DEPARTMENT OF
PRIMARY INDUSTRIES

WEEDS OF NATIONAL SIGNIFICANCE

Monitoring and Evaluation of Willow Management

Stage 1: Report of Current Practices in Australia

Victoria
The Place To Be

National Willows Taskforce

Australian Government

Monitoring and Evaluation of Willow Management - Stage 1: Report of Current Practices in Australia

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Front Cover Photo
Crack willow developing in-stream, King River, Cheshunt, north east Victoria (Fiona Ede, DPI).

For more information about DPI visit the website at www.dpi.vic.gov.au or call the Customer Call Centre on 136 186.

For more information on the National Willows Program visit: www.weeds.org.au/WoNS/willows/

Executive Summary

Willows are a serious weed of waterways in temperate Australia and as such, significant investment is made annually in willow management by both community groups and agencies such as Catchment Management Authorities and state government departments. However to date, there has been limited evaluation of the effectiveness of willow management in achieving desired outcomes, particularly those relating to improved river health. This means it is difficult to confidently determine the effectiveness of investment in willow management.

In recognition of this gap, a project to develop consistent national monitoring and evaluation guidelines for willow management projects has been initiated by the National Willows Taskforce. The first stage of this process is to determine the extent of current monitoring and the barriers which currently limit monitoring activities. In order to investigate this, an on-line survey was distributed to willow managers nationwide to seek information relating to willow management activities, as well as monitoring and evaluation programs.

Responses to this survey were received from 32 agencies from five states and territories, and included a broad range of both community and professional willow management agencies.

Current Willow Management

- Most agencies spend 1 – 10% of their total on-ground resources on willow management;
- Half of the respondents reported an increase in investment in willow management over the past five years;
- A similar number of agencies expect an increase in investment over the coming five years.

Current Monitoring and Evaluation

- Most agencies monitor some or most projects, with only six reporting that they monitor all projects;
- Up to 2% of total project budgets is generally allocated to monitoring;
- Four agencies reported spending more than 5% of project budgets on monitoring;
- Most monitoring activities are informal and largely unstructured;
- Variables relating to the effectiveness of willow control measures are most frequently monitored;
- Many agencies also monitoring revegetation outcomes and establish photo-points;
- Monitoring of water quality variables and biodiversity variables occurs less frequently;
- Waterwatch programs contribute to the assessment of water quality for some agencies;
- Formal monitoring programs often include a range of both physical and biological monitoring variables;
- The frequency of monitoring differs between variables within programs, with water quality variables monitored more frequently than other variables;
- However, willow management effectiveness and photo-points tend to be monitored over a longer time frame after completion of works.

Use of Monitoring Information

- Monitoring data is used to assess effectiveness of willow control by most agencies;
- It is also used to determine where follow-up willow or other weed management is required and to plan future willow management projects;
- Monitoring data provides important information for reporting to stakeholders, including funding bodies, the local and scientific communities, the parent agency and state agencies.

Barriers to Monitoring

- Financial resources and time constraints are the two most important barriers currently limiting monitoring activities;
- Lack of skills, organisational culture, uncertainty about monitoring methods and uncertainty about the usefulness of monitoring data are less important in limiting monitoring for most agencies.

Monitoring Guidelines

- Standard monitoring guidelines are used to develop monitoring programs by less than 40% of agencies;
- Several guidelines exist to assist with monitoring and evaluation (M&E) of general natural resource management (NRM) activities; water quality and aquatic systems; riparian management and river health; and weed management activities.

Conclusions and Recommendations

- Development of a national monitoring framework for willow management activities is technically feasible, and is likely to be welcomed by many agencies;
- However, universal implementation of such a framework is likely to be hindered by resource constraints within agencies;
- This issue will need to be addressed to ensure the successful adoption of a national framework to monitor and evaluate willow management programs;
- Further development of a national framework will require input from a range of stakeholders including funding bodies, state and federal agencies, on-ground managers and monitoring experts;
- A national database system to collate data which complements the monitoring framework has potential to be a very useful resource;
- It is important that the development of an M&E framework and/or a database addresses the issue of whether these should relate solely to willow management activities or be incorporated into broader river health or general NRM M&E programs;
- Different levels of monitoring will be appropriate for different projects undertaken by an agency, ranging from comprehensive monitoring on a sub-set of projects to more limited monitoring on remaining projects;
- The most basic monitoring needs to assess the effectiveness of willow control, the requirement for ongoing willow or other weed control, and revegetation outcomes;
- Comprehensive monitoring should also include before and after monitoring at works sites and unmanaged sites, and assessment of all biological and physical factors on which willow management and other management interventions are likely to impact;
- This information should then be synthesised into an evaluation process and incorporated into an Adaptive Management cycle which results in improved management.

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List of Abbreviations

AUSRIVAS	Australian River Assessment System
CMA	Catchment Management Authority
DO	Dissolved Oxygen
DPI	Department of Primary Industries, Victoria
DSE	Department of Sustainability and Environment, Victoria
GPS	Global Positioning System
ISC	Index of Stream Condition
M&E	Monitoring and Evaluation
MER	Monitoring, Evaluation and Reporting
MERI	Monitoring, Evaluation, Reporting and Improvement
N	Nitrogen
NRM	Natural Resource Management
P	Phosphorus
RARC	Rapid Appraisal of Riparian Condition
WoNS	Weeds of National Significance

Section 1: Introduction

1.1 Project Background

Willows (*Salix* spp.) are serious weeds of waterways and wetland areas in many parts of temperate Australia, due to their highly invasive nature and their impacts on waterways. These impacts include modification of stream channels and hydrological processes, reduction of native biodiversity (in-stream and riparian), and reduced access to streams for fishing.

In recognition of both their impacts and invasibility, willows are a Weed of National Significance (WoNS) and declared noxious in all States. Considerable resources are invested annually in the management and control of willows, with much of this investment aimed at improving river health outcomes as part of overall river health programs. As landscape-scale willow management requires significant resources, state and federal agencies provide the bulk of the funding to undertake these activities.

It is being increasingly acknowledged that much investment in a wide range of on-ground natural resource management (NRM) activities has failed to demonstrate whether or not the desired outcomes have been achieved through management interventions. This has led to the recognition of the need for increased monitoring and evaluation (M&E) of all NRM activities, including willow management. There is a need for better understanding of the effects and effectiveness of willow management programs, to gain confidence in the outcomes of these programs in both the short- and long-term.

In order to evaluate and report on the outcomes of willow management, it is important to determine:

- the level of confidence we have that current willow reduction practices are benefiting the stream and riparian environment; and
- whether current practices achieve the desired goals in environmental management of willows and the associated waterway.

The National Willows Taskforce, through a national research forum held in February 2007, has identified the need for a project to facilitate the long-term monitoring and evaluation of willow removal activities, as one of its priorities. This project would run for 6 - 8 years and develop a strong scientific rigour to test assumptions as to the long-term benefits of willow reduction to stream and riparian environments. The project has three components:

1. develop a formula and methodology for consistent data collection;
2. undertake both pre- and post-willow reduction monitoring;
3. outsource the project to ensure that the longevity of the monitoring is not compromised.

The project described in this report addresses the preliminary stage of the first component, by investigating the current extent of monitoring and evaluation undertaken by agencies involved in willow management, and barriers which currently limit monitoring.

This information can then be used to guide development of a nationally consistent and coordinated approach to monitoring and evaluating willow management programs. The information gained from implementation of such a monitoring and evaluation framework will contribute to a greater understanding of the consequences of large scale willow reduction activities, leading ultimately to providing confidence for future investment in willow reduction programs.

1.2 Project Activities

The main focus of the project was an on-line survey to determine how much monitoring and evaluation of willow management activities happens on-ground. The survey was broken down into several parts. The first section sought information about the nature of the agency responding and the extent of their current, past and future willow management activities. The next section asked questions relating to the extent of monitoring undertaken by the agency, including resource allocation, and the barriers which limit monitoring activities. The third section focussed on the variables included in monitoring programs and the frequency and timing of monitoring of these variables. Questions relating to the use of monitoring data and standard monitoring guidelines comprised the final section. Appendix 1 contains the complete survey.

This survey was sent out electronically to a wide range of agencies nationwide, in particular those known to undertake willow management in NSW, ACT, Victoria, South Australia and Tasmania. It was also distributed via the National Willows Network email lists and through distribution from initial recipients to colleagues and other relevant parties. Due to this means of dispersal, the precise size of the final distribution network is not known, but it estimated that around 100 people are likely to have received the survey.

Once survey responses were received, a number of respondents were contacted by telephone to follow up the information they had provided and to find out more about the monitoring activities being undertaken by their organisation. This additional information is reported as case studies in Section 4 from three of the respondents who were contacted.

The final component of the project identified existing M&E guidelines from a range of sources and commenced the initial process of developing a framework for national willow M&E guidelines by identifying the minimum requirements of a monitoring program as contrasted with the requirements that would be incorporated into a comprehensive M&E program.

Figure 1: Machinery being used to clear willows along a creek line near Ovens, north east Victoria (Photo: Trevor Hunt)

Section 2: Responses to the On-line Survey

Responses were received from 32 people, with half the respondents working for Catchment Management Authorities (CMAs) or NRM Boards while a further two are employed by Water Authorities. Seven responses were received from community or private groups, including Landcare groups, and five from State Government agencies. The remaining respondents were from local government and an NRM consultancy (one response each).

Some respondents filled in all questions, while others skipped some questions. Thus in the analyses presented below, the number of respondents to many question is less than 32. A number of questions also allowed multiple answers per question. There were some internal ambiguities in answers whereby the answer to one question contradicted the answer to another, so a level of interpretation was required and this resulted in some answers to questions not being included in the analysis in a small number of cases.

The majority of respondents were based in NSW (13 respondents), ACT (4 respondents) or Victoria (12 respondents), with only two respondents from Tasmania and one from South Australia (Fig. 2). Some organisations work across multiple states, particularly between NSW and ACT, while one respondent is a national, community-based agency with NRM activities in all states and territories.

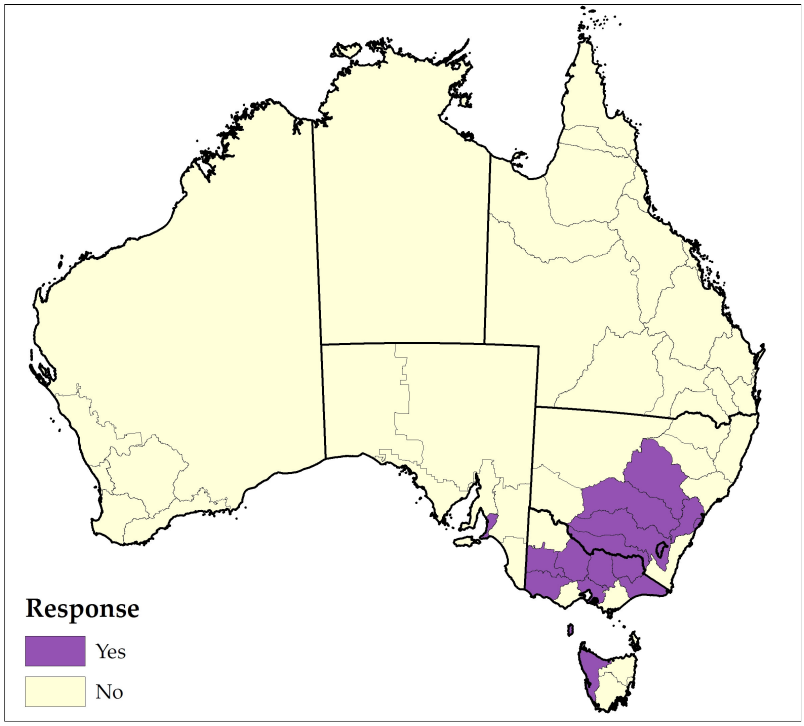


Figure 2: Map of NRM regions in Australia highlighting those regions from which survey responses were received

2.1 Willow Management Activities

For the majority of agencies that responded to the survey, investment in willow management comprises between 1% and 10% of their overall budget for on-ground activities (Table 1). Of the organisations which have a higher investment in willow management, six are either CMAs or a State Government agency. The remaining two are community groups, one of which is a Landcare group.

Table 1: Extent of Total On-ground Resources Invested in Willow Management Activities

Investment in willow management	Number of respondents
0%	1
1 – 10%	19
11 – 25%	3
26 – 50%	2
51 – 75%	2
76 – 100%	1
Total respondents	28

The NRM consultancy does not currently undertake any willow management, but is involved in monitoring of willow management activities.

Investment in willow management activities as a proportion of total on-ground investment had increased over the past five years for half the respondents, and had decreased in four cases (Table 2). Fourteen agencies are expecting their investment in willow management to increase over the next five years, while six expect investment to decrease (Table 2). These results indicate that the overall increase in investment in willow management expected in the coming five years is very similar to that which has occurred in the past five years.

Table 2: Change in Investment in Willow Management Activities

Investment in willow management	Number of respondents		
	Increase	Decrease	No change
Past five years	15	4	11
Next five years	14	6	10

Eight agencies that had increased their investment over the past five years expect further increases over the next five years, while increases in investment are forecast for three agencies which decreased investment over the past five years. Of the six CMAs or State agencies which currently invest more than 10% of their on-ground resources in willow management, three are forecasting no change in investment levels, while two are forecasting a decrease and one an increase.

2.2 Monitoring Willow Management Activities

The majority of respondents reported undertaking monitoring and evaluation of willow management activities either “often” or “sometimes” (most or occasional projects) while six agencies “always” monitor (Table 3). Of these latter agencies, five are based in NSW.

Four agencies “never” undertake monitoring and evaluation of willow management projects (Table 3), including two CMAs, a water authority and a community group. Each of these agencies spends 1 – 10% of their on-ground budget on willow management.

Of the agencies that do undertake monitoring, eleven had been monitoring for more than five years, while only seven had been monitoring for two years or less. There was no obvious relationship between the extent of monitoring and the length of time the agency had been undertaking monitoring.

Table 3: Extent of Monitoring of Willow Management Activities

Occurrence of project monitoring	Number of respondents
Always (every project)	6
Often (most projects)	9
Sometimes (occasional projects)	8
Rarely (few projects)	3
Never (no projects)	4
Total respondents	30

Almost half of the respondents (12 of 26) estimated that up to 2% of overall project budget is allocated to monitoring and evaluation, while for one agency this allocation is greater than 20% of the project budget (Table 4) but is expected to decrease in the future. This agency "always" undertakes monitoring and evaluation of projects.

Table 4: Percentage of Total Project Budget Allocated to Monitoring and Evaluation

Allocation of budget to monitoring	Number of respondents
< 1%	4
1 - 2 %	8
3 - 5%	7
6 - 10%	3
11 - 20%	0
>20%	1
Not possible to determine	3
Total respondents	26

Of the eight agencies which invest more than 10% of their on-ground budget in willow management activities, three "always" undertake monitoring with the remainder answering "often" or "sometimes" to that question. Four of these agencies spend up to 2% of their project budget on monitoring, one spends 3 – 5% and the remainder were either unable to estimate the amount or did not answer the question.

Ten respondents expect their investment in monitoring and evaluation to increase in the next five years, four expect it to decrease (including one agency that currently invests 1 – 2% of their project budgets) and 13 expect no change (Fig. 3).

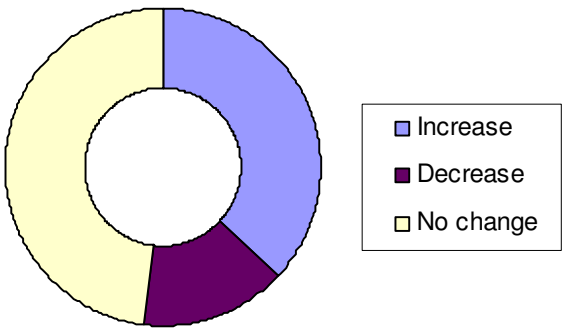


Figure 3: Expected change in investment in monitoring and evaluation over next five years

2.3 Barriers to Undertaking Monitoring and Evaluation

For those agencies that do monitor willow management activities, the barriers that are most important in limiting their monitoring and evaluation activities are lack of time (capacity) and financial resources (Fig. 4). All agencies rated lack of time as either "moderately important" or "very important" with these ratings used by almost 90% of respondents in relation to financial resources. This was the case even for those eleven agencies which are spending 3% or more of their project budget on monitoring, with four of these agencies rating financial resources as "very important" and eight rating lack of time as "very important".

The responses to the importance of the remaining barriers – lack of skills (capability), organisational culture, uncertainty about monitoring methods and uncertainty about usefulness of the data – were very similar to one another (Fig.4), with slightly more respondents rating uncertainty about usefulness of data as "moderately important".

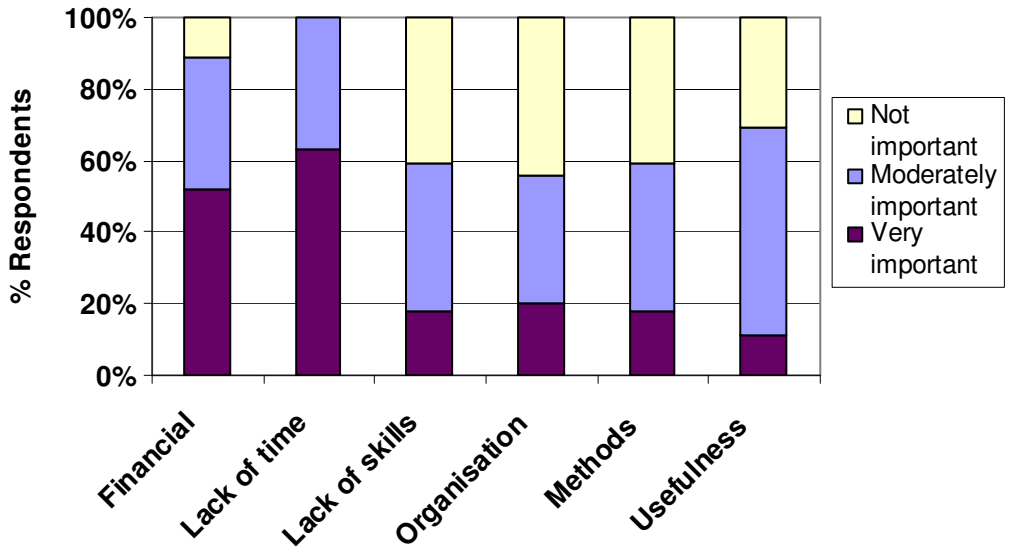


Figure 4: Importance of barriers to undertaking monitoring and evaluation

Of the four agencies which currently invest <1% of project budget on monitoring and evaluation, two rated all factors as "moderately important", except lack of skills which was "not important". For one agency all factors were rated as "very important" except lack of skills ("moderately important"), while for the remaining agency financial resources and lack of time were "very important" while other factors were less important.

Comments were included in response to this question by a number of respondents. Access to sites was a barrier to monitoring, with one respondent citing physical access to wetlands as an issue while a second commented that changes in land ownership or tenure limited ongoing monitoring at some sites. Another respondent cited uncertainty about the appropriate frequency and timing of monitoring as a barrier. It was also noted by some respondents that although there is rhetoric from funding agencies about the importance of long-term monitoring and evaluation of projects, the short-term nature of the funding environment makes it very difficult to resource ongoing monitoring.

For two of the four agencies that never undertake monitoring and evaluation, all factors were rated as "very important". However one of these agencies, a water authority, undertakes willow management on an ad hoc basis to remove willows from areas where they pose a

threat to water supply or infrastructure. Other state NRM agencies are responsible for river management and therefore undertake willow management in order to achieve river health or biodiversity outcomes.

The third agency that does not currently monitor, a community group, rated lack of time and uncertainty about methods as "very important", with financial resources and organisational culture rated as "not important". This group also commented that the scale of work (removal of a few willows only) was such that monitoring was not considered important.

For the remaining agency that currently does not undertake monitoring, the major barrier was organisational culture, with financial resources and uncertainty about usefulness of data rated as "not important". However, this respondent did note that although the lack of organisation-wide and systematic monitoring for river health outcomes was the most significant barrier, it is expected that monitoring and evaluation will be introduced in the near future.

2.4 Structure of Monitoring Programs

The majority of respondents described current monitoring programs associated with willow management activities as informal and largely unstructured (21 respondents). Some agencies reported that a mixture of informal and formal monitoring is undertaken, with only five agencies always undertaking formal monitoring of projects.

2.4.1 Informal Monitoring

For those agencies which generally undertake informal monitoring, much of the monitoring relates to assessing the effectiveness of the willow control and the need for any follow-up treatments, particularly for seeding willows. One respondent commented that the extent of monitoring of any project is highly dependent on the enthusiasm or interest of the individual project manager. Another noted that monitoring is driven by the requirements of the funding agency and government reporting requirements.

In some instances, informal monitoring occurs in conjunction with other activities at the site, such as additional weed management or as part of contractor performance evaluation. Contractors undertake informal monitoring for some agencies, while in other cases monitoring is performed by agency staff or by land-holders. It may involve collection of anecdotal information, a discussion on-site with a land-holder or more a rigorous GPS-based weed mapping activity or use of photo-points.

One agency which generally undertakes informal monitoring has also been using aerial surveys to more formally assess the current willow infestation in the region and to determine the effectiveness of recent control works.

2.4.2 Formal Monitoring

Four of the five agencies that always undertake formal monitoring reported that they either "always" or "often" monitor projects, while the fifth agency "rarely" monitors projects. However this agency does spend 6 - 10% of their on-ground budget on monitoring when it does occur, and incorporates such monitoring into their broader condition change assessment using an Adaptive Management Framework. One agency has developed a formal monitoring protocol, in association with a scientist on staff, which incorporates assessment of a variety of vegetation measures, and physical site and stream characteristics.

One respondent described an intensive and structured monitoring program being undertaken as an integral part of a major project to remove seeding shrub willows from a significant metropolitan water supply. This agency invests >20% of the project budget on monitoring which includes water sampling, soil sampling, macro-invertebrate sampling and analysis of the impacts of willow control on threatened species and communities. Aerial photographs of the project are also taken two to three times a year. The results of this monitoring program are reported annually within the organisation.

2.5 Variables Included in Monitoring Programs

2.5.1 Water Quality

The majority of respondents indicated that water quality variables were not frequently included in monitoring programs to assess willow management activities (Fig. 5). More than half the programs never included assessment of nitrogen (N) and phosphorus (P) levels or dissolved oxygen (DO), while pH, turbidity and temperature (temp) were included in monitoring activities a little more frequently (Fig. 5).

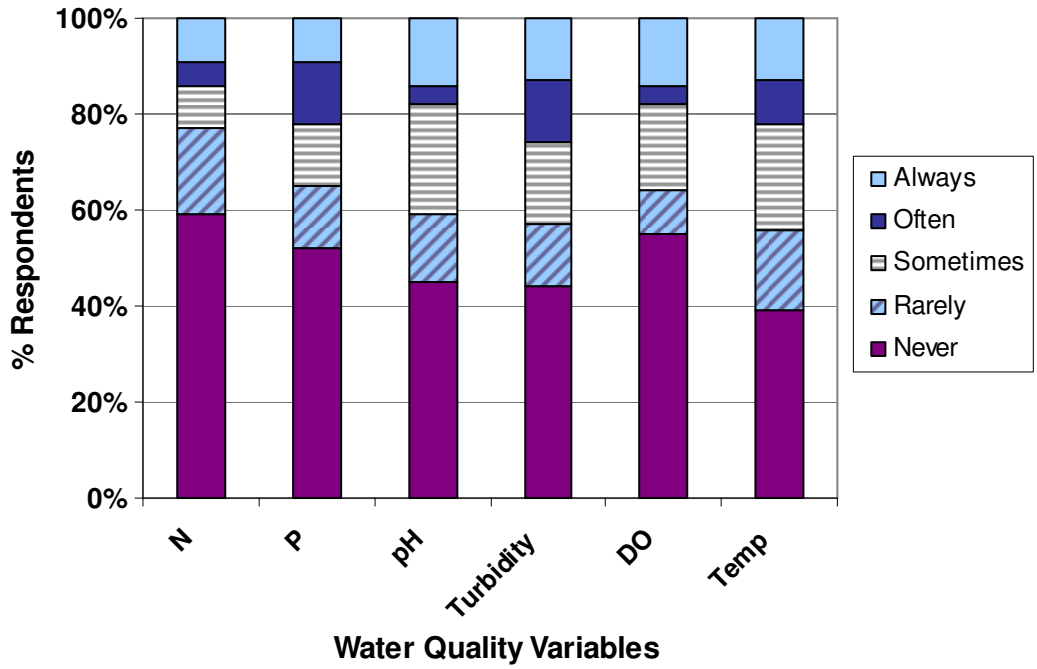


Figure 5: Inclusion of water quality variables in monitoring programs

Only two agencies reported "always" including all water quality variables in their monitoring activities. These agencies monitored most projects, with one spending 3 – 5% of their project budget on monitoring activities. Nine agencies reported "never" including any of the six water quality variables into their monitoring programs.

Other related variables that are measured at some sites include salinity (electrical conductivity) and levels of *E. coli*. At one site near a significant metropolitan water supply, the water is monitored for herbicide levels for the two herbicides used to control willows. Two respondents commented that water levels, flow and rainfall events are also monitored.

2.5.2 Biodiversity Measures

Of the biodiversity measures included in the survey, those relating to vegetation were most frequently incorporated into monitoring programs, with measures of native (native veg) and exotic riparian vegetation (weeds), and in-stream vegetation (in-stream veg) "always" included in approximately 40% of programs (Fig. 6). Sampling of in-stream macroinvertebrates (macroinv) and birds was less common (Fig. 6) with all respondents bar three sampling bird populations either rarely or not at all.

Those agencies which do not include water quality variables in their monitoring programs tend to not sample of macroinvertebrates either, but several of these agencies do "always", "often" or "sometimes" include the various vegetation assessments in their monitoring programs.

Other biodiversity variables measured by respondents include algae, platypus, lizards and water rats. One agency noted that measures specific to the on-ground project are monitored, for example the area of habitat rehabilitated for a particular frog species or other threatened species.

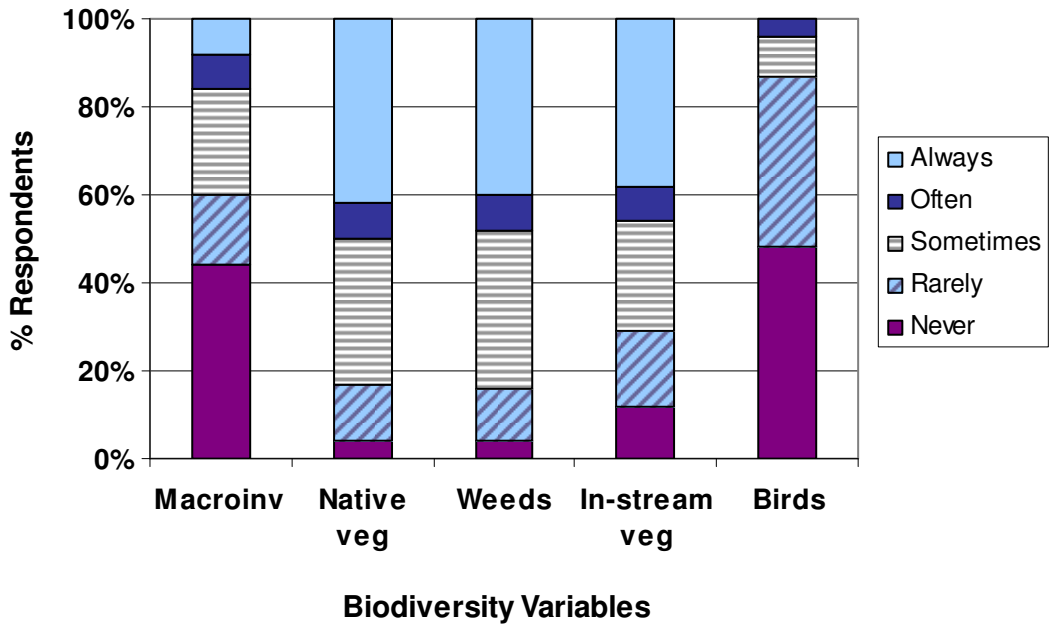


Figure 6: Inclusion of biodiversity variables in monitoring programs

One respondent commented that weed management is monitored, but that the responses to the weed problems that often arise after willow removal range from nil to complete management, depending on the land manager.

2.5.3 Effectiveness of Willow Control Measures

Monitoring the effectiveness of the control measures applied to willows is a form of output monitoring, in comparison with assessing outcomes such as changes in water quality or biodiversity variables which may occur as a consequence of undertaking willow management. Three quarters or more of respondents reported that assessment of tree death and extent of regrowth from treated willows is "always" or "often" incorporated in monitoring programs

(Fig. 7). There is also frequent assessment of whether new willow plants are developing, either from seed or from stem fragments (Fig. 7).

Several agencies undertake monitoring of management effectiveness in order to determine if follow-up treatments are required to adequately control willows, with one agency anticipating that new plants will arise from fragments and as such, treatment of these plants is programmed into future works. Other agencies monitor the number of re-treatments required to achieve effective willow management and compare the effectiveness of different control treatments.

In terms the establishment of new willow seedlings, it was noted by one respondent that the source of seed may be remote to the project site, while conversely another respondent commented that seedlings may arise outside of the project site. In both cases vigilance is required to ensure all seedlings are controlled.

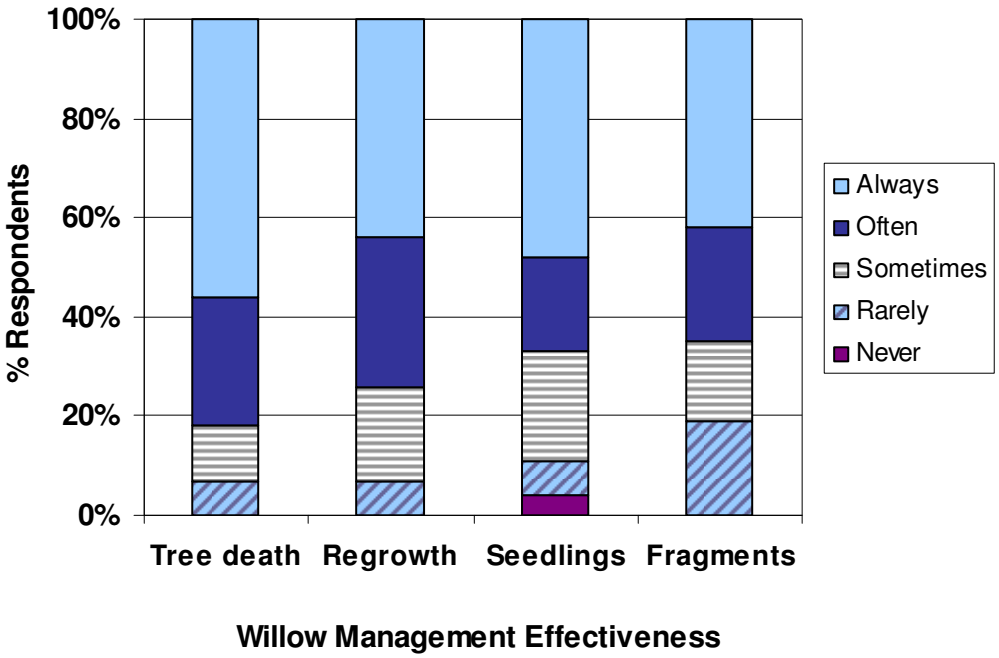


Figure 7: Inclusion of willow management effectiveness variables in monitoring programs

2.5.4 Revegetation Outcomes

Active revegetation of sites is a common activity after the control of willows, with native species deliberately reintroduced into sites through planting of nursery raised material or by direct seeding. At some sites, the native overstorey and/or soil seed banks are sufficient that the natural processes of regeneration result in the development of a riparian community dominated by native species.

Respondents reported that monitoring programs "always" incorporate assessment of revegetation outcomes in 40% or more of monitoring programs (Fig. 8), with more respondents assessing the outcomes of natural regeneration (natural regen) than the outcomes of direct seeding (sown seed).

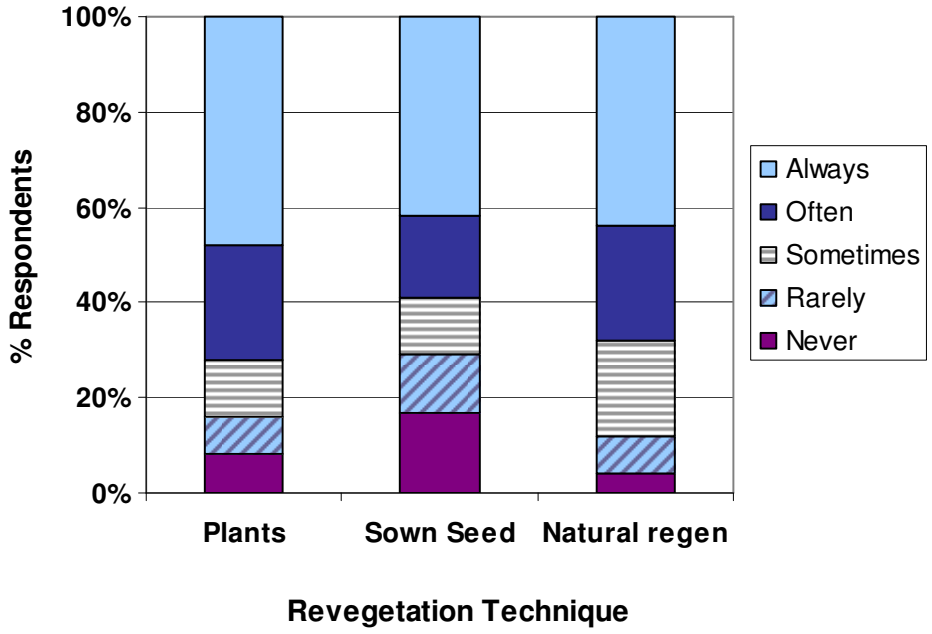


Figure 8: Inclusion of assessment of revegetation outcomes in monitoring programs

2.5.5 Photo-points

About 60% of respondents (16 of 27) "always" or "often" include photo-points in their monitoring programs (Table 5). Of the 12 agencies that "always" include photo-points, half tend to also "always" or "often" include biodiversity measures relating to vegetation, willow management effectiveness and revegetation outcomes in their monitoring programs.

Table 5: Frequency of Inclusion of Photo-points in Monitoring Programs

Photo-points in monitoring programs	Number of respondents
Always	12
Often	4
Sometimes	7
Rarely	2
Never	1
Total respondents	26

2.5.6 Other Variables

A number of agencies added comments related to other variables incorporated into monitoring programs. These included:

- physical aspects of stream morphology such as bank and bed stability;
- the effects of willow control on bed material and bed deepening;
- AUSRIVAS assessments of stream characteristics (see Section 5.2 for a brief description of this system);
- monitoring for blockages caused by willow debris;
- presence of other weeds;
- evidence of stock using the waterway; and
- evidence of willow sawfly.

2.6 Frequency of Monitoring Activities

The majority of respondents reported monitoring most variables at least annually or more frequently (Table 6). Assessment of water quality variables tended to occur either "several times per year" (7 respondents) or "irregularly" (9 respondents), while biodiversity variables were also measured "irregularly" by seven agencies (Table 6). In one agency, water quality variables are assessed monthly or after storm events.

Some agencies noted that the frequency of monitoring changed over time. One respondent commented that assessment of willow management effectiveness, revegetation outcomes and photo-points occurs 1 - 3 times per year initially then decreases to once every two years after the first phase of the project. Another agency monitors regrowth of willows for 12 months after control and any follow-up treatment, with sites then monitored every two years for seedlings until no further seedlings are found.

One agency also noted that although formal assessments of biodiversity variables occur every three years, informal assessments may occur more frequently.

Table 6: Frequency of Monitoring of Variables

Variables	Number of respondents				
	Several times/year	1 - 3 times/year	Annually	Less frequently	Irregularly
Water quality	7	3	0	2	9
Biodiversity	0	9	2	4	7
Management effectiveness	2	7	10	4	2
Revegetation outcomes	2	8	8	3	4
Photo-points	1	8	5	5	5

2.7 Timing of Monitoring Activities

A number of agencies reported that monitoring of variables occurs before, during and after works for varying periods of time, although a measure of judgement must be applied to these results as several respondents answered that both willow management effectiveness and revegetation outcomes are assessed before and during works (Table 7).

Table 7: Timing of Monitoring Activities in Relation to Willow Management Works

Variables	Number of respondents					
	Before works	During works	<12 months post works	1-2 years post works	2-5 years post works	>5 years post works
Water quality	12	4	5	6	3	4
Biodiversity	17	6	9	10	6	5
Management effectiveness	9	12	19	14	10	7
Revegetation outcomes	5	3	17	12	8	5
Photo-points	19	16	18	14	10	7

Willow management effectiveness and photo-points tended to be most consistently monitored variables over the medium- to long-term by the majority of respondents, whereas the number of respondents still measuring water quality and biodiversity variables at a works site more than two years after works had decreased to about 30% in comparison with those measuring

these variables before works (Table 7). Measurement of revegetation outcomes was greatest in the first two years after works (Table 7). One respondent commented that monitoring before and during works is always undertaken, but that monitoring after works remains opportunistic.

2.8 Use of Monitoring Information

Overwhelmingly, agencies responded that monitoring data do assist with determining the effectiveness of willow management projects. Evaluation of effectiveness ranges from assessment of condition change over time to effectiveness of different control techniques, different contractors and project expenditure.

As well as highlighting any requirement for follow-up treatment of willows or other management interventions required at project sites, this information also contributes to the planning and development of future willow management projects. This includes improving methods of control, determining the location of future projects and developing resourcing options for those projects. As one respondent noted, monitoring data allows the agency to "identify, justify and prioritise further work".

The data collected also are used to report to various stakeholders, including the local community and land-holders, the parent agency, funding agencies and government bodies. In particular, data are required to justify the investment to funding agencies and to develop the case for future funding. Two agencies mentioned that they use their monitoring data to contribute to the body of science through publication of results in journals for some projects, and to the overall development of best management practice. A third agency reported that data are used to promote the activities of the CMA and its investments in land management through educational events such as field days and forums.

Data collected by the local management agency tends to stay within that agency and is used internally. In some instances where projects are undertaken by the local NRM agency in partnership with the relevant state government agency, data are reported to the state agency. However, there does not appear to be any state-based or national collation of data from willow management projects at this stage.

2.9 Use of Monitoring Guidelines

Only 38% of respondents reported using standard guidelines to develop monitoring programs. In some cases these guidelines have been developed internally within the organisation using a variety of sources, while other agencies use or adapt protocols developed externally, such as Waterwatch and state and federal government MER (Monitoring, Evaluation and Reporting) guidelines. One respondent reported using the National Willows Management Guide, which provide detailed information on willow management techniques and some information about monitoring for willow management effectiveness. Some agencies reported that monitoring programs include a mixture of these externally and internally developed protocols.

Three agencies reported having staff members who are responsible for the development of monitoring programs, while two agencies reported that some aspects of monitoring are contracted out.

Section 3: Analysis of Monitoring Activities and Barriers

3.1 Current Monitoring Activities

The 32 respondents to the on-line survey represented a number of different types of agencies involved in willow management, including community groups, CMAs, state government agencies and water authorities. Although the sample was self-selecting, both the range of agencies and range of geographic locations of these agencies suggest that the respondents do constitute a relatively representative sample of agencies undertaking willow management in Australia.

The majority of agencies reported that current monitoring activities are informal and largely unstructured, and for some, monitoring occurs in an ad hoc, haphazard and/or opportunistic fashion. In these circumstances monitoring may occur if a site is visited for another purpose or if an individual staff member, contractor or land-holder undertakes the monitoring.

In contrast, five agencies reported undertaking formal monitoring, with some applying comprehensive monitoring protocols, while an additional four agencies reported undertaking a mixture of formal and informal monitoring.

These responses reflect the average proportion of total project budgets allocated to monitoring and evaluation. Approximately 50% of agencies reported allocating up to 2% of project budgets to monitoring and evaluation, while only four agencies reported investing more than 5% of project budgets in monitoring and evaluation. This is in contrast to the requirement of the recent “Caring for our Country” federal funding applications where 10% of total project budgets were expected to be committed to MERI (monitoring, evaluation, reporting and improvement) activities.

Eight agencies reported that more than 10% of their total on-ground budget was invested in willow management activities, yet only one of these agencies invests more than 2% of project budgets on monitoring and evaluation. Six of these agencies reported that their monitoring programs were informal, while the remaining two reported a mixture of formal and informal monitoring programs.

3.2 Design of Current Monitoring Programs

The most commonly monitored variables across agencies relate to determining the effectiveness of willow control. Assessments of revegetation outcomes are also often included in monitoring programs, although fewer respondents reported assessing the outcomes of direct seeding activities than survival of planted stock or natural regeneration. This may reflect the limited amount of direct seeding that currently occurs in riparian areas. Photo-points are also included in many monitoring programs.

Biodiversity variables are incorporated into monitoring programs less frequently, with assessment of indigenous and exotic riparian vegetation and in-stream vegetation more commonly monitored that bird populations or macroinvertebrates. Those agencies which monitor macroinvertebrates also tended to monitor water quality variables.

A number of respondents mentioned the involvement of Waterwatch monitoring programs in their overall river management activities, which include assessment of both water quality variables and macroinvertebrates. However in many cases, Waterwatch monitoring is undertaken as a separate activity to monitoring willow management activities, and although

they may co-occur on the same river, Waterwatch sites do not necessarily correspond with willow management sites.

A number of factors are likely to influence the relatively low frequency of water quality monitoring within willow management programs. The most significant of these relates to the need to assess water quality variables relatively frequently, and especially after event-based disturbances such as floods or storms, and the expense incurred by such intensive monitoring. It is also unclear whether or not willow management activities are likely to significantly affect water quality variables such as nutrient levels, given the impact of other factors in the riparian zone, particularly gazing. The impact of willow control is more likely to be reflected in water temperature and turbidity levels, at least in the short-term.

One respondent commented that instead of directly assessing water quality variables, that more focus was placed on assessing biodiversity outcomes, as an indicator or surrogate for water quality. Another respondent noted that their agency relies on visual assessments (particularly photo-points) to determine effectiveness of willow control and assumes that positive outcomes for biodiversity and water quality variables will ensue.

The other group of variables included in some willow monitoring programs include physical factors such as stream morphology, bed and bank stability and erosion, and bank profile. The most comprehensive monitoring programs incorporate a range of physical and biological variables. However, none of the respondents assess all the variables included in the survey in all of their monitoring activities, with groups of variables being included more or less frequently in monitoring programs.

Figure 9: Recording data on site, prior to willow management works
(Photo: Fiona Ede, DPI)

3.3 Use of Monitoring Data

There was widespread acknowledgement that the monitoring data collected by agencies is useful in determining the effectiveness of their willow management activities. The data are used to:

- Assess effectiveness of willow controls;
- Determine where follow-up willow or other weed management is required;
- Plan future willow management projects;
- Report to stakeholders – funders, community, parent agency, state agencies.

One respondent noted that data collected for remote agencies was not necessarily useful for incorporation into planning on-ground activities as the information was either too infrequently gathered or inappropriately analysed to be useful.

3.4 Future Monitoring Programs

A number of agencies responded that they expect their investment in monitoring and evaluation to increase over the next five years, while two respondents commented directly that they intended to invest more resources into monitoring activities in the future.

In Victoria, the Department of Sustainability and Environment (DSE) is the state agency with responsibility for funding river health activities. The Office of Water, within DSE, is in the process of finalising a monitoring protocol specifically for willow management projects that will be rolled out across the state in coming months. This protocol includes assessment of physical form and streamside vegetation variables, and is designed to provide data to prove condition change as a result of works. It is intended that this rapid assessment of condition will be undertaken before and after works, at varying intervals. The monitoring protocol will be used by all Victorian CMAs.

3.5 Barriers to Monitoring

The most important barriers identified by respondents to undertaking monitoring are financial constraints and lack of time (Section 2.3, Fig. 4). These two barriers are strongly linked, with the financial resources available to an agency determining their ability to employ staff. Both professional agencies and community groups are limited in their activities by resources.

Several respondents noted that the short-term nature of funding cycles mitigates against the development of robust, long-term monitoring programs. As many agencies are reliant on securing funding from outside bodies to fund willow management programs, this is a serious concern. There has been an increased acknowledgement in recent times across all levels of the NRM sector of the need for long-term monitoring of NRM activities, to determine whether or not management actions are being effective in achieving the expected outcomes. Despite this acknowledgement, there is a continued emphasis on “new projects” by many funding bodies, and a lack of commitment to provide the long-term funding required to ensure that monitoring (and even project maintenance) can be continued.

As one respondent commented “It is often difficult to secure the resources required to undertake comprehensive and useful monitoring over the longer term. Usually resources are available for initial data collection, but then follow up is uncertain and opportunistic in spite of it being a priority.” Another respondent had similar comments: “The before and during works information is always obtained, but the monitoring undertaken in the years following remains opportunistic.”

One community group commented that "One of the greatest problems is resources: asking volunteers to undertake all the monitoring tasks at the one site may be excessive, and funding usually has to be acquitted within an unrealistically short time frame, producing before-during-and-after pictures and not much more."

It may be possible to address this issue by encouraging funding bodies to fund applications which focus on monitoring projects, rather than on undertaking on-ground works, or for agencies to set aside a portion of their ongoing budget for monitoring activities. Some respondents reported that organisational culture is a major barrier to monitoring. In some instances this barrier is likely to be linked with those of financial and time constraints, because if the organisation does not value monitoring then resources and support for monitoring are unlikely to be forthcoming.

A limited number of respondents noted that uncertainty about monitoring methods is an important barrier, with one respondent noting that uncertainty about the frequency and timing of monitoring activities was an issue. However, for the majority of respondents, uncertainty about monitoring methods and lack of skills were only moderately important or not important.

3.6 Conclusions

The results of the survey indicate that the development of a national monitoring framework for willow management activities is unlikely to be technically difficult, and would be welcomed by many agencies. However, universal implementation of such a framework is likely to be hindered by resource constraints within agencies. This issue will need to be addressed to ensure the successful adoption of a national framework to monitor and evaluate willow management programs.

Figure 10: Replanting native riparian species under willow trees treated by stem injection, Kergunyah, north east Victoria (Photo: Trevor Hunt, DPI)

Section 4: Case Studies

4.1 A Collaboration Across the Community in North East Victoria

Willows and other weeds are being targeted along the Upper Ovens River in north east Victoria, through the efforts of a group of public and private land managers. Operating as the Upper Ovens Weeds Roundtable, this collaboration includes the convening Upper Ovens Valley Landcare Group, the Alpine Shire, North East CMA, an urban water supply authority, three state government agencies, a private forestry company, a constituted Riverside Walks Committee and a local golf club, all of whom have responsibility for riparian management along some part of the Upper Ovens River.

Significant investment through a number of federal government grants over the past three years has funded removal of willows, control of other weeds and revegetation with indigenous species using tube stock along 12 km (so far) of this iconic, unregulated river. Works have also included extending access for maintenance on both sides of the river along the reach, to allow for ongoing management of the full width of the riparian zone to prevent sites from becoming over-run with re-emergent weeds after willow and blackberry removal.

Although every project within the program is monitored, monitoring is largely unstructured and informal. The Landcare Group walks the reach once a year to monitor for any regrowth of willows and to identify areas that require re-treatment. The Group also identifies the need for other weed control, including spot spraying around tube stock and around the significant amount of natural regeneration that occurs. Survival of both planted and naturally regenerating plants is monitored. Assessment of other biodiversity or water quality variables occurs through the local schools' Waterwatch program, using kits donated by Upper Ovens Valley Landcare.

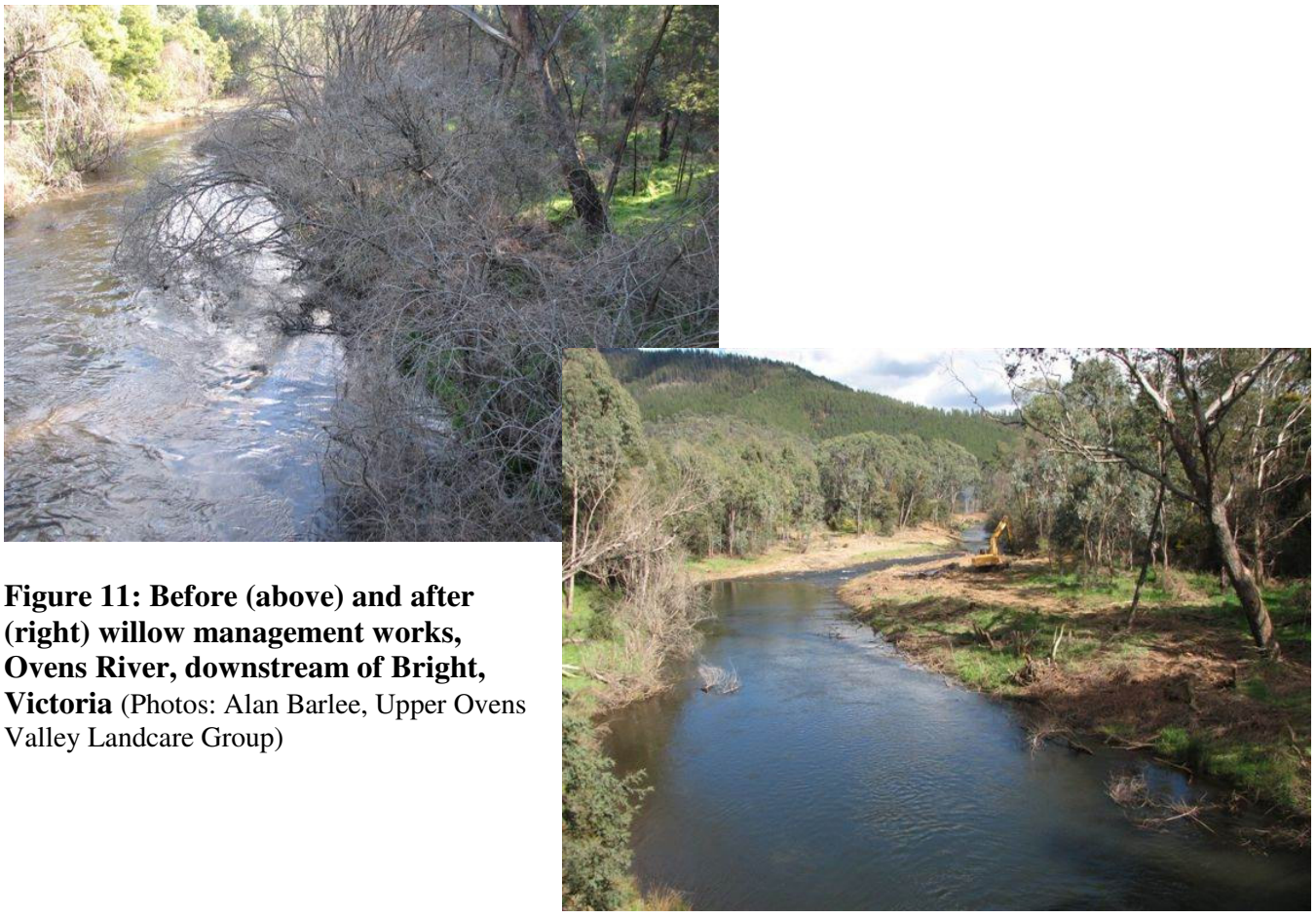


Figure 11: Before (above) and after (right) willow management works, Ovens River, downstream of Bright, Victoria (Photos: Alan Barlee, Upper Ovens Valley Landcare Group)

As well as identifying the need for follow-up treatments, the data collected during the annual monitoring assessment are used in planning future willow management projects, including the funding and other resources required to undertake these activities. The foundation built by this program in managing willows, blackberry and other weeds in the Upper Ovens River over the last three years has provided the opportunity to leverage funding for further management interventions. An application is currently under consideration by a state government agency for funding to improve fish habitat by re-seeding the river bed with large boulders in one part of the reach, and for the extension and consolidation of a footpath to improve recreational access to the river.

Project contact: Alan Barlee, Upper Ovens Valley Landcare Group (abarlee@bigpond.net.au)

4.2 Managing Willows to Assist the Survival of Threatened Frogs in NSW

For the Murray CMA in southern NSW, willow management in the Upper Murray catchment areas forms a major component of a program to rehabilitate habitat for the threatened Booroolong frog (*Litoria booroolongensis)*. The mats formed by willow roots can severely restrict the breeding habitat available for this frog species by blocking the crevices in rocks and cobbles. Other management interventions include fencing and revegetation.

Between 3% and 5% of the project budget is allocated to monitoring and evaluation, and a member of staff has responsibility for designing monitoring programs. Willow management projects in general are always monitored before and after works for willow management effectiveness, revegetation outcomes and biodiversity measures, and include photo-points. Given the specific nature of the desired outcomes for this program, monitoring also includes measuring variables that evaluate the success of habitat rehabilitation for the Booroolong frog.

Some of these habitat-specific monitoring activities are out-sourced to state government agencies which intend to publish the data and recommendations arising from this work. Within the CMA, monitoring data are used to evaluate the effectiveness of the program, to report to funding agencies and, through an adaptive management process, to provide input into the planning of future management activities.

Project contact: Kylie Durant, Murray CMA (Kylie.Durant@cma.nsw.gov.au)

Figure 12: Willow root mats block the crevices in rocks and cobbles and reduce available breeding habitat for the Booroolong Frog (Photos: Kylie Durant, Murray CMA)

4.3 Boorowa River Recovery Monitoring and Evaluation, NSW

A comprehensive and highly structured monitoring program has been developed for the Boorowa River Recovery program, undertaken by Greening Australia ACT and the Lachlan CMA in NSW. The on-ground management program involves a range of interventions, including willow control work, river protection works, fencing and revegetation. There are 60 sites along 80 km of the river, which includes 29 km of continuous willow control. Resourcing for this management program has come from a variety of sources.

The project sites are grouped according to the management interventions applied and a representative subset of each group has been assigned to the monitoring program. This subset (generally five sites per intervention type) is paired with an equivalent number of unmanaged sites which are as similar as possible. Overall 20 managed sites and 20 unmanaged sites are included in the monitoring program, which has been designed by a highly trained staff member.

The monitoring includes a general site description to record existing vegetation, paddock use, stock grazing, adjacent land use and expected native vegetation community, as well as location details. Transects are used to assess the composition, structure and health of the vegetation community, including the extent of willow infestation. Macroinvertebrates are measured as are physical features of the site relating to in-stream habitat, geomorphology, soil stability and erosion. In addition to this on-ground monitoring, heli-monitoring in 2005 and 2008 has allowed a comparative analysis of a number of variables at the landscape scale.

The data collected through this monitoring program are used to assess the effectiveness of the management activities and to drive management actions. They also assist in the process of communicating the project to a wide range of stakeholders, including the local community and the broader scientific community.

Project contact: Lori Gould, Greening Australia ACT (Lori.Gould@act.greeningaustralia.org.au)

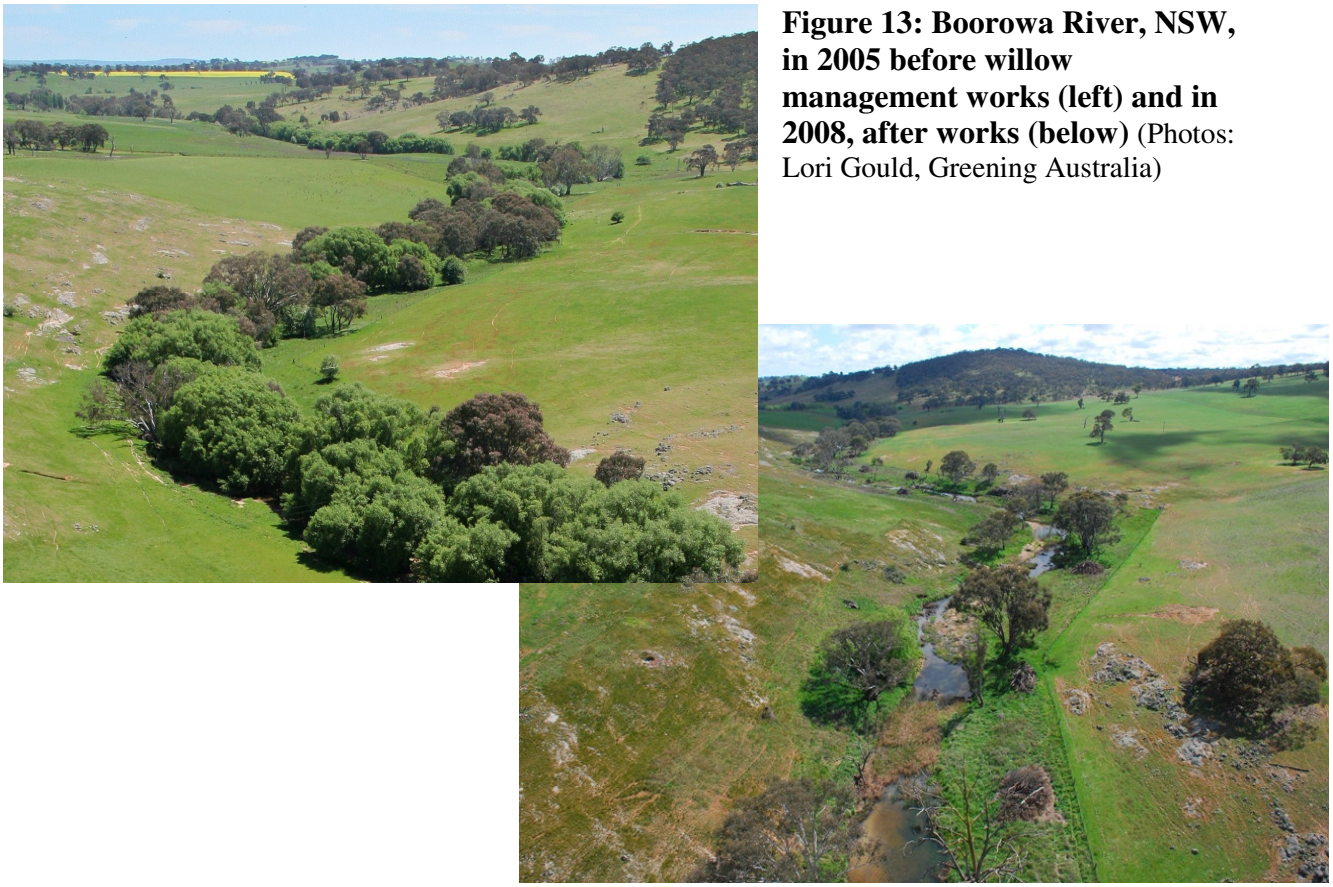


Figure 13: Boorowa River, NSW, in 2005 before willow management works (left) and in 2008, after works (below) (Photos: Lori Gould, Greening Australia)

Section 5: Existing Monitoring and Evaluation Guidelines

Although specific national willow management M&E guidelines do not exist, there are a number of guidelines that have been developed by different state and federal agencies that provide valuable assistance to those developing M&E procedures. A selection of existing guidelines are summarised below, relating to different types of NRM activities.

5.1 General M&E Guidelines

Australian Government Natural Resource Management Monitoring, Evaluation, Reporting and Improvement Framework

A federal government initiative, the MERI framework provides a generic framework for monitoring, evaluating, reporting on and improving Australia's approach to managing key NRM assets.

http://www.nrm.gov.au/publications/frameworks/meri-framework.html

Tracking a Bushland Project, Greening Australia, ACT

The ACT region of Greening Australia is currently finalising a monitoring manual for the ACT which addresses monitoring protocols across a range of NRM activities. It includes a supplement on monitoring riparian projects. Publication is expected in mid 2009 and further details are available from Lori Gould (Lori.Gould@act.greeningaustralia.org.au).

5.2 Water Quality and Aquatic Systems M&E Guidelines

Waterwatch Australia

Waterwatch Australia is a national, community-based water quality monitoring network which operates under the auspices of the federal government. Through community and school groups, it undertakes intensive monitoring programs on local waterways, which do include limited assessments of riparian and other factors.

http://www.waterwatch.org.au/index.html

AUSRIVAS

The Australian River Assessment System (AUSRIVAS) is a rapid prediction system used to assess the biological health of Australian rivers, developed by the federal government. It primarily assesses in-stream variables including macroinvertebrates, diatoms, fish, macrophytes, physical and chemical factors, and benthic community metabolism, but does include limited assessment of riparian vegetation.

http://ausrivas.canberra.edu.au/

South East Queensland Healthy Waterway Partnership: Ecosystem Health Monitoring Program

A comprehensive monitoring program to assess the ecosystem health of the freshwaters in south east Queensland has been developed. It is comprised of five indicators – physical/chemical, nutrient cycling, ecosystem processes, aquatic macroinvertebrates and fish. There are a number of measures within each of these indicators. All measures relate to in-stream processes and riparian systems are not assessed in this program.

http://www.ehmp.org/EcosystemHealthMonitoringProgram/Home.aspx

5.3 Riparian Management and River Health M&E Guidelines

Rapid Appraisal of Riparian Condition (RARC)

Land and Water Australia, in association with Charles Sturt University, have developed a tool to assess the ecological condition of riparian habitats using indicators that reflect functional aspects of the physical, community and landscape features of riparian areas. The index is made up of five sub-indices, each with a number of indicators: Habitat continuity and extent; Vegetation cover and structural complexity; Dominance of natives versus exotics; Standing dead trees, hollows, fallen logs and leaf litter; and Indicative features.

http://lwa.gov.au/files/products/land-water-and-wool/pf071292/pf071292.pdf

Index of Stream Condition, DSE Victoria

DSE Victoria has developed an integrated and comprehensive assessment of the environmental condition of state's rivers, the Index of Stream Condition (ISC). It assesses five key components of river health at a reach scale - hydrology, water quality, streamside zone (vegetation), physical form (bed and bank condition and in-stream habitat) and aquatic life. State-wide ISC assessments are undertaken every five years.

http://www.ourwater.vic.gov.au/monitoring/river-health/isc

Victorian River Health Works Monitoring Method, DSE Victoria

A monitoring method to be applied before and after river works is currently being developed by DSE Victoria, with state-wide roll-out expected in the 2009/2010 year. It has been designed to provide quantifiable data to prove condition change at the landholder scale, and focuses on two of the components of river health included in the ISC - streamside zone (vegetation) and physical form (bed and bank condition and in-stream habitat). It is anticipated that the results from this monitoring will be integrated into the overall ISC process.

5.4 Weed Management M&E Guidelines

Monitoring Biodiversity for Changes Associated with Invasive Plants, DSE Victoria

Through the "Weeds and Pests on Public Land" initiative, DSE Victoria has developed a monitoring protocol to monitor outcomes for biodiversity at a broad scale in relation to weeds. This document also reviews existing monitoring schemes, and outlines issues to be considered in designing a monitoring protocol.

Ainsworth, N., Adair, R. and Cheal, D. 2008. *A Method of Monitoring Biodiversity for Changes Associated with Invasive Plants.*

http://www.dse.vic.gov.au/DSE/nrenpa.nsf/LinkView/67DD93B05F5FDB21CA2570580016DF4A13C24D2D2F5A2CBCCA2574CC000B4D6E

Bitou Bush Threat Abatement Plan, Department of Environment and Climate Change, NSW

A monitoring manual is being developed which describes three tiers of monitoring activities – standard, advanced and research-level monitoring. The manual will provide guidelines on monitoring techniques and design of programs, and will include example data sheets for the various methods described.

http://www.environment.nsw.gov.au/bitoutap/monitoring.htm

Section 6: Recommendations for a National M&E Framework

6.1 Developing Guidelines – The Process

Given the M&E resources already available, developing a national framework of M&E guidelines for willow management activities is highly feasible. This process will require input from a range of stakeholders including representatives from funding bodies, state and federal agencies, as well as on-ground managers (both professional and community) and monitoring experts. This may involve a national workshop or series of workshops and/or an on-line forum to bring together this expertise.

In addition, some form of national collation and analysis of monitoring data has the potential to be a very useful resource to provide evaluation of willow management activities, and to contribute to the ongoing refinement of best practice management, through an Adaptive Management process.

However, it needs to be recognised that any expectation of implementation of national M&E guidelines or contribution of monitoring data to a national database is likely to be hindered by the resource constraints experienced by management agencies, as discussed above. Unless these limitations are addressed, particularly around the level of resourcing and the short-term nature of current funding cycles, it remains unlikely that management agencies will be able to adopt more comprehensive M&E programs. A commitment by funding agencies to provide significant, ongoing resources for M&E activities would help to overcome this hurdle.

Similarly, the level of commitment required to establish and maintain a national database over the long-term needs to be recognised before such an undertaking proceeds. Resources will be required to set up the database, collate data over several years and to analyse those data so the information can be used to contribute to improved on-ground management.

It is also important that any development of a willows M&E framework addresses the issue of whether this framework should relate solely to willow management activities or whether the M&E of willow activities should be integrated into broader river health or NRM M&E programs, either existing or new programs. If the data are to be incorporated into a broader program, then the decision must be taken as to which program is most appropriate, which may vary from state to state, or between state and national bodies.

It is highly unlikely that agencies will be able to collect more than one set of M&E data for reporting purposes and so ideally, data from willow M&E would contribute to one standard, national, NRM database containing data from a wide range of NRM activities. These data would be collected using standard protocols, and would be comparable over time, between sites and across NRM activities. Such a system would require national co-ordination and commitment.

6.2 Developing Guidelines – The Content

A willows M&E framework will need to provide guidance on different levels of M&E as it is unlikely that all projects will be comprehensively monitored. Across the suite of willow management projects undertaken by an agency over a given time period, it is realistic to expect that comprehensive monitoring will occur on a sub-set of projects, with more limited monitoring occurring on remaining projects. Some respondents indicated that sampling strategies which provided guidance on selecting that mix of projects would be useful.

The extent of M&E required on any willow management project will also be driven by the objectives of the project. At one end of the spectrum, willow management may be undertaken to remove a serious weed from the landscape. In this case monitoring of the effectiveness of the control measures and for any new willow plants, or other weeds, that arise at the site is likely to be sufficient to allow the success or failure of the project to be evaluated.

At the other end of the spectrum, willow management may be part of a larger project seeking to improve river health outcomes or the functioning of a particular ecosystem. For projects such as these, comprehensive monitoring will need to incorporate not only an assessment of willow management effectiveness, but also a range of measures that assess the impact of this willow management on relevant factors. These include the riparian vegetation community and in-stream vegetation; aquatic and terrestrial fauna; water quality variables; hydrology, geomorphology and other physical components of the system, as well as assessments of the outcomes of other management interventions such as replanting or erosion control.

The appropriate level of monitoring for many projects is likely to fall between these two extremes, incorporating both assessment of willow management effectiveness and a subset of other variables. A decision support tool which provides guidance on the most appropriate levels of monitoring for different sites would be an integral part of a monitoring framework.

Minimum M&E Requirements of Willow Management Projects:

- all sites are monitored for the effectiveness of willow control;
- all sites are monitored for the establishment of new willow plants and other weeds for a period of time after the completion of management;
- at all sites where revegetation has occurred, plant survival and seedling establishment rates are monitored;
- monitoring able to be undertaken by the agency managing the project or by the land manager.

Comprehensive M&E of Willow Management Projects:

- monitoring as above, plus
- before and after monitoring of appropriate variables at several time intervals;
- monitoring of comparable sites with and without willow management;
- monitoring of all biotic and physical factors on which willow management and other management interventions are likely to impact;
- synthesis of monitoring data into an evaluation process and incorporation of this information into an Adaptive Management cycle which results in improved management.

Development and implementation of a national M&E framework has the potential to provide management agencies with the tools to demonstrate whether or not willow management activities are effective at achieving the desired outcomes. This information can then be used refine and adapt future management interventions, and to demonstrate the importance of this investment to all their stakeholders – funding bodies, government agencies, local communities and land-holders.

Appendix 1: On-line Survey

Part One: Organisation Description

1. Which category BEST describes your organisation?

- ☐ Catchment Management Authority or Natural Resource Management Board
- ☐ Water Authority
- ☐ Water Retailer
- ☐ State Government Agency
- ☐ Local Government Agency
- ☐ Community/Private Group

Other (please specify):

2. In which state/s does your organisation operate? (You may tick multiple boxes).

- ☐ ACT
- ☐ New South Wales
- ☐ Northern Territory
- ☐ Queensland
- ☐ South Australia
- ☐ Tasmania
- ☐ Victoria
- ☐ Western Australia

3. If you are willing to be contacted to follow-up this survey, please provide your contact details.

Name:	
Organisation:	
Address:	
City/Town:	
State:	
Postal Code:	
Email Address:	
Phone Number:	
Mobile Number:	

Part Two: Willow Management

1. In relation to on-ground activities, what proportion of resources does your organisation invest in willow management activities?

- ☐ 0%
- ☐ 1 - 10%
- ☐ 11 - 25%
- ☐ 26 - 50%
- ☐ 51 - 75%
- ☐ 76 - 100%

2. Has investment in willow management by your organisation changed over the past five years?

- ☐ Increased
- ☐ Decreased
- ☐ Remained static

3. Do you expect levels of investment in willow management activities to change over the next five years?

- ☐ Increase
- ☐ Decrease
- ☐ Unlikely to change

Part Three: Monitoring Willow Management Activities

The remainder of the survey seeks information about monitoring of projects that involve willow management activities.

1. Does your organisation currently undertake monitoring and evaluation of projects that include willow management activities?

- ☐ Always (every project)
- ☐ Often (most projects)
- ☐ Sometimes (occasional projects)
- ☐ Rarely (few projects)
- ☐ Never (no projects)

2. How long has your organisation been undertaking monitoring and evaluation of willow management activities?

- ☐ < 12 months
- ☐ 1 - 2 years
- ☐ >2 - 5 years
- ☐ > 5 years

3. How important are the following barriers in limiting monitoring and evaluation activities in your organisation?

Financial resources	☐ Very important	☐ Moderately important	☐ Not important
Lack of time (capacity)	☐ Very important	☐ Moderately important	☐ Not important
Lack of skills (capability)	☐ Very important	☐ Moderately important	☐ Not important
Organisational culture	☐ Very important	☐ Moderately important	☐ Not important
Uncertainty about monitoring methods	☐ Very important	☐ Moderately important	☐ Not important
Uncertainty about usefulness of data	☐ Very important	☐ Moderately important	☐ Not important

Other barriers (please specify):

4. Does monitoring of willow management follow a formal structured process or is it generally more informal and/or unstructured?

Part Four: Monitoring Program

1. If possible, please estimate the proportion of project resources allocated, on average, to monitoring and evaluation for willow management activities.

- ☐ < 1% total project cost
- ☐ 1 - 2% total project cost
- ☐ 3 - 5% total project cost
- ☐ 6 - 10% total project cost
- ☐ 11 - 20% total project cost
- ☐ >20% total project cost
- ☐ Not possible to determine

2. Do you expect this resource allocation to change in the next five years?

- ☐ Increase expected
- ☐ Decrease expected
- ☐ No change expected

Part Five: Monitoring Variables

This section seeks information about whether different types of variables are generally included in monitoring programs for willow management activities in your organisation.

1. Water quality variables

Nitrogen (N)	☐ Always	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Phosphorus (P)	☐ Always	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
pH	☐ Always	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Turbidity	☐ Always	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Dissolved oxygen (DO)	☐ Always	☐ Often	☐ Sometimes	☐ Rarely	☐ Never
Temperature	☐ Always	☐ Often	☐ Sometimes	☐ Rarely	☐ Never

Other (please specify):

2. Biodiversity measures

In-stream macroinvertebrates	Always	Often	Sometimes	Rarely	Never
Indigenous riparian vegetation	Always	Often	Sometimes	Rarely	Never
Exotic riparian vegetation	Always	Often	Sometimes	Rarely	Never
In-stream vegetation	Always	Often	Sometimes	Rarely	Never
Birds	Always	Often	Sometimes	Rarely	Never

Other (please specify):

3. Willow management effectiveness

Extent of tree death	Always	Often	Sometimes	Rarely	Never
Extent of regrowth from existing trees	Always	Often	Sometimes	Rarely	Never
New seedlings	Always	Often	Sometimes	Rarely	Never
New plants arising from fragments	Always	Often	Sometimes	Rarely	Never

Other (please specify):

4. Revegetation outcomes

Survival of planted stock	Always	Often	Sometimes	Rarely	Never
Extent of establishment from sown seed	Always	Often	Sometimes	Rarely	Never
Extent of natural regeneration	Always	Often	Sometimes	Rarely	Never

Other (please specify)

5. Do your monitoring programs include photo-points?

- ☐ Always
- ☐ Often
- ☐ Sometimes
- ☐ Rarely
- ☐ Never

6. Do your monitoring programs include other variables?

Part Six: Timing of Monitoring Activities

1. How frequently are the following variables generally monitored?

Water quality	☐ Several times per year	☐ 1-3 times per year	☐ Annually	☐ Less frequently	☐ Irregularly
Biodiversity	☐ Several times per year	☐ 1-3 times per year	☐ Annually	☐ Less frequently	☐ Irregularly
Willow management effectiveness	☐ Several times per year	☐ 1-3 times per year	☐ Annually	☐ Less frequently	☐ Irregularly
Revegetation outcomes	☐ Several times per year	☐ 1-3 times per year	☐ Annually	☐ Less frequently	☐ Irregularly
Photo-points	☐ Several times per year	☐ 1-3 times per year	☐ Annually	☐ Less frequently	☐ Irregularly

Other (please elaborate if required):

2. In relation to the on-ground works, when does monitoring occur? (You may tick multiple boxes for each group of variables).

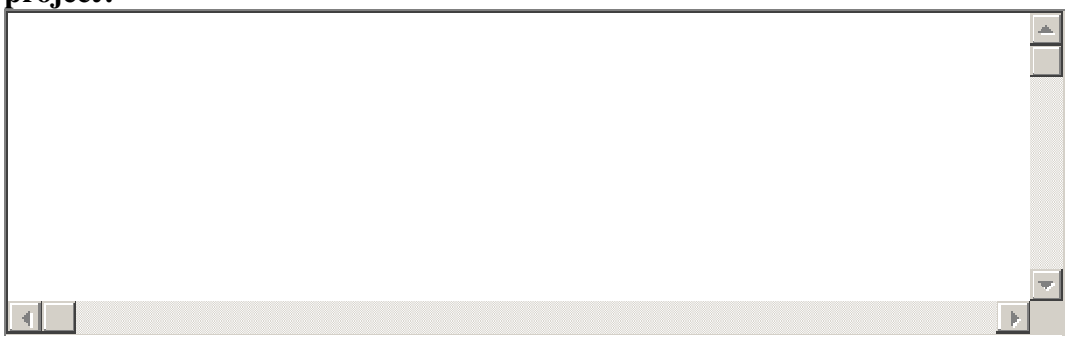
Water quality	☐ Before works	☐ During works	☐ < 12 months after works	☐ 1-2 years after works	☐ 2-5 years after works	☐ > 5 years after works
Biodiversity	☐ Before works	☐ During works	☐ < 12 months after works	☐ 1-2 years after works	☐ 2-5 years after works	☐ > 5 years after works
Willow management effectiveness	☐ Before works	☐ During works	☐ < 12 months after works	☐ 1-2 years after works	☐ 2-5 years after works	☐ > 5 years after works
Revegetation outcomes	☐ Before works	☐ During works	☐ < 12 months after works	☐ 1-2 years after works	☐ 2-5 years after works	☐ > 5 years after works
Photo-points	☐ Before works	☐ During works	☐ < 12 months after works	☐ 1-2 years after works	☐ 2-5 years after works	☐ > 5 years after works

Comments:

Part Seven: Use of Monitoring Data

1. How does your organisation use the data collected in monitoring programs?

2. Do the monitoring data assist with the process of determining the effectiveness of the project?

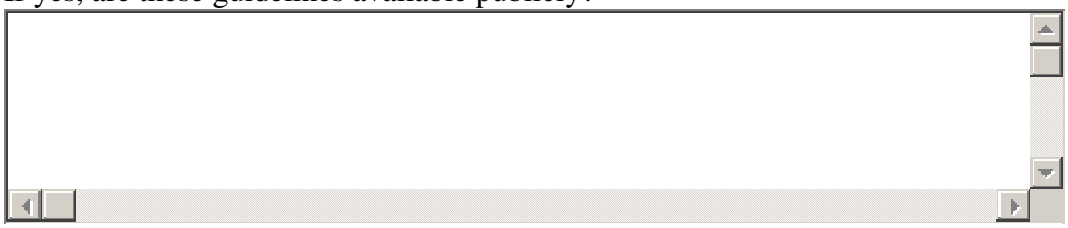


3. Does your organisation use standard guidelines to develop monitoring programs?

☐ Yes

☐ No

If yes, are these guidelines available publicly?



Thank You. The information you have provided will be used to guide the development of national standards for monitoring and evaluating willow management activities.