

Improving Data Confidence: Queensland's New *Community Waterway Monitoring Manual*

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ABSTRACT: The Department of Natural Resources and Water has developed three new products to support and guide community-based waterway monitoring throughout Queensland:

- *Queensland Community Waterway Monitoring Manual*
- *Monitoring Plan Tool for Community-Based Waterway Monitoring*
- *Health and Safety Guidelines for Community-based Waterway Monitoring*

The *Queensland Community Waterway Monitoring Manual*, released in October this year, encompasses all aspects of a monitoring project, from design to implementation and review. It includes chapters on study design, data confidence and data management, interpretation, reporting and communication. The Manual provides advice on a range of monitoring methods and guidance on selecting the most appropriate method for each projects' requirements. This novel approach is underpinned by an emphasis on evaluating data quality, driven by an increased demand for scientifically supported community monitoring data under the current regional NRM arrangements.

The Manual assists users to meet project data quality requirements by providing three levels of monitoring methods. Tiered methods are provided for physico-chemical, biological and stream condition and habitat indicators. For each method, the skill level, time and costs involved are outlined, allowing selection of the most appropriate methods for a project's objectives and available resources. The three levels vary in complexity, producing data of a demonstrative, indicative or analytical quality level. Analytical-level methods are based on state agency practice and may be applied with confidence throughout Queensland. Suitable data confidence procedures are linked to each method level.

The *Monitoring Plan Tool* software application complements the Manual, using the same structure to guide users through the development of a monitoring program. It allows electronic storage all the relevant information and automatically generates monitoring plan reports.

The *Health and Safety Guidelines* further supports community-based monitoring by providing information on how coordinators can identify and address health and safety risks associated with their waterway monitoring programs.

The combination of these three products has the potential to greatly advance community-based waterway monitoring in Queensland, enhancing the capacity of such programs by providing technical resources to support a range of program outcomes. Following the uptake of this package community waterway monitoring stakeholders, government agencies and the groups themselves will have greater confidence in the data produced; increasing the potential application of such monitoring programs.

INTRODUCTION

Since the introduction of regional (community-based) arrangements for natural resource management in Queensland in 2003, there has been increased interest in the data collected by

community-based waterway monitoring programs. These programs have always had a highly valued role in delivering valuable education outcomes. However, regional natural resource management bodies across Queensland (known as catchment management authorities in other states) are now investing in community-based waterway monitoring for both educational and scientific data outcomes. Regional natural resource management (NRM) bodies require long-term scientifically credible data on waterway condition to support natural resource management planning and decision making, and for reporting on the effectiveness of their management activities.

In Queensland, it is becoming increasingly clear that data collected by state agencies will not have sufficient spatial coverage at a fine enough scale for regional natural resource management, particularly in the larger and more remote regions of the state. While roles and responsibilities between agencies and regional NRM bodies for resource condition monitoring are still being resolved, many regional NRM bodies are interested in using community-collected data to compliment data from agency-based programs. This is because most community-based waterway monitoring groups have an exclusively local or regional focus, where their proximity to site (spatial coverage) and understanding of context (local knowledge) can make their contributions particularly valuable.

To support this increasing demand for community-based waterway monitoring data, the State Community Waterway Monitoring Team (Waterwatch Queensland), based in the Queensland Department of Natural Resources and Water, commenced a new project in 2003. Funded under the National Action Plan for Salinity and Water Quality (NAP) and undertaken in partnership with the Queensland Environmental Protection Agency, the WQ05 project aimed to enhance community capacity to monitor water quality and contribute to regional natural resource management. The project had a particular focus on building a high level of data confidence in community-based waterway monitoring among regional NRM stakeholders.

In addition to training, technical advice and state-wide knowledge sharing workshops, the project delivered a trio of new resources to support the emerging needs of community-based waterway monitoring across Queensland. These three products are:

- the Queensland Community Waterway Monitoring Manual
- the Monitoring Plan Tool for Community-based Waterway Monitoring
- the Health and Safety Guidelines for Community-based Waterway Monitoring.

Recently completed, these three products form an integrated package to support the evolution and enhancement of community-based waterway monitoring programs in Queensland. This paper discusses the key attributes of these three products and how they will support the emerging needs of community waterway monitoring and regional natural resource management across Queensland.

KEY RESOURCES

Queensland Community Waterway Monitoring Manual

The Queensland Community Waterway Monitoring Manual (the Manual) is a comprehensive technical reference resource to support all stages in the development and implementation of a community-based waterway monitoring project for perennial lotic (flowing) freshwater systems. Building on the *Waterwatch Queensland technical manual* (1994), the manual promotes a strategic and scientific approach to community monitoring that supports local and regional natural resource management.

The manual has been developed for use by the broad range of participants currently involved in community-based waterway monitoring programs. Although the key audience for the Manual are those involved in leading, designing and coordinating community monitoring programs, people involved in other roles may also find it useful. Consequently, the manual will mainly be of interest to coordinators from local community NRM groups (such as Landcare), regional NRM bodies, local councils, water authorities and industry groups. Other potential users that stand to benefit include senior high schools, universities, monitoring program participants, State and Federal Agencies, and regional NRM bodies.

The information presented in the Manual is designed to step new users through the key stages of developing and implementing a waterway monitoring program, as well as acting as a reference manual for more experienced users. The Manual provides detailed information and advice on all stages of a waterway monitoring program, including:

- establishing a monitoring program
 - establishing a community-based waterway monitoring group
 - identifying monitoring objectives
 - developing a monitoring plan
 - implementing a monitoring project
- defining and ensuring data confidence
- study design
 - defining the type of monitoring program
 - deciding what, when and where to monitor
- methods for monitoring physico-chemical indicators
- methods for monitoring biological indicators, including a guide to identifying macro-invertebrates
- methods for monitoring stream condition and habitat indicators
- data management, interpretation, reporting and communication, including advice on how to use results for improved natural resource management
- participant training and development
- record sheets and documentation
- case studies of successful programs

The Manual has been designed to support the diverse objectives of community waterway monitoring groups across Queensland, from school-based activities with a purely educational focus to those aiming to collect higher quality data for natural resource management purposes. The manual provides advice across a spectrum of monitoring approaches, from simple through to more complex. This supports the diverse range of monitoring programs across Queensland, recognising the variation in skill levels, time availability and access to resources between groups.

The manual has been developed with a particular focus on data confidence. The manual promotes the concept that data confidence can be achieved through 'defined' data quality not necessarily 'high' data quality. This approach was selected to ensure community-based waterway monitoring groups can design and implement projects and collect data that meet both their needs and those of stakeholders. Further, this focus aligns with Queensland's increased requirements for the delivery of high-confidence data from community-based monitoring programs for regional NRM purposes.

To assist groups to design a program that meets their needs and those of their stakeholders, the manual has a number of key features that distinguish it from existing resources. These are outlined below.

Monitoring plan framework: the Manual promotes the development and use of monitoring plans to ensure the activities of community-based waterway monitoring groups are carefully considered and thoroughly documented. Monitoring plans are project-specific plans that outline the what, where, why and how of monitoring. A monitoring plan ensures that the project is carefully designed to meet the needs of all stakeholders, and should be developed prior to commencing monitoring activities. It combines all relevant project information into one easily managed document that can be used to encourage confidence in the data collected, or to promote activities to external groups and organisations.

The Manual guides users through the development of monitoring plans using a specifically-designed framework (Table 1). This framework is adapted from the monitoring plan framework developed by the Waterwatch Australia Steering Committee and:

- encourages strategic planning of waterway monitoring projects
- encourages groups to consider their monitoring objectives and data quality requirements before project commencement
- provides stakeholders with confidence in the data collected and assurance that the project will meet their requirements.
- supports enhanced communication between project participants and stakeholders
- enables integration of individual monitoring projects into an over-arching program or alliance

Table 1: The monitoring plan framework developed for the Queensland Community Waterway Monitoring Manual

Key Steps	Monitoring Plan Questions	
Set monitoring objectives	Q 1	Why are you monitoring?
	Q 2	Who will use your data?
	Q 3	How will the data be used?
	Q 4	What data quality do you require?
Develop a study design	Q 5	What is your study type?
	Q 6	What will you monitor?
	Q 7	Where will you monitor?
	Q 8	When and how often will you monitor?
Choose monitoring methods and procedures	Q 9	What methods will you use?
Plan data management, interpretation, reporting and communication	Q 10	Who will be involved and how?
	Q 11	How will the data be managed and reported?
	Q 12	How will you ensure confidence on your data?

Monitoring plans developed through this framework can also be useful communication tools. A well-documented monitoring plan can:

- communicate information about a monitoring project to other stakeholders
- underpin funding applications
- identify common program objectives between monitoring groups
- support the development of joint and complimentary programs and other monitoring partnerships
- form the foundation for understanding and agreement between community water monitoring groups and project funding bodies.

The monitoring plan framework developed for the Manual was also used to develop the Monitoring Plan Tool for Community-based Waterway Monitoring. The software tool provides an electronic format for developing a monitoring plan and is discussed in more detail under the heading 'Monitoring Plan Tool'.

Data quality categories: Data quality is defined as the level of accuracy, precision, representativeness, completeness, comparability and sensitivity of data. In order to develop a

monitoring plan that meets program objectives and stakeholder requirements, the required level of data quality must be identified. The data quality level influences all aspects of a monitoring plan, including equipment purchases, study design and method selection. To assist groups to define their required data quality up-front, a simple, three-tiered data quality system has been developed for the Manual.

The tiered approach provides three broad categories of data quality for users to select from. These levels act as broad analogues of data accuracy and precision and are designed to ensure data is produced from community-based waterway monitoring programs within a known degree of quality and confidence. The three data quality categories are:

- Demonstrative level data – programs in this data quality category are designed to illustrate the underlying principles of waterway monitoring and aquatic ecosystem health. Although data generated using these methods cannot be used to make assessments of condition or trend, or inform natural resource management, it is suitable for demonstrating concepts and generating broad descriptions of condition.
- Indicative level data – programs at the indicative data quality level are designed to detect large-scale changes in condition, but not more incremental changes. Data generated at this level may be used to assess large-scale changes over time, such as major trends in condition, or to assess the effects of rehabilitation projects or similar activities.
- Analytical level data – programs working at the analytical data quality level have outcomes requiring high levels of accuracy and precision. Data generated at the analytical level meets Departmental quality requirements and can be used to detect incremental changes in waterway condition and trend. Due to the high quality, analytical level data is highly valuable for natural resource management planning and decision-making.

Once users have determined the data quality category that best matches their project requirements, the Manual provides monitoring methods linked to each data quality level. The provision of tiered methods is discussed in the 'Methods guides' section.

Methods guides: The Manual provides methods for monitoring scientifically-accepted indicators of waterway condition across three broad data quality categories. These indicators fall into three monitoring categories; physico-chemical, biological, and stream condition and habitat monitoring. Each category contains methods for monitoring one or more indicator(s). The indicators selected are those used by the Queensland Government in state-wide assessments of waterway condition, and were selected as they have been specifically developed for and tested to produce meaningful results across the diverse range of aquatic ecosystems occurring in Queensland. Aligning the manual with Queensland Government monitoring techniques will also assist the future integration of community-based and state agency waterway monitoring programs.

Indicators and monitoring methods developed in other states and territories were considered for inclusion (such as the Index of Stream of Condition, Rapid Assessment of Riparian Condition and the Tropical Rapid Assessment of Riparian Condition); however at the time the Manual was developed none has been conclusively demonstrated to meet Queensland-wide requirements. However, attributes of these other monitoring approaches have been incorporated into the Manual's demonstrative and indicative monitoring methods. In particular, the scoring systems and visual assessment techniques developed for stream condition and habitat monitoring methods were influenced by these other approaches.

The manual provides monitoring methods for the following indicators in three monitoring categories:

- physico-chemical monitoring indicators
 - dissolved oxygen
 - electrical conductivity
 - water flow
 - pH monitoring
 - water temperature
 - transparency
 - total suspended solids
 - turbidity
 - nitrogen
 - phosphorus
- biological monitoring indicators
 - macro-invertebrates
- stream condition and habitat monitoring indicators
 - bed and bank stability
 - stream habitat availability
 - riparian zone disturbance

Multiple monitoring methods were developed for each indicator type based on the three data quality categories outlines above. Each individual method for an indicator differs in both the level of data quality it produces, and the skills, costs and resources required to undertake it (table 2). This approach allows users to select the monitoring methods that best meet their data quality requirements and available resources (people, time, equipment and money).

Table 2: Hypothetical example of a methods guide from the Queensland Community Waterway Monitoring Manual.

<i>Indicator X</i>	Method 1			Method 2			Method 3		
Data quality level	Knowledge & skills	Time (hr)	Cost (\$)	Knowledge & skills	Time (hr)	Cost (\$)	Knowledge & skills	Time (hr)	Cost (\$)
Demonstrative	Beginner	< 1	~200						
Indicative				Some experience	< 3	~500			
Analytical							Expert advice	< 5	~700

Users can select methods from the data quality level that best meets the aims and desired outcomes of their monitoring project. Methods for the same indicators are aligned; assisting the progression to higher data quality levels as participants build their skills.

Demonstrative-level methods have the least accuracy and precision, but are the simplest and cheapest to undertake. These methods form an introductory point for the concepts and practises of waterway monitoring, whilst requiring minimal time and financial investment. These attributes make these beginner-level methods an ideal starting point for building the conceptual understanding and capacity of a monitoring group. They are designed for use by novices, school groups and education programs.

Indicative-level methods provide an intermediate option for groups with some monitoring experience that do not require analytical-level data quality. These methods generally require more resources (people, skills, money and time) than for demonstrative-level data, and are considered to be suitable for use by established groups and some high-school students.

Participants should have some experience and/or training in waterway monitoring techniques: the training chapter of the Manual can assist users to develop suitable training programs. These methods introduce concepts and techniques that are used in analytical monitoring programs, building participant skills and understanding.

Analytical-level methods produce high-quality data but usually have the highest skill and resource requirements. Methods producing data at this level are based on Queensland best practice standards for monitoring used by state agencies. They have been designed for experienced users and require participants to undergo training and competency assessments and generally require greater resources to undertake. These methods would be suitable for very experienced monitoring groups, university students and senior high-school science students.

The selection of methods using this tiered approach assists community monitoring groups to develop monitoring programs that will produce data of a sufficient quality to meet their project objectives. Knowing the potential applications of data collected at each quality level allows users to select methods, develop training and obtain resources that align with their data quality requirements. As such, it is essential that users consider what their data quality requirements will be when they commence development of their monitoring program.

Quality Assurance/Quality Control procedures: The Manual provides advice for maintaining and communicating data quality through the use of quality assurance and quality control (QA/QC) procedures and other data confidence measures. Data confidence refers to the confidence or certainty with which a set of data meets its defined purpose. It is important for assuring stakeholders and data users of the quality of a program's data and conclusions.

Key data confidence considerations presented in the Manual include:

- quality control procedures - procedures used for each monitoring method to minimise errors and therefore increase project data quality, such as
 - sample treatment, preservation, storage and handling protocols
 - washing/cleaning protocols
 - equipment maintenance & repair protocols
 - repeat readings/multiple measurements
 - sample labelling protocols
 - the use of standard operating procedures
 - the use of standardised record sheets (templates are provided in the manual)
- quality control checks – activities that measure and control the quality of data and can be used to demonstrate data quality to other data users, such as
 - calibrations and calibration checks
 - control samples
 - blank samples
 - replicate samples
 - randomised expert checking
 - inter-operator comparisons
- participant competency assurance – measures implemented to ensure monitoring participants have the skills and information required to undertake monitoring at a given data quality level, such as
 - peer-based on-the-job training
 - specific task-based training
 - formal accredited training

- shadow testing workshops
- data management procedures – documented protocols for the management, storage and dissemination of data derived from the monitoring program, such as
 - data recording procedures
 - data entry procedures
 - documentation procedures
 - data trail documentation
 - data storage protocols
 - use of standardised record sheets

By building these QA/QC procedures into their monitoring program design, users of the Manual can be confident in, and assure other users of the quality of data produced. This high level of confidence supports uptake and use of the data by regional NRM bodies, local government, industry groups and other stakeholders.

In summary, this strong emphasis on data quality and data confidence makes the new Queensland Community Waterway Monitoring Manual a valuable resource for community-based waterway monitoring program coordinators. By following the information and advice provided in the Manual, users can develop a comprehensive monitoring program that will produce data to meet their monitoring objectives. Users of the Manual will have a clear understanding of the quality of their data, its applications and its limitations. Through following and documenting suitable quality control/quality insurance measures, data-users can have high confidence in the data, leading to increased uptake and application of community-collected waterway condition data for natural resource management.

Monitoring Plan Tool

The Monitoring Plan Tool for Community-based Waterway Monitoring (the Tool) is a software application developed alongside the Queensland Community Waterway Monitoring Manual that assists users to develop and document a waterway monitoring plan. The Tool has been designed to assist community-based waterway monitoring coordinators to develop and document monitoring plans for their specific projects. This reflects the importance placed on the development of monitoring plans in the Manual.

The Monitoring Plan Tool promotes the development of monitoring plans using the framework developed in the Manual. As this framework is adapted from the monitoring plan framework developed by the Waterwatch Australia Steering Committee, the Monitoring Plan Tool is aligned with the National Waterwatch Technical Manual. It provides an attractive and easy-to-use alternative to developing a written plan, encouraging greater uptake of the monitoring plan framework.

Developed in consultation with potential users, the Monitoring Plan Tool assists the development of monitoring plans that are strategic, scientifically rigorous and aligned to stakeholder needs. This is achieved by ensuring that all aspects of a monitoring project are carefully considered and documented. Clear, methodical documentation of a monitoring plan contributes to increased users confidence in the data collected. High levels of data confidence increase the potential uses of the data collected and provides assurance to stakeholders.

The Monitoring Plan Tool operates via a simple graphical user interface (figure 1). Users are guided through the monitoring plan framework and prompted to enter essential information regarding their monitoring program. The Tool poses a series of eleven questions regarding the

different components of a monitoring plan, with users answering the questions by typing or selecting a response from a given menu.

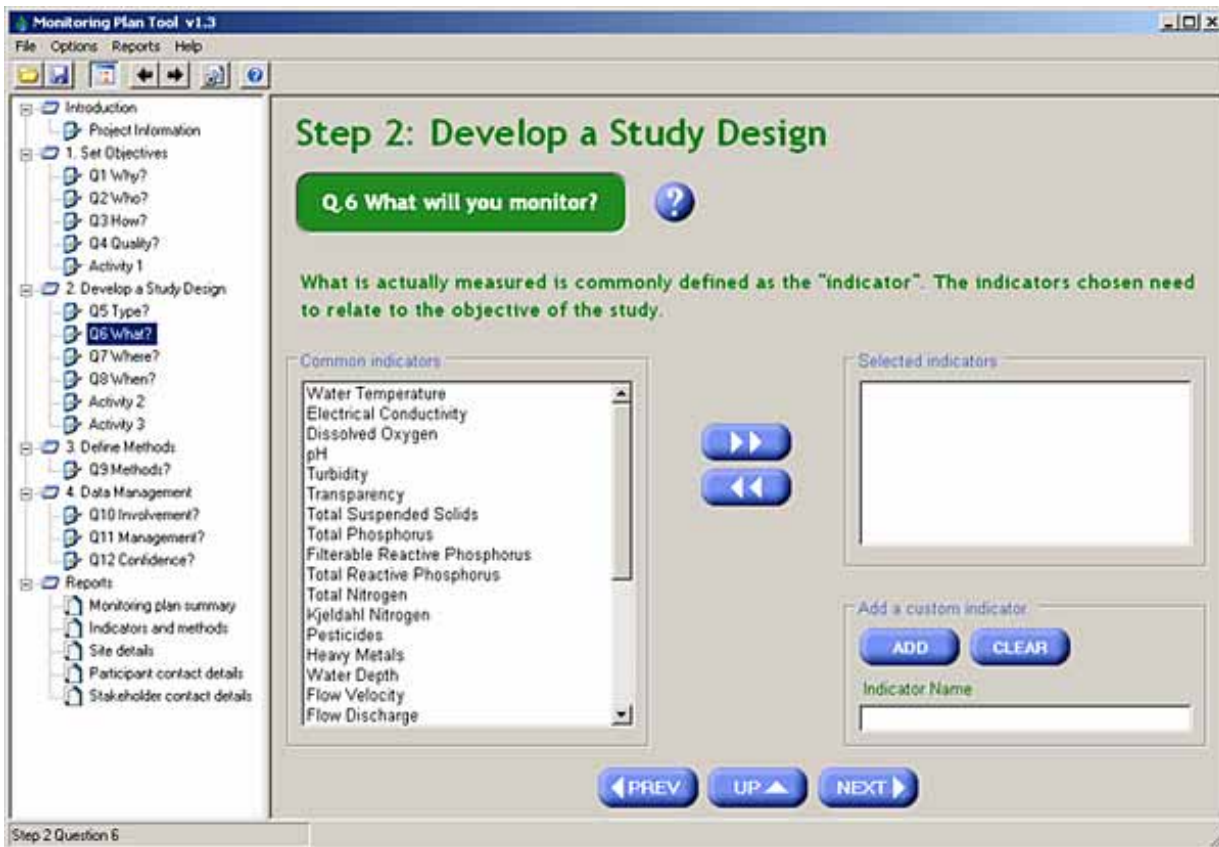


Figure 1: A screenshot from the Monitoring Plan Tool for Community-based Waterway Monitoring showing the program's graphical user interface.

The eleven questions used by the Tool follow the format used in the Manual, ensuring the two resources provide cohesive advice and approaches. The questions are divided into four key aspects of developing a monitoring plan:

- setting monitoring objectives
- determining the study design
- selecting monitoring methods
- managing data

The Tool can also automatically generate five reports based on the information entered by users:

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

The Tool is designed to be intuitive to use and easy to navigate. A thorough help system exists to support new users. All information entered into the Tool can be saved as a project. A project file can be opened and updated at any time, allowing users to store and retrieve all relevant information about their monitoring projects. The type of information entered into the Tool includes information on what, where, how, when and why monitoring is being undertaken, as well as contact information for stakeholders and participants, key program dates and how the data collected will be managed. The Tool does not, however, store waterway data collected through the monitoring program.

The Monitoring Plan Tool for Community-based Waterway Monitoring assists the development of a comprehensive waterway monitoring program by clearly identifying the types of information and considerations required up-front. The Tool's ability to save and retrieve project files and generate reports provides users with a straightforward way to manage project documentation, contributing to increased levels of data confidence.

Health and Safety Guidelines

The Health and Safety Guidelines for community-based waterway monitoring are a comprehensive and practical resource for monitoring coordinators covering all the health and safety aspects of community and volunteer-based waterway monitoring programs. Participant health and safety is an important aspect to consider when developing a community-based waterway monitoring project. The Health and Safety Guidelines assist monitoring coordinators to understand their legal obligations and responsibilities, find necessary information and document risk management procedures.

Developed by Conservation Volunteers Australia on behalf of the State Community Waterway Monitoring Team, the Health and Safety Guidelines address specific health and safety issues for community-based waterway monitoring activities. The guidelines provide information on managing volunteer health and safety issues in areas such as site selection and access, working in water, travel and personal protective equipment. This addresses an identified gap in the availability of advice specifically targeted to community waterway monitoring coordinators on managing health and safety risks. This has largely been in response to the growing interest in flood event monitoring programs across Queensland and the higher level of risks associated with community involvement in these activities.

Information provided in the Health and Safety Guidelines includes:

- insurance requirements
- developing safety protocols
- conducting risk assessments
- using material safety data sheets
- templates for useful health and safety forms and record sheets

Participant safety should be the highest priority in any community-based waterway monitoring program. Procedures to ensure volunteer safety should be incorporated into a waterway monitoring plan. The Health and Safety Guidelines provide the necessary information for users to develop and document these safety procedures, ensuring participant safety and legal obligations are understood, documented and incorporated into every monitoring project.

OUTCOMES AND IMPLICATIONS

Outcomes

Although the Health and Safety Guidelines have been available for some time, the Queensland Community Waterway Monitoring Manual and the Monitoring Plan Tool were both only released in October this year. As a consequence, it is not yet possible to report directly on the uptake and impacts of these products.

However, both the Manual and the Monitoring Plan Tool have been employed by community-based monitoring groups whilst in their draft forms. Content from the Manual was used to develop an accredited training program for community monitoring networks in South East Queensland as part

of the Ecosystem Health Monitoring Program Capacity Building Pilot; a project aiming to integrate community-based monitoring with agency programs in South East Queensland. The draft material has also formed the basis of training workshops delivered in other regions.

A draft version of the Monitoring Plan Tool was used by several Queensland community-based monitoring groups to assist with the development of monitoring plans. The monitoring plan framework presented in the Monitoring Plan Tool provided guidance on how to develop a monitoring plan and what information to include.

Monitoring plans developed using the tool by community monitoring networks in the Fitzroy and Burnett-Mary regions have been used to facilitate communication with regional stakeholders and to seek endorsement and funding for their monitoring activities from regional NRM bodies.

In South East Queensland, the tool was used as part of the Ecosystem Health Monitoring Program Capacity Building project. Standardised monitoring plans were developed for three different sub-regions using the tool. This standardisation allowed the project steering committee to review and endorse the plans in an integrated manner.

The State Community Waterway Monitoring Team has used the Monitoring Plan Tool as a component of training session on monitoring plan development.

Early responses indicate a very high demand for both products, particularly the Manual. Requests for copies of the Manual have been received from a wide array of users, including local community groups, regional NRM bodies, tertiary institutions and government agencies. This high demand suggests the Manual will fill a critical gap in scientific support for community-based waterway monitoring, created by the move towards the collection of higher quality, scientifically validated data.

Since their release in January 2006, numerous groups have made use of the Health and Safety Guidelines for Community-based Waterway Monitoring. For example, monitoring groups in the Mackay Whitsunday and Burdekin catchments have applied the Guidelines to develop health and safety procedures for community-based event monitoring programs. In the Cape York region, community-based monitoring groups have adapted the Guideline's volunteer sign on/sign off sheets and other record sheet templates for use in their ambient waterway monitoring programs.

Although these early indications have been positive, the outcomes of the WQ05 resource package will not be fully known until all resources are formally released and implemented across Queensland and a thorough evaluation undertaken.

Implications

The trio of resources produced under the WQ05 project are intended to support the emerging requirements of community-based waterway monitoring for regional natural resource management in Queensland. All three resources are interlinked, providing consistent, clear advice on all the aspects of developing and implementing a comprehensive waterway monitoring project.

The information provided by the Queensland Community Waterway Monitoring Manual, the Monitoring Plan Tool and the Health and Safety Guidelines supports the development and implementation of monitoring projects that:

- are scientifically based

- are carefully planned to meet the objectives of monitoring groups and their wider stakeholders
- produce data at defined data quality and data confidence levels
- are aligned with Queensland best practice monitoring standards and approaches
- are based on a standardised approach across Queensland
- ensure volunteer health and safety

Through the use of these resources, community-based waterway monitoring groups with sufficient resources and experience should be able to develop monitoring programs capable of providing high-level, scientifically-valid data suitable for natural resource management decision-making. The WQ05 resources support this through:

- the provision of training advice to build volunteer capacity to suitable skill levels
- the use of monitoring methods producing analytical-level data quality
- the adoption of data confidence procedures to produce data within defined and narrow tolerable error ranges
- the thorough documentation of all stages of a monitoring program, including health and safety risk assessments, monitoring plan development and data management procedures
- the use of templates to develop standardised forms, logs and record sheets.

The provision of scientifically-credible waterway condition data through community-based monitoring programs has extensive implications for natural resource management across Queensland. Key benefits of such programs include:

- **Economic:** these types of programs will greatly increase the amount of data potentially available to regional natural resource managers, through providing a cost-effective way to conduct monitoring at a localised scale. An increased availability of suitable data at this scale would lead to improved understanding of the waterway and catchment, enhanced NRM planning and decision-making and more successful environmental outcomes
- **Social:** significant social benefits of scientifically-based monitoring programs include increased participant knowledge and understanding of waterway health issues in their area. Informed participants help educate other members of the community, increasing the rate of change in uptake of waterway-friendly practises. Greater community awareness and involvement in waterway management activities results in an increased sense community ownership of local waterways and their management.

Engagement: such monitoring programs increase participant retention as participants know they are collecting meaningful information that can be used to support natural resource management decision-making and contribute to waterway management activities.

FUTURE USES AND SUPPORT

The current regional NRM arrangements that are driving the demand for scientifically-based community waterway monitoring programs are expected to continue over the long term, ensuring strong demand for these new resources continues. At present, many community-based programs are being developed and/or refined to support regional natural resource management monitoring and evaluation needs. Through support from the regional NRM bodies and other regional NRM stakeholders, ambient catchment scale programs are being refined to:

- identify waterway issues and 'hotspots' and prioritise management investments

- assist with the development of regional water quality targets
- evaluate the effectiveness of management activities and report on progress towards targets

Currently, the development of Water Quality Improvement Plans in many Queensland catchments is also driving interest and investment in community-based water quality monitoring programs. This is particularly the case for event monitoring and paddock-scale monitoring programs involving landholders and industry groups. Event monitoring programs are needed to assess pollutant runoff into waterways from agricultural areas and refine catchment models. Paddock-scale programs are needed to engage landholders in implementing best practice farming methods and assessing their effectiveness in reducing pollutant run-off into their local waterways. Monitoring and evaluation strategies, involving local communities, are currently being developed for Water Quality Improvement Plans across Queensland. The resources developed under the WQ05 project significantly support these developments.

The resources developed through this project will also assist the integration of community-based waterway monitoring with state-wide agency monitoring programs and frameworks. In Queensland, key state-wide agency monitoring frameworks are currently under review and their relationship to other monitoring activities, including those undertaken by community groups, is under consideration. Since the resources developed by the State Community Waterway Monitoring Team align with Queensland best practices for waterway monitoring, there is likely to be increased future interest in using these resources to achieve more integrated monitoring approaches and frameworks across Queensland.

The incorporation of community-collected data into strategic waterway monitoring programs is expected to increase as the structures put in place through the new Queensland regional arrangements mature and evolve. It is anticipated that community-based waterway monitoring programs will contribute further to natural resource management at the local, regional and state scales as stakeholder confidence in community-gathered data increases and new monitoring programs are established.

Given this predicted long-term demand, there is a clear need to build on the new resources developed by the Queensland Community Waterway Monitoring Team to further support the development of strategic community-based waterway monitoring programs. Currently, there are several activities already underway or to be developed in the near future to support and extend the new resources. These include:

- *A training package to support modules from the manual:* Training packages will be developed for monitoring program coordinators focussing on key chapters from the manual. Training modules will be developed for use by monitoring program coordinators to train monitoring program participants, as well as for coordinator use. Likely modules to be initially developed include training in developing and documenting a monitoring plan, developing data confidence procedures, and sampling using physico-chemical, biological and stream condition and habitat monitoring methods. Options will be explored for this training to part of a nationally accredited training package or to align with state agency training packages.
- *The development of a specialised version of the Manual for schools:* The development of a specialised version of the Manual for schools is currently in the early stages of investigation. This is being driven by an identified need for school-based waterway monitoring resources that link with the current Queensland curriculum and are also aligned with current Queensland best practices for waterway monitoring. It is proposed

that the resource will link with regionally-based school resources and professional development activities, where they exist.

Further support and extension products may be developed based on identified critical support requirements, available funding and Government priorities.

These capacity building activities will be needed to ensure the new resources developed by the Queensland Community Waterway Monitoring Team are implemented and successfully utilised by community-based waterway monitoring groups across Queensland. This will enable community-based waterway monitoring programs to contribute valuable educational, social and scientific data outcomes for regional natural resource management.