

Collaborating to deliver better monitoring outcomes: lessons learned from the Victorian Environmental Flows Monitoring Program

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Key Points

- Collaboration between research scientists, waterway managers and policy makers is one of the strengths of the Victorian Environmental Flows Monitoring Assessment Program (VEFMAP).
- This paper describes how five specific forms of collaboration have helped the project and how those collaborations could be improved in future
- We recommend that large scale monitoring programs should explicitly build-in collaboration and use the lessons from VEFMAP to maximize success

Abstract

The Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) is a large-scale monitoring program that uses innovative scientific approaches to quantify ecological responses to flow variation. VEFMAP combines the technical expertise of researchers, with legislative and policy drive of state-level managers, local knowledge of waterway managers, and the pragmatic approach of consultants to deliver monitoring programs that are sufficiently technical to overcome the scientific problems of detecting ecological effects of environmental flows, yet simple and affordable enough to implement over large scales.

The collaboration between VEFMAP partners has evolved throughout the project and is now a major strength that has ensured the program applies a scientifically rigorous method to address questions of direct relevance to waterway managers. Science-management collaborations often fail because of different cultures, motivations and reward structures within research and government institutions. Early and explicit recognition of these motivations has been critical to the success of VEFMAP and allowed partners to work towards a shared goal. This paper describes how the VEFMAP partners have collaborated throughout the project. It highlights the aspects of collaboration that have worked well, opportunities that have been missed, and considers lessons learned that could be applied to improve the effectiveness of other monitoring programs.

Keywords

VEFMAP, environmental flows, monitoring and evaluation, collaboration

Introduction

The Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) was initiated in 2005 to determine whether environmental flows have their intended effect throughout Victoria (Cottingham *et al.*, 2005). VEFMAP differs from other environmental flow monitoring programs in several ways. Rather than test responses to specific flow releases in individual catchments, VEFMAP monitors response variables using the same techniques in nine regulated river systems that have existing environmental flow allocations, to quantify the relationships between flow regime and particular environmental endpoints. Bayesian Hierarchical Analyses are used instead of traditional statistical approaches and data are analysed at a Statewide level as well as at the individual catchment or reach scale. The approach used in VEFMAP is specifically intended to circumvent issues encountered with monitoring environmental flows, such as the lack of suitable spatial controls and the lack of any clear before and after treatment periods that render traditional Before-After-Control-Impact (BACI) type of assessments of limited applicability (Webb *et al.*, 2010b).

VEFMAP is also unique in terms of the sustained collaboration between different stakeholders that all have an interest in environmental flow delivery and assessment. VEFMAP has been supported and funded from the outset by the Victorian Department of Sustainability and Environment (now renamed the Department of Environment and Primary Industries – DEPI), whose main interest is the need for robust science to support past and future policies regarding the use of the Environmental Water Reserve (EWR). The Waterway Managers (i.e. five Catchment Management Authorities (CMAs)

and Melbourne Water) that are responsible for each of the nine VEFMAP rivers oversee the implementation of VEFMAP monitoring within their catchments and are particularly interested in evidence that will help them to explain the need for and benefit of environmental flows to various local stakeholders. Waterway managers are also interested in any information that will assist them to deliver environmental water in a more effective and efficient manner. Finally, the overall program design and analysis is of interest to academics and scientific researchers and a team from the University of Melbourne is conducting the Statewide analysis with the primary aims of increasing understanding of the relationship between hydrology and ecology and developing novel solutions to complex problems.

VEFMAP is being implemented in the Goulburn River, Broken River, Campaspe River, Loddon River, Wimmera River, Glenelg River, Thomson River, Macalister River and the Yarra River. Specific monitoring programs for each river were developed between 2006 and 2007, and on-ground monitoring commenced in 2007. VEFMAP had an initial life of five years, but in 2010 the program partners, and in particular the research team at the University of Melbourne, secured an Australian Research Council (ARC) Linkage Grant that will extend the Statewide analysis until August 2014. DEPI recently committed to fund VEFMAP for another two years to collect more data and complete further analyses.

Various papers (e.g. Stewardson and Webb, 2010, Webb et al., 2014, Webb et al., 2010a, Webb et al., 2010b, Miller et al., 2012, Webb et al., 2012, Miller et al., 2013, Webb et al., 2013) have been written about the VEFMAP that either describe preliminary results and/or evaluate the use of Bayesian Hierarchical Networks, which are informed by a combination of expert elicitation and quantitative monitoring data. This paper focuses on the collaboration between VEFMAP partners. Science-management collaborations often fail because of different cultures, motivations and reward structures within research and government institutions. Early and explicit recognition of these motivations has been critical to the success of VEFMAP and allowed partners to work towards a shared goal. Our paper describes how the VEFMAP partners have collaborated throughout the project. It highlights the aspects of collaboration that have worked well, opportunities that have been missed, and considers lessons learned that could be applied to improve the effectiveness of other monitoring programs.



Figure 1: Map of Victoria showing the nine VEFMAP rivers. (Figure reproduced from Webb et al., 2014)

Who are the VEFMAP partners and what are their motivations?

The VEFMAP partners can be divided into three main groups: Scientific Researchers, Waterway Managers and a State Environmental Agency. Consultants also work within these partnerships. Each group has a different focus, but they all share a need to understand with more certainty how different environmental values respond to changes in flow (see Figure 2).

The State Agency (DEPI) that oversees and funds VEFMAP is primarily interested in outcomes that credibly demonstrate whether their investment in environmental watering programs has been worthwhile, and which increase the confidence in predicting responses to particular water management decisions. On a secondary level, DEPI is also interested in demonstrating VEFMAP is meeting its intended objectives and that their investment in the program has been worthwhile.

The waterway managers want to understand the effect that environmental flows are having in their particular catchments. They want to know if flow releases are meeting their intended objectives; if not why not and what they can do to achieve a better outcome. They are primarily interested in understanding the results of monitoring conducted within their particular river system, but will use results from other catchments if they are relevant and can be reliably extrapolated to their catchment. These waterway managers need to report to their boards on the overall success of their environmental flows delivery programs and need simple stories and messages that they can use to convey the effect and value of environmental watering to landowners and other stakeholders in their communities.

The research scientists involved in VEFMAP are predominantly interested in developing new and better methods for addressing NRM related questions and filling knowledge gaps in the ecological literature. They are motivated by publishing their ideas and results in peer-reviewed journals and at conferences.

Scientists, waterway managers and policy makers often collaborate on environmental monitoring programs. For example, waterway managers often engage consulting scientists or academics to help them design an environmental monitoring program and may again engage scientists to help analyse or review data that have been collected. However, these collaborations tend to be restricted to discrete stages of the monitoring program. Moreover, there are rarely sufficient funds to implement monitoring recommendations widely enough or for long enough to reliably answer the stated monitoring objectives. On the other hand, research scientists planning to undertake rigorous field based studies may ask waterway managers what questions they should investigate, but often end up modifying the scale at which the question is tested or modify the question itself to accommodate a more robust experimental design. If left to their own devices, waterway managers are likely to implement programs with low statistical power and research scientists are likely to implement programs that either have limited practical application or whose results are not readily conveyed to waterway managers. VEFMAP has attempted to overcome some of these issues by fostering ongoing collaboration between research scientists, waterway managers and State agencies throughout the program. In this way the program applies a scientifically rigorous method to addressing questions of direct relevance to environmental managers. Moreover, the results will be communicated in tailored manner to different program partners and stakeholders who are aware of the program and preparing to use the information as it becomes available.

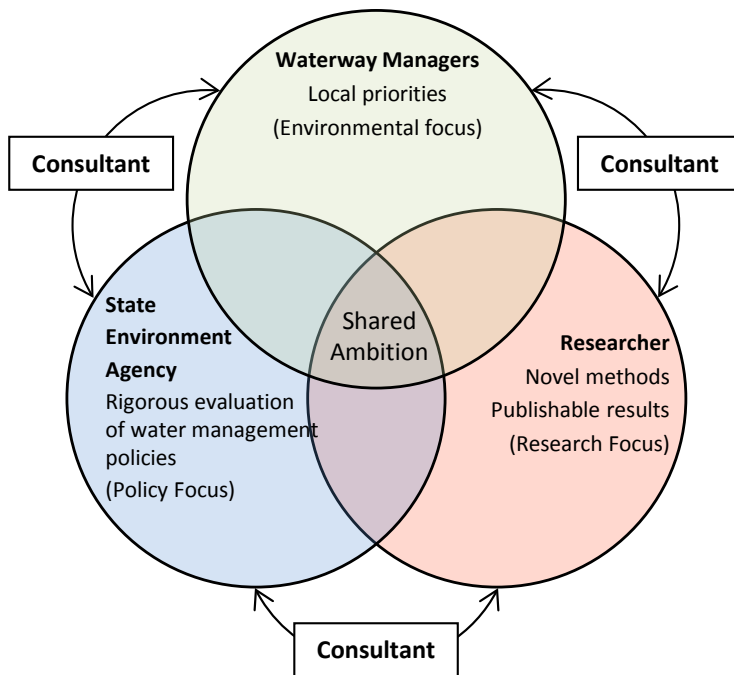


Figure 2: Schematic showing the relevant focus of the main VEFMAP partners.

Collaborations between VEFMAP partners

This paper describes five specific forms of collaboration that have contributed to the success of VEFMAP and also highlights ways in which those collaborations could have been further improved.

Collaboration 1 – Waterway managers identified monitoring priorities in their catchments at the start of the program

Each of the waterway managers directly involved in VEFMAP developed on-ground monitoring programs for their catchment using guidelines developed by the science research team. Three out of the five CMAs and Melbourne Water worked with members of the scientific research team and Jacobs to develop these on-ground monitoring programs. In each case, the waterway managers identified the environmental flow monitoring objectives that were most relevant to their catchment and then selected monitoring indicators (from a list of indicators specified in the VEFMAP guidelines document) that they would measure to address the highest priority objectives.

The monitoring methods (i.e. sampling techniques, number of sites per reach and sampling frequency) for each type of indicator were prescribed by the research team to ensure consistency across all VEFMAP rivers, but the waterway managers individually decided which variables they would monitor in their catchments and where they would monitor specific variables. For example, all waterway managers chose to include adult fish surveys in their programs because they all released environmental flow to specifically benefit native fish populations, but they did not necessarily survey fish in every environmental flow reach. Macroinvertebrate responses to environmental flows were generally considered a lower priority and therefore macroinvertebrate monitoring was only included in two of the VEFMAP rivers. The only mandatory monitoring elements were hydrology and hydraulic models, which had to be measured and developed for every environmental flow reach included in VEFMAP.

Advantages of Collaboration 1

Giving each waterway manager the responsibility for developing their own on-ground monitoring program provided a very definitive form of engagement in the early stages of the program and also gave the waterway managers a stake and sense of ownership in VEFMAP. Waterway managers ensured that VEFMAP targets the monitoring questions that are

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most relevant to their catchment, rather than being something that was being done for them or done in their area without consultation. The process of working with members of the research team and consultants who were partners in VEFMAP helped to establish relationships early in the project. These relationships have been important as these researchers and consultants have been the primary contacts for any questions that the waterway managers have had throughout the life of VEFMAP.

What could we do better next time

Although individual waterway managers worked closely with the research scientists, DEPI and consultants to develop their on-ground monitoring programs, each waterway manager developed their programs at slightly different times and there was little interaction or collaboration between different waterway managers. If we were starting the process now, we would have set up a forum (e.g. meetings or workshops) for waterway managers to share their ideas and monitoring priorities during the program development stage. Such a forum would help establish relationships among the waterway managers responsible for each catchment and enable each of them to explain why they were targeting particular monitoring activities and challenge each other about their monitoring priorities. Sharing these ideas at the outset could have helped clarify the specific questions that the Statewide analysis could target (see Collaboration 3) and help identify supplementary monitoring activities or co-variables that could be measured in all VEFMAP rivers to improve those analyses.

Collaboration 2 - Funds for VEMAP monitoring have been provided by DEPI, but waterway managers have been responsible for engaging contractors to conduct the relevant monitoring in their catchments

Virtually all of the on-ground monitoring for VEFMAP has been conducted by contractors with specialist skills in fish, vegetation, macroinvertebrate, water quality, geomorphological or physical habitat survey. The overall funding for VEFMAP is provided by DEPI, but each waterway manager is responsible for engaging contractors to conduct the required monitoring in their catchment. The waterway managers use the monitoring program design reports for their catchments to determine the monitoring activities that need to be completed each year and then engage contractors to conduct the relevant field assessments and collect the required VEFMAP data. The research team, DEPI and consultants involved in the overall implementation of VEFMAP are available to answer any questions that the waterway managers, or their contractors, may have in relation to the data collection.

Advantages of Collaboration 2

Giving the waterway managers responsibility for engaging contractors to collect VEFMAP data has helped reinforce their ownership of the program and the data that are collected in their catchment. Waterway managers have reported the benefits of being able to select and develop professional relationships with contractors over the last seven years. Some waterway managers have established very strong relationships that have helped them to better understand the aquatic values in their systems and the effect that different flow releases have on those values. Having direct control over the contracts has also allowed the waterway managers to direct contractors to analyse and interpret the data they collect to address catchment specific questions that may not be answered through the Statewide analysis.

What could we do better next time

The biggest short-coming of VEFMAP has been inconsistent and, on occasion, poor-quality data collected in some VEFMAP rivers. These problems are predominantly due to different contractors being engaged by each waterway manager and in some cases, waterway managers engaging different contractors from year to year. They are also compounded by staff changes within Catchment Management Authorities, which has on occasion resulted in staff with relatively little understanding of VEFMAP having to direct contractors to collect field data. If the waterway managers have little understanding of VEFMAP they may not be able to answer their contractor's questions and cannot reasonably check to ensure that the contractors are applying the correct method and collecting the required information. Finally, in some cases collected data have not been entered into the central database or checked by the research team until a year or more after they were collected, which has made it difficult to identify and correct any errors.

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When developing the monitoring plans, the consultants and research team assumed that the written methods for how to measure each indicator were practical, achievable, clear and had sufficient detail to allow contractors to implement the methods consistently. We were wrong.

In hindsight, our assumptions were naïve. These problems rarely arise or are rarely identified in research programs where the people designing the monitoring program are also closely involved in overseeing the data collection. They also are not detected on projects where consultants or researchers are asked to design a monitoring program for a single river. In those cases, a single contractor will generally be responsible for measuring each indicator and therefore variation between data collectors is not an issue, or the consultants involved in designing the monitoring program have little involvement in subsequent stages and therefore do not identify inconsistencies or errors. The data collection problems encountered in VEFMAP are particularly relevant for long-term monitoring programs, across multiple river systems that involve a large number of collaborators.

The field methods manuals have now been updated and expanded to provide more detail including specific types of accreditation that contractors must hold and specific equipment they must use. We have also suggested that waterway managers require their contractors to enter the collected data into the VEFMAP central database to verify that it is complete and in the correct format prior to them being paid for the contract. These amendments have improved the situation, but if we were embarking on this project again from the start, we would do the following:

1. Prepare a much more detailed field manual to describe all of the methods and sampling tasks that are required for each indicator. We would also ask a number of different field ecologists and contractors to review the field manuals to identify elements that may be difficult to implement or could be interpreted in a variety of ways. This review could involve a workshop and field trials.
2. Provide training for potential contractors who may bid for contracts to implement VEFMAP monitoring and/or specify certain types of qualifications and accreditations that potential contractors must have to be able to bid for VEFMAP work.
3. Conduct field audits to ensure that contractors are implementing the prescribed monitoring methods.
4. Provide a VEFMAP induction for any waterway managers that take over as the VEFMAP representative for their organisation to ensure that they are adequately equipped to manage contractors.
5. Hold a meeting of contractors and other people involved in collecting VEFMAP data in the first two to three years of the program to discuss issues with the sampling methods and collectively agree on any changes to standard approaches.

Collaboration 3 – Waterway managers consulted to select monitoring endpoints

VEFMAP has yielded a lot of data and there are countless numbers of questions that the data could be used to answer. However, considerable effort is required to develop the hierarchical models that are used for the Statewide analyses and therefore the total number of questions that the research team can address is limited. The waterway managers were consulted individually and collectively (in a facilitated workshop) to articulate the questions that they most wanted the research team to address and rank them in priority order.

Advantages of Collaboration 3

Asking the waterway managers to identify the questions that the research team will address in the Statewide analyses is absolutely critical to the success of VEFMAP. Without such input, the research team may focus on questions that are likely to have the clearest results or that are of mainly academic interest. Involving the waterway managers in this part of the process helps to maintain their engagement and more importantly ensures that the program will provide results that are directly relevant to the waterway managers and are therefore more likely to be used for environmental water management.

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What could we do better next time?

The consultation on monitoring endpoints was done in the third year of VEFMAP. This was partly because it was the first year of an ARC Linkage Grant project to undertake a much more in-depth analysis of the VEFMAP data. Regardless of the timing of the ARC Linkage Project, it would have been better to work with all of the VEFMAP partners to discuss and rank the monitoring questions that would be addressed during the main Statewide analysis.

Collaborative discussions to identify and rank monitoring questions would have ideally been held at the same time as the initial on-ground monitoring programs were being developed (see Collaboration 1). The discussions would have provided a logical context for debate about the importance of different monitoring objectives among the waterway managers, DEPI and research scientists. They may have highlighted additional co-variables that could have been included, and some superfluous monitoring activities that could have been omitted to ensure the data collection phase of VEFMAP was more effective and cost efficient. The discussions may also have increased the level of engagement among some waterway managers and more importantly highlighted catchment specific questions that were not likely to be addressed through the Statewide analysis. Waterway managers could use that information to plan and conduct their own catchment specific analyses during different stages of VEFMAP. Those catchment specific analyses would increase the variety of analyses that are being conducted as part of VEFMAP, and increase the sense of ownership that some waterway managers have for the VEFMAP data.

Collaboration 4 - Consulted waterway managers about communication products

The results and outcomes of VEFMAP need to be conveyed to the organisations that have provided funding, or other resources for the program and to organisations who are responsible for securing and allocating environmental water in Victoria. However, other groups including landowners within the VEFMAP catchments, industry groups that rely on water extraction licenses, environmental groups and scientists are also likely to be interested in various outcomes from VEFMAP. Each of these different groups is likely to want to know about different aspects of the program (e.g. results at a particular site or the novel methods used for the analysis) and require different levels of detail. Different groups will also favour different modes of communication (e.g. fact sheets, peer reviewed scientific papers, video stories, or interactive tools). Providing a suitable range of information products to meet the needs of these groups, and providing consistent and clear messages in all forms of communication should maximise the lasting benefits of the program.

The waterway managers, DEPI and the main research team are currently working together to determine the main messages that need to be communicated from VEFMAP, the specific language that will be used to convey those messages and the different types of communication products that will be used to share that information with different stakeholders.

Advantages of Collaboration 4

The main advantages of this collaboration are:

- As with other forms of consultation, the process of developing specific communication products has contributed to the overall engagement of each of the VEFMAP partners, particularly at a point in the program where some partners were potentially disengaging.
- Having targeted messages and communication products for different stakeholders will maximise the reach of VEFMAP and increase the likelihood that it will influence environmental flow management and potentially provide a model that may be adopted for other long-term and large scale monitoring programs.
- The consultation process has forced us to engage with people with different skill sets and information requirements. These consultations have challenged us to think about and clearly articulate the main purpose and objective of VEFMAP and what the results mean. In our experience, this level of scrutiny and refinement is rarely applied to normal monitoring programs and research studies.

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What could we do better next time?

This current form of collaboration is ongoing and therefore we have not had the opportunity to reflect on how we could improve it in future. However, it would have been good to start these discussions earlier to avoid the risk of running out of funding just as the messages are being refined.

Collaboration 5 - Held working group meetings 2-4 times per year

Throughout the life of the VEFMAP we have held working group meetings between two and four times per year. These meetings have been attended by the VEFMAP representative from each of the CMAs and Melbourne Water, the VEFMAP manager from DEPI, the University of Melbourne Research team and the main project consultant. The meetings have provided an opportunity to share experiences and learn from each other and for the Research team to present results, identify problems that they have encountered and that need addressing and for DEPI to discuss their needs.

Advantages of Collaboration 5

The main advantage of the working group meetings is that they have provided a semi-regular forum for all of the VEFMAP partners to connect with each other and engage in the project. They have been a good way to introduce new waterway managers to VEFMAP and have been a forum where all partners can raise issues or concerns they have with the program, to determine whether other partners have had similar experiences and to collectively agree on solutions to those problems. Most of the problems discussed at these meetings have usually related to difficulties encountered by contractors that the waterway managers have engaged to collect the data.

What could we do better next time?

The main problem with the working group meetings is that information has tended to flow in one direction. Waterway managers have diligently attended most meetings, but have generally come to get an update on the progress being made by the Research team. VEFMAP is a long-term project and relatively few Statewide analyses were completed in the early and middle stages of the program. The lack of early results has caused some waterway managers to disengage and feel more like data providers than active partners who can analyse and use the monitoring data for other purposes.

In hindsight, we should have set aside time in these working group meetings for waterway managers to present summary results from the monitoring in their catchments and to describe how they have used those results in their work. Such a request would have reinforced the fact that the waterway managers own the data and can use it for a wide range of applications and also meant that interim results from different catchments could be shared among the waterway managers to help build a qualitative assessment of the effect of environmental flow releases in Victorian Rivers over the last seven years.

Conclusions

The collaboration between VEFMAP partners is one of the main strengths of the program and has ensured that scientifically rigorous methods have been used to address questions of direct relevance to waterway managers. The collaboration has been largely successful in setting the direction for VEFMAP and maintaining its momentum over seven years, but as with any new approach we have encountered some obstacles along the way and indeed made mistakes. NRM monitoring programs that are driven by waterway managers often lack the scientific sophistication that is needed to ensure results can be extrapolated beyond the specific monitoring area or monitoring period. While, research programs conducted by academic scientists can focus on questions that do not directly inform adaptive management. We think that the benefits of sustained collaboration between scientists, waterway managers and State government agencies are significant and hope that the lessons from VEFMAP can be used to increase the success of such collaborations in the future.

This paper has focused on five specific aspects of collaboration between the VEFMAP partners. It has discussed the benefits of these collaborations and how others undertaking similar projects could look to improve those collaborations. Most projects do not happen in isolation and can also benefit from formal and informal collaborations beyond the main

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project partners. We have not discussed these collaborations in detail in this paper, but acknowledge that they are important. Of particular note are collaborations with other scientists. Greater collaboration with other research scientists and a wider range of field scientists during the initial program design phase may have improved specific aspects of the prescribed monitoring methods, which could have made them clearer and easier to implement and in some cases made them more relevant to some of the questions and monitoring endpoints they are being used to address.

Some readers may see aspects of this paper as being rather negative. That is definitely not our intention. As key members of the VEFMAP team we are very proud of the program and what we have been able to achieve to date. However, in all forms of science and environmental management it is essential to critically evaluate what we have done and consider what we would change with the benefit of hindsight. We think that long term co-ordinated monitoring programs are invaluable and that collaboration between research scientists, waterway managers and government agencies are critical to their success. We encourage others to embark on such projects and hope that the points raised in our paper will assist others who undertake similar types of projects in the future.

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