Quantifying the water needs of flood-dependent plant communities in the Macquarie Marshes, south-eastern Australia

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Sharon Maree Bowen declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Life Sciences, Faculty of Science, at the University of Technology Sydney.

The thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research has been supported by the Australian Government Research Training Program.

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Preface

This research outlines how to quantify measures of condition for flood-dependent plant communities in inland floodplain wetlands. This is critical for efficient ecological monitoring, use in predictive modelling, and to define vegetation restoration targets and management strategies for environmental water. This study has developed a quantitative framework for assessing flood-dependent vegetation community condition and has added to the empirical knowledge about the water requirements of these plant communities.

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Abstract

Inland floodplain wetland plant communities of the Macquarie Marshes occur in the lower reaches of the Macquarie River catchment in the Murray-Darling Basin in semi-arid South-eastern Australia. The natural flood regimes are no longer operating in the Marshes due to river regulation, and in periods of low catchment rainfall they are now sustained solely by delivered environmental water allocations. Flood-dependent plant communities can show considerable negative ecological consequences when natural flow and flooding regimes are significantly disrupted. For effective management of water resources to meet targets for the maintenance and restoration of flood-dependent plant communities, it is critical to know the condition or state of the component plant communities, and to quantify change in condition in response to inundation actions.

This research developed quantitative condition benchmarks derived from a long-term dataset and adds to the knowledge of water requirements for eight inland wetland flood-dependent plant communities of the Macquarie Marshes. It examines the benchmarks and key inundation predictors for forests and woodlands dominated by river red gum (*Eucalyptus camaldulensis*), woodlands of coolibah (*E. coolabah*), shrublands of lignum (*Duma florulenta*), and non-woody wetland communities of water couch (*Paspalum distichum*), sedges (*Eleocharis* spp.) and floodplain grasslands. Condition class schemas for measuring community and tree stand condition were developed and tested using Multivariate Regression Forest (MRF) analysis of data collected at 74 sites in the Macquarie Marshes from 2008 to 2016. The most important inundation regime predictor variables for these vegetation communities were identified from companion inundation data using MRF. Then Ecological Reference Models (ERMs) were developed using Generalised Linear Mixed Modelling (GLMM), of condition scores against inundation regime predictor variables.

The study of the Macquarie Marshes explores the assessment of flood-dependent vegetation community condition using species group responses to water regime and a wetland vegetation typology that can be applied to other flood-dependent vegetation communities and other wetlands. Both the condition class schemas and the ERMs could assist in data supported decision making about current and future ecological restoration activities by defining the appropriate species composition and structure for these and similar flood-dependent vegetation communities.