Catchment Management Authority Murray

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Yanco & Colombo Creek Riparian Vegetation Mapping Baseline Condition Survey 2013

October 2013

WATER TECHNOLOGY

WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

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PROJECT DETAILS

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Cover Photo: Yanco River, Reach 6 downstream of Site 80, looking downstream from right bank, (Yanco_Ck_6_WP39_ds_extensive_fringing_cane_grass.jpg)

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EXECUTIVE SUMMARY

Water Technology was engaged by the Murray CMA to assess the key attributes of riparian vegetation of the Yanco and Colombo Creeks to increase their knowledge of the condition of the vegetation and to assist with identifying investment priorities for the system in the future. The project reach has a creekline length of 375 kilometres (249km Yanco Creek, 126km Colombo Creek). This project follows a similar project undertaken by Water Technology in 2012 on the Billabong Creek from Walbundrie downstream to Moulamein, a creekline length of 561 kilometres. This current project applies the same methods and builds upon the Billabong Creek data sets. Results for this project have been consolidated with the Billabong Creek data to produce overall mapping and reach condition data comparisons.

The following assessment methods and parameters were adopted to ensure the key deliverables could be captured:

- "Land manager self-assessment method" (DSEb) (tree density, cover of overstorey and understorey, weediness, recruitment, logs and litter, patch size and connectivity).
- Sub-set of the "Index of Stream Condition" (DNRE 1999) physical habitat variables (stream-side zone width, presence of significant discontinuities, macrophyte cover and Large Woody Debris abundance).
- Internally produced indices of tree health, threat /land-use pressures and trajectory.
- General site information and photo-point information.
- Flora information (rapid species listing, commentary on native and exotic flora present) and predicted condition trajectory (Improving, Stable or Declining) for the site.

Determining reaches for the Yanco and Colombo Creeks was undertaken after the condition assessment data was compiled. The authors wanted to identify any obvious changes in condition that may be driven by factors other than flow regulation (e.g. soil type, landuse, and geomorphology). However, on review of condition data, no clear reach breaks based on condition were evident, or at least not on the larger scale. Therefore, to maintain consistency with the Billabong Creek numbering, and to conform with the recent 'Yanco Creek environmental flows study' reaches, the following delineation was adopted:

- Reach 5 – Upper Yanco Creek – Murrumbidgee River to the Tarabah Weir.
- Reach 6 – Lower Yanco Creek - Tarabah Weir to Billabong Creek (Conargo).
- Reach 7 – Colombo Creek – Morundah to the Billabong Creek.

Effort was made to ensure all reaches were adequately sampled so that condition results could be reported on a reach by reach basis.

63 sites were assessed within the project area. 44 sites were assessed along the Yanco Creek from the Murrumbidgee offtake to Conargo between the 20th and the 29th of May 2013. 19 Sites were assessed along the Colombo Creek from Morundah to the Billabong Ck confluence between the 30th of May and the 19th of June 2013. Ten days field assessment was budgeted for in this program and an average of six sites assessed per day was achieved.

Results from the Billabong Creek and the Yanco Colombo projects has been combined in both mapping an analysis. Condition trends across the entire Billabong and Yanco Colombo systems analysed by theme are as follows:

- Habitat Quality – This measures vegetation and habitat condition. The results indicate that the condition of frontages is quite variable and that there are no very strong condition trends across the project area. However, site scores out of 20 for the six reaches indicates that the middle Billabong Creek Reach 3 (13.8/20) has the highest average score while the Colombo Creek has the poorest average (10.4/20).

- Riparian and Instream Health - The data shows a general trend of condition decline in score in a downstream direction along the Billabong Creek from Reach 2 (12.0/20) to Reach 4 (10.4/20), and downstream along the Yanco Creek from Reach 5 (12.8/20) to Reach 6 (12.5/20). Although the Colombo Creek (10.6/20) scores an average slightly above Reach 4 (10.4/20), it scored very poorly for the instream habitat component.
- Canopy Health – The Billabong Creek shows a distinct decline in tree health within its downstream Reach 4. Conversely, the Yanco Creek Canopy Health improves in the downstream reach and the Colombo Creek has the healthiest canopy of all reaches.
- Weed Cover - Weed cover shows a general trend of reducing as one moves further downstream into the drier western plains, however, overall cover also tends to decrease.
- Condition Trajectory - The results are variable across reaches but the following is evident:
    - Although the upstream Reach 2 has the highest percentage of sites considered to have an improving condition trajectory, this reach also has the highest percentage of sites likely to decline in condition.
    - Reach 3 has no sites considered likely to decline under current management arrangements.
    - Reach 4 has more sites likely to decline than improve.
    - Most of Reach 5 sites are considered to be in a stable condition, however, no sites were considered to have an improving condition trajectory under current management.

A number of site specific and reach specific recommendations for ongoing management within the Billabong, Yanco and Colombo Creek system have been developed, however overall recommended actions include consideration of the following:

- A fish survey has recently been completed across the project area. The data collected for this project should be analysed alongside the fish assemblage data to draw out any correlations between fish species presence/abundance and vegetation/habitat condition.
- A holistic Waterway Action Plan (WAP) should be developed. A WAP provides a considered approach to investment of existing funds and also provides a clear and well considered document to leverage future funding. A WAP process will review recently completed studies, consult with the community and undertake additional field study to identify values and threats, undertake a risk assessment and develop a prioritised and costed set of actions.
- Communicate the findings of this and associated projects to the community and stakeholders. Celebrate the high value locations and features and communicate the interesting findings and flood responses that were evident. Use this communication to inform landholders of what makes a creek frontage special, what to look out for and how to protect environmental assets.
- A number of the weirs were observed in poor condition throughout the project area, particularly on the Colombo Creek. Some of these weirs were in danger of outflanking or undermining. A review of weir condition, in conjunction with the fish surveys, may provide strategic direction for future repair or replacement, and the incorporation of fish friendly options (e.g. appropriately designed rock chute or fish ladder).

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1 Overview

The Murray Catchment Management Authority (Murray CMA) is a statutory body with the principle role to set future direction for natural resource management (NRM) within the Murray CMA Catchment. One of the key natural resource assets identified in the Murray Catchment is the Billabong Creek system that includes the Yanco and Colombo Creeks as major tributaries. The upper Yanco and Colombo Creeks originate within the Murrumbidgee CMA Region and flow into the Murray catchment. Figure 1 shows the project reaches highlighted within the Murray and Murrumbidgee CMA Regions.

The Yanco Creek is an effluent of the Murrumbidgee River, with its offtake channel above the Yanco Weir, approximately 15km downstream of Narrandera. The Yanco Creek flows in a south westerly direction for 38km before diverging into two channels upstream of Morundah (see Figure 1 Purple line). The southern arm becomes the Colombo Creek at Morundah and continues to flow generally south west for 126km before discharging into the Billabong Creek upstream of Jerilderie (see Figure 1 Red line). The Yanco Creek follows the western arm with the Tarabah Weir and fish ladder just below the divergence. The Tarabah weir controls flows down the Yanco Creek thereby forcing water down the Colombo Creek when required. The Yanco Creek flows west-south-west from the Tarabah Weir for 211km before discharging into the Billabong Creek at Conargo (see Figure 1 Green line).

The Yanco Creek system supplies water to a vast area of the Riverine Plains of New South Wales for agricultural production and also water supply for townships of Morundah, Jerilderie, Conargo and Wanganella. Along the system there are a number of environmental assets including significant wetland areas that have been impacted by historic water management practices. The community along the creek system is highly committed to improving the ecological health of all the system and has initiated and/or supported several studies and environmental restoration programs, particularly for riparian habitat.

1.2 Project Scope

Water Technology was engaged by the Murray CMA to assess the key attributes of riparian vegetation of the Yanco and Colombo Creeks to increase their knowledge of the condition of the vegetation and to assist with identifying investment priorities for the system in the future. The project reach, as highlighted in Figure 1, has a creekline length of 375 kilometres (249km Yanco Creek, 126km Colombo Creek). This project follows a similar project undertaken by Water Technology in 2012 on the Billabong Creek from Walbundrie downstream to Moulamein. The current project applies the same methods and builds upon the Billabong Creek data sets. Results for this project have been consolidated with the Billabong Creek data to produce overall mapping and reach condition data comparisons.

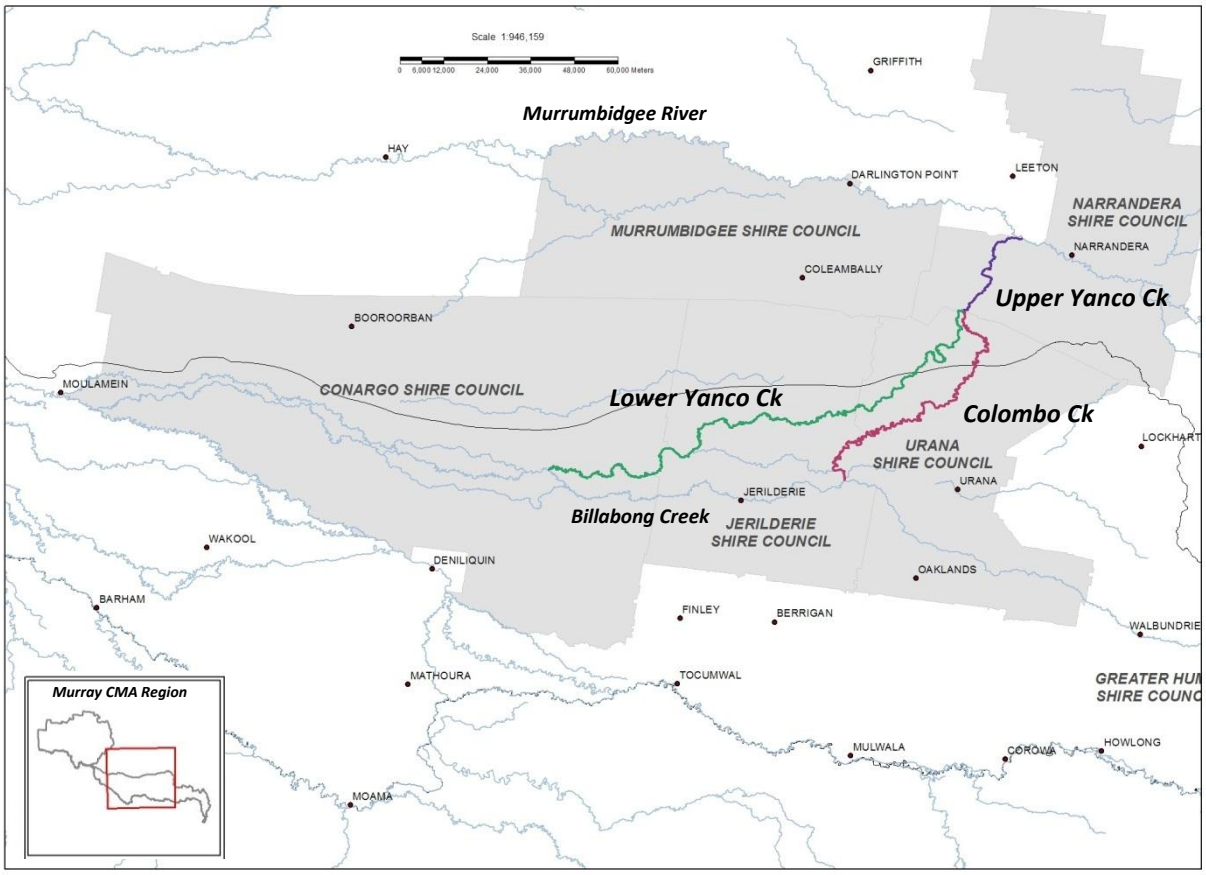


Figure 1 Project area waterways (MyCMA 2012)

2. METHODS

This project builds on data gathered for the 'Billabong Creek Riparian Vegetation Mapping 2011-12 project'. The method of assessment and condition data collected replicates that applied on the Billabong Creek, thereby allowing direct comparison of data across the two project areas. Although the Yanco-Colombo data was gathered a year later, the seasonal conditions were similar and the assessment timing coincided (Billabong Creek 24/5/12 – 29/6/12, Yanco-Colombo Creeks 20/5/13 – 19/6/13).

A meeting was held in April 2012 at which assessment parameters and field methods were proposed by Water Technology ecologists and discussed and agreed upon with Murray CMA project managers. The methods adopted needed to be rapid and repeatable. There also needed to be a balance between scientific rigour and practicability so that a reasonable number of sites could be assessed within the budgetary constraints. The method also needed to be well documented and relatively easy to apply so that future monitoring could be undertaken by suitably skilled consultants or Murray CMA staff.

It was agreed that the key deliverables would include:

- Ground-truthing of Murray CMA remote analyses for:
  - riparian canopy width.
  - longitudinal continuity.
  - broad vegetation type (including presence of exotics such as willows). (Note: this Ground-truthing analysis was not required in 2013).
- On-ground assessment of:
  - intactness of understorey canopy layers.
  - extent of regeneration of all canopy layers.
  - condition of riparian trees.
  - land-use type, any major threats to riparian vegetation condition and the trajectory of those threats.

It was agreed that the following methods be adopted to ensure the key deliverables could be captured:

a) "Land manager self-assessment method" (DSEb) (tree density, cover of over and understorey, weediness, recruitment, logs and litter, patch size and connectivity).
b) Sub-set of the "Index of Stream Condition" (DNRE 1999) physical habitat variables (stream-side zone width, presence of significant discontinuities, macrophyte cover and LWD abundance).
c) Internally produced indices of tree health, threat /land-use pressures and trajectory.
d) General site details (including broad vegetation type) and photo-point information.

It was agreed there was no need to assess detailed floristics at each site and that these attributes would instead be reported on by exception (e.g. notation of presence of weeds of significance, threatened species, key gaps in floristic community in comparison to other sites). A rapid list of native and exotic species was gathered in order to identify species abundance. The number of species was recorded however species names are only recorded (often common names) on the scanned field sheets.

2.1 Reach Determination

This section describes the reach determination and numbering process for the Billabong Creek and the Yanco-Colombo Creeks.

2.1.1 Billabong Creek

Billabong Creek originates from headwaters to the east of Holbrook and generally flows in a westerly direction. The upper reach of Billabong Creek, from its headwaters to Walbundrie, has had vegetation condition monitoring undertaken in recent years and was therefore excluded from this project.

The project area was divided into three reaches, principally based upon the level of river regulation and therefore divided at the confluence of the flow regulated tributaries. The reaches 2, 3 and 4 were assigned to the project area as follows:

- Reach 2 (unregulated reach) – Walbundrie to Colombo Creek confluence.
- Reach 3 (regulated reach) – Colombo Creek confluence to Yanco Creek confluence.
- Reach 4 (highly regulated reach) – Yanco Creek confluence to Moulamein (i.e. downstream extent, confluence with the Edward River).

Effort was made to ensure all reaches were adequately sampled so that condition results could be reported on a reach by reach basis.

2.1.2 Yanco and Colombo Creeks

The Yanco and Colombo Creeks are heavily regulated waterways with numerous weirs, regulators, block dams and by-wash dams throughout the creek system.

Downstream of Morundah, Yanco Creek has a much greater flow capacity than Colombo Creek and carries the major portion of the unregulated flows that generally occur in winter-spring, whereas Colombo Creek carries the major portion of regulated flows in summer-autumn. Both Yanco Creek and Colombo Creek also receive inflows from drains and/or tributary streams. Yanco Creek receives flows from the Coleambally Catchment Drain (CCD) and drain DC 800, both of which carry drainage flows and regulated releases from the Coleambally Irrigation Area (Molino Stewart 1999).

Determining Reaches for the Yanco and Colombo Creeks was undertaken after the condition assessment data was compiled. The authors wanted to identify any obvious changes in condition that may be driven by factors other than flow regulation (e.g. soil type, landuse, and geomorphology). However, on review of condition data, no clear reach breaks based on condition were evident, or at least not on the larger scale. Therefore, to maintain consistency with the Billabong Creek, and to conform with the recent 'Yanco Creek environmental flows study' (Alluvium 2012), the following reaches were assigned:

- Reach 5 – Upper Yanco Creek – Murrumbidgee River to the Tarabah Weir.
- Reach 6 – Lower Yanco Creek - Tarabah Weir to Billabong Creek (Conargo).
- Reach 7 – Colombo Creek – Morundah to the Billabong Creek.

2.2 Field Assessment Parameters

The field assessment sheets developed for this project have been provided in Appendix A. The components assessed at each site are summarised in the following sections.

2.2.1 Site Information

The following detail was recorded for each site:

- Assessor names and date assessed.
- The land tenure type (i.e. Crown or Freehold) and the land manager if known.
- Access details to locate and enter the site, and noting whether site access was Unrestricted (e.g. can drive to the crown land frontage), Limited (public land but access via foot and over fences etc.) or Restricted (e.g. can only be accessed through freehold land).
- GPS coordinates for the peg located in the middle of the site.
- The length, width and area of the assessment site and a sketch of the site and features.
- Photograph GPS locations, photo number and description.

2.2.2 Frontage Management

The current landuse of the assessed frontage was noted. Landuse pressures thought to be impacting on condition of the site were identified (e.g. grazing, recreation, timber removal etc.) and a severity rating attributed to each threat (i.e. High, Medium or Low).

2.2.3 Land Manager Self-Assessment Method (Habitat Quality)

This method is a rapid and simplified version of the Victorian 'habitat hectares' approach developed by Parkes et al. (2003). This method is designed to measure the quality of native vegetation and habitat against a set of known benchmarks. Habitat quality is determined by comparing seven vegetation and three landscape components against known benchmarks. These benchmarks have been identified by botanists after looking at mature and undisturbed examples of each of the 21 Ecological Vegetation Class (EVC) Groups. They have nominated a range of values (percentage, number, length etc.) that best represents the average characteristics for that EVC Group (DSE 2004a). This project used only one EVC Group, that being Group 15 – Riparian Forest or Woodland. Despite being developed in Victoria, this method and EVC Group can be appropriately applied within riparian areas of southern New South Wales.

The assessment of habitat quality applied in this method is an estimation of how altered the site is from a notionally optimal state.

The Land Manager Self-assessment Method produces a total condition score out of 20. The 10 assessed components are briefly described below and the highest score for each component, and therefore weighting, is shown in parenthesis:

1. **Large Trees** (2) – the observed number of large trees per hectare, as specified by a diameter at breast height appropriate to the relevant EVC Group.
2. **Canopy Cover** (1) – the canopy cover provided by the tallest stratum of native trees greater than 5 metres tall.
3. **Understorey** (5) – the cover of understorey provided by native species and the relative life forms that this cover represents.
4. **Weediness** (3) – the proportion of the site covered by exotic vegetation, including both woody weeds and ground weeds.
5. **Recruitment** (2) – the proportion of the mature species recruiting at the site, where the number of recruiting individuals is at least 10% of the mature population of that species.
6. **Organic Litter** (1) – the proportion of the ground covered by organic litter including leaves, twigs and branches with a diameter of greater than 10 centimetres.
7. **Logs** (1) – the length of logs per hectare, defined by the length of stumps, fallen trees and branches with a diameter of greater than 10 centimetres.

8. **Patch Size** (2) – this component was modified for application on the linear creekline feature. Rather than being defined as the size of contiguous linear patch, it was defined by the width of vegetation away from the water's edge (i.e. width <30m = 0, 30-49m = 1, ≥50m = 2).
9. **Neighbourhood** (2) – the proportion of the area within a 1 kilometre radius that is covered by native vegetation.
10. **Distance to Core Area** (1) – the distance from the site to a block of native vegetation of greater than 50 hectares in size.

All sites assessed used the same EVC Group, that being Group 15 – Riparian Forest or Woodland. However, the benchmark values differed between Forests and Woodlands and sites were defined as one or the other when in the field. Sites were assessed as Forests where the canopy trees were more abundant, taller and with a relatively closed canopy cover. However, most sites were assessed as Woodlands with only 8 of the 63 sites being assessed as Forest, 6 of which were in Reach 5 – Upper Yanco.

2.2.4 Riparian and Instream Health

The Riparian and Instream Health assessment components were selected to complement and expand upon the Habitat Quality assessment by providing measures more specific to waterways. Five condition components were assessed, each scored out of four for a total score out of 20. Four of the five components were adopted from the Index of Stream Condition (ISC) 2004 (1st edition) method. The fifth non-ISC component assesses the presence of macrophytes along the toe of the bank being assessed. The Riparian and Instream Health components are as follows:

1. **Width of Streamside Zone** – the width of woody vegetation measured from the toe of bank perpendicular to the flow, as per the 2004 ISC (1st edition) 20% cover rule.
2. **Longitudinal Continuity** – vegetation is considered to be continuous where woody cover of vegetation provides at least 20% cover, extending at least 5m from the toe of bank and where any gaps in vegetation are less than 10 metres.
3. **Instream Habitat** (large wood) – the presence of instream physical habitat is based on wood loadings within the stream, assessed as per the 2004 ISC (1st edition) reference photographs and scoring (See the ISC 'Large Wood Reference Photographs' in Appendix B).
4. **Bank Stability** – the bank stability is measured by comparing the condition of the bank with the relevant photographs and descriptions shown in the guide within Appendix B. The factors taken into account in this assessment include bank profile, slope, cover of vegetation, amount of exposed roots and severity of erosion.
5. **Macrophytes** (rushes and reeds) – the presence and relative abundance of macrophytic vegetation growing along the toe or face of the bank.

2.2.5 Canopy Health Assessment

A visual guide to tree health was undertaken by estimating the proportion of expected healthy canopy cover present at each site. The visual guide tree health is provided in Appendix B.

The proportion of large tree canopy cover present was assessed by estimating the average projective foliage cover of canopy trees within the assessment area and comparing this to the expected 'healthy' projective foliage cover. Effectively, this is a measure of how far the small leaf bearing branches that make up the canopy are from maximum foliage carrying capacity. Note that absent or fallen branches do not necessarily correspond to reduced tree health and as such are not accounted for as part of the tree health component. Loss of foliage on sub-canopy branches and lower limbs is similarly not included in the assessment. Large dead trees were included in the health assessment and have a canopy health cover of 0% (derived from DSE 2004).

The percentage canopy health was assessed at a number of locations across the assessment area and an average percentage calculated.

2.2.6 Additional Flora Information

Despite floristics not being required for this project, a rapid list of native and exotic species was documented at each field site. The lists were compiled to provide a species abundance number for both natives and exotics. The lists are not exhaustive and should not be considered to be absolute numbers found at these sites at this time of year. Plant names were recorded rapidly and written as scientific or common names. These lists can be accessed from the scanned field sheets if required.

Native and Exotic Vegetation Observations were documented to provide a brief written description of the structure, dominant species and character of vegetation across the site.

2.2.7 Condition Trajectory

Following completion of all condition assessments at a site, a future condition trajectory was predicted based on the landuse and considered recovery/improvement potential assuming the current management regime remains the same (e.g. the same level of grazing pressure continues). Future hydrological influences are unknown and were not considered in the trajectory prediction.

The trajectory was predicted as **Improving**, **Stable** or **Declining**, and commentary was written to rationalise that prediction.

2.3 Site Selection

2.3.1 Billabong Creek

The Murray CMA provided spatial data including aerial imagery to facilitate the selection of field sites. A desktop selection of sites based on the following criteria was undertaken prior to entering the field:

- Proximity to a road or track for ease of access.
- Proximity to a homestead.
- Varying land tenure (i.e. freehold and crown land).
- Differing landuse (e.g. grazing and irrigated cropping).
- Varying Broad Vegetation Type.
- Varying vegetation width and continuity.

An abundance of sites were selected and a point shapefile of selected locations was created and provided to the Murray CMA to facilitate landholder contact. An A3 base map series was produced using aerial photography annotated with chosen assessment sites and crown land parcels (Travelling Stock Reserves).

However, once in the field it was evident that site selection needed to be opportunistic and rapid. In order to assess a reasonable number of sites per day and to ensure good distribution of sites, attempts were made to proceed approximately five kilometres downstream and to locate a site as quickly as possible. Site selection still required good access and importantly, landholder permission. It was also not practical to cross the creek other than at bridge crossings and therefore long sections of creek were often assessed on the same bank.

Yanco and Colombo Creeks

A different approach to site selection and landholder contact was adopted for the Yanco Colombo project. Jim Parrett was engaged by the Murray CMA to provide landholder names, contact details and access details. Jim was requested to select approximately 80 sites across the project area that provided a range of landuse types and conditions. Jim provided this detail to assessors in the form of client listings and Google Earth maps (.kmz files). Although the client listings and access details were very helpful, the site selections were not strictly adhered to as sites typical of that section of creek were selected.

Based on the Billabong Creek assessment experience, a target of assessing at least 6 sites per fieldwork day was set. The project area was divided into 10 equal creek lengths to match the number of field days. Assessors attempted to spend only one fieldwork day, and assess at least 6 sites, within each division. This approach worked well and for the most part a good distribution of sites occurred and a total of 63 sites were assessed over the 10 fieldwork days.

2.4 Landholder Contact

Prior to entering the field, Jim Parrett had provided assessors with contact names, property names and phone numbers for the majority of landholders with creek frontage within the project area. The Murray CMA had also provided a GIS property boundary layer. The combination of these data provided accurate property identification and corresponding landholder contact.

Landholder contact was made initially by phone of an early evening, ideally a few days prior to the planned fieldwork. Assessors also met with landholders or managers on site whenever possible to discuss the project and to glean information about the condition of the creek, the nature of the recent flooding, native vegetation and weed responses to flooding and any other matters of interest including the fish.

2.5 Field Assessment Procedure

2.5.1 Assessment Timing and Site Distribution

63 sites were assessed within the project area. 44 sites were assessed along the Yanco Creek from the Murrumbidgee offtake to Conargo between the 20th and the 29th of May 2013. 19 Sites were assessed along the Colombo Creek from Morundah to the Billabong Ck confluence between the 30th of May and the 19th of June 2013. Ten days field assessment was budgeted for in this program and an average of six sites assessed per day was achieved.

The project area was divided into three reaches. **Error! Reference source not found.** indicates the umber of sites assessed within each reach, the length of that reach and the corresponding creek centreline average distance between sites.

Table 1 Reach and site numbers

Reach number and description	Number of sites assessed	Creek centreline reach length	Average distance between sites
Reach 5 – Upper Yanco Creek – Murrumbidgee River to the Tarabah Weir.	9	38 km	4.2 km
Reach 6 – Lower Yanco Creek – Tarabah Weir to the Billabong Creek confluence (Conargo).	35	211 km	6.0 km
Reach 7 – Colombo Creek – Morundah to the Billabong Creek confluence.	19	126 km	6.6 km
Total	63 sites	375 km	(6.0 km av.)

2.5.2 Site Assessment Location and Setup

Once an assessment site was decided upon, a wooden peg was hammered into the ground near the top of bank at a location that was as inconspicuous as possible. This is to prevent injury to people, livestock, machinery and fauna. The peg was typically located close to a tree or under a fenceline

wherever practicable. The peg identified the middle of the assessment area longitudinally, and the width of the assessed area usually depended upon the width of woody vegetation offstream. All assessed areas extended 50 metres upstream and downstream of the peg. The location and dimensions of the assessed area was sketched on the first page of the fieldsheets.

The habitat assessment was carried out over the area indicated in the sketch, that being 100m along the creek, from the toe of the bank offstream to the edge of canopy or for a maximum width of 50 metres. Canopy health, additional flora information, landuse and condition trajectories were noted and assessed over the same area.

The Riparian and Instream Health assessment was undertaken over the adjacent length of bank and instream, that is, 50 metres upstream and downstream from the peg.

2.5.3 Photograph Convention

673 digital photographs were taken during the 10 days of field assessment on the Yanco and Colombo Creeks. A standard convention was adopted for taking photos at each assessment site. Figure 2 shows the photo convention adopted for this Yanco Colombo and previous Billabong Creek project.

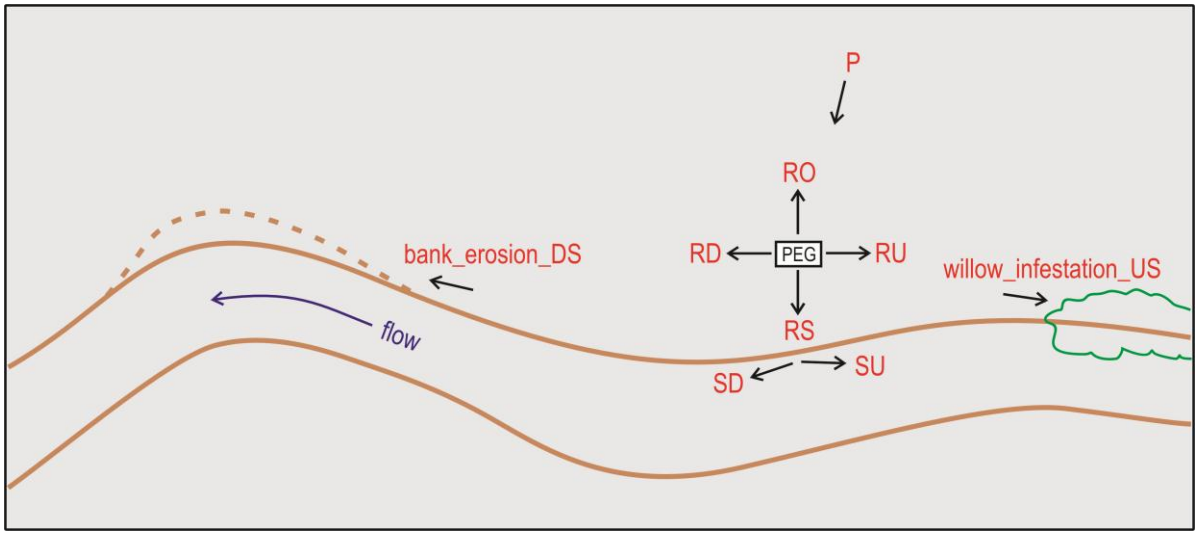


Figure 2 Photograph conventions and codes

The photograph direction and naming convention adopted for this project was as follows:

Photos were renamed by Waterway_Reach_Site Number_Bank_Description/code

For example Yanco_Ck_5_66_R_SU

Referring to a photo taken on Yanco Creek, within Reach 5, at Site number 66, located on the right bank (determined while looking with the direction of flow), from the toe of the bank adjacent to the peg looking up the bed of the stream.

The Description/code at the end of the photo name is either a standard convention code (see below) or a description of the feature of note (e.g. bank_erosion, willow_infestation, as shown in Figure 2) followed by a direction if applicable (e.g. US, DS). The seven standard coded photos listed below were taken at each site and the peg coordinate was attributed to these photos. Feature photos were taken opportunistically and their location coordinates were recorded independently.

Standard photo description codes

P	Peg:	Peg locator photo, usually taken towards the stream with the peg in the bottom centre of frame, with enough detail around and in the background to allow relocation of the peg in the future.
RU	Riparian Upstream:	Taken from the peg looking upstream showing the riparian vegetation.
RS	Riparian Stream:	Taken from the peg looking towards the stream, ideally showing bank vegetation
RD	Riparian Downstream:	Taken from the peg looking downstream showing the riparian vegetation.
RO	Riparian Offstream:	Taken from the peg looking directly away from the stream showing vegetation or adjacent landuse.
SU	Stream Upstream:	Taken from the toe of bank adjacent to the peg, looking upstream at the bed of the stream within channel.
SD	Stream Downstream	Taken from the toe of bank adjacent to the peg, looking downstream at the bed of the stream within channel.

All photos have been renamed and are located in the digital data DVD located in Appendix D. A hotlinked ArcMap project has also been created so that all photographs can be viewed spatially using GIS software. This hotlinking project file can be run from the DVD of digital data contained in Appendix D.

3. SUMMARY OF RESULTS

All assessment data has been entered into a spreadsheet with separate tabs for each assessment theme. This data is provided electronically on the DVD contained in Appendix D.

There are a large number of condition parameters that have been assessed at each of the 123 (63 sites in the current program) assessment sites, however, this summary of findings looks at five main themes and provides a brief discussion of the condition trends throughout the project area and between the three reaches.

The five themes for discussion are as follows:

1. Habitat Quality (Land Manager Self-assessment Method).
2. Riparian and Instream Health.
3. Canopy Health.
4. Weed Cover.
5. Condition Trajectory.

Commentary has been provided where an explanation for the condition trends can be identified.

3.1 Habitat Quality (Land Manager Self-Assessment Method)

The total score out of 20 for each site has been displayed graphically in Figure 3. The mapping indicates that the condition of frontages is quite variable and that there are no very strong condition trends across the project area. The Habitat Quality results do not appear to be strongly affected by flow regulation as the overall condition of each reach is similar (see the habitat quality score graph on Figure 3). That said, component scores within the method do indicate some differences between reaches.

A review of Habitat Quality and Species Number count shows the following:

- All sites have a greater number of native species present than exotic.

Reach 2

- Lowest average number of native species per site and had a relatively high average number of exotics per site. This partly due to the higher rainfall in this reach and the proliferation of annual grasses, smaller landholdings and more intense agriculture.

Reach 3

- Highest average overall Habitat Quality score.
- Highest native species diversity, averaging just over 16 species.
- Reach 3 scored highest in the following components of the Habitat Quality assessment:
    - Weediness (lack of weeds).
    - Recruitment.
    - Neighbourhood.

Reach 4

- Site 47 (Wanganella Reserve) has the highest score (19/20) of all sites assessed.

Reach 5

- Reach 5 is the only reach without a site below a score of 11/20.
- Highest percentage cover of weeds (includes exotic grasses) and subsequently has the poorest weediness score.
- Reach 5 scored highest in the following components of the Habitat Quality assessment:
    - Understorey.
    - Width.

Reach 6

- Good Neighbourhood score.
- Poor understorey score, lowest of all reaches.

Reach 7

- Lowest average overall Habitat Quality score (10.4/20).
- Site 110 has the lowest HQ score of 3/20.
- Reach 7 has a very high average number of native species per site, but also has the highest number of exotic species, averaging approximately 10 species per site.
- Reach 7 scored lowest in the following components of the Habitat Quality assessment:
    - Large Trees.
    - Logs.
    - Width.
    - Neighbourhood.
    - Core Area.

N

0 10 20 30 40 50 km

WATER TECHNOLOGY

Reach 5
Yanco Ck
Murrumbidgee River to Tarabah Weir

Reach 6
Yanco Creek
Tarabah Weir to Billabong Ck

Reach 7
Colombo Creek
Morundah to Billabong Ck

Reach 4
Billabong Creek
Yanco Ck to Edward River

Reach 3
Billabong Creek
Colombo Ck to Yanco Ck

Reach 2
Billabong Creek
Walbundrie to Colombo Ck

Murrumbidgee River
Leeton
Narrandera
Coleambally
Morundah
Yanco Creek
Colombo Creek
Lockhart
Urana
Oaklands
Rand
Walbundrie
Moulamein
Billabong Creek
Wanganella
Conargo
Jerilderie
Edward River
Wakool
Deniliquin
Finley
Berrigan
Barham
Murray River

LEGEND

Habitat Quality (score/20)

19 17 15 13 11 9 7 5 3

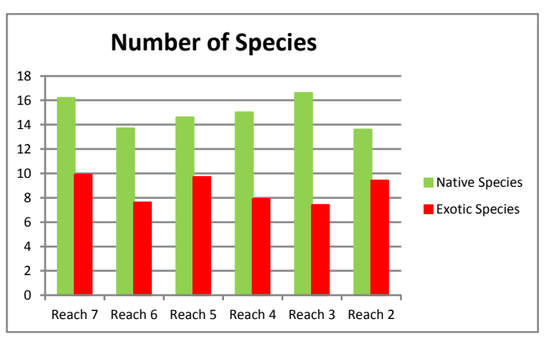
Reach break

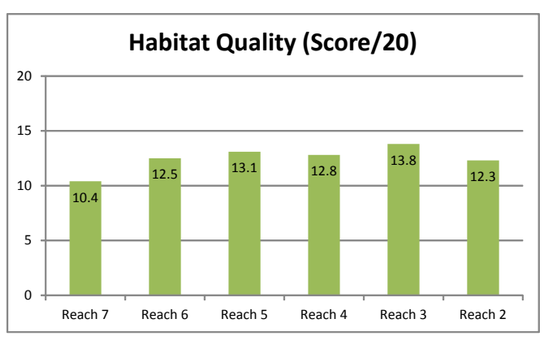
45 Site number

Waterway

Road

Township





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Habitat Quality

Figure 3

3.2 Riparian and Instream Health

The total score out of 20 for each site has been displayed graphically in Figure 6. Total scores show a general trend of declining condition as both the Yanco and Billabong Creeks move downstream. The Yanco Creek shows a better condition than both the Billabong and Colombo Creeks.

A review of overall and individual component scores within the method show the following trends:

- Instream Habitat is more abundant throughout the Yanco Creek and upper Billabong Creek.
- Within the Yanco-Colombo reaches, the most of the very poor sites (scores below 8) are located around and downstream of Morundah.

Reach 2

- Equal highest score for Instream Habitat (large wood instream).
- Highest score for Bank Stability. The Billabong Creek shows a steady decline in bank condition downstream. The Yanco and Colombo Creeks showed similar.

Reach 3

- Instream Habitat was less abundant in this reach compared with the other Billabong Creek reaches and the Yanco Creek.

Reach 4

- Reach 4 has the lowest overall average score (10.4/20).
- Lowest scoring reach for Macrophytes.
- Lowest scoring reach for Bank Stability due to stock access, pugging and tracking rather than fluvial erosion.

Reach 5

- Reach 5 has the highest average score (12.8/20) with no sites scoring below 10/20.
- This reach scored the highest average for the following components:
    - Width of Streamside Zone.
    - Longitudinal Continuity.
    - Instream Habitat (equal with reach 2).

Reach 6

- This reached scored very well overall (12.5/20) and had a good Instream Habitat score.

Reach 7

- Extensive willow removal may have influenced scores within Reach 7 (both positively and negatively).
- Overall Reach 7 had the poorly and had the lowest average scores for the following components:
    - Width of Streamside Zone.
    - Longitudinal Continuity.
    - Instream Habitat.

3.2.1 Canopy Continuity

Longitudinal Continuity of woody vegetation along the bank, principally canopy cover, was assessed at each of the 124, 100m long sites. Canopy continuity along the top of bank was observed as being either Fully Continuous (i.e. no breaks in canopy of more than 10m long within the 100m site length), Mostly Continuous (i.e. some breaks of more than 10m but the majority of frontage vegetated), or Mostly Discontinuous (i.e. breaks in continuity, greater than 10m long, form the majority of the frontage). Figure 4 indicates that the majority of assessed sites have fully continuous vegetation. The anomalous result is the high percentage (5/19 sites, 26%) of mostly discontinuous sites within the Colombo Reach 7. All of these discontinuous sites are located in the middle sections of the Colombo Creek.

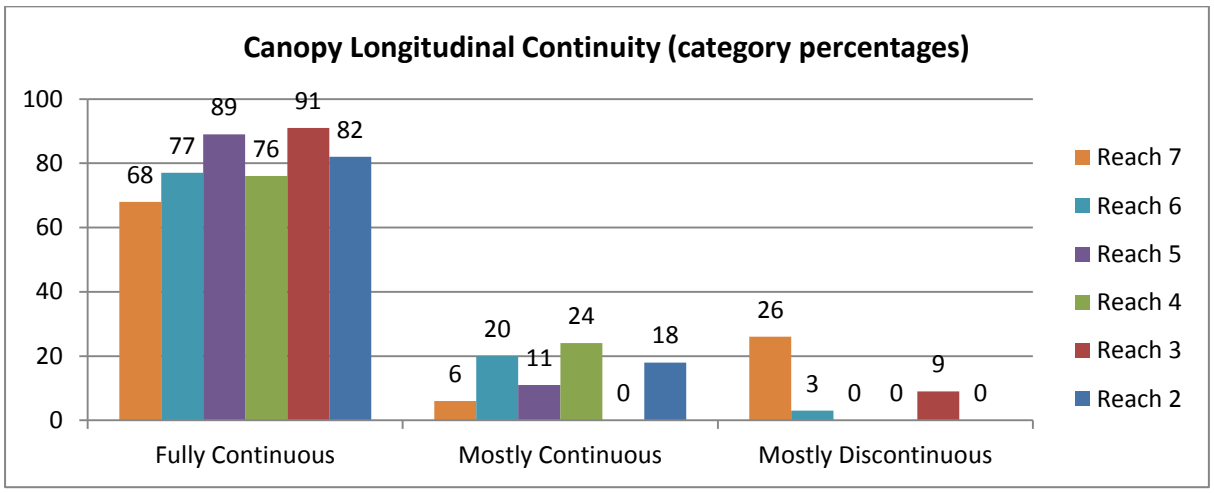


Figure 4 Reach percentage of sites within each continuity category

3.2.2 Canopy Widths

Canopy widths were measured at each of the 104 assessment sites. Figure 5 indicates the percentage of sites within each width category (i.e. 5-10m, 10-30m, 30-50m, >50m) plotted by Reach.

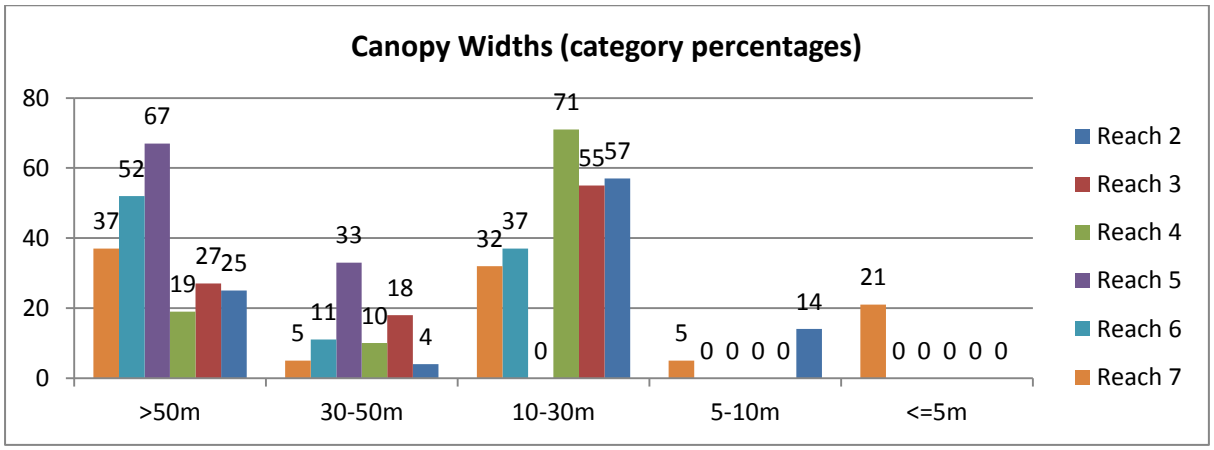


Figure 5 Reach percentage of sites within each canopy width category

The width categories indicate that the majority of Billabong Creek sites (Reaches 2-4) were in the 10-30m wide, whereas the majority of Yanco and Colombo Creek sites (Reaches 5-7) were in the >50m wide category; this is despite Reach 7 having a high percentage of mostly discontinuous sites.

N

0 10 20 30 40 50 km

WATER TECHNOLOGY

Reach 5
Yanco Ck
Murrumbidgee River to Tarabah Weir

Reach 6
Yanco Creek
Tarabah Weir to Billabong Ck

Reach 7
Colombo Creek
Morundah to Billabong Ck

Reach 4
Billabong Creek
Yanco Ck to Edward River

Reach 3
Billabong Creek
Colombo Ck to Yanco Ck

Reach 2
Billabong Creek
Walbundrie to Colombo Ck

Murrumbidgee River
Leeton
Narrandera
Coleambally
Morundah
Yanco Creek
Colombo Creek
Billabong Creek
Moulamein
Wanganella
Conargo
Jerilderie
Urana
Lockhart
Oaklands
Rand
Walbundrie
Wakool
Deniliquin
Finley
Berrigan
Barham
Edward River
Murray River

LEGEND

Riparian & Instream Health (score/20)

20 18 16 14 12 10 8 6 4

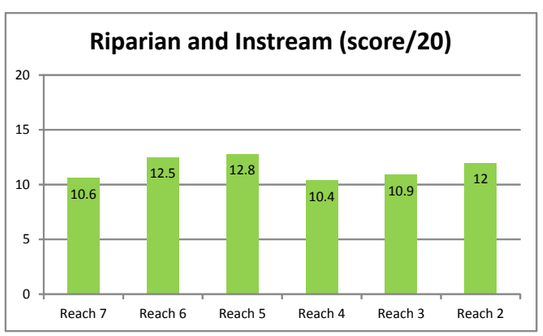
Reach break

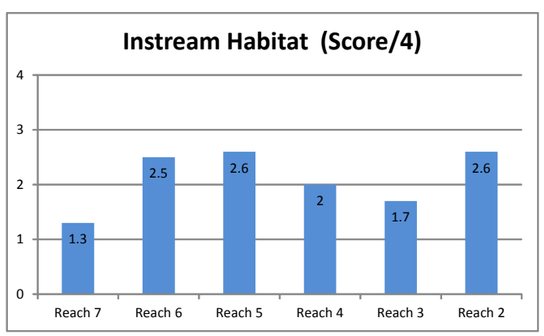
45 Site number

Waterway

Road

Township





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Riparian and Instream Health

Figure 6

3.3 Canopy Health

It was observed during field assessment that following the recent flooding trees throughout the study area were generally healthy and actively growing. However, the visual guide used to assess canopy health (See Appendix B) considered the amount of dead small branches in the canopy. Despite trees displaying fresh leaf growth, the deadwood within the canopy, particularly the small branches, provided some insight as to how drought stressed trees were prior to the recent flooding.

The Canopy Health percentage covers show some curious results (Figure 7). When the Billabong Creek was assessed in 2012, the results showed a decline in canopy condition as the creek moved further downstream. This was attributed to the cumulative effects of water extraction leading to a reduction in flow further downstream. Interestingly, the upstream Yanco Creek reach between the Murrumbidgee River offtake and Morundah was assessed as having poorer condition Canopy Health than the downstream reaches. This reverses the trend on the Billabong Creek and is likely to be due to the highly regulated nature of flows in the Yanco and Colombo Creeks.

Reach 7 has the highest Canopy Health average score. Although Reach 7 shows poor Width and Continuity scores, the trees that are present are in relatively good health. This is possibly due to there often being a narrow strip of trees at the top of bank which have permanent access to water in the creek, therefore maintaining vigour during the recent drought period.

Reach 4 has the lowest Canopy Health average while Reach 5 has lower than expected Canopy Health given the high scores for Habitat Quality and Riparian & Instream Health.

N

0 10 20 30 40 50 km

WATER TECHNOLOGY

Reach 5
Yanco Ck
Murrumbidgee River to Tarabah Weir

Reach 6
Yanco Creek
Tarabah Weir to Billabong Ck

Reach 7
Colombo Creek
Morundah to Billabong Ck

Reach 4
Billabong Creek
Yanco Ck to Edward River

Reach 3
Billabong Creek
Colombo Ck to Yanco Ck

Reach 2
Billabong Creek
Walbundrie to Colombo Ck

Murrumbidgee River
Leeton
Narrandera
Coleambally
Morundah
Yanco Creek
Colombo Creek
Lockhart
Urana
Oaklands
Rand
Walbundrie
Moulamein
Billabong Creek
Wanganella
Conargo
Jerilderie
Edward River
Wakool
Deniliquin
Finley
Berrigan
Barham
Murray River

LEGEND

Canopy Health
(% expected cover)

98 90 80 70 60 50 40 33

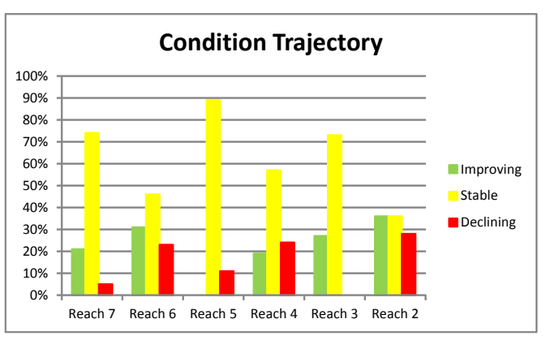
Reach break

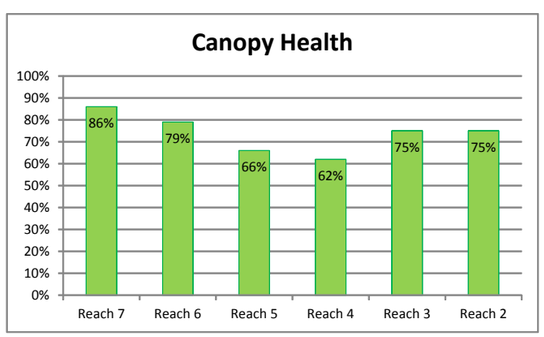
45 Site number

Waterway

Road

Township





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Canopy Health

Figure 7

3.4 Weed Cover

Weed cover percentages are presented graphically in Figure 8. The following comments have been drawn from the Weed Cover results:

- The Billabong Creek Reaches 3 and 4 show considerably less weed cover than the other reaches. Reach 3 has the lowest percentage weed cover, the lowest number of weed species per site, and the highest number of native species per site.
- The upper Yanco Reach 5 has the highest exotic understorey cover and also has the highest native understorey cover. This indicates that there is little bare ground and the inter-tussock spaces are occupied by exotic herbs and grasses.
- The weed cover percentages tend to correlate with the average number of exotic species identified within each Reach as graphed on Figure 3.
- Sites 2, 3, and 21 within Reach 2, and sites 110 and 119 within Reach 7, have high weed cover at 85%.
- Sites 47 (Wanganella Reserve) and 92 (recently burnt and little ground cover at all) had low weed cover at 1%.

N

0 10 20 30 40 50 km

WATER TECHNOLOGY

Reach 5
Yanco Ck
Murrumbidgee River to Tarabah Weir

Reach 6
Yanco Creek
Tarabah Weir to Billabong Ck

Reach 7
Colombo Creek
Morundah to Billabong Ck

Reach 4
Billabong Creek
Yanco Ck to Edward River

Reach 3
Billabong Creek
Colombo Ck to Yanco Ck

Reach 2
Billabong Creek
Walbundrie to Colombo Ck

Murrumbidgee River
Leeton
Narrandera
Coleambally
Yanco Creek
Morundah
Billabong Creek
Wanganella
Moulamein
Conargo
Jerilderie
Urana
Lockhart
Colombo Creek
Edward River
Wakool
Deniliquin
Oaklands
Rand
Finley
Berrigan
Barham
Murray River
Walbundrie

LEGEND

Weediness (% cover)

1 5 15 25 35 45 55 65 75 85

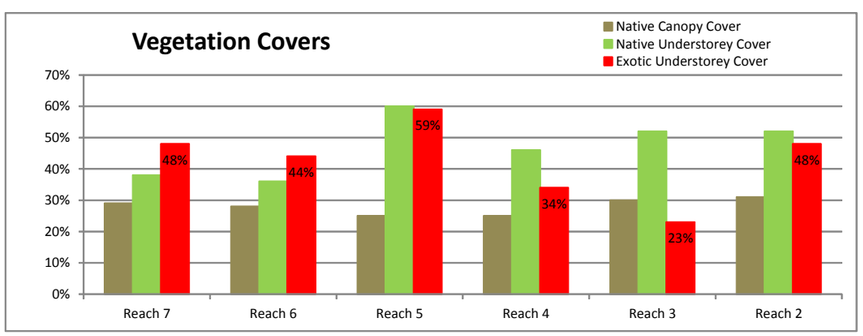
Reach break

45 Site number

Waterway

Road

Township



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Weed Cover

Figure 8

3.5 Condition Trajectory

The Condition Trajectory results are shown graphically in Figure 9. The graph in Figure 9 indicates the reach wide averages of sites considered to be improving, stable or declining.

A review of Condition Trajectory results by reach shows the following trends:

- Reaches 2 and 6 have high percentages of improving sites, but also have high percentages of declining sites.
- Reach 3 had no declining sites.
- Reach 5 has no improving sites and most sites were assessed as having a stable Condition Trajectory.

N

0 10 20 30 40 50 km

WATER TECHNOLOGY

Reach 5
Yanco Ck
Murrumbidgee River to Tarabah Weir

Reach 6
Yanco Creek
Tarabah Weir to Billabong Ck

Reach 7
Colombo Creek
Morundah to Billabong Ck

Reach 4
Billabong Creek
Yanco Ck to Edward River

Reach 3
Billabong Creek
Colombo Ck to Yanco Ck

Reach 2
Billabong Creek
Walbundrie to Colombo Ck

Murrumbidgee River
Leeton
Narrandera
Coleambally
Morundah
Yanco Creek
Colombo Creek
Billabong Creek
Moulamein
Wanganella
Conargo
Jerilderie
Urana
Lockhart
Oaklands
Rand
Walbundrie
Wakool
Deniliquin
Finley
Berrigan
Barham
Edward River
Murray River

LEGEND

Condition Trajectory
- Improving
- Stable
- Declining

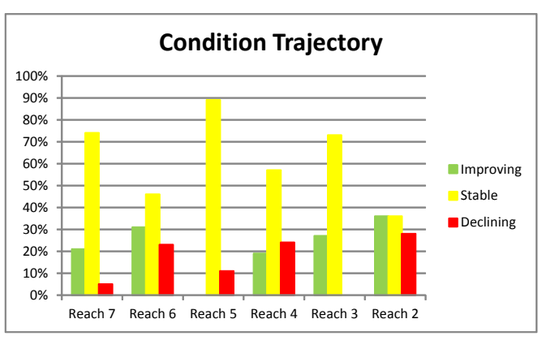
Reach break

45 Site number

Waterway

Road

Township



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Condition Trajectory

Figure 9

4. OTHER OBSERVATIONS

4.1 Project Area Vegetation Changes

4.1.1 Billabong Creek

Interesting riparian vegetation changes appear as one moves westward along the Billabong Creek. The assessment sites are ordered from the upstream end at Walbundrie (Site 1) westward and downstream to Moulamein (Site 60) at the downstream end. The project area is more arid in the west with the long term average annual rainfall at Walbundrie of 560mm decreasing to 347mm at Moulamein.

A rapid listing of species, native and exotic, was undertaken at each of the 60 assessment sites and some interesting transitions are noted chronologically as follows:

- Silver Wattles (*Acacia dealbata*) are abundant in the sub-canopy between Sites 1 and 8. However, they were not recorded in assessment areas downstream of Site 8 and are replaced with drier climate wattles further west.
- Yellow Box (*Eucalyptus melliodora*) were occasionally observed within assessment areas amongst River Red Gums but were not recorded west of Site 9.
- Nardoo (*Marsilea* spp.) was first observed at Site 16 and was commonly observed at sites to the west.
- Black Roly-poly (*Bassia quinquecuspis* var. *quinquecuspis*) was first observed at Site 19 upstream of the Urana Road. This species was ubiquitous further west.
- Lignum (*Muehlenbeckia cunninghamii*) was first identified at Site 20 downstream of the Urana Road. Thereafter it commonly occurred further west.
- River Cooba (*Acacia stenophylla*) and Canegrass (*Eragrostis australasica*) were first observed at Site 27, upstream of the Colombo Creek confluence.
- Black Box (*Eucalyptus largiflorens*) and Nitre Bush (*Chenopodium nitrariaceum*) were first recorded at Site 32.
- Black Box usually dominates or exclusively occupies the near riparian zone canopy from Site 34.
- River Red Gums (*Eucalyptus camaldulensis*) are present throughout the study area and dominate the banks and floodplain that are more regularly inundated.

The assessors were conscious of these subtle changes in vegetation due to changes in climate and channel morphology as they progressed westward during field assessments. The relatively high rainfall, high banks and large channel capacity of the Billabong Creek seemed to change downstream of Rand. Approximately 10km downstream of Rand, the channel capacity reduces as the creek connects with a broader floodplain. Floodways, wetlands and associated vegetation become more evident near the channel downstream from Site 11. This evidence of overbank flows being more common is reaffirmed by the fact that the public roads move away from the creek to higher ground downstream of Site 11.

The vegetation and landscape seems to change again around the Urana Road. The plains are clearly evident to the north and a few drier climate plants appear including Black Roly-poly and Lignum. The mature River Red Gums also appear shorter, with a more spreading habit, around and downstream of the Urana Road.

There is another transition into Black Box county and associated Nitre Bush around and downstream of Jerilderie. This indicates a transition towards a drier climate again and is also an indicator of less frequent overbank flows. Black Box dominate the majority of the floodplain downstream of Jerilderie, with River Red Gums present only on the Billabong Creek banks and more regularly inundated, or irrigated, depressions and flood runners.

4.1.2 Yanco and Colombo Creeks

The vegetation changes along the Yanco and Colombo Creeks was less obvious than those observed along the Billabong Creek. Narrandera has a long-term mean rainfall of 467mm per annum while Jerilderie is 450mm per annum. This suggests there is not a significant change in rainfall down the length of the Yanco and Colombo Creeks, however it is drier towards the western end of the Yanco Creek near Conargo.

A rapid listing of species, native and exotic, was undertaken at each of the 64 assessment sites along the Yanco and Colombo Creeks and some gradual transitions are noted chronologically/downstream as follows:

- Yellow Box (*Eucalyptus melliodora*) was common amongst River Red Gums (*Eucalyptus camaldulensis*) within Reach 5 but they tended to become more scarce or absent downstream of Morundah.
- Black Roly-poly (*Bassia quinquecuspis* var. *quinquecuspis*) was first recorded within Site 72 near Morundah. This species was common west of the Kidman Way (i.e. western half of Reach 6).
- Lignum (*Muehlenbeckia cunninghamii*) was first recorded at Site 83, upstream of the Kidman Way, and became more common further west.
- River Cooba (*Acacia stenophylla*) was recorded on the Yanco Creek downstream of Morundah and was relatively abundant further west. It was first recorded on the Colombo Creek at Site 115 and then was present at most sites downstream to the Billabong Creek confluence.
- Some very large old Black Box (*Eucalyptus largiflorens*) were recorded on the Yanco Creek just upstream of Morundah. However, Black Box was not commonly recorded at sites upstream of the Kidman Way. Black Box became more prevalent towards the western end of Reach 6 however River Red Gums remain dominant all the way to the confluence with the Billabong Creek.
- Nitre Bush (Chenopodium *nitrariaceum*) was not common until the downstream end of Reach 6.

Cumbungi (*Typha* sp.),which had been abundant on both creeks prior to the recent flooding, was mostly drowned within the Yanco Creek but has persisted within the Colombo Creek. The drowning occurred on the Yanco as the depth was much higher than that which is experienced in the Colombo Creek. The Colombo Creek, having low banks within a very flat floodplain means that flood flows spill across the floodplain before fully inundating the Cumbungi on the higher fringing areas, allowing them to persist.

All landholders along the Yanco Creek were pleased that the Cumbungi had drowned as it was totally covering the bed of the creek in many areas and causing issues particularly around pumps. It was reported that the Cumbungi proliferated during the drought when only very low base flows were released providing ideal conditions for the plant to recruit into the shallow muddy bed of the Creek.

4.2 Channel Shape

4.2.1 Billabong Creek

There is a distinct channel shape change that occurs approximately between Sites 25 and 26 in the vicinity of the Berrigan Road. The channel changes from relatively steep upright banks upstream to a flattened bank profile downstream. Figure 10 shows the change in shape between Site 23 and Site 26 located approximately 10km further downstream.

Figure 10 Defined steep banks at Site 23 (left) transitioning to a flatter bank profile at Site 26

4.2.2 Yanco Creek

Yanco Creek is a constructed/cut channel most of the section from the Murrumbidgee River offtake to the Sturt Highway (Figure 11). It then enters the natural creek course downstream of the Highway and has relatively steep banks approximately 2m high (Figure 12). Note the relatively young fringing River Red Gums on the constructed channel and the mature individuals along the natural channel bank.

Figure 11 Constructed channel u/s of the Sturt Hwy, and natural channel at Site 63

As was the case with the Billabong Creek, the channel broadens and the banks flatten as the creek progresses downstream.

Figure 12 **The Yanco Creek Site 72 near Morundah, and Site 102 near Conargo, showing channel shape change with progression downstream**

4.2.3 Colombo Creek

The majority or the Colombo Creek is broad and shallow. Figure 13 shows two sites towards the upstream end of the Colombo Creek that are fairly representative. The sites differ in their relative abundance and lack of adjacent native riparian woodland vegetation, yet the channel width and shape is not dissimilar.

Figure 13 **Broad shallow channel shape typical of the Colombo Creek (Sites 106 and 109)**

4.3 Highest Quality Vegetation Identified

The most intact site assessed within the project area (Billabong, Yanco and Colombo Creeks) was Site 36, on the left or southern bank, within Billabong Creek Reach 2, approximately 20km west of Jerilderie off the Conargo Road. This site had the following characteristics:

- The canopy was continuous along the bank and extended more than 50m offstream.
- A relatively healthy Black Box Woodland (with fringing River Red Gum) is present with an extensive native understorey (see Figure 14).
- The site is species diverse with the rapid species list identifying 29 native species. The average number of native species identified at each site across the project area was half that amount at 14.6.
- The 'Assessment of Habitat Quality' scored 19/20. The average score for sites across the project area was just under 12/20.
- A wetland, well connected to the river, and holding water at the time of assessment, was contiguous with the riparian vegetation a short way downstream from the assessed site (see Figure 14).
- There was no evidence of recent grazing by stock.
- All woody species appeared to be naturally recruiting and native vegetation was competing well with exotic vegetation.
- Nine exotic plant species were identified, which is just above the average number across all sites within the project area (8.6/20).
- A patch of recently poisoned willows was present within the Billabong Creek downstream from the assessment area.
- A number of scarred trees were observed on the edge of the wetland adjacent to the assessment area (see Figure 15).

Figure 14 High quality riparian frontage and adjacent wetland near Site 36

Figure 15 Scarred Trees on the edge of wetland near Site 36

4.4 Poor Health Vegetation Requiring Additional Investigation

Black Box, River Red Gums and River Cooba were in very poor health or dead in the vicinity of Site 55. Salt was also evident on tree trunks within the Billabong Creek channel. The area needs to be revisited to determine the location of what is presumed to be the input source of saline and possibly agricultural chemical laden water. Figure 16 shows dead river Cooba and very poor health River Red Gums with salt deposits evident at the base of trunks.

Figure 16 Very large dead River Cooba (left) and poor health River Red Gums

5. RECOMMENDATIONS FOR FUTURE WORK

5.1 Vegetation Specific Recommended Action

The following provides recommendations for future work or investigation that will help to protect or enhance vegetation condition:

- Canopy Longitudinal Continuity should be further investigated by the Murray CMA to identify significant breaks. Breaks in continuity reduce habitat, restrict fauna passage along the riparian corridor and cause the loss of valuable inputs to the creek (e.g. shade and cover, leaf and log inputs, bank stability). The proposed automated GIS identification of breaks, utilising the field validation data, should be undertaken to identify these gaps. If the process proves to be unsuccessful, Aerial Photograph Interpretation (API) should be undertaken on a GIS to map all significant breaks. The identified breaks could then be prioritised for revegetation depending upon factors such as tenure and/or presence of significant fauna.
- The concept of 'Protect the Best' may be adopted whereby the highest quality frontages are managed firstly to ensure their condition does not decline. The habitat quality scores/mapping could be used to identify high quality areas and approaches made to the respective land managers, firstly to inform them of the asset they have, and secondly to discuss management practice to ensure the quality is maintained.
- 'Minimum Standards' could also be considered whereby a minimum acceptable vegetation condition standard is identified. For example, a minimum Habitat Quality score of 10/20 might be adopted. Sites with a condition score of less than 10 (Note that the average score across the project area is 12.75 and only 5/60 sites scored less than 10) might then be reviewed to determine if the minimum standard could be met through management change (e.g. reducing grazing pressures by closing gates on fenced frontages, repairing fences) or active intervention (e.g. revegetation, fencing, weed control).
- The continuation of tree health monitoring, particularly in Reach 4, could help inform environmental flow recommendations for the lower Billabong Creek. Tree health declined significantly in Reach 4 despite the recovery of trees following the floods. The amount of dead small branches within Reach 4 trees indicated that there was widespread severe drought stress prior to flooding. Future environmental flow determinations for the creek should ensure adequate water reaches the bottom reach of the creek to maintain or enhance riparian and instream health, and canopy health.
- A weed control program could be developed with the assistance of weed lists recorded in the project. Willows were surprisingly scarce within the project area and most of the infestations observed had been recently poisoned. Peppercorns (*Schinus areira*) were the most abundant and spreading woody weed within the project area, mainly in Reach 2. Exotic vegetation observations, and in some cases control recommendations, have been recorded on field sheets and have been entered into the data spreadsheet. Woody weeds were generally more abundant in Reach 2 and the exotic vegetation observation notes will provide a guide to the species present and distribution with the project area. API might also be used to identify woody weeds throughout the project area.
- Site 36 was identified as the best condition frontage assessed across the project area. With the cooperation of the landholder, this site may be identified as a demonstration or reference site.
- Monitor the growth of Cumbungi particularly within the Yanco Creek. Monitor its growth patterns relative to flows and consider flow manipulation to prevent it colonising the bed of the Yanco Creek and anabranches.
- River Red Gum recruitment into the bed of wetlands and anabranches was evident throughout the Yanco Creek system. The vegetation 'terrestrialisation' of these areas was of concern to some landholders. Many areas have had River Red Gums invade these low lying areas and reach

sufficient height that allowed them to survive the recent high and prolonged flooding events. These trees are now sufficiently tall to withstand significant flooding events without drowning (Figure 17). It is also unlikely that manipulated flows could be delivered for sufficient duration to drown these trees.

Figure 17 **River Red Gum invasion (terrestrialisation) of a well-connected Yanco Creek anabranch, Site 79**

- Concern was raised about the long term health and viability of mature floodplain trees in the vicinity of anabranches and flood runners that have had recent formal or informal regulators constructed at creek offtake locations. These concerns should be discussed with the relevant land managers (e.g. Silver Pines manager) and the monitoring of floodplain tree health in appropriate locations may be considered.

5.2 Project Area Recommended Actions

- A fish survey has recently been completed across the project area. The data collected for this project should be analysed alongside the fish assemblage data to draw out any correlations between fish species presence/abundance and vegetation/habitat condition.
- A holistic Waterway Action Plan (WAP) should be developed. A WAP process will review recently completed studies, consult with the community and undertake additional field study to identify values and threats, undertake a risk assessment and develop a prioritised and costed set of actions. A WAP provides a considered approach to investment of existing funds and also provides a clear and well considered document to leverage future funding.
- Communicate the findings of this and associated projects back to the community and stakeholders. Celebrate the high value locations and features and communicate the interesting findings and flood responses that were evident. Use this communication to inform landholders of what makes a creek frontage special, what to look out for and how to protect environmental assets.
- A number of the weirs were observed in poor condition throughout the project area, particularly on the Colombo Creek. Some of these weirs were in danger of outflanking or undermining. A review of weir condition, in conjunction with the fish surveys, may provide strategic direction for future repair or replacement, and the incorporation of fish friendly options (e.g. appropriately designed rock chute or fish ladder).

5.3 Reach Specific Recommended Actions

Reach 2

- Weed management – target woody weeds including Peppercorn (*Schinus areira*), Willow (*Salix* spp.), Ash (*Fraxinus* spp.), African Boxthorn (*Lycium ferocissimum*) and Sweet Briar (*Rosa rubiginosa*).

Reach 3

- Protect the best frontages and secure Site 36 as a reference or demonstration site.
- This reach scores well in most categories but had a relatively poor instream habitat score. Review fish study data in this reach and consider large woody habitat placement if appropriate and available.

Reach 4

- Investigate the reason for poor tree health in the vicinity of Site 55.
- Ensure environmental flow determinations are adequate to ensure the health of riparian vegetation, particularly trees. Riparian vegetation health may be the controlling criteria for environmental flow recommendations for this reach.

Reach 5

- Investigate the relatively poor tree health and the observation that no sites were thought to be improving in condition.

Reach 6

- A number of scarred trees (Black Box) were identified around and immediately upstream of Site 72, upstream of the Yamma Road Bridge, near Morundah. Discuss the scarred trees presence with the landholder and determine if these trees are likely to be significant and if they are worthy of more protection (there is currently a single hot wire surrounding the frontage in this area that appears to be restricting grazing).
- Investigate River Red Gum invasion of wetlands and anabranches to determine if intervention is warranted.
- Investigate if the alteration to flow delivery to anabranches within 'Silver Pines' is having an adverse effect on floodplain tree health.
- Investigate the legitimacy of timber harvesting in the vicinity of Site 82.

Reach 7

- Reach 7 has had large areas of willow removal in the middle to upstream sections, mostly between Sites 109 and 117. These areas have long lengths of bank (one or both sides) without any woody vegetation. Implement a revegetation program within this section of the Colombo Creek. Recreating longitudinal continuity of native woody bank vegetation on at least one bank will improve both instream and terrestrial habitat.
- Instream woody habitat scored relatively poorly in this reach. A review of the recent fish survey data will identify what native fish exist in the Colombo Creek and determine if habitat improvement works (e.g. large woody habitat placement) are warranted.

6. REFERENCES

DNRE (1999), *An index of stream condition: Field manual*. Department of Natural Resources and Environment, East Melbourne.

DSE (2004a), *Vegetation Quality Assessment Manual – Guidelines for applying the habitat hectares scoring method*. Version 1.3. Victorian Government Department of Sustainability and Environment, Melbourne.

DSE (2004b), *Assessing habitat quality using the 'Land manager self-assessment method', Work Sheet No 4*. Victorian Government Department of Sustainability and Environment, Melbourne.

Molino Stewart (1999), *Strategic plan for the Yanco and Billabong Creeks System volume 1 – the plan itself*. Report prepared for Yanco Creek and Tributaries Advisory Council and Department of Land and Water Conservation.

MyCMA, (2012), *Request for Quote, Billabong Creek Riparian Vegetation Mapping 2011-12*. Murray Catchment Management Authority, Albury.

Lamp, C.A., Forbes, S.J., Cade, J.W. (2001), *Grasses of Temperate Australia, a field guide*. Bloomings Books, Melbourne.

Parkes, D., Newel, G., Cheal, D. (2003), *Assessing the quality of native vegetation: The 'habitat hectares' approach*. Journal of Ecological Management & Restoration Vol 4 Supplement February 2003.

Water Technology (2012), *Billabong Creek Riparian Vegetation Mapping 2011-2012*. Report for the Murray Catchment Management Authority, Albury.

APPENDIX A FIELD SHEETS TEMPLATE

APPENDIX B FIELD ASSESSMENT GUIDES

APPENDIX C ORIGINAL FIELD SHEETS

See Appendix D – Digital Data for the Scanned Original Field Sheets

APPENDIX D DIGITAL DATA