

2. Getting started



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Introduction

Overview of this chapter

Chapter 2 provides an overview of the process involved in undertaking successful waterway monitoring projects, focusing on the need to plan carefully prior to commencing monitoring activities in the field.

Specifically, this chapter gives advice on:

- group planning (Part A)
 - forming or joining a monitoring group
 - getting to know your catchment
 - setting group goals
 - identifying and selecting potential monitoring projects
 - developing a data confidence statement
- project planning (Part B)
 - developing and documenting a project monitoring plan
- project implementation (Part C)
 - undertaking a health and safety risk assessment
 - preparing monitoring procedures and record sheets
 - delivering training
 - conducting monitoring
 - handling data entry and management
 - summarising, interpreting and reviewing your data
 - reporting and communicating results
 - reviewing your project.

Why this chapter is important

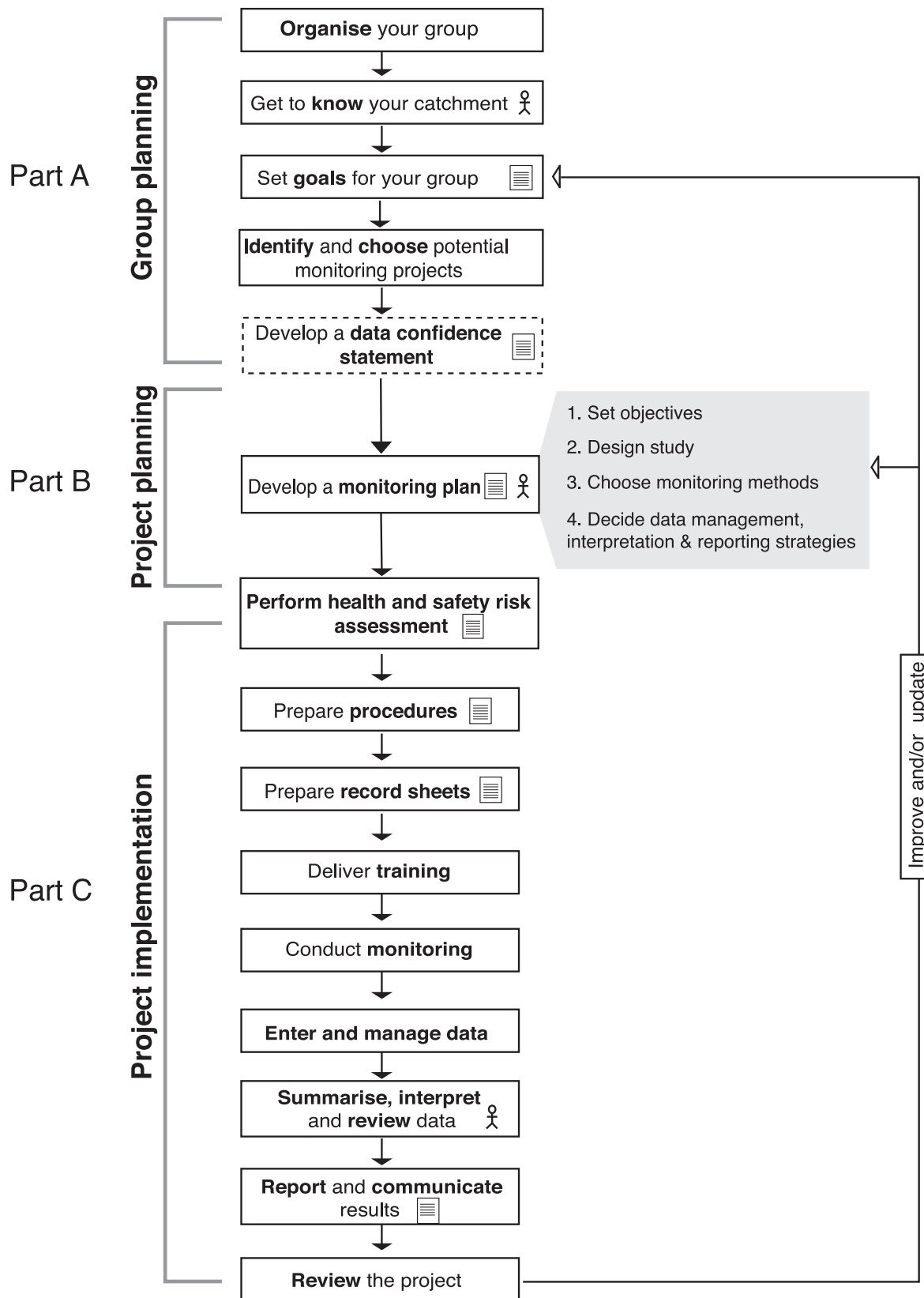
Chapter 2 is important because it outlines the steps involved in planning and developing your waterway monitoring projects.

Before undertaking any waterway monitoring activities, it is important to meet with your group to identify priority issues in your catchment, group goals and possible monitoring projects. This ensures that your monitoring efforts focus on those issues of most concern to the group. A carefully designed and documented monitoring plan for each of your projects is vital to ensure that the data you collect meets your needs and achieves your objectives. A monitoring plan will also ensure that others understand your project and have confidence in your data. You will need to complete a number of other steps before you commence any fieldwork, and also after monitoring activities have been completed. This chapter is designed to ensure that you don't forget any of these important actions.

How to use this chapter

This chapter is divided into four sections. Part A, 'First steps for your group', is useful for community members and groups keen to get involved in waterway monitoring for the first time. Part B, 'Developing a project monitoring plan', is useful for groups who have already identified a potential monitoring project and are ready to design their project monitoring plan. Groups who have already developed and documented their monitoring plan can go straight to Part C, 'Implementing your monitoring project'. The final part of the chapter, 'Developing a monitoring plan—steps and documentation' provides an easy-reference list of the documentation required for each step in developing your monitoring plan.

At the outset, all groups should examine Figure 2-1. This figure is a useful guide to the whole process of undertaking a waterway monitoring project, including group planning, project planning and project implementation.



- Indicates that this step should lead to the development of a document
- Indicates that scientific expert advice should be sought in this step
- - - Indicates an optional step in project process

Figure 2-1 Overview of the process involved in undertaking a waterway monitoring project



Part A: First steps for your group

Organising your group

Your decision to become involved in local waterway monitoring may have been due to a variety of reasons, and there will certainly be others in your community who share your interest in waterway monitoring. Interested parties could include other local residents and landholders, schools, community-based catchment groups, your local council, your local water authority, your regional natural resource management (NRM) body and state government agencies.

Before starting any waterway monitoring activities, you should first identify whether any existing community-based groups in your area share your interest. It is much easier to enlist an existing group than to set up your own. Some groups may already have skills and experience (or have access to other experts) in waterway monitoring that they can share with you. Even if your local community NRM group is not currently involved in waterway monitoring, they may be keen to establish a new project.

To identify relevant community NRM groups in your area, contact:

- Waterwatch Queensland
<www.qld.waterwatch.org.au>
- Queensland Water and Landcarers Inc.
<www.qwalc.org.au>
- your regional NRM body
<www.regionalnrm.qld.gov.au>
- your local council
- your local agricultural industry association.

If you are interested in setting up your own group and monitoring program, the first step is to identify the human, financial, and expert resources available. Ask yourself the following:

- Who are the good organisers in your area?
- Who knows the waterway?
- Who knows how to raise funds for your project?

Consult with people who use the waterway and live on the waterway, as well as catchment committees, water authorities, local businesses, local councils, schools and your regional NRM group, and tell them about your plans.


It is worthwhile to hold a public meeting made up of a broad range of community members and groups who share your interest. Use this meeting to guide the formation and development of your group's activities. The input of many contributors will build a strong foundation for your group.

Be clear about the requirements asked of group members and how much time will be involved. Identify useful skills and experience within the group, such as technical skills in monitoring or on-ground rehabilitation of the waterway. Identify possible sources of expert technical advice and training, and begin to build relationships with these sources. The most likely source of local expertise is your regional NRM body. Your local council, state government agency, university or even other community-based groups with extensive experience in waterway monitoring may also be able to provide advice and training.

Queensland Water and Landcarers (Inc.) can provide valuable advice on how to establish your own group, such as accessing establishment grants and insurance cover.

The Queensland Government regional NRM website at <www.regionalnrm.qld.gov.au/get_involved/community_groups> is also a useful source of information on finding or establishing a community NRM group.

Getting to know your catchment

 Before undertaking any waterway monitoring activities, it is important for your group to develop an understanding of the catchment, including its geographic boundaries, natural and modified features, and human-induced issues.

Getting to know your catchment will help you to:

- appreciate the importance of local waterways and their interconnections within the catchment
- identify land uses, pollution sources and 'hot spots' with the potential to affect the health of the waterway



- identify issues in your catchment that you may want to address and research further within the scope of your monitoring activities
- identify the geographic boundaries of your catchment and therefore understand the potential extent of a waterway health issue and the scope of your monitoring activities
- identify natural and modified features of the catchment that may help explain the results of your monitoring activities
- identify potential sites for your monitoring projects.

To understand your catchment, you will need to undertake a detailed background investigation.

You should research and collect:

- maps showing catchment and subcatchment boundaries, major land forms, land uses, soil types, rainfall data, population centres, sewage treatment plants, outfall pipes into waterways, bridges, weirs, and dams
- descriptions of the climate, including seasonal, annual and long-term patterns
- descriptions or maps of the types of flora and fauna present in your catchment
- a list of current and historical uses of the surrounding land and of the waterway itself (including any protected environmental and cultural values of the waterway)
- descriptions of the issues and pressures facing your waterway, and local efforts and projects underway to address these.

A great deal of this information will be available from a topographic map of your catchment. Topographic maps are available to the public from customer service centres of the Department of Environment and Resource Management, map centres, and some larger newsagencies. Your local council, water authority or regional NRM group may also generate a map specifically for your area.

Other sources of information could include:


- regional NRM group databases
- local council reports and databases (for example, for information on land uses and zoning, draining maps or council waterway management works)
- state government agency reports and databases (such as the Department of Environment and Resource Management, Queensland Herbarium and Queensland Primary Industries and Fisheries)
- records and reports compiled by local

community groups

- community members as sources of local anecdotal knowledge (including Indigenous knowledge), particularly older members of the community.

You may also wish to undertake your own catchment survey to allow you to cross-check some of the information gathered by your group's background investigation. You should focus your catchment survey on specific issues and areas of interest rather than trying to cover everything. Catchment surveys can be time-consuming, so it is better to collect detailed information on a specific issue or area than to conduct a brief survey where follow-up surveys are then required. To conduct your survey, use the record sheet template provided in Chapter 10.

Setting goals for your group

The next step in establishing your group is to set  some general goals or define what your group would like to achieve. Your goals can be short-term or long-term and should be informed by the catchment issues identified through your background investigation. It is a good idea to make your goals public to gain support and understanding from the wider community.

The following list provides general examples of group goals:

- Identify issues and opportunities for improving the condition of waterways and take action to address these.
- Assess whether efforts to control pollution and restore waterway health are working.
- Provide regional NRM groups with water quality data to assist with decision making.
- Educate the local community and encourage stewardship of the environment
- Provide students with skills, experience and understanding of methods in environmental science.



Identifying and choosing potential monitoring projects

To identify and choose a potential monitoring project, it may be useful to:

- consider your group's goals and the catchment issues identified as being of most concern
- prioritise these issues and consider what monitoring projects may be required to gather evidence, address, and further research these issues
- identify information gaps that exist for your waterway. Think about what sort of monitoring projects are required to fill those information gaps (for example, undertake monitoring to establish baseline values for a particular parameter)
- determine the spatial extent and severity of the water quality issue so that you can target your monitoring efforts
- consider your group's capacity to undertake a possible monitoring project. Do you have the necessary skills and resources? If not, can you build or access them from elsewhere?

2-6


When developing your project ideas, it is also a good idea to examine opportunities for developing partnerships with other groups undertaking, or planning to undertake, similar projects. Forming partnerships should be a strong focus of your monitoring activities. The most successful way to approach a catchment-wide issue is to engage as many groups as possible within that catchment to work towards a unified goal. This is particularly important when developing community ownership of NRM plans.

Collaborative partnerships create opportunities for:

- disseminating information to the wider community
- coordinating planning
- establishing links with water managers and other potential users of your monitoring information
- involving catchment stakeholders to realise changes where necessary
- influencing planning and decision making by authorities
- tapping into the available expertise and resources of agencies
- increasing resources from sponsors
- empowering local people through knowledge, planning and action
- improving awareness of how one part of the catchment is influenced by processes and events elsewhere in the catchment
- linking areas of study by school students to real local and regional issues.

(Cassidy 2003)

Developing a data confidence statement

 A data confidence statement documents your group's capacity to capture and manage data and includes information about the group, its participants, projects, resources, data management and reports. It assures others that the data you collect meets its defined purpose and is of appropriate quality.

Developing a data confidence statement (sometimes known as a quality assurance manual) is optional; many groups choose to include this information in their monitoring project plan instead. However, a data confidence statement is particularly useful to groups undertaking simultaneous monitoring projects. To avoid repeating the same information in each project monitoring plan (such as your data management procedures), you may find a group data confidence statement useful for documenting a standard set of procedures that are simply referred to each in of your project monitoring plans. For this reason, many groups opt to develop a data confidence statement once they have a few projects underway rather than at the start of their group's monitoring activities.

Your data confidence statement should be a living document, and should be updated as necessary to reflect changes to your group's participants, equipment and skills.

See Chapter 3 for detailed information on how to develop a data confidence statement and what it should contain.



Part B: Developing a project monitoring plan



Monitoring plans are project-specific documents that address the what, where, why and how of monitoring. They are very important documents that outline your monitoring strategy and the reasons behind it. Monitoring plans encourage a strategic approach and should be developed prior to commencing monitoring activities. They combine all relevant information about the project into one easily managed document that can be used to improve confidence in the data you collect or to promote your activities to external groups and organisations.

Despite the best intentions, skills and enthusiasm of those involved, many monitoring projects do not achieve their anticipated outcomes, leaving participants disheartened and unsure of what to do next. Such monitoring projects do not meet their anticipated outcome for a variety of reasons, including:

- poorly defined or unsuitable project objectives
- unrealistic expectations of what may be achieved
- unsuitable data for the objectives of the project
- compromised study design
- insufficient quality assurance and quality control procedures
- inadequate training or experience in monitoring, equipment and maintenance
- inadequate data management and documentation.

Monitoring plans offer protection against such problems, as well as providing a clear and simple format for recording and storing important project information.

A monitoring plan provides a record of all decisions made in developing a monitoring program, as well as a guide ensuring that all decisions are sound and that the study will successfully meet its objectives. When used properly, monitoring plans can be a very effective data confidence tool, as they ensure a level of critical thought in project planning and provide a consistent framework for documentation. Documentation is one of the most important considerations in developing and implementing a data confidence framework (see Chapter 3 for further information), and monitoring plans provide a mechanism for this documentation.

A well-thought-out monitoring plan will ensure that the appropriate questions are asked, and that data is collected in the right way to answer these questions. The plan will assist in deciding what to measure, where to measure, when to measure, and who will be involved, as well as determining the required quality assurance and quality control procedures to support this data.

Monitoring plans are also useful to communicate project information within groups or to external stakeholders. If other monitoring groups have similar objectives, groups could consider a combined or complementary effort. Monitoring partnerships are an effective way of increasing available information to contribute to regional NRM planning. Additionally, endorsed monitoring plans may be used as the foundation for understanding and agreement between community water monitoring groups and project funding bodies.

The monitoring plan promoted in this document is adapted from the monitoring plan framework developed by the Waterwatch Australia Steering Committee (2002).

The four key steps and twelve questions involved in developing a monitoring plan are listed in Table 2–1.



Table 2–1 Steps in developing a monitoring plan

Key steps	Monitoring plan questions
Set monitoring objectives	Q1 Why are you monitoring? Q2 Who will use your data? Q3 How will the data be used? Q4 What data quality do you require?
Develop a study design	Q5 What is your study type? Q6 What will you monitor? Q7 Where will you monitor? Q8 When and how often will you monitor?
Choose monitoring methods and procedures	Q9 What methods will you use?
Plan data management, interpretation, reporting and communication	Q10 Who will be involved and how? Q11 How will the data be managed and reported? Q12 How will you ensure confidence in your data?

The majority of these questions do not have a simple answer but require considerable time and thought to clearly answer and state the reasons behind the decisions made. It is important to answer and document your responses to each of the twelve questions within the monitoring plan, as they step you through the range of considerations that need to be made prior to implementing a monitoring program. The level of detail and complexity of responses will depend on the type of monitoring being undertaken and the way that the collected data will be used.

Further guidance on how to address these questions and develop your monitoring plan is provided in chapters 4 to 8.

Before you begin

Before developing a monitoring plan, it is necessary to document some project details. These details provide background information about who will be managing the project. Relevant information to capture includes:

- **the name of the project.** Each project should have a specific and distinct name or title, which should be used when referring to the project. The project name should convey sufficient information to enable others to understand what the project is about
- **a project code.** It is often beneficial to give each project a code in addition to a project name. This is usually an abbreviation of the

project name that allows simple identification of the project. The project code is useful for marking files and other documents

- **a project description.** Also known as a project brief, this outlines the purpose and scope of your project and is a useful summary to provide to external parties to explain what you are doing
- **the name of the project manager or leader.** Each project should have a nominated project manager who is responsible for running the project. They are also responsible for coordinating the development of the monitoring plan. The managing organisation or group for your project should be documented
- **contact details.** Sufficient information should be provided to enable prospective data users to contact the project manager. Information should include
 - o postal address
 - o telephone number(s)
 - o fax number
 - o email address
 - o website URL (if applicable)
- **project duration.** Information regarding the anticipated commencement and finish dates for the project, as well as all review dates, should be provided. Some projects will be ongoing and will not have a specified finish date. Nevertheless, it is very important that you set a review date, when the project will be evaluated to ensure that it is meeting your objectives.



Step 1: Set monitoring objectives

Setting project objectives is a critical step in any monitoring project. The objectives should be succinct statements of what the project seeks to achieve, and will accordingly guide all other aspects of the project.

Often, monitoring projects try to achieve too much. If you have difficulty in determining a succinct statement of the objectives of your project, or there are many differing objectives within a single project, you should consider breaking the project down into a number of smaller projects and develop a monitoring plan for each.

Before you can determine the objectives, you must consider what issues are going to be investigated and why, who will use the data and how it will be used, and what level of data quality is required. This information can be obtained by answering the first four questions of the guide to developing a monitoring plan.

Q1 Why are you monitoring?

The first question can often be the most difficult to answer but it is critically important that you are able to explain why you are interested in undertaking a particular monitoring project. The answer given to this question will influence answers to all other questions so you should consider it carefully.

During your initial catchment survey you may have identified a number of water quality issues that your group would like to address. However, you need to be specific about which of these issues you will be investigating in your monitoring project. It is also crucial to identify your reasons for undertaking the monitoring program.

You may have one or several reasons, such as to:

- increase community awareness
- increase community skills
- assess the current condition using a snapshot (once-off) survey
- assess current condition by identifying and establishing baseline values
- monitor trends through time to determine decline or improvement in condition

- develop or refine water quality guidelines for ecosystem health
- detect any pollution events, pest species outbreaks or similar events
- estimate pollutant loads associated with flow events—for example, to refine catchment models
- estimate pollutant concentration and distribution over a given time period, including flow events
- assess impacts of a land use or pollutant source
- assess the effectiveness of a management action
- assess compliance with guidelines for a human use—for example, drinking, irrigation or recreation
- achieve other goals—you should specify these.

Q2 Who will use your data?

Your group must consider all potential information users, clients and other possible stakeholders when developing a monitoring plan. Think about which individuals or organisations you would like to use your data, as well as those you are hoping to influence as a result of the project. Anybody with a potential interest in the data, results or outcomes of the project should be considered a stakeholder.

Develop a list of potential stakeholders. Data users may include:

- members of your group
- landholders
- Waterwatch groups
- catchment groups
- Landcare groups
- environmental organisations
- schools
- industry groups
- local councils
- regional NRM bodies
- state government agencies
- federal government agencies
- universities
- consultants.

Contact each potential stakeholder and tell them what you are planning to do and why. Gauge their interest in the issue and establish their support for the project. You should also ask them if they wish to be associated with the project or kept informed with project updates.



As well as considering what types of groups may have an interest in or use for your data, you should clearly document who the data users are and how they can be contacted. Provide contact details for each stakeholder, including:

- organisation
- contact name
- postal address
- telephone number(s)
- email address.

Q3 How will the data be used?

The data collected must be compatible with the expected use of the data for both your group and other potential data users (those you identified in Question 2). An effective way to achieve this is to involve your stakeholders in developing your monitoring plan.

Community-based waterway monitoring data can be used at different scales. Consider the scale of use (local, regional or state) and how data will be used at that scale. For example, at the local scale, data could be used by catchment groups, schools and local councils. They may use your data to:

- raise awareness among school students about the general health of the local creek
- identify any major water quality issues or 'hot spots'
- develop a catchment management plan
- evaluate the effectiveness of river restoration work
- decide where to place a new sewage treatment facility
- achieve other local objectives.

At a regional scale, potential data users could include regional bodies, which may use your data to:

- evaluate the effectiveness of a Water Quality Improvement Plan
- measure targets or progress towards regional water quality targets (resource condition targets)
- report on the state of the region
- achieve other regional objectives.

At the state scale, data could be used by state agencies or research institutions, which may use the data to:

- contribute to State of the Environment reporting
- develop or refine water quality guidelines
- assist with academic research activities
- achieve other state objectives.

Some of these uses may be similar to your answers to the earlier question, 'Why are you monitoring?' However, answers to Question 1 are only related to your own group's reason for monitoring and using the data. Your stakeholders may be hoping to use the data for different purposes, so it is important to ask them for and document their requirements. Record the answers they give in relation to each question within the monitoring plan guide. In particular, consider how they intend to use the data and what data quality is required to achieve this. As far as possible, any problems or differences of opinion should be sorted out during the project planning phase rather than once monitoring has taken place.

For some groups, the value of monitoring work is not so much in the data it produces, but rather in promoting community involvement, building awareness and a sense of stewardship towards the environment, and educating young people. Therefore, some groups may not be able to nominate a specific use for the actual monitoring data. This should still be noted within your monitoring plan.

Q4 What data quality do you require?

After you have an idea of who your potential stakeholders are and how they may use the data, you can work out what level of data quality you require. This will assist you to design a monitoring plan (especially to choose monitoring methods and equipment) suitable for your needs.

Consider how *accurate* and *precise* you require your data to be. As data is never 100% accurate or precise, you need to think about what level of error in your measurements is acceptable to your group. This is known as a *tolerable error range* (TER).



This manual covers three levels of data quality: *demonstrative*, *indicative*, and *analytical* (see Chapter 3 for further detail). You should select the most stringent category for your intended data uses.

To determine the level of data accuracy and precision (or tolerable error range) your group requires, think about what level of data quality will adequately answer your project objectives. You must also ensure that the level of data quality is achievable within your available resources (time, budget, knowledge and skills). Considerably more resources are required to collect higher quality data than lower quality data.

Table 2–2 outlines three different levels of data quality. Consider which level meets your project needs.

Keep in mind that achieving higher data quality not only depends on having accurate and precise data. It is also achieved by having *complete*, *representative* and *comparable* data (see Chapter 3 for a full explanation of these terms). These aspects of data quality relate to how meaningful your data is from a whole study perspective (that is, does it provide a good picture of what is going on?) rather than just in relation to each single sampling point.

When developing your monitoring objectives, you need to think about how representative and comparable you want your data to be as this will help you design your study—for example, where to monitor at the site, the number of sites used and frequency of monitoring.

Remember that there is often a trade-off between these two aspects of data quality—accuracy and precision versus completeness and representativeness—because significant resources (time and money) are needed to achieve both. Striking a balance requires deciding between monitoring fewer sites to a high degree of accuracy and precision (low completeness and representativeness) or monitoring more sites to a lower degree of accuracy and precision (higher completeness and representativeness).

For further information on selecting data quality and establishing a tolerable error range, refer to Chapter 3, ‘Data confidence’.

Table 2–2 Data quality categories for community-based waterway monitoring

Details of categories	Data quality categories		
	Demonstrative	Indicative	Analytical
Accuracy and precision of data	Lower level	Intermediate level	Higher level
Tolerable error range (TER)*	High (e.g. > 50% for physico-chemical monitoring)	Medium (e.g. 10–50% for physico-chemical monitoring)	Low (e.g. < 10% for physico-chemical monitoring)
Data uses	Demonstrate general waterway condition Raise community or school students’ awareness about waterway health concepts and issues Train in general waterway monitoring techniques	Indicate general waterway condition Identify major trends over time	Assess specific waterway conditions Identify minor trends over time Contribute to State of the Environment reporting Assist government agencies to refine or develop water quality guidelines

* Note that the TERs specified here are generalisations, and users (especially those aiming for indicative or analytical data) should develop their own TERs for each parameter being measured. See Chapter 3 for further background on how to define your TERs.



Developing your objectives statement

By this stage you will have identified why you are monitoring, who will use your data, and how your data will be used. You will also have defined what data quality you require. Next, you need to finalise your project objectives by:

- compiling background information
- developing a model or diagram of your waterway issue
- summing up your objectives into a statement or question.

Compiling background information

Develop your understanding of the issues and the catchment or waterway you wish to investigate (if you have not already done so) by compiling existing background information. Where possible, your monitoring project should build on existing knowledge and help to fill in some of the identified knowledge gaps. Possible sources of information include published scientific and technical reports, water quality and stream condition data, community and stakeholder knowledge, and land-use maps and plans.

Developing a model or diagram of your waterway issue

You should aim to develop a shared understanding of the main components of your waterway issue and how they interact. This is known as creating a conceptual model and can be done by drawing a simple diagram or flow chart on paper or using a computer program. Some websites are available to help you do this—refer to the ‘Further reading’ section at the back of this chapter.

Conceptual models are an effective method of showing how the waterway functions, and what the dominant and important processes are. They are also a useful way to identify factors that may be causing changes in the system, and the consequences of those changes. Through developing a model, what to monitor and what data is important should become apparent. For some examples of conceptual models, see Figures 2–2 and 2–3.

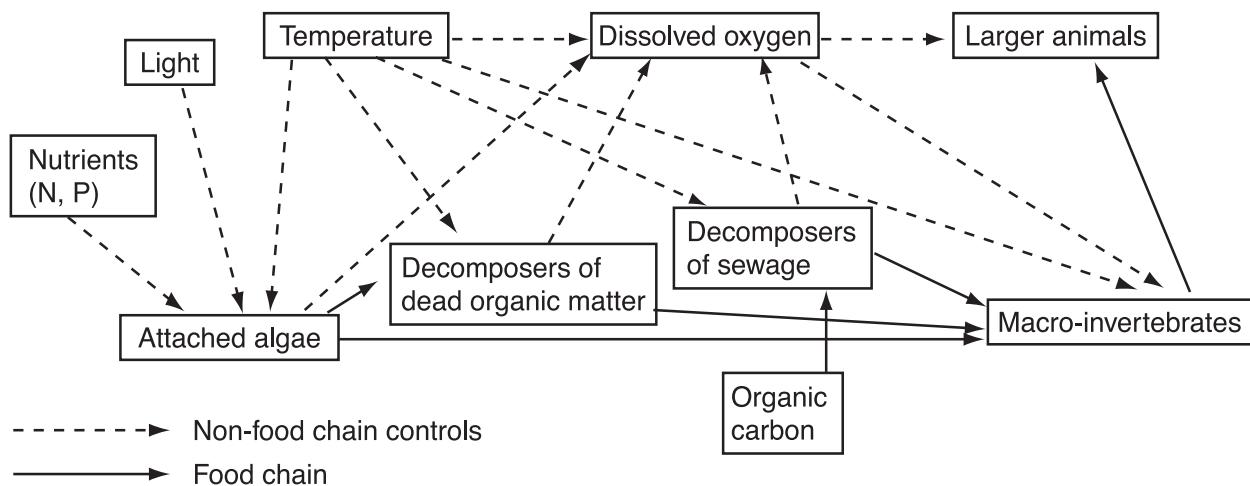


Figure 2–2 Model of a waterway showing the impact of nutrients on water quality and the aquatic ecosystem (Cassidy 2003)

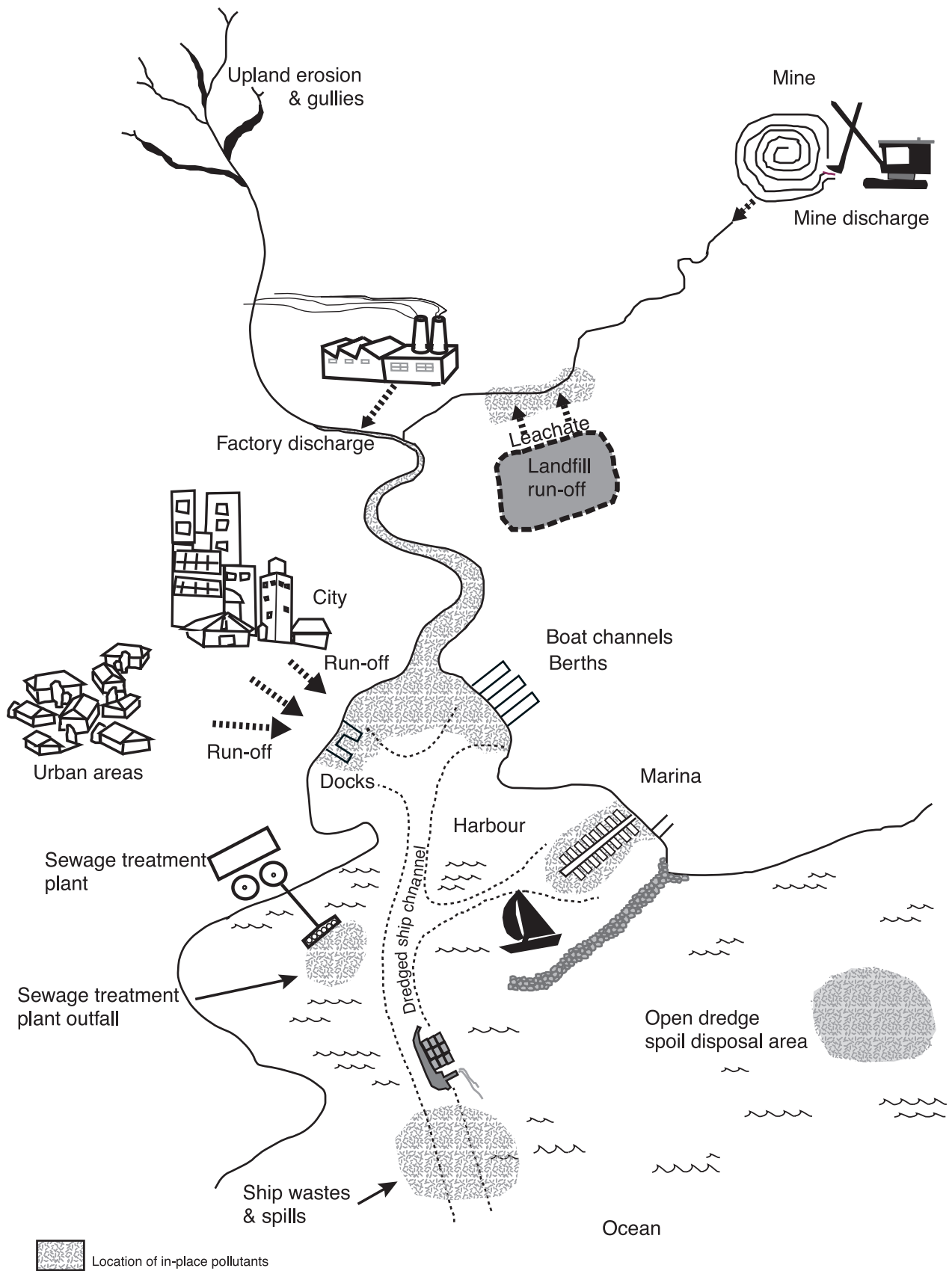


Figure 2-3 Model of sources of metal contaminants to the aquatic environment (ANZECC & ARMCANZ 2000)



Summing it all up

Your project objectives statement should sum up what, where, when and why you will be monitoring, and the required level of data quality. According to ANZECC and ARMCANZ (2000), objectives should be:

- specific—well defined
- measurable—expressed in numbers where possible
- attainable—realistic given your resources
- relevant—to the issues you are faced with
- time-based—you should know when you want to achieve them.

Below are some examples of objective statements:

- This project will measure turbidity in Smiths Creek after rainfall events to assess ‘hot spots’ for sediment delivery.
- This project will assess current stream health (water quality, biology and habitat) throughout the Burdekin catchment to establish baseline conditions.
- This project will investigate the effectiveness of riparian plantings and stabilisation works on Jones’ Farm after floods.

Another way to define your objectives is to state them as a question:

- Is water quality across the Emu Creek catchment within the recommended guidelines for ecosystem protection?
- Is the condition of Ti-tree Creek declining over time?

See below for some examples of common objective questions with suggestions on how they could be improved (Moss & Hunter 1992).

Objective question 1: Is water polluted?

This objective is too broad and imprecise to undertake a monitoring project.

Objective question 2: Are there pesticides in the water?

Although it has narrowed down the pollution source of interest, this is still too vague to allow an efficient project to be designed.

Objective question 3: Do concentrations of phosphate exceed recommended levels for human consumption?

This is a better monitoring plan objective as it defines the parameter to be monitored and the level of data required.

Step 2: Develop a study design

This step will guide you through making decisions about what type of study to undertake, what to measure, and where and when you should monitor. All of these considerations will be influenced by the objectives of your monitoring program, and the methods you will use.

Detailed information to assist in developing your study design can be found in Chapter 4, ‘Designing your study’.

Q5 What is your study type?

Defining your study type will assist you to develop a study design relevant to your objectives. Each study type will have a different design, particularly for the frequency and location of your monitoring.

The seven main types of monitoring are:

- snapshot assessments
- baseline condition and trend (routine) monitoring
- load-based monitoring
- impact assessments
- restoration assessments
- compliance monitoring
- investigative studies.

The study type relevant to your project will be based on your reason(s) for monitoring, which you will have defined in your project objectives. Defining your study type will help direct you to the appropriate advice on how to design your study.

For more information on how to define your study type, refer to the section ‘Defining your study type’ in Chapter 4.



Q6 What will you monitor?

What is actually measured is commonly defined as the *indicator*. This manual provides information on monitoring for a range of physico-chemical, biological, and stream condition and habitat indicators.

Physico-chemical indicators include:

- water temperature
- electrical conductivity
- dissolved oxygen
- pH
- turbidity
- transparency
- total suspended solids
- total phosphorus
- filterable reactive phosphorus
- total nitrogen
- oxides of nitrogen (nitrate and nitrite)
- ammonia
- pesticides
- heavy metals
- water depth
- flow velocity
- flow discharge
- depth to groundwater
- chlorophyll *a*.

Biological indicators include the number, species and diversity of:

- macro-invertebrates
- fish
- frogs
- waterbirds
- aquatic macrophytes
- algae
- diatoms.

Indicators of stream condition and habitat include the presence and condition of:

- in-stream habitat
- riparian vegetation
- bank and bed stability
- channel habitat.

The indicators that you choose will be guided by the objectives of the study, particularly the issues of concern and your reason(s) for monitoring. A conceptual model will help you choose your indicators and help you identify the factors that are important for your issues of concern, such as those causing or being affected by the issue.

For most studies, there is a large range of potential indicators, so it is essential to consider your group's capabilities and resources when selecting which indicators you will use.

For more information on deciding what to monitor, refer to the 'What to monitor' section of Chapter 4.

Q7 Where will you monitor?

Your project's monitoring objectives and study type directly influence the spatial scale of your project, and also the number and pattern of sites required within in your geographical boundaries.

Since many monitoring projects are restricted by resources (time, budget, skills and people), a trade-off between resources and number of sites must occur. Therefore, the sites that are chosen should be appropriate to, and representative of, the conditions you are seeking to investigate.

Key considerations relating to where you monitor include:

- the geographic boundaries of the project
- the scale at which you will be monitoring—for example, region, subregion, catchment, subcatchment or paddock
- the type of water body you will be monitoring—for example, upland streams or lowland streams (or other estuarine, marine, groundwater or non-flowing water body types if you are adapting the manual to monitor them)
- how many monitoring sites your project will have and where they will be located. For each site, provide a map of the site location and give site details as outlined on the site description record sheet (see Chapter 10)
- whether the sites selected are representative of the conditions you seek to investigate.

For more information on deciding where to monitor refer to the 'Where to monitor' section of Chapter 4.



Q8 When and how often will you monitor?

The goals of your monitoring project are the key to determining when and at what frequency you are going to monitor.

Monitoring strategies can be divided into three categories based on the nature of their occurrence: once-off, routine and event-based.

For once-off monitoring, you will need to choose and document the date of monitoring.

For routine monitoring, choose and record the:

- monitoring start date
- monitoring end date
- monitoring frequency—for example, daily, weekly, monthly or annually.

For event-based monitoring, you will need to consider and document:

- the event that will trigger monitoring
- the monitoring frequency during the event
- when monitoring will finish
- how many events will be monitored.

Regardless of the monitoring strategy adopted, all monitoring programs must specify the circumstances under which they will commence (this may be a time, date or trigger condition), the monitoring frequency, and a finish date or review date.

You should decide on monitoring dates and the time of the day that monitoring will be done. The time should be recorded, and future monitoring should occur at the same time whenever possible, as the time of day can affect some physico-chemical indicators. Additionally, you should ensure that the required number of monitors will be available on each planned monitoring date.

Determining when and how often you will need to sample will depend on the objectives of the monitoring program. For more information on deciding when to monitor, refer to the 'When to monitor' section of Chapter 4.

Step 3: Choose monitoring methods and procedures

This step requires you to choose a monitoring method for each indicator that is right for your needs. Detailed guidance on monitoring methods and procedures can be found in chapters 5, 6 and 7.

Q9 What methods will you use?

You must select an appropriate method for each indicator identified in Question 6, 'What will you monitor?'.

Choose a method that can achieve your required data quality and is within your available resources in terms of time, budget, participant knowledge and skills. If you cannot find a method that suits both criteria, you should review your project objectives. Do not take on more than you can achieve.

When choosing your monitoring methods, consider what type, make and model of equipment is appropriate, and keep a record of equipment details. Ensure that the accuracy and sensitivity (range, detection limits and resolution) of equipment is suitable. Decide on and document the units of measurement to be used.

Consider how you will demonstrate data confidence. You will need to keep a record of when and how you carry out:

- calibration procedures
- equipment maintenance procedures
- participant training and competency checks
- quality control checks.

You will also need to develop and document health and safety procedures for each monitoring method chosen.

For detailed information on monitoring methods and procedures refer to chapters 5 (physico-chemical), 6 (biological) and 7 (stream condition and habitat).



Step 4: Plan data management, interpretation, reporting and communication

This step requires you to consider information on roles and responsibilities, data trails and storage, as well as interpretation and reporting requirements.

Each of these considerations is dealt with in more detail in Chapter 8, 'Data management, interpretation, reporting and communication'.

Q10 Who will be involved and how?

Community monitoring activities often involve a diverse range of participants, scattered throughout the catchment, with limited face-to-face contact. It is therefore extremely important to keep up-to-date information regarding who is involved in the monitoring program and how. This data must be updated whenever details change. Relevant information includes:

- a list of all participants involved in monitoring, technical support or other roles
- contact details for each participant such as name, organisation, telephone number, postal address and email address
- a list of each participant's roles and responsibilities within the project
- a description of the skills or competencies required to successfully undertake each role
- competency or training information such as a training strategy and details of any training completed.

Q11 How will the data be managed and reported?

You must consider how the data will be managed and reported. Of particular concern to data users is the possibility that the data could become corrupted; that is, errors could creep in as the data is transcribed from the actual readings taken in the field to its final data storage format. The process of this data transcription is called a data trail. Data trails should be documented to show clients and data users how you have considered and managed the risk of data corruption at each stage of the data trail. Relevant information to document includes:

- **data trails.** Describe the path your data has taken from point of capture to secure storage. This can often be done using box and arrow (flow) diagrams

- **data storage.** Describe how and where the data is going to be stored (including how to access it), in what format, who people should contact to gain access to the data, and other storage considerations. Ideally, data should be stored in more than one place (such as on a local hard drive, on a local network drive, in hard copy, and in an external organisation database)
- **data checking.** Document what processes have been put in place to check for possible transcription errors, when in the data trails they take place and who is responsible for them
- **interpretation.** Describe how the data will be interpreted and presented
- **reporting.** Provide details of what type of reporting will take place, who it will be available to, and how, where and when.

Refer to Chapter 8, 'Data management, interpretation, reporting and communication', for further information.

Q12 How will you ensure confidence in your data?

If you have followed the monitoring plan process thoroughly, and have carefully researched and answered the prompts to each of the twelve questions, then you can have confidence in the data collected and your monitoring plan will demonstrate this to others.

You should discuss, promote, and gain support for your monitoring plan among all potential data users. The monitoring plan can be used as a communication tool to gain critical support for your monitoring activities. Approach your key clients and data users and seek their endorsement of the plan. This is a formal process in which both parties acknowledge and agree on the approach indicated by the plan.

Through this process, the monitoring plan becomes an extremely powerful tool for providing very high levels of data confidence as well as justification for the decisions made when developing the project.



Monitoring Plan Tool

The *Monitoring plan tool for community-based waterway monitoring* (the 'Monitoring Plan Tool') CD-ROM has been developed to complement this manual and make it easier for project coordinators to develop and document plans for waterway monitoring projects. The Monitoring Plan Tool is designed to guide the development of monitoring plans by ensuring that the appropriate information is recorded, thus enhancing confidence in the data that is collected.

A benefit of the Monitoring Plan Tool is its ability to save and store all information for later retrieval. In this way, it can be used as a filing system for storing your entire relevant waterway monitoring project information.

Users are guided through each of the twelve questions of the plan framework and prompted to enter their answers to each question. This information is used to generate a number of useful reports including:


- a monitoring plan summary
- user contact details
- participant contact details
- site details
- indicator and method details.

The help section provides explanations and guidance on how to use the Monitoring Plan Tool, and examples are given to assist users with answering each question. An electronic version of the *Queensland community waterway monitoring manual* is also available on the CD-ROM, providing scientific reference information to assist users with designing their plan.

The CD-ROM is available with this manual or by contacting the Department of Environment and Resource Management.

Part C: Implementing your monitoring project

Performing a health and safety risk assessment

 A health and safety risk assessment should be conducted before and during any monitoring project, to assess what can go wrong and to identify methods of preventing or minimising any potential problems. Hazards should be identified and highlighted to group members, and risk control measures should be explained and documented. A risk assessment process must be completed for every site or for every change in the nature of work being undertaken or proposed. A simple risk assessment process should involve:

- consideration of the site
- consideration of the tasks
- consideration of the people
- assessment of how a person could be injured
- identification of risk control strategies
- supervision and monitoring
- an emergency response plan.


No task is so urgent or important that personal safety should be compromised.

Refer to the *Health and safety guidelines for community-based waterway monitoring* (Department of Natural Resources and Water 2006) for further information and a template for conducting a health and safety risk assessment.

The template can be used to guide and record the process of systematically assessing risks and formulating appropriate risk management strategies. The completed risk assessment is important because it provides evidence that your group has responsibly assessed risks related to the actions that your group will be undertaking.



Preparing procedures sheets

 You must prepare and document all procedures relevant to your monitoring program. These should include:

- health and safety procedures
- monitoring methods
- data management procedures.


Your health and safety procedures should be based on measures that you have defined as necessary to address your identified risks.

Your monitoring methods and data management procedures should have been finalised when developing your monitoring plan. Next, you need to develop a set of standard operating procedures (step-by-step instructions) in a suitable format for use by all monitoring participants. They should be easy to understand and suitable for people to take out in the field (for example, laminated) and refer to while undertaking monitoring activities.

Documenting procedures also increases your data confidence. Refer to Chapter 3 for more information on data confidence.

Monitoring methods provided in this manual (chapters 5, 6 and 7) may need to be adapted to the unique environmental conditions of your area. If so, these changes should be carefully documented.

Preparing record sheets

 You must record monitoring results and other information about your waterway in a consistent and methodical way. To ensure that all necessary information is recorded at the time of monitoring, a standard results field sheet is recommended. The relevant data for each type of observation can be recorded consistently in the space provided on the record sheet, giving a uniform and complete documentation of your waterway. You should also prepare a number of other record sheets for your project. Record sheets necessary for your project may include:

- a catchment survey record sheet
- a site description record sheet
- a generic field cover sheet
- physico-chemical monitoring field sheets
- biological monitoring field sheets
- biological monitoring laboratory sheets

- stream condition and habitat monitoring field sheets
- an equipment calibration log sheet
- an equipment maintenance log sheet
- a quality control checks log sheet
- a training log sheet.

Chapter 10 provides templates for all of the above record sheets.

In addition to record sheets that gather information about your project, you should prepare a number of health and safety record sheets. These include:

- a volunteer registration form
- a sign off/on form
- an accident/incident investigation report
- a register of injuries
- a register of paracetamol use.

Refer to the *Health and safety guidelines for community-based waterway monitoring* for further details about documenting health and safety procedures (Department of Natural Resources and Water 2006).

Delivering training

Training contributes to data confidence, as the skill level and competency of the person undertaking any stage of the monitoring project can influence the accuracy of the results obtained. At the minimum, training should cover monitoring theory and practice; monitoring method procedures for each indicator of your project; use and care of field equipment; recording of data; and data management procedures. Training records for your group should be kept and regularly updated to identify current skills and future training needs.

See Chapter 9 for more information on what training to deliver and how to deliver it effectively for your monitoring project.



Conducting monitoring


After the preparation work is complete, you are ready for the fun part!

Preparation is essential for setting the foundations of your monitoring project, and for ensuring that the information you collect will answer your monitoring objectives. While conducting your monitoring activities, carefully follow your procedures sheets. This will ensure high confidence in the quality of your data.

Entering and managing data

Once you start collecting monitoring data, carefully follow your data management procedures to ensure that your data is managed appropriately. This will guarantee confidence in the quality of data you collect, and will reduce the chance of errors occurring (such as data being lost or entered into the database incorrectly).

Summarising, interpreting and reviewing data

 The results of your monitoring objectives are often buried within your dataset. You will need to summarise your data for interpretation, in order to present important features of the data and identify outliers or unusual observations. A combination of statistical tools can be used to summarise your data, including:

- graphs—such as line graphs, bar graphs, scatter plots, pie charts, and box and whisker plots
- tables
- numerical measures—such as the mean, median, mode and standard deviation of a dataset.

It is important to choose the appropriate statistical measures for your dataset and for the monitoring questions you want to answer, as different statistical measures are used for different purposes.

Interpretation of results involves:

- making observations about your results
- reviewing background information about your waterway and sites
- explaining your results
- drawing conclusions
- making recommendations.

It is also necessary to review your data and consider whether it has satisfied your monitoring objectives.

If it did answer your monitoring questions, you can then draw conclusions about what you discovered and make recommendations about what action should be taken and what further information is needed.

Even if your data did not give the answer you were expecting, the outcome is often significant and should still be interpreted and reported.

In some cases, the data collected may not adequately answer your monitoring objectives. Inadequate results could have occurred due to flaws in your monitoring methods, inadequate training of monitoring personnel for the required data quality, equipment failure, or difficulties during monitoring such as seasonal variation.


In these cases, the data **should not be reported** and instead it may be necessary to:

- refine the project objectives
- conduct training with monitoring personnel
- maintain or calibrate equipment
- undertake additional monitoring and collect new data.

Once the issues have been rectified and you have collected sufficient data, the results of the project can be reported.

For detailed information on how to summarise, interpret and review your data, refer to Chapter 8.

Reporting and communicating results

 The way you report your findings should be tailored to your audience. Your audiences will have different levels of knowledge and will vary in the way they like to receive information. Communication tools to report your results include newsletters, fact sheets, posters, maps, scientific journals, technical reports, conference presentations, seminars or workshops, open day activities or demonstrations, Internet web pages, or media releases.

Although reporting is necessary because it contains the monitoring results, communication—during the monitoring project when reporting results—is just as important. Reporting and communication will have limited impact if used in isolation from



each other. Participatory information-sharing with key audiences, contributors, and stakeholders at the appropriate times during the monitoring project is highly important.

For detailed information on how to report and communicate your results, refer to Chapter 8.

Reviewing the project

After completing your monitoring project—that is, when your project has satisfied your monitoring objectives—you need to critically review it. Good monitoring projects should be based on adaptive management. What was learnt from a completed project should be incorporated into the next project to ensure continual improvement.

You can devise your own method to review and evaluate your monitoring project; however, an example of one method of evaluation is to set up a table with three columns:

- **plus**—list what you liked or what worked
- **minus**—list what you didn't like or what didn't work
- **change**—list any suggested improvements to your project.

This table can be used to evaluate your success or identify challenges towards achieving your program goals or objectives. Even a simple evaluation such as this will assist you to critically examine your project and help make your next project more successful than the last.

Other handy tips

Ethics and courtesy

The following tips are adapted from the *Waterwatch Queensland community estuarine monitoring manual* (Waterwatch Queensland 2003).

Ethics involves understanding and respecting that people value and use waterways in different ways. Some people depend directly on waterways for their livelihood, and may feel threatened if other organisations question their actions.

Be courteous and avoid attracting negative publicity. The following are some basic tips on ethics and courtesy:

- Be considerate with data use. Do not use results to single out individuals or industries that may be contributing to a problem, as they may be unaware that they are doing so. It is best to monitor to identify issues, rather than to identify who is at fault.
- Do not rush out and make comments about ecosystem health to the press and the general community, based on just a few field tests. This is a quick way to discredit your monitoring program. Remember, several years' worth of data may be required to paint an accurate picture of what you are monitoring. Instead, stick to your predetermined monitoring plans and seek advice from relevant experts.
- Always alert local authorities, industries and landowners as to why, when, where and how you are monitoring—or, even better, involve them!
- Never enter private property without the prior permission of the landowner and/or traditional owners.
- Always remove your rubbish.
- If leaving permanent markers, ensure that they are marked with the group name and an explanation as to why they are there (for example, 'Please do not disturb or remove—volunteer monitoring in progress').
- Always leave any gates as you find them—open or closed.

Permits

Collecting aquatic fauna (from any waterway)

If you are collecting (permanently removing) any aquatic fauna from a Queensland waterway, you will need a fisheries permit from Queensland Primary Industries and Fisheries in the Department of Employment, Economic Development and Innovation. This applies to the collection of aquatic macro-invertebrates ('water bugs') along with other aquatic fauna, such as fish. In addition to the permit, you may need to comply with other conditions such as advising the regional Fisheries Officer of the date, time and location of your activities. For further information, contact Queensland Primary Industries and Fisheries through their website <www.dpi.qld.gov.au> or by phoning 13 25 23.



Monitoring in national parks and state native forests

For most community-based waterway monitoring activities in Queensland national parks and state native forests, an Educational Purpose or Scientific Purpose permit would need to be obtained prior to monitoring. If you are monitoring at a number of sites, plan ahead—the process for obtaining a permit can sometimes take up to a month. For further information, contact Ecoaccess at the Department of Environment and Resource Management on 1300 368 326 or email <eco.access@derm.qld.gov.au>.

Monitoring in state plantation forests

When monitoring in Queensland state plantation forests, you may need a permit from Forestry Plantations Queensland. See the website <www.fpq.qld.gov.au> or contact (07) 3895 3340.

Monitoring from the side of roads

If you will be conducting your monitoring activities from a road reserve or road bridge in Queensland (such as for event-based monitoring), you will need to obtain a permit from the Department of Main Roads. Contact the department through the website <www.mainroads.qld.gov.au> or by phoning your regional Main Roads office.

Monitoring in military areas

If you will be monitoring in a military area, you should contact the Australian Government Department of Defence to obtain permission. Contact the department through the website <www.defence.gov.au>.

Monitoring in Indigenous protected areas and World Heritage areas

If you are monitoring in an Indigenous protected area, a permit may be required from the local Indigenous council. Monitoring in World Heritage areas may also require a permit. Contact the organisation responsible for managing the area for further information.

Developing a monitoring plan—steps and documentation

The lists in this section provide a handy point of reference for the steps involved in developing and documenting a project monitoring plan. Documenting your responses to each of the checkbox items will allow you to produce a clear and concise monitoring plan for your project. These lists follow the steps used in the Monitoring Plan Tool.

Step 1: Set monitoring objectives

Q1 Why are you monitoring?

- Document the issue or problem being investigated.
- Identify your reasons for monitoring. See ‘Q1 Why are you monitoring?’ on page 2–9 for examples of monitoring reasons.

Q2 Who will use your data?

- Document who will use your data. See ‘Q2 Who will use your data?’ on page 2–9 for a list of potential data users.
- Provide contact details for each stakeholder. Include the following information:
 - organisation
 - contact name
 - postal address
 - telephone number(s)
 - email address.

Q3 How will your data be used?

- Select and note the scale of use (local, regional or state).
- Document how data will be used at that scale. See ‘Q3 How will the data be used?’ on page 2–10 for list of hypothetical data uses at each scale.



Q4 What data quality do you require?

- ☑ Document what level of data quality (demonstrative, indicative or analytical) you aim to achieve. See ‘Q4 What data quality do you require?’ on page 2–10 and Chapter 3 for further information on data quality levels.

It is helpful to **develop an objectives statement** by:

- developing a conceptual model of your waterway issue
- compiling the relevant background information on your monitoring issue(s).

Step 2: Develop a study design

Q5 What is your study type?

- ☑ Define what type of study your monitoring program will be. See ‘Q5 What is your study type?’ on page 2–14 for details on study types to meet project objectives. See ‘Defining your study type’ in Chapter 4 for further guidance.

Q6 What will you monitor?

- ☑ Decide on and document what indicators you will monitor to meet your monitoring objectives. See ‘Q6 What will you monitor?’ on page 2–15 for a list of indicators that the manual provides methods for, or select your own indicators. See ‘What to monitor’ in Chapter 4 for further guidance.

Q7 Where will you monitor?

- ☑ Define the geographic boundaries of your project.
- ☑ Determine and document the scale (from a reach to a region) at which you will monitor.
- ☑ Record what types of water bodies you will monitor.
- ☑ Document where your sites are located. You should include:
 - site details as outlined on the site description record sheet (see Chapter 13)
 - a map of site locations.

See ‘Q7 Where will you monitor?’ on page 2–15 and the section ‘Where to monitor’ in Chapter 4 for guidance on monitoring locations.

Q8 When and how often will you monitor?

- ☑ Choose the type of monitoring program you will undertake and complete the corresponding details. See ‘Q8 When and how often will you monitor?’ on page 2–16 and ‘When to monitor’ on page 2–18 of Chapter 4 for further information on monitoring times.

Once-off

- Date of monitoring

Routine

- Monitoring start date
- Monitoring end date
- Monitoring frequency (for example, daily, weekly, monthly or annually)

Event-based

- The event that will trigger monitoring
- Monitoring frequency during event
- When monitoring will finish
- How many events will be monitored

It is helpful to confirm:

- the indicators you will be monitoring at each site
- the monitoring frequency and required data quality for each indicator.



Step 3: Choose monitoring methods and procedures

Q9 What methods will you use?

- State which method you will use and the procedures you will follow for each indicator.
- Provide details of the type, make, and model of equipment that will be used.
- Define the units of measurement for each indicator.
- List the quality assurance procedures you will use. Cover quality assurance procedures for:
 - calibration
 - equipment maintenance
 - participant competency
 - quality control checks.

See ‘Q9 What methods will you use?’ on page 2–16 for guidance, and chapters 5, 6 and 7 for methods for each indicator used in the manual.

Step 4: Plan data management, interpretation, reporting and communication

Q10 Who will be involved and how?

- For each participant in the project, keep up-to-date records of their:
 - name
 - role in the project
 - postal address
 - telephone number(s)
 - email
 - training—both required and completed.

See ‘Q10 Who will be involved and how?’ on page 2–17 for guidance. For further information, refer to Chapter 8 and Chapter 9.

Q11 How will the data be managed and reported?

- Document where the data will be stored. Record:
 - the physical location (ideally the data should be stored in more than one place)
 - the name or details of the specific drive or database
 - details on the specific location of the drive or database on the computer (for example, file name and path).
- Document how the data will be managed. Provide details of the data trail (including reference to any quality control checks).
- Document how the data will be reported. Provide details of the type(s) of communication that will be used as well as the audience.
- Document when the data will be reported on. Provide details of the frequency of reporting as well as the time of year. See ‘Q11 How will the data be managed and reported’ on page 2–17, and Chapter 8, for more information on data management and reporting.

Q12 How will you ensure confidence in your data?

If you have followed the monitoring plan process thoroughly, and have carefully researched and answered the prompts to each of the twelve questions, then you can have confidence in the data collected. Your monitoring plan will demonstrate this to others.



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Waterwatch Queensland 2003, *Waterwatch Queensland community estuarine monitoring manual*, Department of Natural Resources and Mines, Brisbane.

Further reading

The following websites contain useful information about conceptual models, and provide tools and examples to help you build your own conceptual models and diagrams.

Coastal CRC 2006, Coastal Zone Australia Ltd, viewed 17 November 2006, <<http://www.coastal.crc.org.au/ozcoast/infopages/models.html>>.

Integration and Application Network 2006, University of Maryland, College Park, Maryland, viewed 17 November 2006, <http://ian.umces.edu/conceptualdiagrams_page.php>.

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