QC cause	Probability of this pattern occurring by chance[1]
one or more points outside of the control limits	Large change in condition of the resource	○ mismeasurement of the sample/survey ○ miscalculated or misplotted data points or control limits	very low
nine points on one side of the centre (average) line	Shift in the average condition of the resource	○ Change in the measurement process or materials	very low
two of three consecutive points outside the warning limits	Early warning that average condition of the resource may be changing	○ Change in the measurement process or materials	low
four of five consecutive points outside ±1 SD	Early warning that average condition of the resource may be changing	○ Change in the measurement process or materials	low
six points in a row upward or downward	Gradual change in the average condition of the resource	○ Gradual improvement or deterioration in the accuracy of measurement ○ Gradual deterioration (or improvement) in equipment or materials	low
fourteen points in a row alternating up and down	Two systematically alternating causes are influencing the condition of the resource	○ Different quality of alternating sources of equipment, materials or operators eg. two alternating suppliers of standard solutions, or different alternating groups doing the monitoring have different levels of quality assurance	very low
fifteen points in a row near the mean line	The condition of the resource is relatively stable with respect to past fluctuations	○ Early measurements may have been inaccurate and control limits set incorrectly	very low

1] The probability of the pattern occurring by chance is low or very low, we can confidently assume that the pattern has some underlying cause. very low = less than 1-in-200; low = less than 1-in-20.

Table 6 Monitoring Analysis Summary Template

Monitoring Parameter	Problem	Rule	Comment	Corrective Action	Action Taken (tick when action has been completed)
Date:					
Date:					
Date:					

Previous comments for monitoring					
Date:					
Date:					
Date:					

Communicating results

Monitoring is undertaken to inform a group of people about the condition of and trends in resource condition in a particular area. Communicating the results to this audience is obviously an important part of your monitoring effort. Your group may wish to communicate to:

- influence some kind of change
- inform people about what they're doing, and/or
- attract new members and supporters.

There are a range of tools that can be used to communicate effectively to different audiences. Your monitoring plan should describe how you will communicate your results and identify which tools would be most appropriate to get your message across to your target audience.

In addition to this introductory text, this section includes the following:

- Guidelines for Preparing a Communication Plan
- Media Release Tips
- Media Release Example
- Briefing Paper Example.

Guidelines for preparing a communication plan

Effective communication is a crucial tool for monitoring programs, especially where the monitoring program is not managed by the same people who manage the resource being monitored. Developing a communication plan is part of fulfilling the monitoring plan i.e. communication is as much part of the project management cycle as measuring the resource.

A clear idea about who needs the information that themonitoring project produces and how it is best to communicate with this audience can also help to shape the monitoring. Planning for communication forces us to think about the eventual use of the results, the timelines of our audience (the audience may have key decision points that communication needs to inform in a timely manner) and producing tailored and user-friendly information products. Preparing a communication plan can also help us to reflect on the objectives of the monitoring project and how well these objectives can be met.

These guidelines aim to provide a simple explanation of the components of a communication plan for a monitoring program and a template for preparing your own plan. The main components of a communication plan are the:

- communication objectives – what and why are you communicating
- target audience – who do you want to communication to
- communication tools – what method of communication is most appropriate for your target audience
- timing and frequency – when and how often to communicate
- responsibilities – who is going to communicate
- communication quality – key concepts for excellent communication.

Communication objectives

Use the following examples to clarify the communication objectives of your project i.e.whether the objectives is to :

- strengthen the relationship between the monitoring project and its supporters and users of the monitoring data or results
- provide stakeholders with information about the activities and outcomes of the monitoring project
- make contact with decision makers, make them aware of the monitoring project and work with them to make evidence-based decisions about management of natural resources
- assure quality at all stages of the monitoring project by remaining mindful that others will have access to information about and from the project
- actively develop and support the continuous improvement of the monitoring program and management of natural resources by shared understanding through appropriate communication
- engage members and potential members who have skills and interests in promotion and communication of the monitoring program and its results
- develop links with local and regional communication products and media in order to use them as a tool to reach the target audiences, including the general public.

Target audience

Many different groups and individuals are potentially interested in the activities and results of monitoring natural resources. However, people are busy and increasingly overloaded with information from many difference sources. For a message to break through the information clutter, messages should be based on the

needs of the target audience and not on the priorities of the sender of the message. For this reason, the messages that are communicated and the means of communication should differ according to the specific audience(s) the project wants to inform or influence. For communication to be effective the audience must be selected and directly targeted with the appropriate message and means of distribution.

The main types of audience for natural resource monitoring are the:

- NRM Board and sub-regional NRM Groups
- researchers
- government agencies
- local government
- Local Action Plan/Landcare or other community NRM groups
- NRM Project Officers
- land managers
- project or community group
- general community

Determine which of these audiences it is important to target. It may be that different audiences will want different information or that the same information needs to be communicated differently to different target audiences.

Communication tools

Your monitoring plan should describe how you will communicate your results and identify which tools would be most appropriate to get your message across to the target audience(s). The main methods of communicating about monitoring programs and their results are listed below:

- project or data report
- conference, forum or information session
- scientific journal article
- regional or local newsletter
- field or demonstration days
- pamphlet or brochure
- project newsletter
- Project meetings
- local newspaper
- word-of-mouth
- State/National newspaper
- local/State radio
- TV
- magazine
- social media pages (e.g. Facebook)
- your own web-page
- blog.

Some of these methods may be in either paper form, electronic form or both. Sometimes the same information can be available for mail-out or put on a website. This is largely a choice about the extent of distribution and the currency of the information. It is possible to archive information on a website for access into the future, whereas, newsletters and information sheets are easily forgotten, lost, superseded or destroyed.

Table 7 below provides recommendations about the most appropriate communication tools to inform different audiences. Choose the communication tools which will most effectively reach your target audience and develop your message to fit that tool.

Tips for timing and frequency of communications to improve effectiveness

The timing and frequency of communications depends on a number of factors related to the availability and form of the information, the need of target audience, the resources of the monitoring group and the time that different communication tools take to get information out to the audience. The most important thing is to optimise the opportunity of communication and not simply send out information because you have it. A few general tips to timing your communication are provided in Table 8.

Responsibilities

The responsibilities for each stage of preparing material for communication, and the stages leading up to communication (eg. analysis and interpretation) need to be allocated to people capable and prepared to undertake them. Determine the tasks to be undertaken, allocate the tasks and set deadlines to keep track of progress. The tasks required when using different tools will be different for different monitoring projects. However, the main tasks to be allocated will be:

- deciding when you want to communicate and what communication tools you will use – including checking things like newsletter deadlines, meeting times, publication policies, word or picture limits etc
- collating and synthesising interpreted information. This may include text, tables, graphs and

photographs.

- drafting the communication text to ensure a clear, concise message in the form appropriate to the communication tool(s) chosen
- nominating a contact person or contact point to answer questions
- responsibility for any revisions or proof checking
- disseminating the information – this might simply be a matter of loading it onto a website or may include printing, typing addresses and stuffing envelopes, or delivering copies to libraries etc.

Quality in communication

To ensure quality in communication, it may be helpful to consider the clarity, consistency, tone, appeal, credibility and openness in the way you have communicated your message.

Clarity
Communication from the project must clearly convey information to create an environment for the target audience to understand the message and to limit the chances of misunderstanding. Clarity is improved when as few technical or bureaucratic terms as possible are used. Eliminate information that the target audience does not need in order to understand the message or make necessary decisions. Be aware that the science and terminology of natural resource monitoring may be unfamiliar to many of the potential target audiences.

Consistency
Messages about the monitoring project should be consistent over time. The communication tools may be the only contact some target audiences have with the project and consistency of message, language and method will assist in engaging the audience. This does not mean that the content of the message cannot change but that each new communication builds on those already disseminated.

Tone and appeal
The messages may be straightforward, reassuring, challenging or even controversial, depending upon the desired response and the target audience. Being clear about the desired response before communications will help to set the tone and appeal of the message. Messages should always be truthful and delivered with appropriately authoritative voice.

Credibility
In all communications, the monitoring project must be believable and trustworthy and should be recognised for its scientific credibility.

Openness
The ongoing significance and success of the monitoring project may depend on support from stakeholders, response from decision makers and the ability of the project to respond to the needs of these audiences. It is important that communications demonstrate openness to ideas and enquiries from stakeholders and users of the monitoring data. This can be as simple as including contact details or information about upcoming activities in communications.

Media release tips

The media need you! Both print and broadcast media need to fill space or air-time and journalists will generally accept a story if you can sell it to them. Sending a written press release is your first step and the most effective way to ensure that your message is correct and packaged the way you like it. If your story is picked up, the journalist may follow up to check details or clarify the topic.

The following tips are to help you to prepare and check your written press release.

Purpose of media release

The key points include:

- attract interest and/or notify potential participants about the activities of the group
- highlight the findings from the monitoring
- give general background information about the monitoring program or the natural resource issue
- outline the organisation's point of view on an issue.

Table 7 Recommended communication tools

Target Audience/Organization	Project or data report	Conference or forum	Scientific journal article	Regional or local newsletter	Field or demonstration days	Pamphlet or brochure	Project newsletter	Project meetings	Local newspaper	Word-of-mouth	State /National newspaper	Local / State radio	TV	Magazine	Social media pages	Your own web-page ○	Blog
NRM Board	●																
Sub-regional NRM groups	●	●															
Researchers		●	●														
Government agencies	●																
Local government	●	●		●													
LAP/Landcare group	●			●	●												
NRM Project Officers	●			●	●	●			●	●							
Land managers					●	●			●	●							
Project/community group				●	●	●	●	●		●					●	●	●
General community									●	●	●	●	●	●		●	●

NOTE: *Remember that the NRM Board, stakeholders or others who host or distribute your communications may have policies, styles or templates that are useful for you or important to ensure communication consistency and limit liability. Ask project officers or NRM Board staff about requirements for communication tools they are responsible for.*

Table 8 Tips for timing and frequency of communications to improve effectiveness

Tip	Explanation
Find out when key decisions are made by stakeholder or supporters of the monitoring project	Providing information in a timely manner to decision makers can increase the chance that they use the information. Many decisions in NRM are made by committees or at meetings. Missing the meeting can mean waiting or missing out on funding or action. Collection of some information could be deliberately timed to be ready for a particular meeting or forum.
Not all information needs to be communicated immediately.	It can be a good idea to wait for the right opportunity to influence a decision rather than diluting your message by sending out information when the target audience is not ready. This could include collating information about change in the natural resource over a few years and presenting it at a key meeting rather than sending it out hoping someone is paying attention.
Provide interpreted results not just raw or analysed data	Use your home ground advantage and decide for yourselves what the results of monitoring mean by properly analysing and interpreting them before communicating them. If other stakeholders disagree with your interpretation they can discuss it after you have established your opinion. You also want to avoid the risk that unanalysed or insufficiently interpreted results are misinterpreted or misunderstood.
Plan for all the stages of your monitoring project, including the communication	Don't forget that each stage of a monitoring project takes time, including preparing communication products. Add some extra time into plans to give yourself a buffer if tasks don't go right at every stage. It is common to underestimate the time taken for things like analysis, writing, formatting, sign-off by authorised personnel and printing. Agreeing on deadlines for specific components can improve the efficiency of preparing for communications. You can work out the timelines by working backwards from the desired publication or communication date.
Use existing communication tools and products where they are appropriate and available	If there are already newsletters, websites or other communication tools you may be able to have your information included for distribution. Distribution can be expensive and it may be necessary to compromise on the amount you can include in an article in an existing newsletter or information product to ensure that you can cheaply and easily reach your target audience. Remember that groups who host or distribute your communications may have policies, styles or templates that are useful for you or important to ensure communication consistency and limit liability. Ask project officers or NRM Board staff about requirements for communication tools they are responsible for. Even if you are not using an existing communication product, you might be able to save some effort by copying what you like from existing products or talking to the people producing them.

Maximising the likelihood of seeing the media release published

Focus on no more than three messages that you want to convey, for example:

1. This monitoring is undertaken by the community.
2. A change has been detected.
3. Planning or management may be affected.

Stick to the facts and be precise. Don't offer your personal opinion, speculate, talk about anything you are unclear or uncertain about and don't let yourself talk too much.

Always be polite and calm in all dealings or interviews with the media. Refer reporters to the most relevant person to discuss any details.

Content

Evaluate the news value of the press release as this is what the media outlet will do. News value can be measured by:

- How many people may be affected or interested in the issue.
- The likelihood that a particular group of people might be affected by the report e.g. Irrigators.
- The likelihood that something will change as a consequence of the report e.g. management of the resource might change if monitoring showed an undesirable trend).
- The level of human or local interest in the story.
- How recent the information is and length of relevancy.

The opening paragraph should summarise the whole story i.e. who, what, when, where, why. It's important to keep it simple, to the point and factual.

Make sure the location of the story matches the distribution of the newspaper/media outlet. Be accurate with names, titles, dates and time and use active language with verbs and avoid adjectives.

Avoid technical language, jargon and clichés. Neither the journalist nor general public, are likely to be familiar with technical or bureaucratic language of natural resource management or monitoring. If possible, make a visual or sound illustration available e.g. photo or recording of a frog found at the monitoring site. The media especially like photos of children, animals and flowers.

Include simple figures or numbers with context and explanation. It is often easier to understand figures which refer to an amount of change rather than an absolute amount e.g. 10 % increase in salinity over 2 year).

A few other tips:

- assume no prior knowledge – i.e. only use acronyms or technical terms if they are explained
- include quotes – the media loves them. "Blah, blah, blah…," said …. (include full title the first time this person is mentioned)
- include a headline made from keywords from your release (no more than six words)
- keep the release to 1 page e.g. 200-400 words.

An example media release is provide on the next page.

Distribution

Weigh up whether the impact would be greater for the release to go out soon after the event (news is new and current) or whether it is best to manage timing for greatest impact. The effectiveness of a release can be enhanced by timing it with profiled events e.g. Watercare Week or World Environment Day.

Determine the target audience for your release and choose appropriate media. Check the media's deadlines and publishing/broadcast schedule (daily, weekly etc.). Include contact details and make sure that the contact person is available for at least 3 days after the release has been sent.

Follow up your release with a brief and to-the-point phone call. Ask if the journalist has received, and had time to read, your release. You can also offer to line up an interview or obtain a good quality photo.

Some of the information provided here has been sourced from the following references:

- Media release guidelines (University of Leeds) www.leeds.ac.uk/media/media_guide/what_news.htm (accessed 2007)
- http://vitw.org/pdfs/Writing_a_Media_Release.pdf (accessed 2007).
- Thanks for additional advice from Rita Reitano, CRC for Australian Weed Management

Media Release Example

Contact details
Borrow Creek Landcare Group
Contact person:……..
Contact details:……...

Healthy Water Flows in Borrow Creek

The quality of water flowing in Borrow Creek has improved according to the results of monitoring by local landholders and a group from the Borrow School.

Forty-five children from the Borrow school have been collecting water samples along the Borrow and Stony Creeks to measure changes in the quality of the water. The information collected has been combined with information collected by the Borrow Creek Catchment Group and shows that the salinity of the water in Borrow Creek has dropped by about 10 % over the past two years.

The monitoring program was started by the Landcare and School groups to help inform the public about potential threats to the unique ecosystems along the Borrow Creek. The chair of the Landcare group Mr John Smith said that the improvement in salinity was expected after such a wet season but that the amount of sediment in the water was on the increase.

“The water is very cloudy which makes it more difficult for plants and animals to live in it” said Mr Smith. “We haven’t found as many frogs this year and there are ongoing weed problems along the creek”.

The group undertakes monitoring on two days each year and welcomes people with an interest in the natural environment and Borrow Creek.

“The monitoring we do isn’t very technical and training is provided” said Rebecca Jones, a project officer assisting the monitoring. “Lots of people like catching the frogs and fish and learning about how these animals live. The program has been very popular with the school” she said. The program is one way for people who want to make a difference to the conservation of the local environment to learn about wetlands and the threats to them.

“We are hoping to provide information to local government and the Natural Resources Management Board on how land management in the area is influencing the quality of water in the creek” said Ms Jones.

Example Board Paper

Continued Degradation of Borrow Creek

Purpose

Highlight evidence of degradation in the condition of water and biodiversity in Borrow Creek and recommend actions to reduce the degradation.

Background

Stock grazing and cropping are the dominant land uses in the Borrow Creek catchment. Changes in agronomic practice and land use rotations in recent years have seen an increase in the period of exposure of soil to erosion risk and potential for sediment movement to Borrow Creek. In 2004 the Borrow Creek Landcare Group began a program to monitor the quality of water in the creek and the condition of the vegetation in the creek and riparian strip. There are now four years of monitoring data on salinity (EC), pH, turbidity, nitrate & phosphate levels and flow in the Burra Creek.

Discussion

Four years of monitoring data in Borrow Creek demonstrate a decline in the quality of water and the condition of vegetation associated with increased sediment load and eutrophication from run-off from agricultural land. Attachment 1 shows the trend in turbidity and nutrient levels in Borrow Creek over the period 2004-2008. These changes are correlated with changes in agronomic practice over the past decade. There has been widespread removal of contour banks and increased periods of soil exposure with cultivation earlier in the year, and increased stocking rates in parts of the catchment. Run-off from agriculture land is contributing to the degradation of Borrow Creek and action is required to raise awareness of the issue and inform land managers of best practice land management techniques to reduce the impact of agriculture on the creek.

Recommendations

AGREES to develop and implement an education/awareness program to inform landholders of current best practices to limit erosion and the movement of sediment to Borrow Creek.

Attachment 1 - Borrow Creek condition monitoring results 2004-2008

Evaluation and Reflection

Introduction to evaluation and reflection

Once a plan has been developed, a common mistake made by groups is not to review their progress and update their plan. To be of any use, a plan needs to be a living document that can be changed as your community monitoring group learns about the natural resource and what monitoring results mean. Evaluating and reflecting on your monitoring plan or project will ensure your monitoring effort is effective and identify required improvements.

A plan is only useful if it works in practice. Evaluation and reflection will help you assess this and gives you information to improve your monitoring plan.

The evaluation and reflection process is not meant to encourage excessive introspection, but focuses on highlighting positive outcomes and successes, identifying problems and weaknesses, and defining future actions to overcome any problems or obstacles.

Figure 11 highlights that evaluation and reflection can form part of continuous improvement and learning for all stages of the project management cycle.

Table 9 provides examples of evaluation and reflection questions These include examples of approaches you might use to answer these questions and can be incorporated into your monitoring plan. You may find it helpful to use the decision trees, Figures 12 to 21.

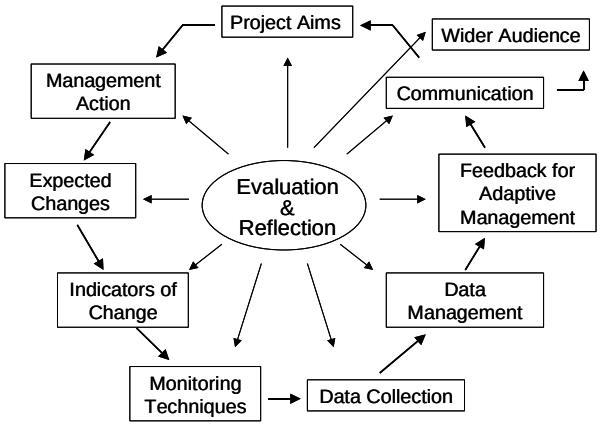
Revising Your Community Monitoring Project

Insight gained from the evaluation and reflection process will help direct a revision of your monitoring program.

Periodic revision of your monitoring plan will ensure that the monitoring activities being undertaken are effective and objectives of your monitoring program continue to be met.

For long-term monitoring of project management cycle natural resource change, data and information must be comparable over time and by location. However, there is no point in maintaining consistency over time if a monitoring program is not meeting objectives, or a methodology is failing to detect changes that are biologically or environmentally significant.

Figure 11 Where evaluation and reflection fits in the project management cycle



When revising your monitoring plan you may find it helpful to use the following decision trees in conjunction with the monitoring plan template:

- revising monitoring objectives
- revise monitoring participants' needs for meeting the revised objectives
- revise funding sources and availability
- revise other related monitoring and associated activity
- revise the type of monitoring
- revise the monitoring methodology
- revise the location(s) of your monitoring activities
- revise the organization of your data management
- revise data analysis and reporting
- revise your communication plan

Each colour in the decision trees represents a different task as follows:

- Make a list.
- Answer a question.
- Identify solutions (revise)
- Continue on to next step in revision.
- Don't continue with revision

Table 9 Example questions for evaluation and reflection

Examples of questions for evaluation and reflection on the stages of the monitoring project management cycle with suggested sources of information[1]. Methods for answering these questions should be chosen to be easy to implement and provide simple unambiguous answers which require minimal processing. The group should decide when the most appropriate time is to evaluate selected stages of the of the project management cycle, who should be involved and what methods will be used.

Component of Project Cycle	Evaluation and Reflection on Your Project	Discussion of project group[2]	Survey of monitoring participants	Survey of stake holders and end-users	Workshop with experts[3]	Analysis of monitoring data[4]
Management Objectives	○ Are the management project objectives still suitable and achievable?	✓			✓	
	○ Did the monitoring help you meet the management project objectives?	✓				✓
	○ Have the project's objectives changed? If so, what are the new objectives?	✓		✓		
Management Action	○ Are your actions working? Are they appropriate, effective and efficient?	✓			✓	✓
	○ Is the monitoring providing information to help improve your actions or choice of actions?	✓		✓	✓	✓
	○ Are you changing your management actions? How should your monitoring change to assist in evaluating the appropriateness, effectiveness and efficiency of the new actions?	✓		✓	✓	✓
Expected Changes	○ Are the changes expected from management action large and easily detected (this may mean that your monitoring program can be small and efficient)?	✓		✓	✓	✓
	○ Are the changes expected from management action small, complex or difficult to detect (this may mean that your monitoring program needs to be large or continue for longer)?	✓	✓	✓	✓	✓
Indicators of Change	○ Are the indicators you selected appropriate for monitoring the specific change of interest?	✓		✓	✓	✓
		✓		✓		
	○ Who is using the results from your monitoring and how do the selected indicators meet their needs?	✓	✓		✓	✓
	○ How will your data be analysed? Do the chosen indicators lend themselves to analysis by the chosen methods?	✓		✓	✓	✓
	○ Are changes expected which the chosen indicators will not detect? If these changes are important for your management, what are they and how might you detect them?					

Component of Project Cycle	Evaluation and Reflection on Your Project	Discussion of project group[2]	Survey of monitoring participants	Survey of stake holders and end-users	Workshop with experts[3]	Analysis of monitoring data[4]
Monitoring Techniques	○ Were the protocols carried out as documented?		✓			
	○ What were the challenges in following the protocols and how did this affect the quality of your data?		✓			
		✓	✓			
	○ How can problems with the protocols be overcome?	✓	✓		✓	
	○ Were there any QA/QC issues relating to the techniques used?				✓	
Data Collection	○ Was data collection well organised, efficient and comprehensive?	✓	✓			
	○ Did volunteer training sessions result in increased competency and high confidence in the data collected?	✓	✓		✓	
	○ What did volunteers find rewarding and/or challenging about data collection? How can the data collection be improved in light of volunteer feedback?	✓	✓	✓	✓	
Data Management	○ Were all datasheets completed, copied, distributed to stakeholders and stored?	✓	✓	✓		
	○ Was data entered and verified in the appropriate databases?	✓	✓			
	○ How have inconsistencies and missing and extreme values been dealt with?	✓	✓			
	○ Are key stakeholders and end-users of the data able to access and use the data for their purposes?	✓		✓	✓	
		✓		✓		
	○ What could be changed to increase the efficiency and effectiveness of data management?				✓	
Analysis and Interpretation	○ Is there evidence that the condition of the resource is really changing?	✓			✓	✓
	○ Are the analysis methods being used adequate to provide confident interpretation?	✓			✓	✓
	○ What are the most likely influences impacting the condition of the resource?	✓			✓	✓
	○ What other explanations are there for the changes observed?	✓			✓	
	○ What corroborative evidence of observed changes is available from other sources?	✓	✓	✓	✓	
	○ Are any results surprising or any unexpected trends beginning to emerge?	✓	✓		✓	

Component of Project Cycle	Evaluation and Reflection on Your Project	Discussion of project group[2]	Survey of monitoring participants	Survey of stake holders and end-users	Workshop with experts[3]	Analysis of monitoring data[4]
Feedback for Adaptive Management	○ Is the management of the resource appropriate or does it need to be modified?	✓		✓	✓	
	○ What knowledge gaps still limit your understanding and management of the resource?			✓		
	○ How can the monitoring program be redesigned/improved to make it more effective and efficient?	✓	✓		✓	✓
Communication to Wider Audience	○ What decisions is the monitoring program influencing?	✓		✓		
	○ How effective are you in communicating your results and progress to a wider audience, including volunteers, local and regional interest groups, government bodies and the media?	✓		✓		
	○ How many and what types of people did the project influence?	✓	✓	✓		
Feedback into Management Objectives	○ How useful was support from project officers and/or SAMDB NRM Board staff?	✓	✓			
	○ What resources/people are required to sustain the monitoring?	✓	✓			
	○ What is the minimum monitoring effort required or when can monitoring stop?	✓	✓		✓	

[1] The project group may be the same or have similar membership as the monitoring participant group.

[2] Not all sources of information will be necessary

[3] A workshop or discussion with technical experts may assist you to bring additional perspectives to the project. The expertise needed may include statistics, planning, evaluation, measurement and management

[4] For planning stages of the monitoring program it may be possible to analyse preliminary data or data from other similar sites

Table 10 Examples of evaluation and reflection on components of your monitoring project

Overall Objective: e.g. Provide evidence of high/increasing sediment loads and declining water quality in creek due to low uptake of minimum tillage practice in catchment				
Project Component	**Evaluation/Reflection Question**	**Timing and Frequency of Evaluation**	**Source of Information**	**Future Actions**
Monitoring Techniques *Surface water quality monitoring:* *Salinty, turbidity and nutrient levels*	*Technique is easy to use* *QA/QC standard high*	*After 12 months monitoring (ie. 3-4 monitoring events)* *After data analysis at the end of the year (ie. once every 12 months)*	*Discussion with monitoring group* *Discussion with monitoring group*	*Review monitoring protocol* *Provide feedback to monitoring group on high quality and confidence of data*
Data Management *Project Database* *Waterwatch database*	*Was the data readily retrievable?* *Was the data well cross-referenced for easy retrieval?*	*At annual meeting of the group* *After every 2 or 3 monitoring events*	*Discussion with project group and stakeholders* *Discussion with project group and NRM Board officers*	*Post quarterly reports on the website and data on FTP link* *Provide training for new members on data entry and verifications*
Communication of outcomes *Inform the Landcare group, the community and decision makers (NRM Board, DWLBC, Goyder & Mid-Murray Council) about the resource and changes in the resource.*	*What decisions is the monitoring program influencing?* *How many and what types of people did the project influence?*	*After 12 months monitoring* *3 months after press release*	*Discussion with project group and stakeholders (including NRM Board)* *Discuss with project officer* *Discussion with project group and stakeholders (including NRM Board)*	*Provide feedback to monitoring group on NRM Board decisions* *Consider survey of local community awareness of water quality* *Produce a 'state of the creek' report for local community*

Figure 12 Decision tree for revising monitoring objectives

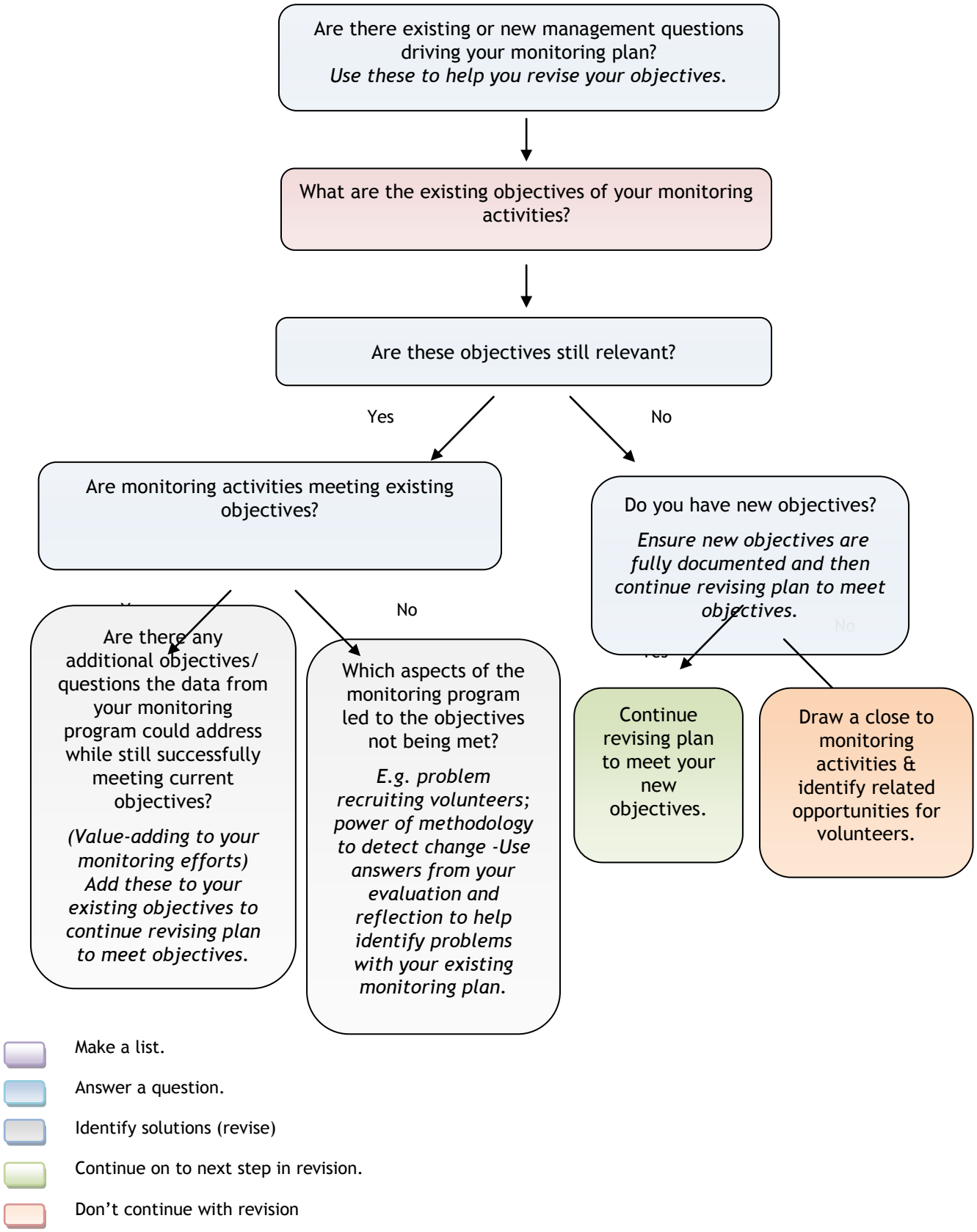


Figure 13 Decision tree for revising your participants' needs for meeting the revised objectives

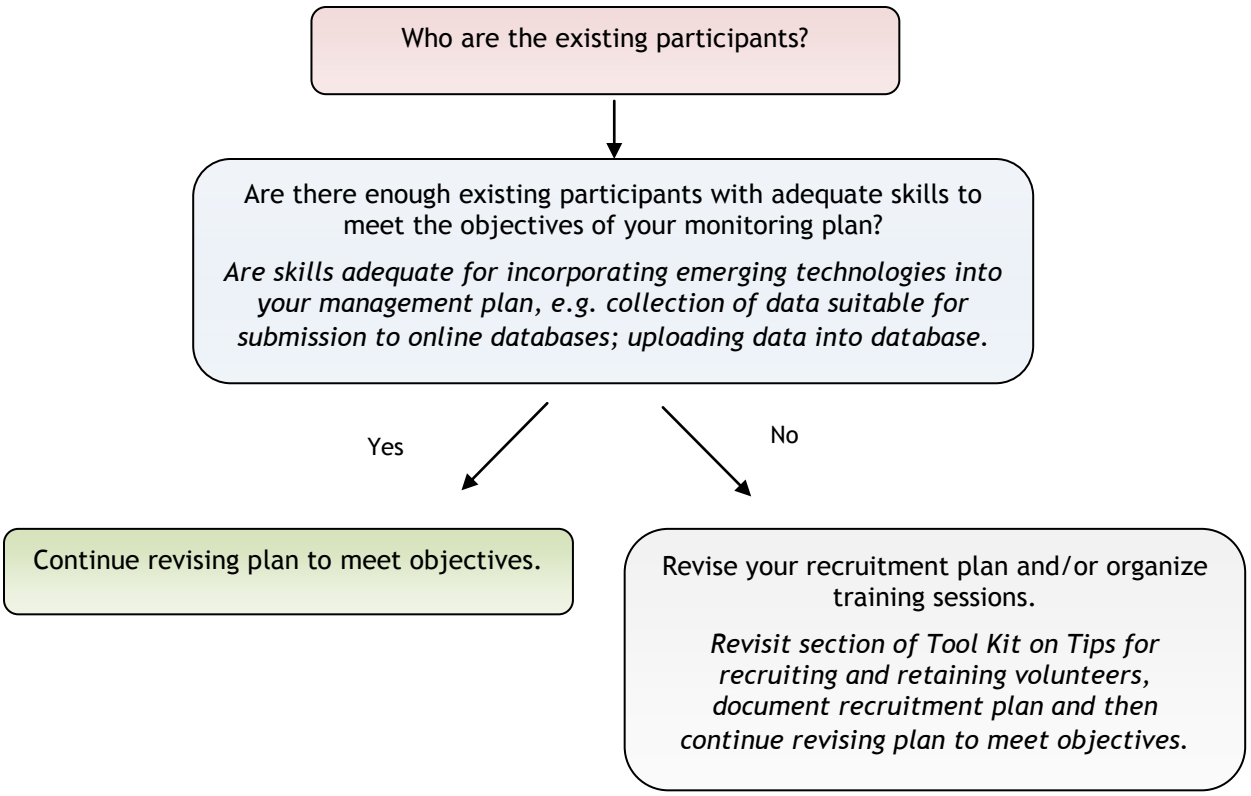


Figure 14 Decision tree for revising funding sources and availability

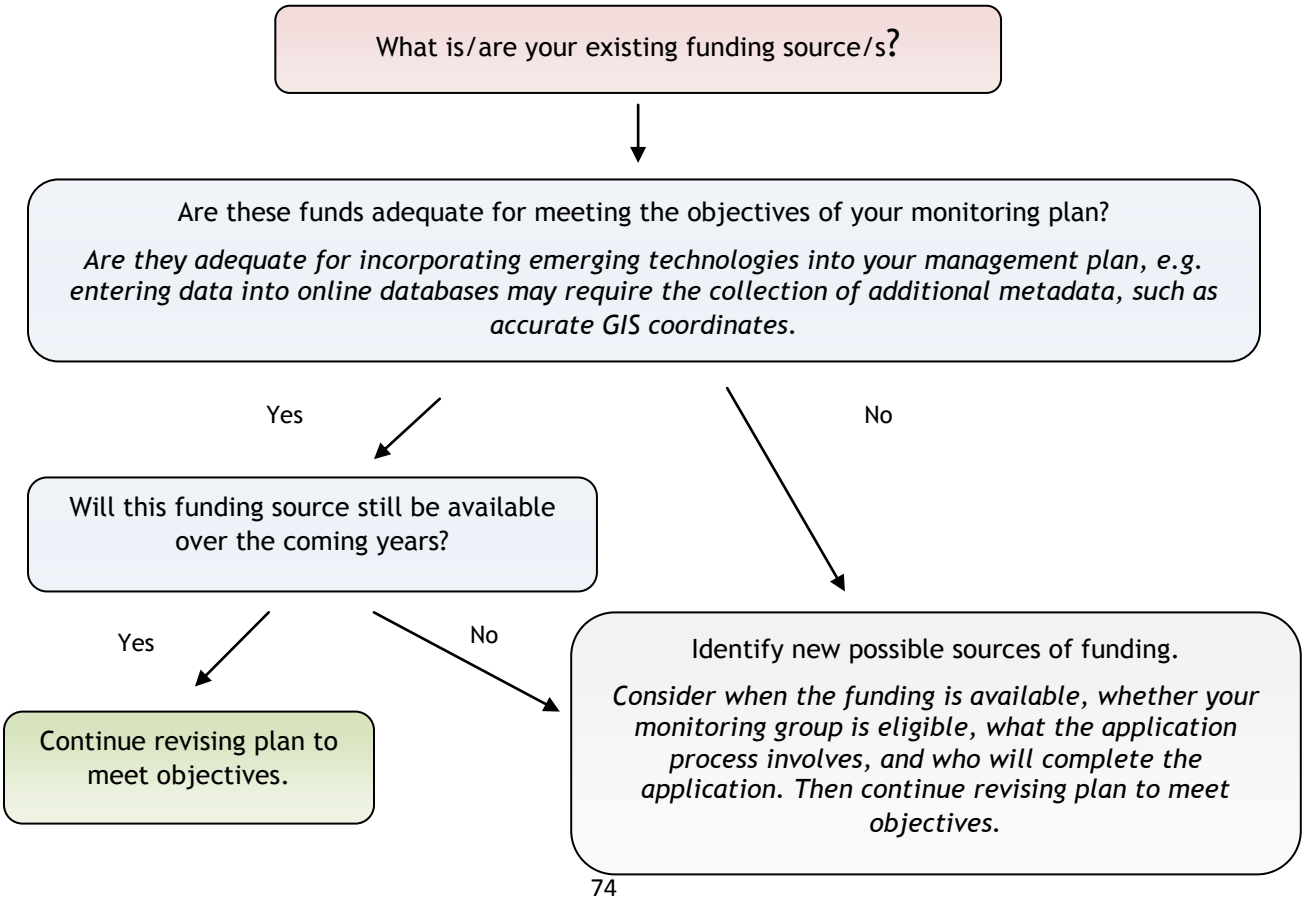


Figure 15 Revise other related monitoring and associated activity

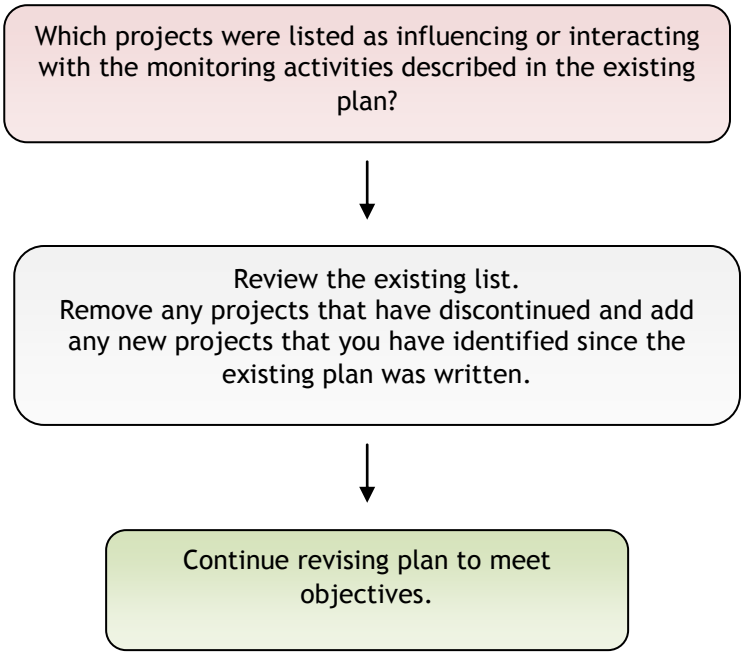


Figure 16 Decision tree for revising the type of monitoring

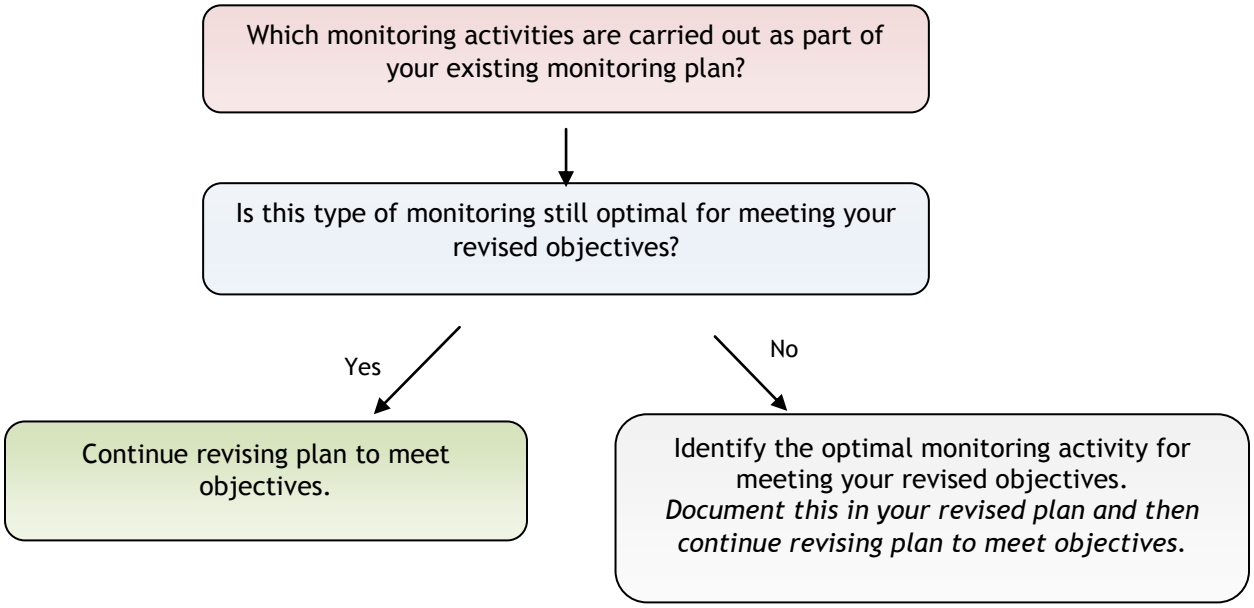


Figure 17 Decision tree for revising the monitoring methodology

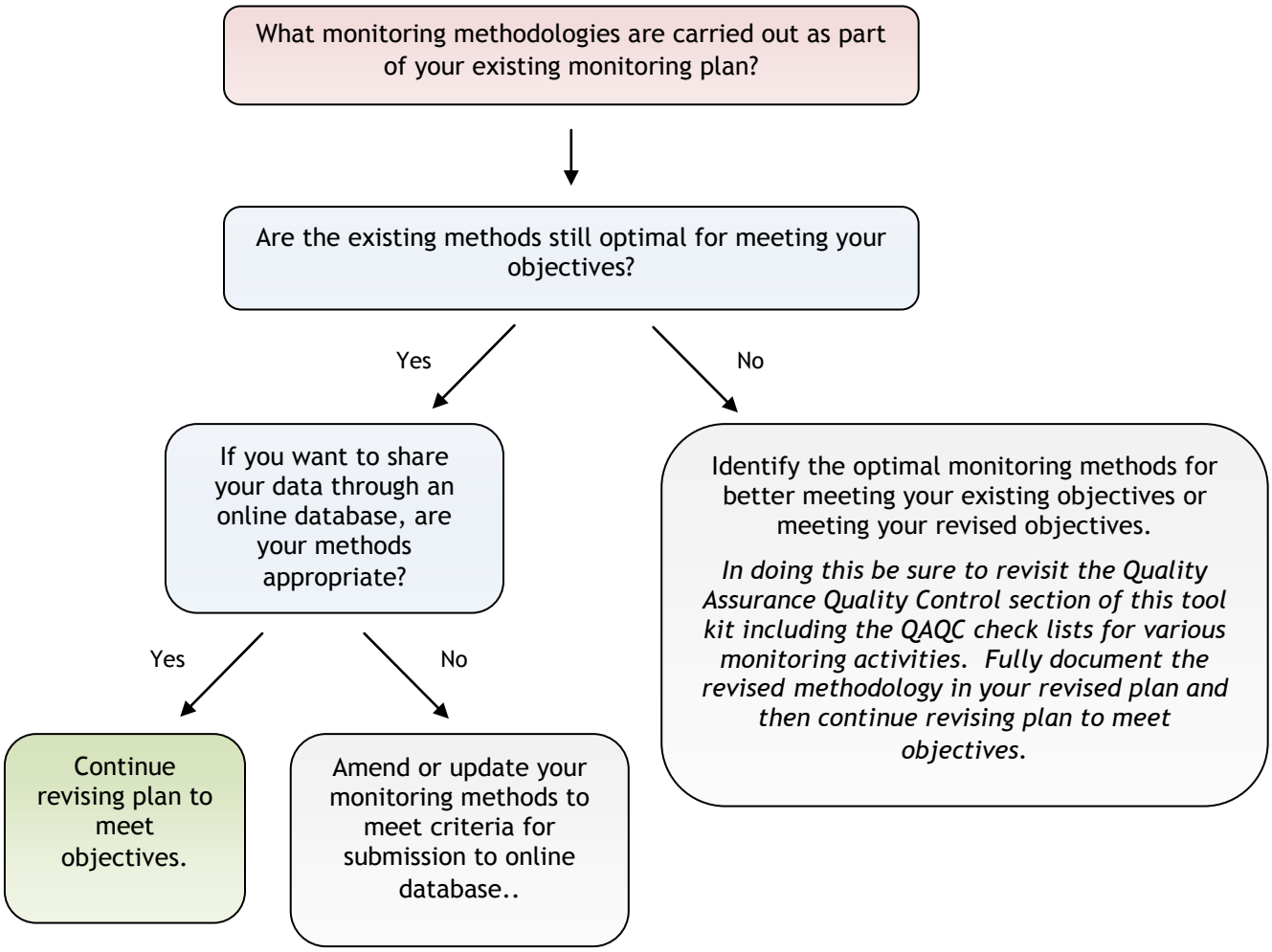


Figure 18 Decision tree for revising the location(s) of your monitoring activities

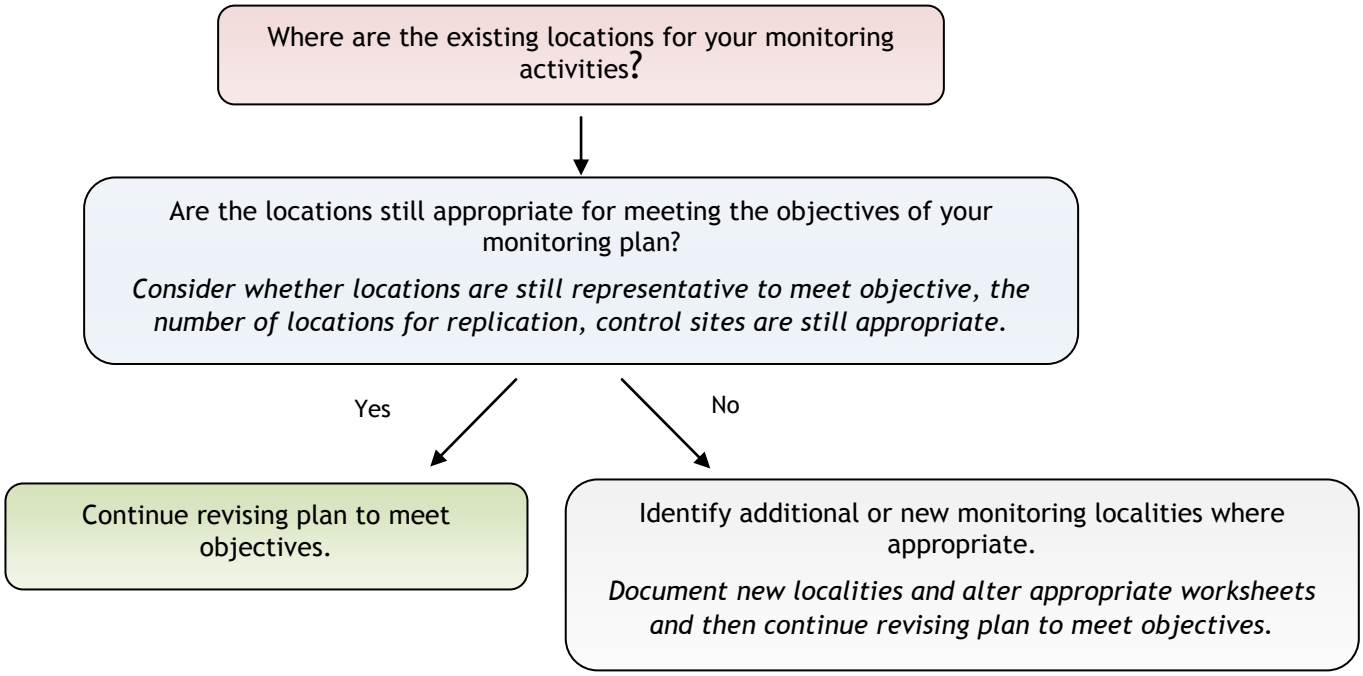
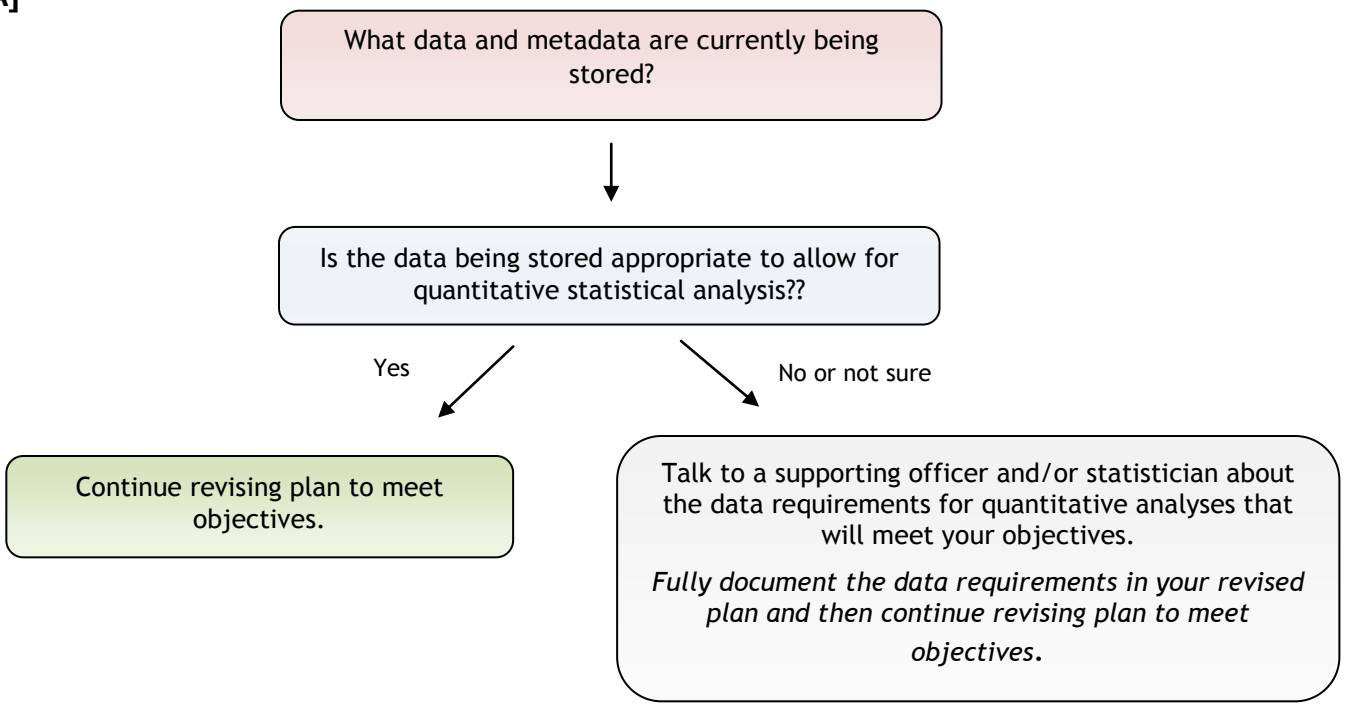


Figure 19 Revise the organization of your data management.

A]



B]

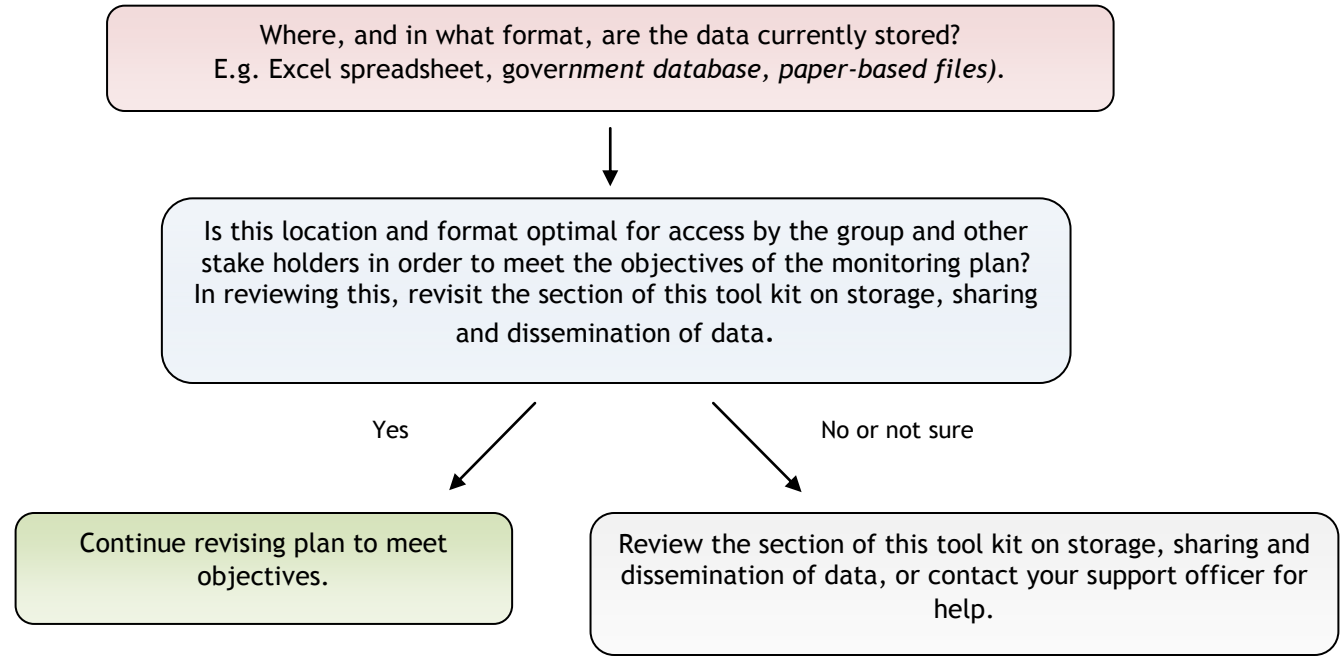


Figure 20 Decision tree for revising data analysis and reporting.

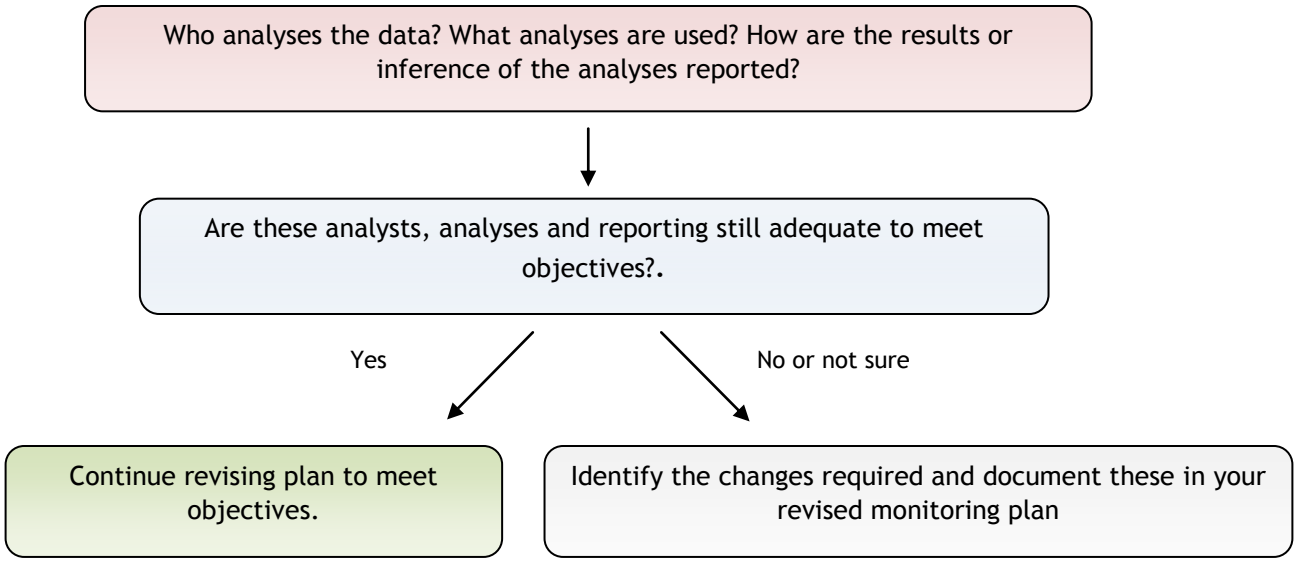
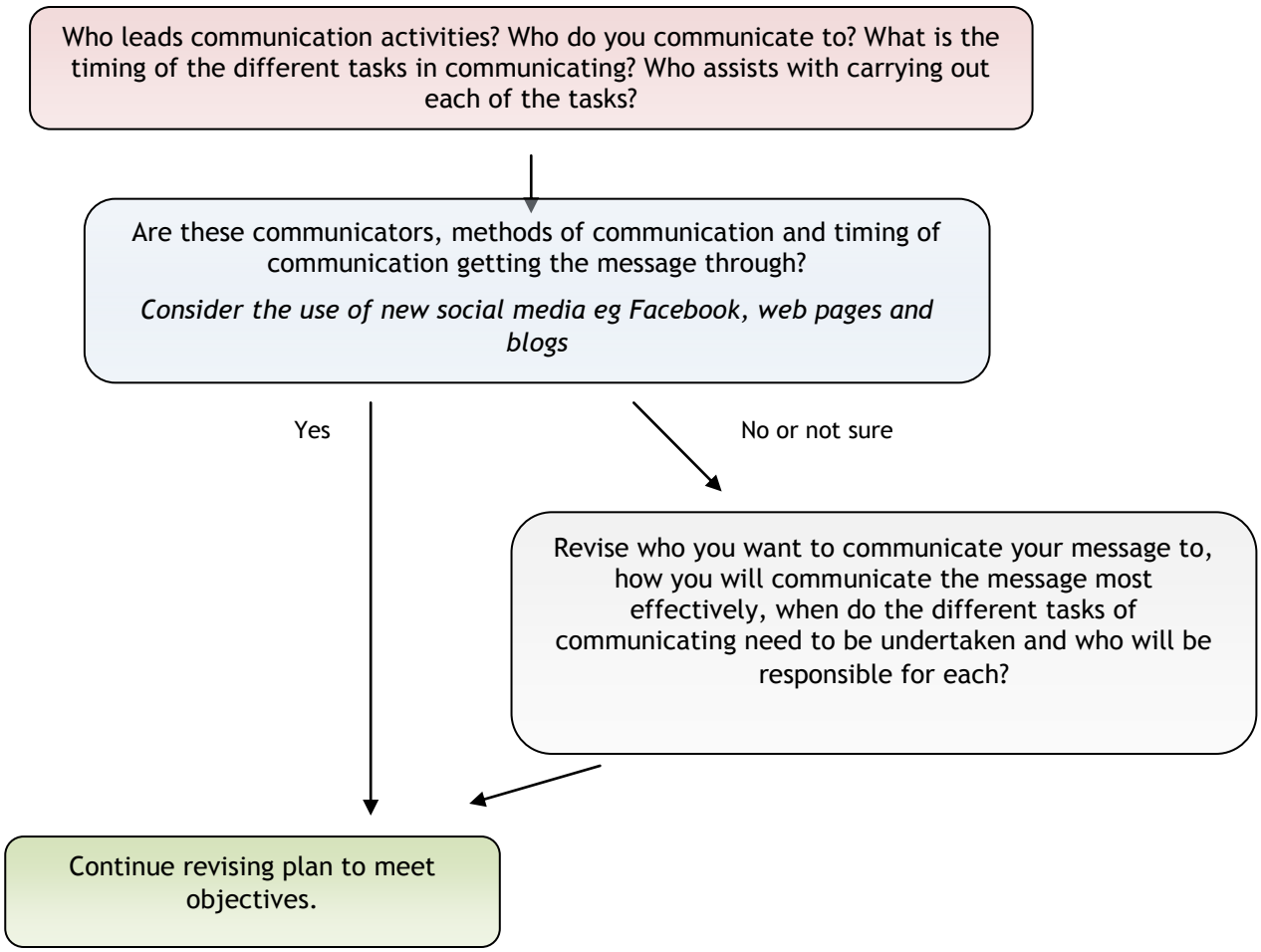


Figure 21 Decision tree for revising your communication plan.



Appendix A Links

Further information can be found at:

Australian Government Natural Resources Management Monitoring and Evaluation (http://www.nrm.gov.au/me/index.html)

Department for Water Monitoring and Evaluation Resources (http://www.environment.gov.au/land/publications/resources.html)

Department of Environment and Natural Resources NRM Monitoring and Evaluation (http://www.environment.sa.gov.au/Conservation/Managing_natural_resources/Policy_plans/Monitoring_Evaluation_Reporting_Improvement_MERI)

Land and Water Australia Audit National Monitoring and Evaluation Framework (http://lwa.gov.au/national-land-and-water-resources-audit/national-natural-resource-management-monitoring-an)

Natural Resources and Water Land Managers Monitoring Guide (http://www.nrw.qld.gov.au/monitoring_guide/index.html)

Appendix B Borrow Creek Landcare Group Water Resources Study Monitoring Plan

1. Objective of Monitoring

1. Understand the resource condition and trend - what is sustainable? Base data to add to existing data which has been collected spasmodically. (Need to consider building on the existing data, replicate existing sites. There is the drill view and 3 subsequent programs of monitoring with datasets covering approx 5-7 bores)
2. Inform the Landcare group, the community and decision makers (NRM Board, DWLBC, Goyder & Mid-Murray Council) about the resource and changes in the resource
3. Need a dataset that could stand up in court - for contesting development assessments etc. (caution about which part of the program may produce data for that purpose)
4. Potential for 'early warning' and threshold levels for pollutants (probably a stretch for the resources for the project and the time available for monitoring frequency)

2. Other Related Monitoring and Associated Activity

- BRS project will pay for some data-logger collection and data analysis
- DWLBC may include some bores in the Obswell program - there is thought to be a bore already in place close to World's End gauging station
- ADCHEM (Aust.) - run the mine at Borrow and have some bores (Simon Kibble is manager)
- There is the drill view and 3 subsequent programs of monitoring with datasets covering approx 5-7 bores.

3. Methodology Used

Method	Reference (where are the methods described?)	Timing	Responsibility	EPA Data category (See EPA Data Category Questionnaire)
Groundwater bore monitoring • Depth to groundwater (standing water level) • Salinty - TDS	• Wetland monitoring manual & the depth cable method • TDS (EUTech tester)	Quarterly monitoring	• Landcare Group	Advanced
Surface water • Salinity - EC • pH • Turbidity • Nitrate & Phosphate levels • Flow (with logger, outside of the community monitoring)	Waterwatch SA recommended equipment	Quarterly monitoring	• Landcare Group • Worlds End Conservation (might do monitoring at the Gorge)	Advanced (need to talk to the school)

4. Location of Monitoring

Groundwater – 3 bores

Bore No.	Property ID	Location
G28	Oasis Soak	E 325988 N 6116982
H45	Stones Rock	E 325452 N 6116652
L231	Wings Rise	E 326003 N 6117246

Surface water - 3 sites

Site No.	Name	Location
1	Borrow Creek	E 325012 N 6116863
2	Logan's Creek (the Gap)	E 325231 N 6116544
3	Hopkins Creek	E 326121 N 6117250

5. Data Storage

Format	Data to be stored (eg. Fields, maps, photos)	Location of data storage	Responsibility
Project Dbase - waterwatch database (version V1.4 2007)	Microsoft Excel spreadsheet to summarise data. Map of site locations Photopoint photos of sites	Copies of raw data sheets to be kept by group and a copy to Berri NRM Board offices. BRS will have a reporting proforma – copy data over to that. BRS website – enter data there when online.	Rebecca/Caren

6. Data Analysis Reporting

Analysis tool	Responsibility	Presentation	To Whom
Salinity Snapshots	BRS project coordinator	• Salinity levels to BRS quarterly	• BRS • NRM Board

7. Additional Metadata

Category	Element	Metadata	
Dataset	Identifier	BC007	
	Title	Borrow Creek Water Resources Study	
Custodian	Custodian	South Australian Murray-Darling Basin NRM Board (Berri Office)	
	Jurisdiction	South Australia	
Description	Abstract	Surface and groundwater quality data including Groundwater - depth to groundwater, Salinity (EC) Surface water - Salinity (EC), pH, Turbidity, Nitrate & Phosphate levels, flow	
	Search Word	Waterwatch, surface water, salinity, nutrients, water quality, Borrow Creek	
	Geographic Extent Name	Borrow Creek, Murray-Darling Basin, South Australia.	
Data Currency	Beginning date	1st March 2004	
	Ending date	2nd February 2007	
Dataset Status	Progress	Baseline data being collected	
	Maintenance and Update Frequency	6 monthly	
Access	Stored Data Format	Waterwatch database – Microsoft Access	
	Available Format Type	Microsoft Excel spreadsheets	
	Access Constraint	Data available without restrictions	
Data Quality	Lineage	Waterwatch procedures	
	Positional Accuracy	All locations recorded as GPS points on GDA94 with 5m accuracy.	
	Attribute Accuracy	±10%	
	Logical Consistency	Standard Waterwatch database	
	Completeness	Data being collected as baseline for a community group. Some monitoring times have been missed and data is incomplete	
Contact Information	Contact Organisation	Borrow Creek Landcare Group	
	Contact Position	Jo Bloggs	
	Mail Address	Box 101 Kensington Park 5069 South Australia Australia	Phone 08 83033333 Fax 08 83033335 Jbloggs@coldmail.com.au
Meta-data Date	Meta-data Date	2nd February 2007	

8. Communication Strategy

Project Officer to report on all data from involved groups. If Landcare Group want separate annual report of their own data, need to do their own. Project Officer to arrange to have it in local media with comments on significance, like Snapshot reports.

Communication Objectives: Inform the Landcare group, the community and decision makers (NRM Board, DWLBC, Goyder & Mid-Murray Council) about the resource and changes in the resource			
Target Audience	**Communication Tool**	**Frequency**	**Responsibility**
• Landcare group • NRM Board • Rangelands sub-regional NRM group • DWLBC • Goyder & Mid-Murray Council • Regional NRM Project Officers • Land managers • General community	• Project report • Newsletter/circular (email?) • Local newspapers (Mid-North Broadcaster, Leader, Herald) • ABC 639 (North & West report)	All annual	Rebecca/Caren

9. What Support is Available / Required?

- 7-8 members of the Landcare group
- Friends of Borrow Parks
- Goyder Council
- Worlds End Conservation (might do monitoring at the Gorge)
- (associated monitoring program of the Borrow school)

NRM Board / BRS project will supply equipment & consumables, database, datasheets, training, analysis, interpretation, technical officer support,

10. Evaluation and Reflection

Overall Objective: Inform the Landcare group, the community and decision makers (NRM Board, DWLBC, Goyder & Mid-Murray Council) about the resource and changes in the resource				
Project Component	**Evaluation/Reflection Question**	**Timing and Frequency of Evaluation**	**Source of Information**	**Future Actions**
Monitoring Techniques *Surface water quality monitoring: Salinty, turbidity and nutrient levels*	*Technique is easy to use* *QA/QC standard high*	*After 12 months monitoring (ie. 3-4 monitoring events)* *After data analysis at the end of the year (ie. once every 12 months)*	*Discussion with monitoring group* *Discussion with monitoring group*	*Review monitoring protocol* *Provide feedback to monitoring group on high quality and confidence of data*
Data Management *Project Database Waterwatch database*	*Was the data readily retrievable?* *Was the data well cross-referenced for easy retrieval?*	*At annual meeting of the group* *After every 2 or 3 monitoring events*	*Discussion with project group and stakeholders* *Discussion with project group and NRM Board officers*	*Post quarterly reports on the website and data on FTP link* *Provide training for new members on data entry and verifications*
Communication of outcomes *Inform the Landcare group, the community and decision makers (NRM Board, DWLBC, Goyder & Mid-Murray Council) about the resource and changes in the resource.*	*What decisions is the monitoring program influencing?* *How many and what types of people did the project influence?*	*After 12 months monitoring* *3 months after press release*	*Discussion with project group and stakeholders (including NRM Board)* *Discuss with project officer* *Discussion with project group and stakeholders (including NRM Board)*	*Provide feedback to monitoring group on NRM Board decisions* *Consider survey of local community awareness of water quality* *Produce a 'state of the creek' report for local community*