ecological AUSTRALIA

bluegum ECOLOGICAL CONSULTING

Canberra | Sydney

# M2G Planting (Tree & Shrub) Monitoring Report

## Construction Corridor (Autumn 2015)

Prepared for
**Icon Water**

July 2015

## DOCUMENT TRACKING

| Item | Detail |
|---|---|
| Project Name | M2G Planting Monitoring: Autumn 2015 |
| Project Number | 12CANECO-0026 |
| Project Manager | Andrew Palmer-Brodie<br>GPO Box 1558<br>Canberra ACT 2601 |
| Prepared by | Tom O'Sullivan |
| Reviewed by | Andrew Palmer-Brodie |
| Approved by | Andrew Palmer-Brodie |
| Status | FINAL |
| Version Number | 1 |
| Last saved on | 13 July 2015 |
| Cover photo | Selection of planting rehabilitation photos from the M2G pipeline corridor (Tom O'Sullivan, 2014) |

This report should be cited as 'Eco Logical Australia and Bluegum Ecological Consulting July 2015. *M2G Planting Monitoring Report*. Prepared for Icon Water.'

## ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd and Bluegum Ecological Consulting with support from Icon Water.

# Contents

# List of figures



# List of tables

# Plates

# Abbreviations

| ABBREVIATION | DESCRIPTION |
|---|---|
| BGGW | Box Gum Grassy Woodland |
| BWA | Bulk Water Alliance |
| EMP | Ecological Monitoring Sub-plan |
| HLPS | High Lift Pump Station |
| LLPS | Low Lift Pump Station |
| LRTEMP | Landscape Rehabilitation and Terrestrial Ecology Management Plan |
| M2G | Murrumbidgee to Googong Water Transfer Project |
| ORMP | Offset Rehabilitation Management Plan |

# 1 Introduction

## 1.1 Background

Eco Logical Australia (ELA) was commissioned by Icon Water (formerly ACTEW Corporation) to deliver terrestrial ecological services as required by the environmental approval process for the Murrumbidgee to Googong Water Transfer Project (M2G). A component of that service is to provide post-construction rehabilitation monitoring in accordance with the Landscape Rehabilitation Management Plan (LRMP) for the M2G project, which has been undertaken by Blue Gum Ecological Consulting on behalf of ELA.

The following report examines the results of the autumn 2015 monitoring session for rehabilitation planting[1] within the M2G construction corridor and structure sites. This is the sixth in a series of bi-annual monitoring studies documenting the progress of tree and shrub plantings.

## 1.2 Study area

The study area extends from the Low Lift Pump Station (LLPS) at Angle Crossing on the Murrumbidgee River to the discharge facility at Burra Creek, situated near the intersection of Williamsdale and Burra Roads. The pipeline construction corridor is approximately 12 km in length (**Figures 1-3, Appendix 1**).

The study area falls within the Williamsdale (8726-4N) 1:25,000 Map Sheet and is part of the South-east Highlands Bioregion (Commonwealth of Australia 2012).

## 1.3 Study aims

The aim of the study is to monitor representative sub-sets of tree and shrub plantings within the M2G construction corridor and record planting success.

As was explained in the autumn 2014 report, there was significant difficulty in discriminating between planted and non-planted herbaceous specimens and the herbaceous component of the planting monitoring was discontinued.

## 1.4 Planting regime

Almost 5,000 tree and shrub seedlings (Hiko Cells, 45Lt and 300SR containers) were planted within the M2G construction corridor and structure sites during spring 2011 and autumn 2012. Native plantings comprised eleven shrub and nine tree species. In addition, five non-native tree and shrub species were planted in the eastern sections of the construction corridor at the request of landowners.

An inventory of planted species is provided in **Table 1**.

Species selection and planting distribution were guided by former vegetation type, spatial characteristics and vegetation lost as a result of construction. Additional woody plantings were included as part of compensatory measures for habitat loss as well as for amenity.

[1] Concurrent plot-based monitoring for seeding rehabilitation within the construction corridor is presented in a separate report.

**Table 1: Species and quantity planted within the M2G construction corridor and structure sites during spring 2011 and autumn 2012.**

| Scientific Name | Common Name | Total plantings pipeline corridor | Total plantings structures | Total |
|---|---|---|---|---|
| **Native tree** | | | | |
| *Eucalyptus blakelyi* | Blakely's Red Gum | | | |
| *Eucalyptus bridgesiana* | Apple Box | | | |
| *Eucalyptus mannifera* | Brittle Gum | | | |
| *Eucalyptus melliodora* | Yellow Box | | | |
| *Eucalyptus polyanthemos* | Red Box | | | |
| *Eucalyptus pauciflora* | Snow Gum | | | |
| *Eucalyptus rubida* | Candlebark Gum | | | |
| *Eucalyptus viminalis* | Manna Gum | | | |
| *Callitris endlicheri* | Black Cypress Pine | | | |
| **Sub-total** | | **624** | **148** | **772** |
| **Native shrub** | | | | |
| *Acacia dealbata* | Silver Water | | | |
| *Acacia genistifolia* | Spreading Wattle | | | |
| *Acacia rubida* | Red Stemmed Wattle | | | |
| *Acacia siculiformis* | Dagger Wattle | | | |
| *Banksia marginata* | Silver Banksia | | | |
| *Bursaria spinosa* | Hairy Bursaria | | | |
| *Leptospermum myrtifolium* | Myrtle Tea Tree | | | |
| *Leptospermum obovatum* | River Tea Tree | | | |
| *Kunzea ericoides* | Burgan | | | |
| *Cassinia longifolia* | Shiny Cassinia | | | |
| *Indigofera australis* | Austral Indigo | | | |
| **Sub-total** | | **3,016** | **1,055** | **4,071** |
| **Non-native tree/shrub** | | | | |
| *Ulmus parvifolia* | Chinese Elm | | | |
| *Quercus robur* 'Fastigiata' | Upright English Oak | | | |
| *Castanea sativa* | European Chestnut | | | |
| *Populus spp.* | Poplar (TBC) | | | |
| *Pyrus ussuriensis* | Manchurian Pear | | | |
| **Sub-total** | | **19** | **-** | **19** |
| **Total native trees/shrub** | | **3,640** | **1,203** | **4,843** |
| **Total non-native tree/shrub** | | **19** | **-** | **19** |

# 2 Methods

## 2.1 Monitoring regime

Permanent monitoring sites were established and are sampled on a bi-annual basis (autumn and spring/summer periods) over a period of at least two-years post-construction.

The current monitoring period occurred during April 2015.

## 2.2 Selection of monitoring sites

Twelve tree and shrub monitoring sites were selected from approximately 80 planting arrays within the M2G construction corridor and structure sites (**Figures 1 – 3, Appendix 1**). Six sites (TSP1-6) are situated in the ACT and six (TSP7-12) in NSW (**Table 2**).

The spatial arrangement of sampling sites was influenced by the original placement of planting arrays (most of which were located in areas of former native vegetation), which resulted in fewer sampling sites in the eastern non-native section of the construction corridor than in the central and western sections. Sample sites were also selected to include variations in landform, such as: slope and aspect, soil moisture and vegetation types.

Sample sites were marked with a red-tipped wooden stake, at which grid co-ordinates and photographs were taken.

**Table 2: Tree and shrub (TSP) monitoring sites within the construction corridor and structure sites.**

| Site ID^ | Approx. chainage from LLPS | Co-ordinates | Jurisdiction | Property |
|---|---|---|---|---|
| TSP1 | 250 | 691345 - 6060236 | ACT | PCS (Murrumbidgee R. corridor) |
| TSP2 | 1025 | 691964 - 6060519 | ACT | PCS (Murrumbidgee R. corridor) |
| TSP3 | 1350 | 692256 - 6060605 | ACT | Icon leasehold |
| TSP4 | 1900 | 692592 - 6060707 | ACT | Icon leasehold |
| TSP5 | 2325 | 693226 - 6060578 | ACT | Icon leasehold |
| TSP6 | 2650 | 693528 - 6060505 | ACT | Icon leasehold |
| TSP7 | 3040 | 693927 - 6060542 | NSW | Smith |
| TSP8 | 4975 | 695663 - 6060392 | NSW | Lonergan |
| TSP9 | 5475 | 696175 - 6060305 | NSW | Lonergan |
| TSP10 | 6425 | 697084 - 6060204 | NSW | Johanson |
| TSP11 | 9300 | 699277 - 6061925 | NSW | Latimer |
| TSP12 | 11900 | 701346 - 6063099 | NSW | Discharge facility |

## 2.3 Survey techniques

A simple quantitative sampling method was used to measure tree and shrub planting success. Specimens were counted, identified to at least genus level and their health determined according to the following criteria:

- *Good Health* - indicated by vigorous growth, fully leaved with expected colouration for that species;

- *Poor Health* - stems or leaves discoloured, foliage limited or easily dislodged, specimen may appear stunted or heavily browsed;
- *Dead* - absence of leaves, stem or leaves entirely discoloured or desiccated with no visible living vegetative material.

## 2.4 Key Performance Target

The current Key Performance Target (KPT) for tree and shrub plantings is 90% survival rate, which was set between the BWA and the planting contractor in early 2012. Unfortunately, the KPT for planting success provided in the M2G Landscape Rehabilitation and Terrestrial Ecology Management Plan (LRTEMP) does not explicitly refer to a 90% target.

In light of declining success rates (particularly in the ACT) it is recommended that the KPT for plantings be reduced to 70%. If accepted by the Environmental Auditor and M2G Environment Reference Group the LRTEMP will be amended and provided to the ACT and NSW regulators for their respective approval. Icon Water have engaged Greening Australia to undertake additional planting and maintenance of trees and shrubs with an objective to meet a 70% target, should this be accepted. Replanting work is currently underway.

# 3 Results

## 3.1 Overview

Of the 701 tree and shrub specimens[2] that were monitored 285 **(40.7%)** were in good health, 52 **(7.4%)** in poor health and 364 **(51.9%)** either dead or missing. Almost **60%** of the sample is categorised as poor, dead or missing (**Table 3**).

Specimens in good health declined by **1.4%** against the previous spring 2014 results and the proportion of dead and missing increased by **8.3%** over the same period. While the results of the past two monitoring periods might suggest some measure of stability the overall trend since autumn 2013 - when planting success peaked at **66.5% -** has been one of decline (**Chart 2**). Summaries of current monitoring results are provided in **Table 3** (see **Table 7 in Appendix 2** for full data sets), and a comparison of previous results is provided in **Table 4.**

While there were minor contradictions to this trend (TSP 3, 5, 8, 9 and 12 showed small increases in planting health) the number of specimens involved (9) were insignificant to the overall result (**Table 3**). All other sample sites recorded declines in planting health relative to the previous monitoring survey added by a noticeable shift in plantings from poor health to the dead and missing category.

Planting success was also differentiated by jurisdiction, with just **28.4%** of the plantings in the ACT (TSP1-6) in good health compared to **60.1%** of the plantings in NSW (TSP7-12) (**Chart 1**). While both the ACT and NSW sections had comparative increases in dead and missing specimens (about **15%**) the former totalled **286** plantings and the latter **78** plantings.

The best performing sites were TSP8, TSP7 and TSP9 - with **88.9%**, **68.2%** and **66.7%** planting success, respectively. However, these sites were also among the least populated and represented less than 8% of the total sample. Of the twelve sample sites, six had greater than **50%** of specimens in good health; two sites in the **40-49%** range, and the remaining four sites scored below **20%** (**Table 3**).

Site 8 has fluctuated between **67%** and **89%** success and is in reach of the KPT. Sites 7 and 9 have also shown consistently higher rates of success, but their percentages show wider fluctuations. Site 11 has consistently met the KPT up to autumn 2014 after which the success rate has declined. Similarly, Site 12 had scores within 10% of the KPT (spring 2013) but declined thereafter. *Note: apart for Site 12 these are among the least populated sample sites in the study and any change in the condition of just a few specimens will result in large percentage shift compared to other sites that have larger planted populations.*

Extrapolating the current results to the total planted population of 4,843 (see **Table 1** in **Section 1**) would yield approximately **1,971** plantings in good health, **358** in poor health and **2,514** dead or missing. Assuming a sample error of +/- 5%, the number of plantings in good health would range from **2,213** to **1,730**. The current sampling period was the least successful result of any monitoring period.

[2] Initial tree & shrub sample size comprised 661 specimens (spring 2012) additional plantings increased the total to 700 in spring 2013.

Summaries and images of each monitoring site are provided in the following sections. Note: bracketed numbers in the central column provide results from the previous spring 2014 monitoring period.

**Table 3: Summary of tree and shrub monitoring results for the autumn 2015 monitoring period.**

| Site ID | Seedling Health | | | Combined | Total | % | |
|---|---|---|---|---|---|---|---|
| | Good | Poor | Dead* | Poor/Dead* | Plantings | Good | Poor/Dead* |
| **TSP1** | 37 | 3 | 52 | 55 | 92 | *40.2* | *59.8* |
| **TSP2** | 62 | 6 | 59 | 65 | 127 | *48.8* | *51.2* |
| **TSP3** | 15 | 4 | 76 | 80 | 95 | *15.8* | *84.2* |
| **TSP4** | 4 | 7 | 65 | 72 | 76 | *5.3* | *94.7* |
| **TSP5** | 3 | 0 | 16 | 16 | 19 | *15.8* | *84.2* |
| **TSP6** | 1 | 2 | 18 | 20 | 21 | *4.8* | *95.2* |
| **TSP7** | 15 | 0 | 7 | 7 | 22 | *68.2* | *31.8* |
| **TSP8** | 8 | 0 | 1 | 1 | 9 | *88.9* | *11.1* |
| **TSP9** | 16 | 3 | 5 | 8 | 24 | *66.7* | *33.3* |
| **TSP10** | 79 | 18 | 42 | 60 | 139 | *56.8* | *43.2* |
| **TSP11** | 7 | 3 | 2 | 5 | 12 (11) | *58.3* | *41.7* |
| **TSP12** | 38 | 6 | 21 | 27 | 65 | *58.5* | *41.5* |
| **Total plantings** | **285** | **52** | **365** | **416** | **701** | | |
| **Av. per site** | **23.8** | **4.3** | **30.3** | **34.7** | **58.4** | | |
| **%** | ***40.7*** | ***7.4*** | ***51.9*** | ***59.3*** | ***100*** | | |

*** Includes missing specimens**

**Chart 1: Proportion of plantings in good health at each site during all monitoring periods. ACT sites = TSP 1-6 and NSW sites = TSP 7-12.**

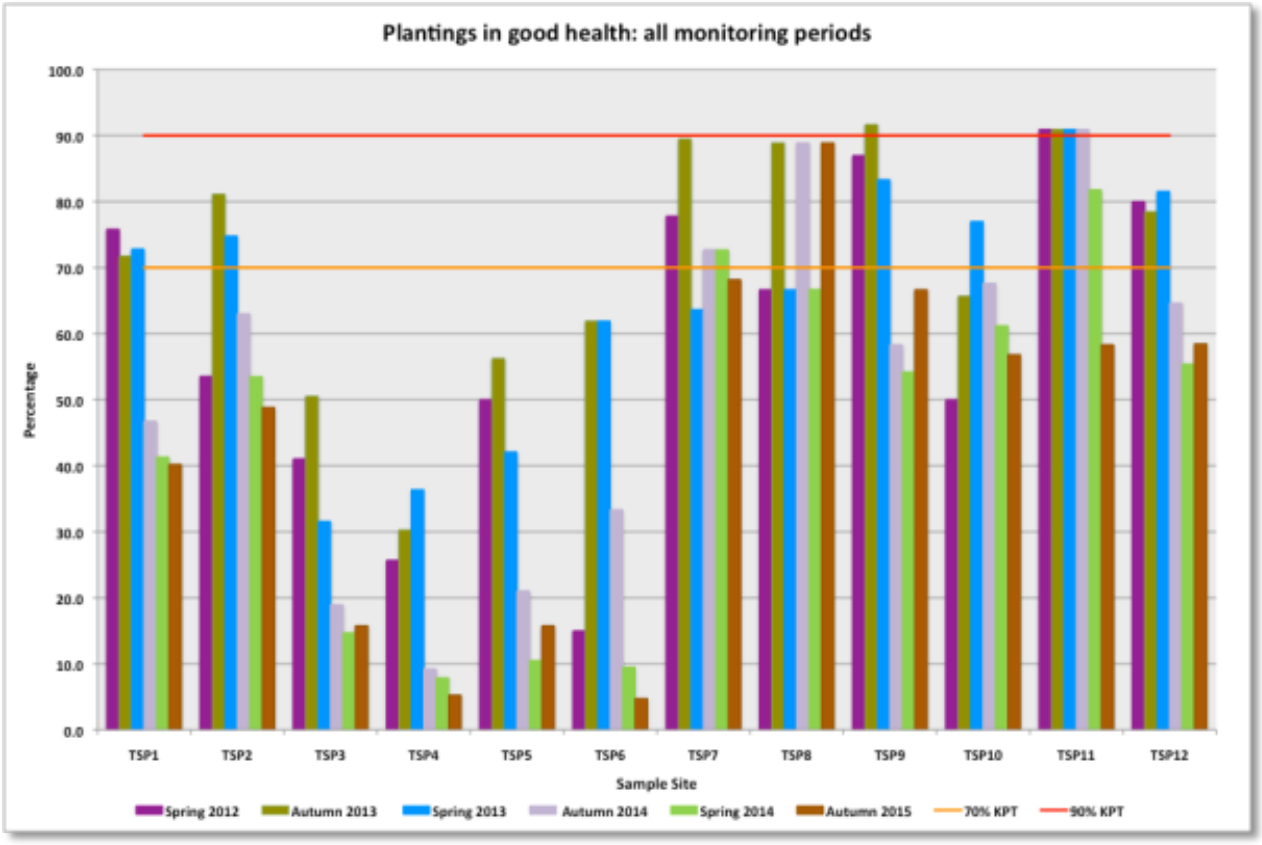
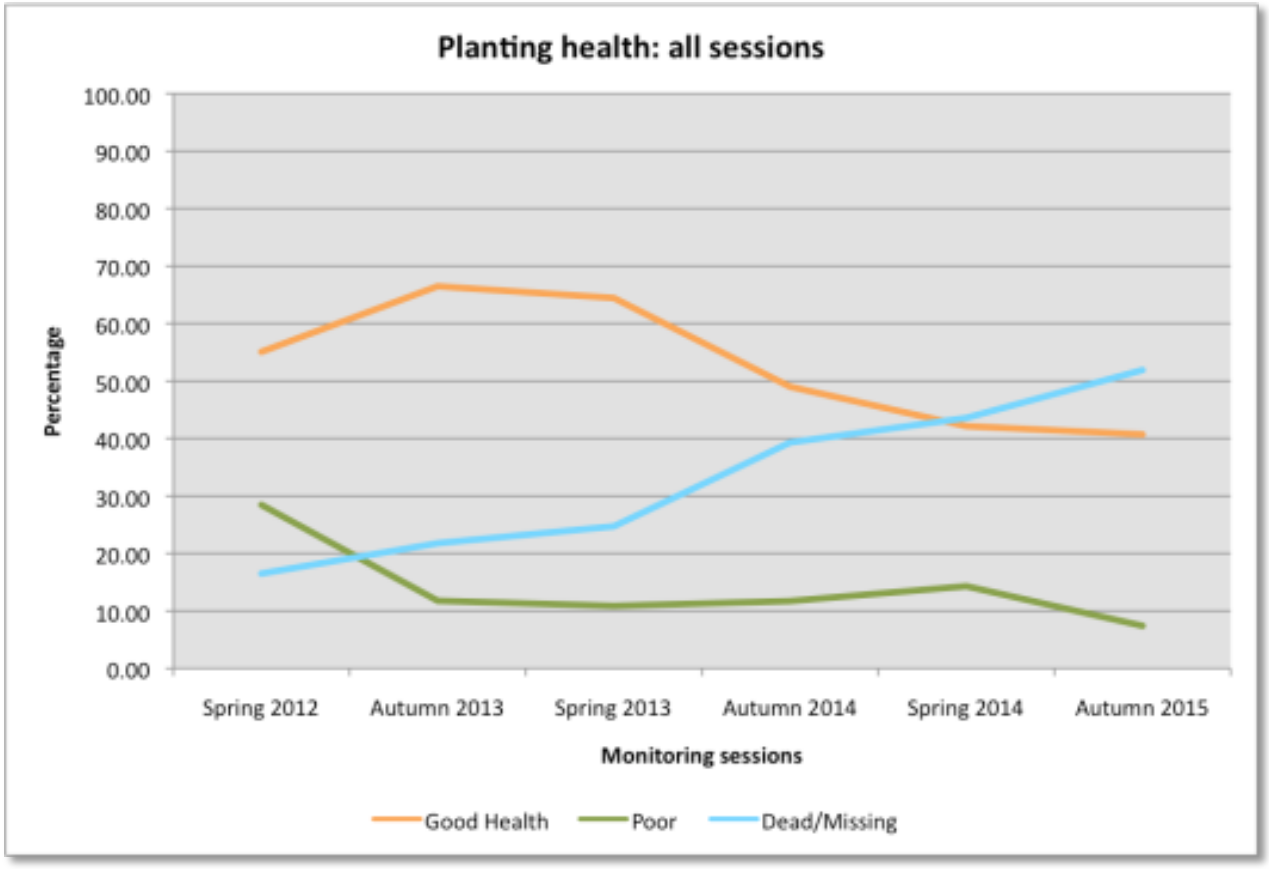


**Table 4: Comparison of tree and shrub monitoring results from all sessions.**

| Monitoring period | Seedling Health | | | Poor/Dead* Combined | Total Plantings |
|---|---|---|---|---|---|
| | Good | Poor | Dead* | | |
| **Spring 2012** | | | | | |
| **Total number** | 364 | 188 | 109 | 297 | 661 |
| **Av. per site** | 30.3 | 15.7 | 9.1 | 24.8 | |
| **%** | *55.1* | *28.5* | *16.5* | *45.0* | |
| **Autumn 2013** | | | | | |
| **Total number** | 458 | 81 | 150 | 231 | 689 |
| **Av. per site** | 38.2 | 6.7 | 12.5 | 19.2 | |
| **%** | *66.5* | *11.7* | *21.8* | *33.5* | |
| **Spring 2013** | | | | | |
| **Total number** | 451 | 76 | 173 | 249 | 700 |
| **Av. per site** | 37.6 | 6.3 | 14.4 | 20.7 | |
| **%** | *64.4* | *10.9* | *24.7* | *35.6* | |
| **Autumn 2014** | | | | | |
| **Total number** | 343 | 82 | 275 | 357 | 700 |
| **Av. per site** | 28.6 | 6.8 | 22.9 | 20.7 | |
| **%** | *49.0* | *11.7* | *39.3* | *35.6* | |
| **Spring 2014** | | | | | |
| **Total number** | 295 | 100 | 305 | 405 | 700 |
| **Av. per site** | 24.6 | 8.3 | 25.4 | 33.7 | |
| **%** | *42.1* | *14.3* | *43.6* | *57.9* | |
| **Autumn 2015** | | | | | |
| **Total number** | 285 | 52 | 364 | 416 | 701 |
| **Av. per site** | 23.8 | 4.3 | 30.3 | 33.7 | |
| **%** | *40.7* | *7.4* | *51.9* | *59.3* | |

*** Includes missing specimens**

**Chart 2: Cumulative planting health across all monitoring periods.**



### 3.1.1 Monitoring site TSP1

| **Jurisdiction** | **ACT** | **TSP1** Situated within the Murrumbidgee River Corridor immediately W and NW of the HLPS, about 250 m from the LLPS.<br><br>Although specimen health continues to decline the rate of decline may have stabilised. Currently **40.2%** of plantings were in good health compared to **41.3%** during the previous spring 2014 session.<br><br>**Recommendation: Replace dead and missing specimens with a view to meeting a revised KPT of 70%** |
|---|---|---|
| Co-ordinates | 691345 – 6060236 | |
| **No. of tree & shrub species planted** | **8** | |
| **Seedling health** | | |
| Good | **37** (38) | |
| Poor | **3** (15) | |
| Dead / Missing | **52** (32) | |
| **Total plantings** | **92** | |

**Plate 1: Monitoring Site TSP1. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.2 Monitoring site TSP2

| **Jurisdiction** | **ACT** |
|---|---|
| Co-ordinates | 691964 – 6060519 |
| **No. of tree & shrub species planted** | **5** |
| **Seedling health** | |
| Good | **62** (68) |
| Poor | **6** (18) |
| Dead / Missing | **59** (41) |
| **Total plantings** | **127** |

**TSP2** is located within the Murrumbidgee River Corridor, about 1,025 m from the LLPS.

Although specimen health continues to decline the rate of decline may have stabilised. Currently **48.8%** of plantings were in good health compared to **53.5%** during the previous spring 2014 session.

*Inset: TSP2 in spring 2012 - within 12 months of planting.*

**Recommendation: Replace dead and missing specimens see previous**

**Plate 2: Monitoring Site TSP2. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.3 Monitoring site TSP3

| **Jurisdiction** | **ACT** |
|---|---|
| Co-ordinates | 691964 – 6060519 |
| **No. of tree & shrub species planted** | **4** |
| **Seedling health** | |
| Good | **15** (14) |
| Poor | **7** (12) |
| Dead / Missing | **76** (69) |
| **Total plantings** | **95** |

**TSP3** is located within the Murrumbidgee River Corridor, about 1,350 m from the LLPS.

Currently **15.8%** of plantings are in good health - a slight increase on the previous spring 2014 session (**14.7%**). The majority of specimens are either dead or missing.

*Inset: TSP3 in spring 2012 -within 12 months of planting.*

**Recommendation: Replace dead and missing specimens same words as previous and where applicable in following**

**Plate 3: Monitoring Site TSP3. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.4 Monitoring site TSP4

| **Jurisdiction** | **ACT** |
|---|---|
| Co-ordinates | 692592 – 6060707 |
| **No. of tree & shrub species planted** | **3** |
| **Seedling health** | |
| Good | **4** (6) |
| Poor | **7** (7) |
| Dead / Missing | **65** (63) |
| **Total plantings** | **76** |

**TSP4** is located about 1,900 m from the LLPS within the ACT.

Planting success declined significantly after spring 2013, with just **5.3%** of specimens now in good health.

*Inset: TSP4 in spring 2012 within 12-months ofplanting.*

**Recommendation: Replace dead and missing specimens.**

**Plate 4: Monitoring Site TSP4. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.5 Monitoring site TSP5

| **Jurisdiction** | **ACT** |
|---|---|
| Co-ordinates | 693226 – 6060578 |
| **No. of tree & shrub species planted** | **3** |
| **Seedling health** | |
| Good | **3** (2) |
| Poor | **0** (3) |
| Dead / Missing | **16** (14) |
| **Total plantings** | **19** |

**TSP5** is located about 2,325 m from the LLPS within the ACT.

Specimens in good health increased from **10.5%** (in spring 2014) to **15.8%** during the current survey, however, the increase was represented by just one specimen. The majority of plantings are either dead or missing.

**Recommendation: Replace dead and missing specimens**

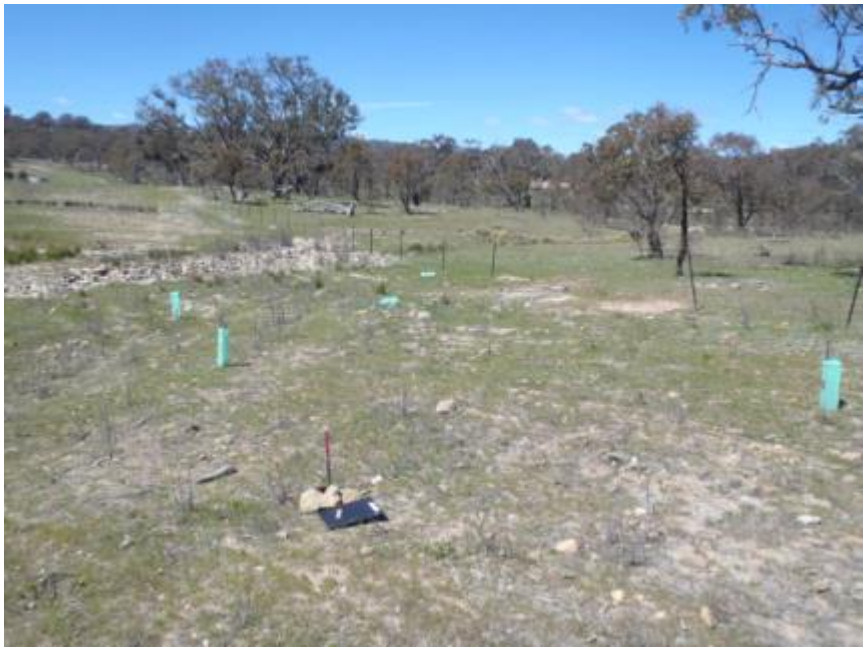


**Plate 5: Monitoring Site TSP5. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.6 Monitoring site TSP6

| **Jurisdiction** | **ACT** |
|---|---|
| Co-ordinates | 693528 – 6060505 |
| **No. of tree & shrub species planted** | **3** |
| **Seedling health** | |
| Good | **1** (2) |
| Poor | **2** (5) |
| Dead / Missing | **18** (14) |
| **Total plantings** | **21** |

**TSP6** is located about 2,650 m from the LLPS - west of and adjacent to the Monaro Hwy within the ACT.

Planting success declined significantly after spring 2013, with just 1 specimen (**4.8%)** now remaining in good health.

Natural recruitment of Yellow Box *Eucalyptus melliodora* and Blakely's Red Gum *E. blakelyi* was recorded nearby.

**Recommendation: Replace dead and missing specimens and improve maintenance (see Section 3.5 of the LRTEMP).**

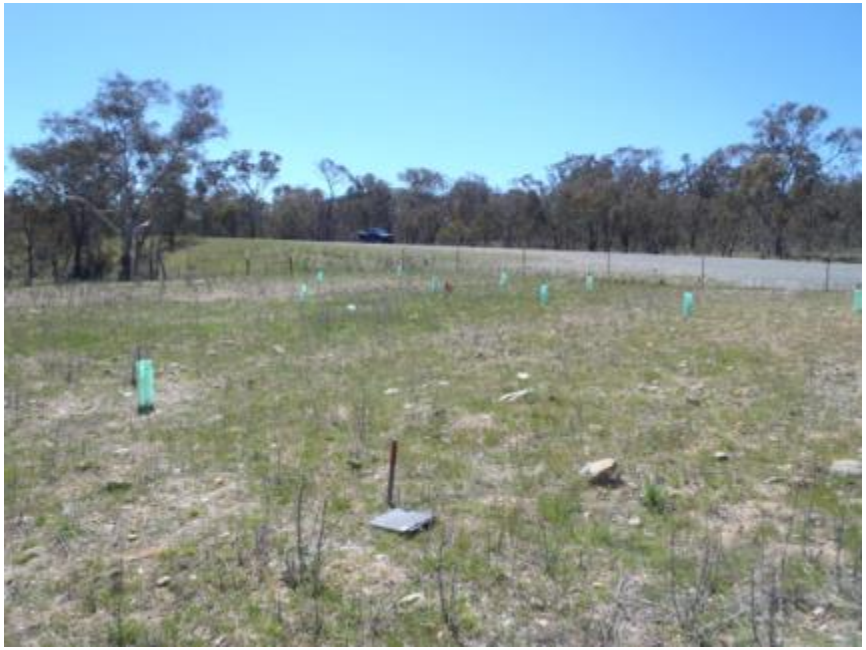


**Plate 6: Monitoring Site TSP6. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.7 Monitoring site TSP7

| **Jurisdiction** | **NSW** |
|---|---|
| Co-ordinates | 693927 – 6060542 |
| **No. of tree & shrub species planted** | **3** |
| **Seedling health** | |
| Good | **15** (16) |
| Poor | **0** (0) |
| Dead / Missing | **7** (6) |
| **Total plantings** | **22 (21)** |

**TSP7** is located about 3,040 m from the LLPS within the Smith property, NSW.

**68.2%** of plantings were in good health compared to **72.7%** during the previous spring 2014 session. *Note*: Sample site is separated in to two planting areas - northern and southern sides of the construction corridor. Natural recruitment of Yellow Box *Eucalyptus melliodora*, Apple Box *E. bridgesiana* and Broad-leaved Peppermint *E. dives* was observed east and west of this site.

**Recommendation: Replace dead and missing specimens (see Section 3.5 of the LRTEMP).**

**Plate 7: Monitoring Site TSP7. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.8 Monitoring site TSP8

| **Jurisdiction** | **NSW** | **TSP8** is located about 4,975 m from the LLPS within the Lonergan property, NSW.<br>This small site has maintained a relatively consistent rate of planting success, which is currently at **88.9%.**<br><br>**Recommendation: Improve planting maintenance (see Section 3.5 of the LRTEMP). No further works required.** |
|---|---|---|
| Co-ordinates | 695663 – 6060392 | |
| **No. of tree & shrub species planted** | **2** | |
| **Seedling health** | | |
| Good | **8** (8) | |
| Poor | **0** (0) | |
| Dead / Missing | **1** (1) | |
| **Total plantings** | **9** | |

**Plate 8: Monitoring Site TSP8. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.9 Monitoring site TSP9

| **Jurisdiction** | **NSW** |
|---|---|
| Co-ordinates | 696175 – 6060305 |
| **No. of tree & shrub species planted** | **3** |
| **Seedling health** | |
| Good | **16** (13) |
| Poor | **3** (10) |
| Dead / Missing | **5** (1) |
| **Total plantings** | **24** |

**TSP9** is located about 5,475 m from the LLPS within the Lonergan property, NSW.

The proportion of plantings in good health rose to **66.7%** from **58.3%** during the previous spring 2014 session. Tree guards have become engulfed by competing pasture grasses, which may affect future planting success.

**Recommendation: Improve planting maintenance and replace trees and shrubs to meet revised KPT targets (see Section 3.5 of the LRTEMP).**

**Plate 9: Monitoring Site TSP9. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.10 Monitoring site TSP10

| **Jurisdiction** | **NSW** |
|---|---|
| Co-ordinates | 697084 – 6060204 |
| **No. of tree & shrub species planted** | **8** |
| **Seedling health** | |
| Good | **79** (85) |
| Poor | **18** (19) |
| Dead / Missing | **42** (35) |
| **Total plantings** | **139** |

**TSP10** is located about 6,425 m from the LLPS within the Johanson property, NSW.

Planting health has declined to **56.8%** from **61.2%** in spring 2014. Some tree guards still remain choked with herbage that has resulted in the death and poor health of many plantings at this site.

**Recommendation: Replace dead and missing specimens and improve planting maintenance (see Section 3.5 of the LRTEMP).**

**Plate 10: Monitoring Site TSP10. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.11 Monitoring site TSP11

| **Jurisdiction** | **NSW** |
|---|---|
| Co-ordinates | 699277 – 6061925 |
| **No. of tree & shrub species planted** | **3** |
| **Seedling health** | |
| Good | **7** (9) |
| Poor | **3** (1) |
| Dead / Missing | **2** (1) |
| **Total plantings** | **12** (11) |

**TSP11** is located about 9,300 m from the LLPS within the Latimer property, NSW.

Currently, **58.5%** of plantings were in good health, down from **81.8%** in the previous spring 2014. This is a small sample site and the decline was represented by just 2 specimens. All surviving specimens exhibited vigorous growth. Some tree guards have become engulfed by competing pasture grasses, which may affect future planting success.

**Recommendation: Improve planting maintenance (see Section 3.5 of the LRTEMP).**

**Plate 11: Monitoring Site TSP11. The image on the left is from spring 2014 and the right autumn 2015.**

### 3.1.12 Monitoring site TSP12

| **Jurisdiction** | **NSW** |
|---|---|
| Co-ordinates | 701346 – 6063099 |
| **No. of tree & shrub species planted** | **4** |
| **Seedling health** | |
| Good | **38** (36) |
| Poor | **6** (8) |
| Dead / Missing | **21** (21) |
| **Total plantings** | **65** |

**TSP12** is located about 11,900 m from the LLPS near the discharge facility, NSW.

The proportion of plantings in good health rose marginally to **58.5%** from **55.4%** during the previous spring 2014 session. About **32%** of specimens were either dead or missing.

**Recommendation: Replace dead and missing specimens and improve planting maintenance (see Section 3.5 of the LRTEMP).**

**Plate 12: Monitoring Site TSP12. The image on the left is from spring 2014 and the right autumn 2015.**

## 3.2 Weeds

Broad-leaf weeds such as *Conyza* sp. (Fleabane), *Hypericum perforatum* (St John's Wort), *Echium vulgare* (Viper's Bugloss) and *Verbena bonariensis* (Purple-top) as well as a variety of annual and perennial exotic grasses: including *Bromus* sp. (Brome), *Lolium s*p. (Rye Grass), *Vulpia* sp. (Fescue), and *Paspalum dilatatum* (Paspalum) were widely encountered within the construction corridor and is discussed in greater detail in the M2G Seeding (Plot) Monitoring Report: Autumn 2015. Smothering of plantings is a persistent problem in the eastern sections of the corridor, particularly at Sites, 9, 10 and 11.

## 3.3 Threatened plants

No new observations to report.

## 3.4 Threatened fauna

No new observations to report.

## 3.5 Main Observations

- The proportion of plantings in good health has declined further and is now at **40.7%.**
- The proportion of specimens that were dead or missing increased to **50.9%** with those in poor condition declining to **7.4%**.
- Once again planting success was significantly higher in NSW (**60.1%**) than in the ACT (**28.4%**).

## 3.6 Key Performance Targets

The KPT for tree and shrub plantings was arbitrarily set at 90% (see Section 2.4), however, the target has not been clearly articulated in the LRTEMP (2014), which states:

> *'**High Conservation Value Woodland**: Ground Cover - >70% vegetation cover of the native species sown and survival of native ground and tree species*'….. and….. '***Native species** (planting success) - all species listed for seeding and planting are present'.* (from Table 3.1 in the LRTEMP).

The KPT for tree and shrub planting should be reviewed and clarified, but most of all it needs to be achievable and consistent with standard expectations.

## 3.7 Replanting

Greening Australia has been engaged to plant an additional 1,300 trees and shrubs (about 26% of the total planted population) on Icon land and at the LLPS in the ACT as well as on private land. Additional plantings will increase the cohort of live specimens to about 75% of the original planted population. However, ongoing planting maintenance will be required in order to meet desired success rates.

## 3.8 Suggested Actions

A number of actions proposed in previous reports relating to replanting and their maintenance have either commenced or are in train.

The current KPT (90%) is considered onerous and would require continued long-term re-planting and maintenance to replace anticipated losses. Ultimately the target may never be achieved. In our opinion the KPT should be reduced to a more acceptable and achievable target of 70%. Furthermore, sample sites shown to have significant failure rates (i.e. TSP4) should either not be re-planted and another site selected or if re-planted an entirely different suite of species might need to be considered.

.

# 4 Conclusion

Monitoring surveys were conducted during April 2015 to measure the performance of tree and shrub rehabilitation plantings within the M2G construction corridor and structure sites. A simple quantitative sampling method was applied to determine planting success.

About 14% of all tree and shrub plantings were sampled at twelve monitoring sites. The current survey found 285 (40.7%) specimens to be in good health, 52 (7.4%) in poor health and 364 (51.9%) either dead or missing. This represents a 26% decline in specimen health since autumn 2013 and while the current decline in specimen health was relatively low (1.4%) it marked the least successful results of any monitoring period.

Extensive supplementary planting was recommended in previous reports and actions are currently underway (by Greening Australia) to plant approximately 1,300 tree and shrub species to address specimen decline. Furthermore, Icon Water have committed resources towards the on-going maintenance of existing and future plantings, which has been a major deficiency in the tree and shrub revegetation program.

# References

Eco Logical Australia (March 2011). *Summary of existing vegetation condition – Murrumbidgee to Googong Water Transfer Project*. Prepared for Bulk Water Alliance Joint Venture.

Blue Gum Ecological Consulting (July 2012) *Rehabilitation Planting Monitoring Report (Spring 2012)*: M2G Construction Corridor. Prepared for EcoLogical Australia Pty Ltd.

Commonwealth of Australia (2012). Interim Biogeographic Regionalisation for Australia, Version 7. Map produced by ERIN for the National Reserved System Section, Australian Government Department of Sustainability, Environment, Water, Population and Communities.

LRTEMP (2014). Murrumbidgee to Googong Water Transfer: Landscape Rehabilitation & Terrestrial Ecology Management Plant. Version 2 (January 2014). ACTEW Corporation Ltd.

# Appendix 1: Figures

**Figures 1 – 4** display the locations of the tree and shrub monitoring sites within the M2G construction corridor:

- **Figure 1**: Western section
- **Figure 2**: Central-western section
- **Figure 3**: Central-eastern section
- **Figure 4**: Eastern section


**Figure 1: Location of tree and shrub monitoring sites within the western section of the M2G construction corridor.**


**Figure 2: The location of tree and shrub monitoring sites within the central-western section of the M2G construction corridor.**

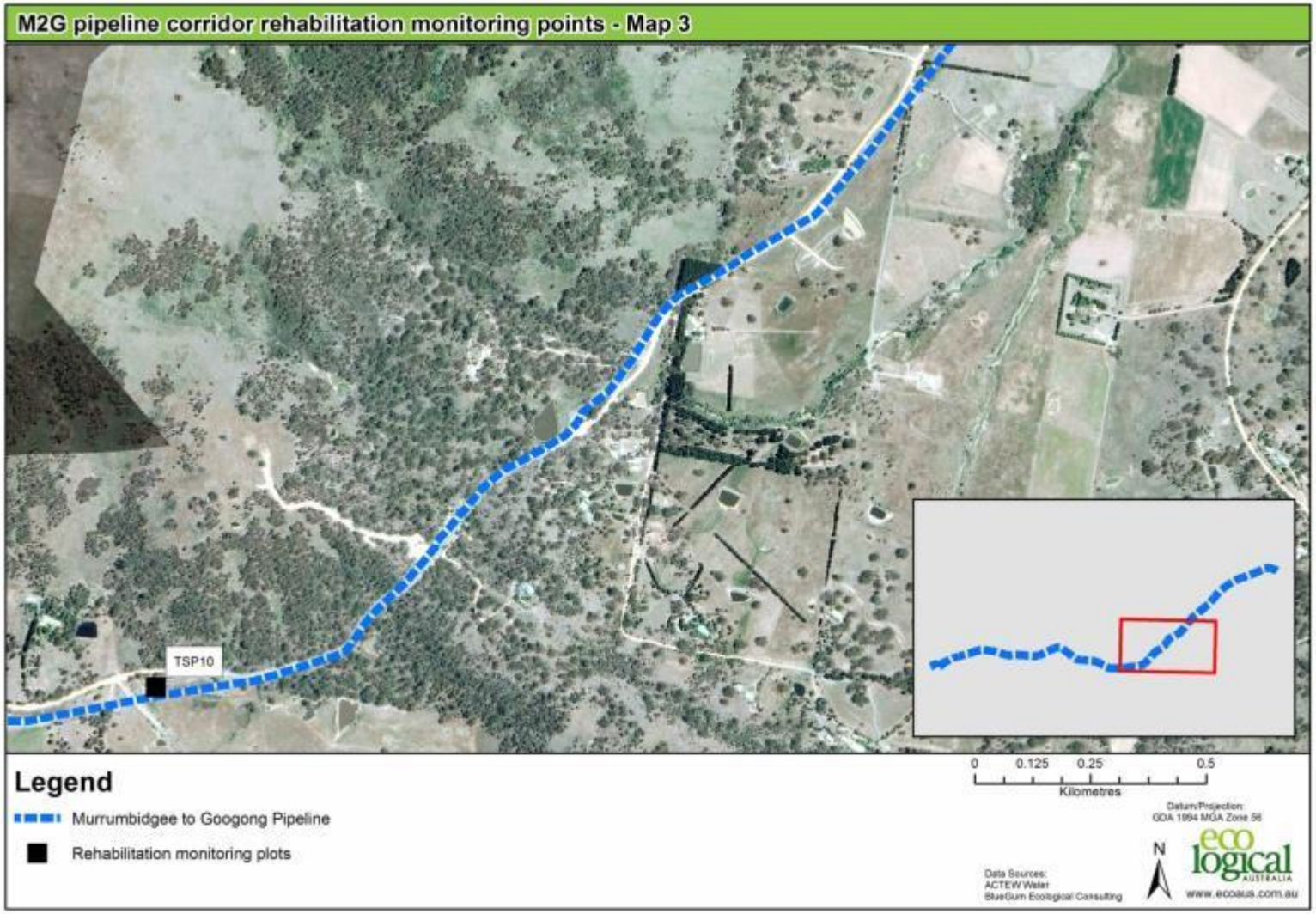



**Figure 3: The location of tree and shrub monitoring sites within the central-eastern section of the M2G construction corridor.**

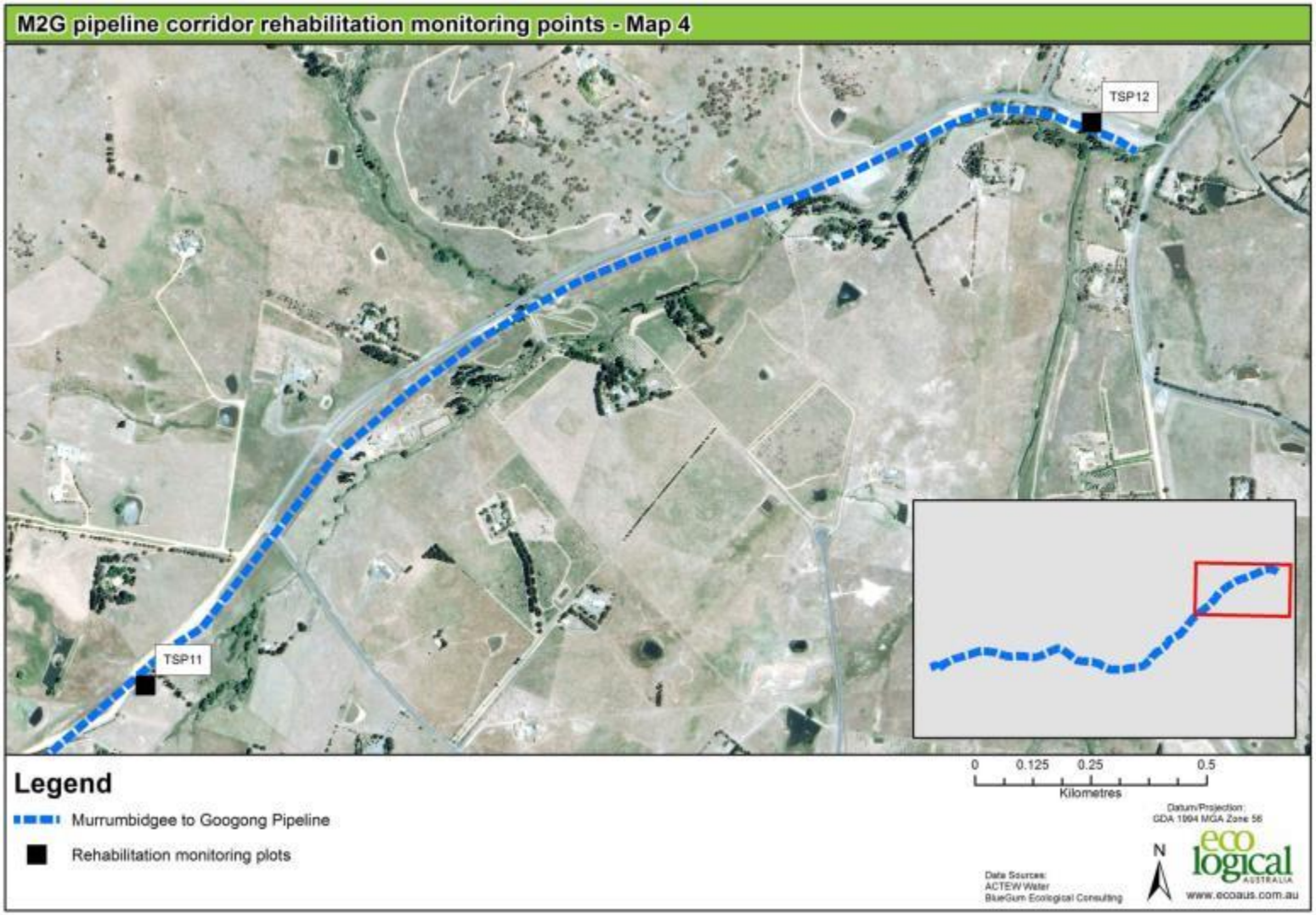



**Figure 4: The location of tree and shrub monitoring sites within the eastern section of the M2G construction corridor.**

# Appendix 2: Floristic data – tree & shrub plantings

**Table 5: Tree and shrub planting data from twelve sample sites: spring 2014 monitoring session.**

- **figures not species specific.**

| Site ID | Species | Good Health | Poor Health* | Dead | Missing | Total |
|---|---|---|---|---|---|---|
| TSP1 | *Acacia sp.* | 20 | | 2 | | 22 |
| TSP1 | *Bursaria spinosa* | 3 | | | | 3 |
| TSP1 | *Cassinia sp.* | 6 | 2 | | | 8 |
| TSP1 | *E. mannifera* | 6 | | | | 6 |
| TSP1 | *E. melliodora* | 2 | 1 | | | 3 |
| TSP1 | *Grevillea sp.* | | | | | - |
| TSP1 | *Hakea sp.* | | | | | - |
| TSP1 | *Leptospermum sp.* | | | | | |
| TSP1 | *Unknown* | | | | 50 | 50 |
| **Total** | | **37** | **3** | **2** | **50** | **92** |
| **% good health** | | | | | | **40.2%** |
| **% poor/dead/missing** | | | | | | **59.8%** |
| TSP2 | *Acacia sp.* | 48 | 5 | | | 53 |
| TSP2 | *Bursaria spinosa* | 55 | | | | 5 |
| TSP2 | *Cassinia sp.* | | | | | - |
| TSP2 | *Grevillea sp.* | 4 | | | | 4 |
| TSP2 | *Kunzea sp.* | | | | | - |
| TSP2 | *Leptospermum/Kunzea sp.* | 5 | 1 | 2 | | 8 |
| TSP2 | *Unknown* | | | | 57 | 57 |
| **Total Spring 2014** | | **62** | **6** | **2** | **57** | **127** |
| **% good health** | | | | | | **48.8%** |
| **% poor/dead/missing** | | | | | | **51.2%** |
| TSP3 | *Acacia sp.* | | 3 | | | 3 |
| TSP3 | *Bursaria spinosa* | 5 | 1 | | | 6 |
| TSP3 | *Leptospermum/Kunzea* | 10 | | | | 10 |
| TSP3 | *Unknown* | | | | 76 | 76 |
| **Total Spring 2014** | | **15** | **4** | **-** | **76** | **95** |
| **% good health** | | | | | | **15.8%** |
| **% poor/dead/missing** | | | | | | **84.2%** |
| TSP4 | *Acacia sp.* | 4 | 7 | | | 11 |
| TSP4 | *Bursaria spinosa* | | | | | - |
| TSP4 | *Leptospermum sp.* | | | | | - |
| TSP4 | *Unknown* | | | | 65 | 65 |
| **Total Spring 2014** | | **4** | **7** | **-** | **65** | **76** |
| **% good health** | | | | | | **5.3%** |
| **% poor/dead/missing** | | | | | | **94.7%** |

| Site ID | Species | Good Health | Poor Health* | Dead | Missing | Total |
|---|---|---|---|---|---|---|
| TSP5 | *E. blakelyi* | 2 | | | | 2 |
| TSP5 | *E. bridgesiana* | 1 | | | | 1 |
| TSP5 | *E. dives** | | | | | - |
| TSP5 | *E. melliodora* | | | | | - |
| TSP5 | *unknown* | | | | 16 | 16 |
| **Total Spring 2014** | | **3** | **0** | **0** | **16** | **19** |
| **% good health** | | | | | | **15.8%** |
| **% poor/dead/missing** | | | | | | **84.2%** |
| TSP6 | *E. blakelyi* | | | | | - |
| TSP6 | *E. bridgesiana* | | | | | - |
| TSP6 | *E. melliodora* | 1 | 2 | 1 | | 4 |
| TSP6 | *Unknown* | | | | 17 | 17 |
| **Total Spring 2014** | | **1** | **2** | **1** | **17** | **21** |
| **% good health** | | | | | | **4.8%** |
| **% poor/dead/missing** | | | | | | **95.2%** |
| TSP7 | *E. blakelyi* | 2 | | | | 2 |
| TSP7 | *E. bridgesiana* [A] | 8 | | | | 8 |
| TSP7 | *E. melliodora* [B] | 4 | | | | 4 |
| TSP7 | *E. polyanthemos* | 1 | | | | 1 |
| TSP7 | *E. dives* [C] | | | | | - |
| TSP7 | *Unknown* | | | | 7 | 7 |
| **Total Spring 2014** | | **15** | **0** | **0** | **7** | **22** |
| **% good health** | | | | | | **68.2%** |
| **% poor/dead/missing** | | | | | | **31.8%** |
| TSP8 | *E. mannifera* | 3 | | | | 3 |
| TSP8 | *E. melliodora* | 5 | | | | 5 |
| TSP8 | *Leptospermum sp.* | | | | | - |
| TSP8 | *Unknown* | | | | 1 | 1 |
| **Total Spring 2014** | | **8** | **0** | **0** | **1** | **9** |
| **% good health** | | | | | | **88.9%** |
| **% poor/dead/missing** | | | | | | **11.1%** |
| TSP9 | *E. melliodora* | 12 | 3 | | | 15 |
| TSP9 | *E. polyanthemos* | 2 | | | | 2 |
| TSP9 | *E. blakelyi* | 4 | | | | 4 |
| TSP9 | *Unknown* | | | 2 | 3 | 5 |
| **Total Spring 2014** | | **16** | **3** | **2** | **3** | **24** |
| **% good health** | | | | | | **66.7%** |
| **% poor/dead/missing** | | | | | | **33.3%** |

| Site ID | Species | Good Health | Poor Health* | Dead | Missing | Total |
|---|---|---|---|---|---|---|
| TSP10 | *Acacia sp.* | 20 | 2 | 1 | | 26 |
| TSP10 | *Callistemon sp.* | 9 | | | | 8 |
| TSP10 | *Dodonaea sp.* | 5 | | | | 6 |
| TSP10 | *E. mannifera* | 5 | 3 | | | 9 |
| TSP10 | *E. melliodora* | 5 | 1 | | | 7 |
| TSP10 | *E. polyanthemos* | 35 | 12 | | | 47 |
| TSP10 | *Unknown* | | | 21 | 20 | 36 |
| **Total Autumn 2014** | | **79** | **18** | **22** | **20** | **139** |
| **% good health** | | | | | | **56.8%** |
| **% poor/dead/missing** | | | | | | **43.2%** |
| TSP11 | *E. blakelyi* | 1 | 2 | | | 3 |
| TSP11 | *E. bridgesiana* | 3 | 1 | | | 4 |
| TSP11 | *E. melliodora* | 3 | | | | 3 |
| TSP11 | *Unknown* | | | 2 | | 2 |
| **Total Spring 2014** | | **7** | **3** | **2** | **0** | **12 (11)** |
| **% good health** | | | | | | **58.3%** |
| **% poor/dead/missing** | | | | | | **41.7%** |
| TSP12 | *Acacia sp.* | 20 | 5 | 1 | | 26 |
| TSP12 | *Bursaria spinosa* | 9 | 1 | 2 | | 12 |
| TSP12 | *Leptospermum/Kunzea* | 9 | | | | 9 |
| TSP12 | *Unknown* | | | 9 | 9 | 18 |
| **Total Spring 2014** | | **38** | **6** | **12** | **9** | **65** |
| **% good health** | | | | | | **58.5%** |
| **% poor/dead/missing** | | | | | | **41.5%** |

**[A] = replanting**

**[B] = one natural recruitment**

**[C] = natural recruitment**

**HEAD OFFICE**
Suite 4, Level 1
2-4 Merton Street
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

**SYDNEY**
Level 6
299 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9264 0717

**ST GEORGES BASIN**
8/128 Island Point Road
St Georges Basin NSW 2540
T 02 4443 5555
F 02 4443 6655

**CANBERRA**
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

**NEWCASTLE**
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

**NAROOMA**
5/20 Canty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

**COFFS HARBOUR**
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

**ARMIDALE**
92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

**MUDGEE**
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

**PERTH**
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 08 9322 1358

**WOLLONGONG**
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

**GOSFORD**
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897

**DARWIN**
16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601

**BRISBANE**
PO Box 1422
Fortitude Valley QLD 4006
T 0400 494 366

1300 646 131
www.ecoaus.com.au