Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) Stage 6

Vegetation Monitoring for 2017-18

VEFMAP Stage 6

The Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) is now in its sixth stage of delivery. VEFMAP Stage 6 will run from 2016 to 2020, funded through the Victorian government's $222 million investment in waterway and catchment health. VEFMAP Stage 6 focusses on 'intervention' or 'event-based' monitoring of fish and vegetation responses to flows and will incorporate data from previous VEFMAP stages.

Stage 6 – Vegetation Objectives

Stage 6 vegetation objectives aim to measure vegetation responses to environmental flows. The monitoring approach will initially focus on individual flow events in individual waterways to detect any short-term responses to environmental water delivery. A longer-term understanding will be gained through repeated short-term assessments and by using data from previous stages of VEFMAP to create longer-term datasets.

Data will be collected to address five Key Evaluation Questions (KEQs) that focus on the influence that environmental flow discharge has on the spatial distribution, foliage cover, species diversity, recruitment and establishment of in-stream, fringing and woody vegetation at a sub-reach scale. Importantly, these responses will be considered in relation to other factors that may influence flow responses, such as grazing, rainfall, soil properties and season (see program overview for details, DELWP 2017a).

2017-18 Field Program

The field program was brief in 2016/17 and included a pilot survey on the Campaspe River that included three surveys over the spring to autumn period. The field program will expand in 2017/18 and 2018/19 to conduct monitoring at similar times on a range of river systems across Victoria. Applying the now established survey method to a set of new rivers, as well as repeating the surveys on the Campaspe River, will significantly broaden the data set to provide evidence for the influence of environmental flows.

All rivers to be sampled in 2017/18 will receive environmental water, but the flow details (e.g. duration, timing, magnitude) will be different for each river. This will help to provide evidence for the influence of different types of environmental flows in different systems.

Rationale for Vegetation Monitoring

The design and evaluation of KEQs for Stage 6 vegetation monitoring are based on specific vegetation responses to flows and flow regimes (Table 1). Some vegetation responses have been previously demonstrated and are well understood, while others are still poorly understood in Victoria. Vegetation monitoring for Stage 6 will aim to quantify the vegetation responses thought to be the most important for environmental flow management, and to fill existing knowledge gaps.

Table 1: The predicted vegetation responses associated with the Key Evaluation Questions for vegetation and the monitoring approaches that will be used to observe and understand them.

Predicted vegetation response	Monitoring approach
Bank wetting through freshes or high-flows can support the growth and reproduction of instream and fringing vegetation within the channel, and it is likely that the increased soil moisture benefits deep rooted woody vegetation well outside the channel. In the short term, inundation of understorey plants can have damaging effects on leaves/shoots, but if applied effectively, the benefits to these plants can far exceed any negative effects.	Broad-scale mapping will record large changes in species composition and distribution, while fine-scale transect surveys will record the magnitude of changes in foliage cover and species richness at a species level in relation to seasonal and hydrological changes (including inundation and soil moisture availability). Soil moisture probes and student research projects investigating soil traits will help to inform the hydrology changes imposed upon plants during and between flow events.
The potentially damaging effects of inundation can be used effectively to favour the more tolerant littoral species (fringing and instream) while limiting the encroachment of terrestrial species (particularly exotics) into the channel. This may help to increase the resilience of the channel vegetation to flooding and intermittent drought disturbance by favouring species that are specifically adapted to recovery from flow disturbances.	Broad and fine-scale vegetation data on abundance, composition and richness can be used to inform changes towards (or away from) inundation tolerant species, and the subsequent vegetation response trajectories after inundation. Longer-term and targeted evaluation of vegetation data may be required to fully evaluate the resilience of a channel ecosystem, but the data collected in Stage 6 will inform this.
Flow events transport propagules (seeds and shoots) throughout the system, maintaining genetic diversity, species diversity, and colonisation of unoccupied areas.	Germination and dispersal will be monitored through recruitment surveys in-situ as well as proposed ex-situ experiments.
Bank wetting events can stimulate germination of soil seedbanks as well as newly transported propagules.	Monitored by comparing recruitment data to vegetation cover data – transects and mapping – to show if species are recruiting without adults present, as well as proposed soil seedbank trials.
Livestock grazing will reduce the cover and reproductive capacity of plants depending on the extent and timing of grazing. Grazed sites may therefore show no vegetation response to flow management.	Grazing exclosures are set up in all sites with current livestock grazing (two exclosures per site). These will inform the impact of livestock grazing on vegetation at the sites and the change in vegetation response to flows when it is grazed.

2017-18 Survey Sites

The Campaspe, Loddon, Moorabool and Wimmera river systems have been selected for survey in 2017/18. To demonstrate the benefits of environmental flows as soon as possible, we aim to collect data on short-term responses in places where we expect to see large vegetation responses to flows, and look across previous data to evaluate longer-term changes. Surveys in low-rainfall areas are likely to show stronger short-term responses to flows. Surveys on sites with previous VEFMAP studies will help to build a longer-term dataset. Rivers with 'control' reaches offer an ideal opportunity to get clearer data to demonstrate the effect of flows. The number of sites for 2017/18 varies for each waterway. Some are entirely new survey sites while others are resurveys of previous VEFMAP locations (Table 2).

Apart from the Campaspe River, at least one control site is located on each river system. On the Loddon River, a specific comparison is being made using the separation of the 12 Mile Creek anabranch from the Loddon River west-arm that makes Canary Island. This is the North Central Catchment Management Authority's (CMA) highest priority location on the Loddon River for vegetation surveys, despite there being no previous VEFMAP sites there. The data are required to inform management of the water allocation down each branch of the bifurcation. Four sites will be surveyed within this section of the system (two on each branch of the bifurcation).

The Sutherland Creek is an unregulated ephemeral stream that feeds into the lower Moorabool River. One site on the Sutherland Creek will be surveyed as a control for a very similar site on the lower Moorabool River. Both sites lie within an agricultural landscape and have been cleared for grazing, apart from some remaining large River Red Gums.

The Wimmera tributary surveys are discrete from the other locations because of the number of waterways being surveyed (three), the number of sites (12 for vegetation surveys), and the direct link to fish surveys. Each tributary contains two reaches with different flow regimes; these different reaches act as a range of treatments to compare different flow impacts.

Table 2: The number of sites within each river system to be surveyed in 2017/18 for Stage 6 and the subset of those sites that were previous VEFMAP survey locations.

River system	No. of Sites	Previous VEFMAP sites
Campaspe Rv	6	6
Loddon Rv, Tullaroop Ck, 12 Mile Ck	6	2
Moorabool Rv, Sutherland Ck	4	NA = 0
Wimmera: Mackenzie Rv, Burnt Ck, Mt William Ck	12	NA = 0

2017-18 Flow Deliveries

All four river systems have planned winter/spring freshes or high flow events. The priority for initial surveys is to complete the first survey prior to any major flow release. We will work closely with each CMA to confirm the timing and logistics of each survey. The details for subsequent environmental flows in 2017/18 are still to be confirmed by each CMA; we will determine the timing of resurveys as this information is acquired.

Survey Methods

Survey methods are outlined in detail in VEFMAP Stage 6 Part B: Monitoring design and sampling methods (DELWP 2017b), with minor changes detailed in the 2016/17 annual report (DELWP 2017c).

2017-18 Vegetation Sampling

Each of the four river systems will be surveyed on three occasions that roughly correspond to spring, summer and autumn. The exact timing will depend on the environmental flow delivery plans for each system.

Broad-scale mapping surveys

These surveys measure spatial distribution patterns of vegetation. On-ground mapping will be conducted in the first and third vegetation surveys (spring 2017 and autumn 2018). The distance mapped during the survey will vary for each river system (up to 500 m on both sides of the stream).

Vegetation surveys provide area data for patches of individual species and point location data for one or a few individual plants of each species. All riparian (fringing, emergent and instream) species and specific, high-threat terrestrial weeds will be mapped at an individual species level.

Fine-scale transect and quadrat surveys

These surveys measure the expansion/contraction of existing plant species or groups of plants, as well as the recruitment of new individuals. Surveys will be conducted on all three sampling occasions.

Grazing Exclosures

Two grazing exclosure plots are currently constructed on the banks of the Campaspe River at two sites (Doaks Reserve, Strathallan Road) and will continue to be surveyed in 2017/18. Two additional exclosures will be constructed at English's Bridge on the Campaspe River (after the planned spring fresh in early Sept 2017).

Grazing exclosures will be installed at all sites in new rivers where livestock grazing access occurs and there is permission to install them. This is likely to include one site (two exclosures) on the Loddon River in Reach 2 and one site (two exclosures) on the Moorabool River in Reach 4.

Photo-points

To document the delivery of environmental flows, simple time-lapse photography will occur at a range of rivers and scales to capture flows and/or vegetation changes. Standard photo-points will continue to be taken on all surveyed rivers.

Hydrology

To accurately assess the response of vegetation to environmental flows, it is important to characterise both natural and environmental flows that occur prior to and between survey periods. There are two key components: instream flow-event hydrology and soil moisture recording.

Instream hydrology

- Instream loggers were installed on the Campaspe River in early 2017 and the data will be used to calibrate and update existing river hydrology models

for each site. These models will be used to generate hydrology data variables for analysis over the current survey period and in years prior. University of Melbourne (UoM) will process hydrology data.
- Instream loggers have been installed in six reaches of the three Wimmera River tributaries (Aug 2017). A water level logger is installed within each reach at a vegetation survey site, and a barometric pressure logger within each waterway (three loggers).

Instream hydrology loggers will remain in place during high and low flow periods to correctly calibrate models for flow variables in other time periods. Once they have been exposed to a sufficient range of flows, the loggers will be removed and installed in the Moorabool and Loddon river sites, as deemed appropriate.

Soil moisture

Soil moisture monitoring will continue on the Campaspe and Goulburn rivers and will be conducted in the Wimmera River tributaries (spring 2017).

- Six soil moisture recording probes are installed on the Campaspe River (three sites).
- Four probes are installed at two Long-Term Intervention Monitoring (LTIM) vegetation survey sites on the Goulburn River.
- Three pairs of new soil moisture probes will be installed in the upper Wimmera system across the three streams, one pair in each.

Each probe records soil moisture and temperature at 10 cm intervals along its length to 85 cm deep. Data are continuously recorded every hour.

Student Research Projects

Three teams of three UoM students will conduct research projects on the Campaspe, Goulburn and Wimmera soil moisture data. This will involve collection and analysis of soil samples from the soil-moisture probe sites. The soil attributes will be tested at depth intervals that correspond to the recording depths of the moisture probes. Data analysis will include descriptive examination of soil attributes and interpretation of soil moisture in relation to the soil attributes.

Data analysis

Data analysis will largely involve descriptive statistics for the annual and river summary reports until all data have been collected and collated. After the hydrology data for the Campaspe River are compiled, Bayesian hierarchical models will be trialled and evaluated. Similar approaches were used in previous stages of VEFMAP (e.g. Miller et al. 2014) and have proven to be well suited to the types of data being collected.

References

DELWP (2017a) VEFMAP Stage 6 Part A: Program context and rationale. Department of Environment, Land, Water and Planning.

DELWP (2017b) VEFMAP Stage 6 Part B: Monitoring design and sampling methods. Department of Environment, Land, Water and Planning.

DELWP (2017c) VEFMAP Stage 6 - Monitoring vegetation response to environmental flow delivery in Victoria 2016/17 – Pilot study. A report to Water and Catchments, Department of Environment, Land, Water and Planning.

Miller et al. (2014) How effective are environmental flows? Analyses of flow-ecology relationships in the Victorian Environmental Flow Monitoring and Assessment Program (VEFMAP) from 2011-2014. Report prepared for the Department of Environment and Primary Industries.

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