# MURRAY-DARLING BASIN TREE STAND CONDTION ASSESSMENT (SCA) TOOL

This document provides:

* a list of all products associated with this project
* context and background to the project
* a project description

## Products associated with this project, including access details

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| **Information Type** | **Product** | **Format** | **Size** | **Distribution platform** |
| Report | Development of SCA tool final report | pdf | 1.19MB |  [www.data.gov.au](http://www.data.gov.au)  |
|  Report | User Guide for SCA tool | MS word | 5.71MB |  [www.data.gov.au](http://www.data.gov.au) |
|  Output data | Stand condition time series shapefiles (6 epochs between 2009-2016) for red gum, black box and coolibah | geodatabase of shape files | 990MB | For access contact MDBA at gis@mdba.gov.au  |
|  Output data | 4 bands Landsat stand condition output image with bands 1 to 4 contains crown extent (CE), plant area index (PAI), live basal area (LBA) and Condition score respectively: | floating point raster image | 331GB (~50GB per epoch) | For access contact MDBA at gis@mdba.gov.au |
| Input Data | Field data used for model calibration and validation | comma delimited csv file | ~10MB |  [www.data.gov.au](http://www.data.gov.au) |
| Input Data | 6 epochs including 2009, 2010, 2012-2016 Landsat time composite images | floating point raster image |   | For access contact MDBA at gis@mdba.gov.au |
| Input Data | Basin-wide Environmental Watering Strategy (BWS) Appendix 3 regions  | geodatabase | 1.95MB | [www.data.gov.au](http://www.data.gov.au) |
| Input Data | Cunningham 2013 tree classification layer for red gum, black box and coolibah  | integer raster image | 66.4 MB zipped  |  [www.data.gov.au](http://www.data.gov.au)  |
| Input Data | Murray-Darling Basin managed floodplain | shapefile | ? |  [www.data.gov.au](http://www.data.gov.au)  |
| SCA tool | SCA tool software  | .exe | 299MB | For access contact MDBA at gis@mdba.gov.au |

## Context

The floodplain and riverine forests of the Murray Darling Basin (the Basin) are a key indicator of the environmental health of the Basin and support important cultural, social and economic values.

The Basin Plan and its subordinate instrument the Basin-wide Environmental Watering Strategy (<https://www.mdba.gov.au/managing-water/environmental-water/basin-wide-environmental-watering-strategy>) identify the expected outcomes from changes in water management including from the use of environmental water. Expected changes are quantified for the red gum, black box and coolibah forests and woodlands of the lowland floodplains of the Basin.

The Murray Darling Basin Authority (MDBA) has developed a robust approach to monitoring the condition of riverine and floodplain forests and woodlands that uses both field data and contemporaneous summaries of satellite imagery (Newell et al 2017).

A description of the development of the Landsat-based tool can be found in the project’s final report (Newell et al 2017) associated with this record. The description below is extracted from that report. Please see the above table showing the resources that are available through [www.data.gov.au](http://www.data.gov.au) and through MDBA.

## Introduction (from Newell et al 2017)

Notable declines in the condition of the floodplain forests and woodlands have been evident across the Murray-Darling Basin over many decades (Cunningham et al., 2009b). These detrimental changes are associated with river regulation, water extraction for agriculture declines in rainfall across the Basin (Cunningham *et al.* in press).

In 2002 the then Murray-Darling Basin Commission (MDBC) instituted ‘The Living Murray’ (TLM) program which aimed to restore the health of the Basin by returning water to many of the natural floodplains across the it (MDBC, 2002). The ‘TLM’ program comprised a variety of activities at a series of Icon Sites including the construction and development of infrastructure supporting positive environmental effects through water recovery, environmental watering and monitoring. The physical and geographic scale of the region led to the decision in 2008 to undertake monitoring of the changes in the environmental condition of forests and woodlands across the Murray region through using remote sensing technologies.

Previous stand condition modelling

Several approaches have been taken to assess and report on the condition or quality of native vegetation across the Basin. The initial models and maps of stand condition related to river redgum and black box stands across TLM Icon Sites, by using a combination of field data (175 reference sites) and Landsat satellite imagery (Cunningham, *et al.,* 2009a & b). This work suggested that approximately 79% of these vegetation communities were in a stressed state. These models were successfully developed using an artificial neural network modelling framework, using structural data from the remote sensed imagery and field data (R2 = 0.68). When these models were applied retrospectively to data for the Icon Sites from 2003 to 2008 using historic Landsat imagery, there was a discernible trajectory of increasing stress on these ecosystems. Importantly, it was recognised that this general approach was capable of reporting on condition states over both time and space. Furthermore, it was possible to detect and document decreased levels of vegetation stress for regions associated with environmental watering events between 2003 and 2009, as well as a continued decline for regions across the Murray River floodplain where water was more restricted (Cunningham *et al.* 2009a).

A follow-up study in 2010 using an updated field data and similar modelling approaches displayed poorer model performance (R2 = 0.58; Cunningham *et al.,* 2011), which was attributed to imbalances in stratification of the field based data, where the extremes of the condition states (both good and poor condition) were not widely surveyed, and that majority of the data (77%) related to sites in poor to moderate condition. The effect of the distribution of training data was to ‘flatten’ the model, decreasing model performance at the ‘tails’, and this was addressed statistically by the linear transformation of the predictions (Cunningham *et al*. 2014). This scaled and enforced a direct relationship between the stand condition and full range of condition states observed in the field and improved the statistical performance of the models.

A subsequent modelling investigation during 2013 altered the approach by using RapidEye imagery, following the demise of the Landsat 5 satellite. This was accompanied by delays in field data acquisition in response to extensive floods, and time allowed for ecological responses to this natural event. This modelling study coincided with the development of the original Basin-wide Stand Condition Modelling Tool (Cunningham *et al*. 2013a), and therefore necessitated the need to re-model stand condition for the three preceding years to ensure consistent model performance within the tool. These stand condition models provided relatively strong model fit for TLM Icon Sites (R2 = 0.75 and 0.61; 2009 and 2010 respectively). Building a multi-year model from surveys recorded during two drought years, and the year following extensive floods provided substantial improvements for the predictions of condition (R2 = 0.87), when compared with models based on individual years (R2 = 0.60-0.75). The Stand Condition Tool built from the multi-year model provided strong predictions (R2 = 0.84) for a survey of 50 sites not used for modelling stand condition. Together these results suggested that the Stand Condition Tool would be able to predict stand condition under a range of environmental setting and conditions. The combination of these studies demonstrated that the stand condition modelling approach provided a robust framework for assessing, understanding and reporting on stand condition over time, and across extensive spatial extents.

This current report details the approaches taken to update the models of stand condition, and the software tools that enable the MDBA to develop mapped outputs of stand condition across the Murray-Darling Basin. This was achieved by incorporating additional field observations recently acquired across the Basin in 2014, 2015 and late 2016 / early 2017, in conjunction with updates to the library of remote-sensed data available to develop models. In contrast to previous documents, this report does not report on current stand condition, but on the production of a software tool that enables the MDBA to produce up-to-date appraisals of stand condition on an as-needs basis, and therefore provides the ability to monitor stand condition over time. This monitoring tool will provide useful expressions of stand condition, until the models can be revised with new field data in the future. This software is provided with an installation manual, and an additional tool that allows users to view input imagery and modelled outputs.

**References**

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