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Monitoring Ecological Response to Flooding

A study of Kinnairds Swamp

FINAL REPORT

March 2011

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The following report is an extract from Jolly, K. and Osler, D. (2011) Monitoring ecological response to flooding: a study of Black, Doctors, Kinnairds and Reedy Swamps in the Goulburn Broken Catchment. Unpublished report prepared for the Goulburn Broken Catchment Management Authority. Australian Ecosystems Pty Ltd, Patterson Lakes, Victoria.

Photographs on cover page (from top to bottom): Pseudoraphis spinescens (Spiny Mud-grass) amongst dense carpets of Azolla filiculoides (Pacific Azolla) December 2010; Black Swans (Cygnus atratus) at Kinnairds Swamp July 2010; Red Gum Swamp October 2010; Flame Robin (Petroica phoenicea) Kinnairds Swamp July 2010; Kinnairds Swamp December 2010

EXECUTIVE SUMMARY

Project Context and Methodology

Australian Ecosystems Pty Ltd was engaged by the Goulburn Broken Catchment Management Authority (GBCMA) and Moira Shire Council to measure water quality and depth, and to survey understorey vegetation, and waterbird and frog populations, at Kinnairds Swamp in northern Victoria. The purpose of the study was to monitor the ecological response of the swamp to flooding from the delivery of environmental water and from rainfall induced catchment runoff. The study area lies within the Victorian Riverina bioregion and falls within the Goulburn Broken Catchment Management Authority region.

The wetland was independently surveyed on three occasions at approximately one month intervals between April and July 2010, with a further three surveys undertaken at the same frequency between September and December 2010. Floristic diversity and abundance was sampled using 10 X 10 metre vegetation quadrats located in the most prominent Ecological Vegetation Classes (EVCs) supported by the wetland. Water depth was recorded at the south west corner of each vegetation quadrat, and where water depth permitted, parameters such as Electrical Conductivity ($\mu\text{S}/\text{cm}$), pH, temperature ($^{\circ}\text{C}$) and turbidity (NTU) were measured.

Bird populations were sampled using timed transects, where a distance of approximately 250 metres was slowly traversed over a period of 30 minutes to record bird species, their numbers and breeding activity such as courtship, nest building or chick feeding. Frog populations were sampled similarly, with a focus on identifying calling frogs and attempts to estimate approximate numbers for each species heard.

Ecological Vegetation Classes and Flora

Five EVCs were sampled at Kinnairds Swamp; Plains Grassy Wetland (EVC 125), Plains Rushy Wetland (EVC 961), Red Gum Swamp (EVC 292), Riverine Swampy Woodland (EVC 815) and Tall Marsh (EVC 821). One hundred and thirty-seven flora species were recorded across the six survey events, 90 (65%) of these indigenous, and 46 wetland species that respond to flooding. Four species listed on the DSE Advisory List of rare and threatened flora, the poorly known *Alternanthera* sp. 1 (Plains) (Plains Joyweed), the rare *Cardamine moirensis* (Riverina Bitter-cress),

the vulnerable *Dianella tarda* (Late-flower Flax-lily), and poorly known *Haloragis glauca f. glauca* (Bluish Raspwort), were recorded. Additionally, the FFG Act listed *Myriophyllum gracile var. lineare* (Slender Water-milfoil) was recorded. A decline in species richness was observed from April to December within the quadrats sampled.

Vegetation Change

Overall, species composition changed following the delivery of environmental water between the first and second monitoring events. A number of terrestrial weed species were recorded during the first monitoring event when all quadrats were dry, however many of these species drowned when the wetland filled, and a large proportion were no longer present at the third monitoring event. Comparatively, the cover of indigenous wetland species such as *Marsilea drummondii* (Short-fruit Nardoo) increased markedly following watering. The abundance of other species such as *Eleocharis acuta* (Common spike-sedge) and *Amphibromus nervosus* (Common Swamp Wallaby-grass) also increased.

Wetland species such as *Lemna disperma* (Common Duckweed), *Ranunculus pumilo* (Ferny Small-flower Buttercup) and *Myriophyllum gracile var. lineare* (Slender Water-milfoil), were first recorded during October. The cover of *Azolla filiculoides* (Pacific Azolla) had also increased dramatically by this fourth survey. Consistent high water levels provided optimum conditions for this species, enabling it to form large carpets across inundated areas of the swamp between October and December. These dense mats prevented the establishment of many species which had previously been recorded at Kinnairds Swamp, and additionally, caused a reduction in the cover of other species which had been present during the earlier autumn/winter surveys undertaken as part of the current program.

As water levels recede, it is expected that the cover of *Azolla filiculoides* (Pacific Azolla) will decrease, thus providing an opportunity for other species to establish. In some parts of the wetland there was evidence of a reduction in cover between November and December, although this was observed in response to a further influx of water, rather than recession. Other species favoured by prolonged periods of inundation include *Pseudoraphis spinescens* (Spiny Mud-grass).

Bird and Frog Populations

Seventy-one bird species were recorded across the six survey events at Kinnairds Swamp, including 35 wetland species, and six DSE Advisory listed species, the near threatened Brown Treecreeper (*Climacteris picumnus victoriae*), Nankeen Night-heron (*Nycticorax caledonicus*) and Pied Cormorant (*Phalacrocorax varius*), the endangered Australasian Shoveller (*Anas rhynchos*) and the vulnerable Hardhead (*Aythya australis*) and Royal Spoonbill (*Platalea regia*). The FFG Act listed Blue-billed Duck (*Oxyura australis*) and Eastern Great Egret (*Ardea modesta*) were also recorded. Total species richness was similar across the first two survey events in April and May, with richness increasing markedly between the second and third surveys in May and July. Total abundance decreased from April to May, before peaking in July. There was a decrease in both total species richness and total bird abundance from July to October. There was little change in either measure between October and December.

While water fowl were always recorded in low numbers, Black Swan (*Cygnus atratus*) had a very successful breeding year, with juveniles observed in July, October and November. Little Pied Cormorant (*Microcarbo melanoleucos*) were also observed nesting in the latter month. There was an increase in breeding activity in December, with several wetland species, Australasian Shoveller (*Anas rhynchos*), Black Swan (*Cygnus atratus*), Eurasian Coot (*Fulica atra*), Little Pied Cormorant (*Microcarbo melanoleucos*), Pacific Heron (*Ardea pacifica*), Royal Spoonbill (*Platalea regia*), and Yellow-billed Spoonbill (*Platalea flavipes*) observed nesting.

Three species of frog, the Plains Froglet (*Crinia parinsignifera*), and Common Froglet (*Crinia signifera*), the Peron's Tree Frog (*Litoria peronii*), were recorded at Kinnairds Swamp over the six survey events.

Conclusions

The artificial delivery of environmental water allocations can stimulate reproduction and improvements in the ecological health of indigenous vegetation communities, plants, wetland birds and frogs. Although water was delivered to the wetlands between the first and second monitoring events, and the wetland had filled from catchment runoff as a consequence of heavy rainfall, many wetland plants had only just begun to respond to inundation or increased soil moisture by the

conclusion of the first series of surveys (April – July), and at this stage of the program it was generally expected that more species were likely to become apparent as water and substrate temperatures increased through spring and summer (September – December). Continued heavy rains during spring and summer resulted in very little drawn down across the wetland, with water generally deepest in December, and thus this trend was for the most part not observed.

Despite recording a high diversity of flora including several rare and threatened species, and vegetation with good structural characteristics, the absence of a spring draw down, impeded the establishment and expansion of species such as *Myriophyllum* (Water-milfoil) and *Amphibromus* (Wallaby-grass) and a plethora of small herbs. Differences in weather patterns in 2010 when compared to those of 2008/09, also meant that many of the rare and threatened species recorded in the later months of 2008 were not recorded during the current study. Similarly, the dramatic increases in species diversity that were evident post environmental water delivery during previous studies of the same wetlands were not matched.

While little discernable change in vegetation condition or floristics was recorded at Kinnairds Swamp during the autumn/winter surveys, significant floristic change occurred between these and the subsequent spring/summer surveys. Typically, with continued flooding in spring, many of the species that had begun to establish in response to the earlier water delivery drowned, and those such as *Azolla* became prevalent and subsequently inhibited the establishment of a diversity of other ground flora. As the *Azolla* died back with a further influx of water, species such as *Ludwigia peploides* (Clove-strip) and *Pseudoraphis spinescens* (Spiny mud-grass), a species that given its necessity for long wet periods in order to establish was infrequent during previous studies of the same wetlands, began to establish. In December, by the conclusion of the surveys, the cover of *Ludwigia peploides* and *Pseudoraphis spinescens* had expanded, and a moderate diversity of *Carex* spp. (Sedges), *Eleocharis* spp. (Spike-sedges) and *Juncus* spp. (Rushes) had begun to regenerate around the wetland margins.

Documentation of bird and frog populations yielded similar results. Despite recording a reasonable diversity of wetland and non-wetland bird species, including several rare and threatened species, correlation between water depth and species richness that was evident in previous studies (see Cook *et al.*, 2009), was not apparent at the conclusion of the first series of surveys (April – July).

As the wetlands are quite large and support areas of dense cover it was difficult to accurately estimate bird numbers and detect all cryptic bird species, particularly if they were not calling. The rainy and windy conditions on a number of the survey days impeded visibility, and is likely to have influenced the identification of some birds and total bird counts.

Utilisation of the wetlands by different species varied significantly over the monitoring period. During the autumn/winter surveys migratory bird species were only just beginning to arrive in the region and the courtship or nesting behaviour of some bird species had only just begun, and was yet to commence in other species. Although the trend is not strongly reflected in the small sampling effort, birds proved more abundant during the spring/summer surveys, and a different suite of species, including several rare and threatened species, were observed utilising the wetlands. Numerous species were observed nesting or exhibiting breeding behaviour in the final surveys, and many young were recorded, indicative of a successful breeding season. Birds utilised a variety of vegetation types, but were most abundant in areas where there was a reliable food source such as *Pseudoraphis spinescens* (Spiny mud-grass).

Similarly, during the autumn/winter surveys, many frog species were not active and their presence in the wetlands could not be determined by call recognition or by limited active searching. Prevailing weather conditions, and the time of day at which surveys were conducted, also influenced the number of species detected and their abundance, and continued to do so during the spring/summer surveys. Although there was evidence of some species having bred, a greater sampling effort is likely to reveal more breeding, and a higher diversity of frog species.

Continued heavy rains post the final survey (late January and February) suggest that the wetland is unlikely to draw down for some time. As this occurs it is expected that aquatic perennial grasses and species typical of Aquatic Herbland will begin to develop. In order to comprehensively document this process, along with other responses attributable to prolonged inundation resulting from environmental water delivery coupled with spring and summer flooding, it is proposed that the monitoring program be extended to include post drawn down surveys.

CONTENTS

EXECUTIVE SUMMARY	ii
1.0 INTRODUCTION	1
1.1 Context	1
1.2 Project Objectives	1
1.3 Study Area.....	3
2.0 METHODOLOGY	5
2.1 Field Survey	5
2.1.1 Water quality	5
2.1.2 Flora survey	6
2.1.3 Fauna survey	6
2.1.4 Incidental observations	8
2.2 Taxonomy.....	8
2.3 Limitations	10
3.0 KINNAIRDS SWAMP	11
3.1 Water quality, depth and extent	11
3.2 Vegetation	14
3.3 Birds.....	32
3.4 Frogs.....	40
3.5 Other Fauna	41
4.0 CONCLUSIONS	42
5.0 REFERENCES	45

LIST OF APPENDICES

APPENDIX 1 GPS COORDINATES FOR VEGETATION MONITORING SITES.....	47
APPENDIX 2 QUADRAT DATA KINNAIRDS SWAMP	48
APPENDIX 3 DETAILS OF FAUNA SURVEY EFFORT	62
APPENDIX 4 PHOTO-MONITORING RECORD	63
APPENDIX 5 DAILY WEATHER OBSERVATIONS FOR SHEPPARTON	72

LIST OF PHOTOGRAPHS

Photograph 1 Red Gum Swamp at Kinnairds Swamp May and November 2010	3
Photograph 2 <i>Pseudoraphis spinescens</i> (Spiny Mud-grass) amongst dense carpets of <i>Azolla filiculoides</i> (Pacific Azolla) December 2010.....	22
Photograph 3 <i>Solanum esuriale</i> (Quena) Kinnairds Swamp December 2010	23
Photograph 4 <i>Myriophyllum gracile</i> var. <i>lineare</i> (Slender Water-milfoil) and <i>Myriophyllum porcatum</i> (Rigid Water-milfoil) inset and within the field-layer, Kinnairds Swamp 2008.....	28
Photograph 5 Flame Robin (<i>Petroica phoenicea</i>) Kinnairds Swamp July 2010	34
Photograph 6 Black Swans (<i>Cygnus atratus</i>) at Kinnairds Swamp July 2010	41
Photograph 7 Quadrat 1 (Plains Rushy Wetland) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)	48
Photograph 8 Quadrat 2 (Red Gum Swamp) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right).....	50
Photograph 9 Quadrat 3 (Tall Marsh) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right).....	52
Photograph 10 Quadrat 4 (Plains Grassy Wetland) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)	53
Photograph 11 Quadrat 5 (Red Gum Swamp) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)	55
Photograph 12 Quadrat 6 (Red Gum Swamp) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)	57
Photograph 13 Quadrat 7 (Riverine Swampy Woodland) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)	59
Photograph 14 Kinnairds Swamp Photo-monitoring Point 1 (left to right) April, May, July, October, November and December 2010	63
Photograph 15 Kinnairds Swamp Photo-monitoring Point 2 (left to right) April, May, July, October, November and December 2010	64
Photograph 16 Kinnairds Swamp Quadrat 1 (left to right) April, May, July, October, November and December 2010.....	65
Photograph 17 Kinnairds Swamp Quadrat 2 (left to right) April, May, July, October, November and December 2010.....	66



Photograph 18 Kinnairds Swamp Quadrat 3 (left to right) April, May, July, October, November and December 201067

Photograph 19 Kinnairds Swamp Quadrat 4 (left to right) April, May, July, October, November and December 201068

Photograph 20 Kinnairds Swamp Quadrat 5 (left to right) April, May, July, October, November and December 201069

Photograph 21 Kinnairds Swamp Quadrat 6 (left to right) April, May, July, October, November and December 201070

Photograph 22 Kinnairds Swamp Quadrat 7 (left to right) April, May, July, October, November and December 201071

LIST OF TABLES

Table 1 Overview of survey effort.....	5
Table 2 Temporal change in water quality at Kinnairds Swamp autumn to spring/summer 2010/11	12
Table 3 Summary of floristic data collected at Kinnairds Swamp autumn to spring/summer 2010/11	16
Table 4 Vascular flora recorded at Kinnairds Swamp autumn to spring/summer 2010/11	17
Table 5 Species totals for quadrats sampled at Kinnairds Swamp autumn to spring/summer 2010/11	24
Table 6 Rare and threatened flora recorded at Kinnairds Swamp autumn to spring/summer 2010/11	28
Table 7 Environmental weeds recorded at Kinnairds Swamp autumn to spring/summer 2010/11 ..	29
Table 8 Summary of bird richness and abundance at Kinnairds Swamp	32
Table 9 Wetland birds recorded at Kinnairds Swamp autumn to spring/summer 2010/11	35
Table 10 Non-wetland birds recorded at Kinnairds Swamp autumn to spring/summer 2010/11	37
Table 11 Frogs recorded at Kinnairds Swamp autumn to spring/summer 2010/11	40
Table 12 Butterflies recorded at Kinnairds Swamp autumn to spring/summer 2010/11	41
Table 13 Mammals recorded at Kinnairds Swamp autumn to spring/summer 2010/11	41
Table 14 GPS coordinates for vegetation monitoring sites (easting and northing format, map datum GDA94).....	47
Table 15 Flora species recorded Quadrat 1 (Plains Rushy Wetland) Kinnairds Swamp	48
Table 16 Flora species recorded Quadrat 2 (Red Gum Swamp) Kinnairds Swamp	50
Table 17 Flora species recorded Quadrat 3 (Tall Marsh) Kinnairds Swamp.....	52
Table 18 Flora species recorded Quadrat 4 (Plains Grassy Wetland) Kinnairds Swamp	53
Table 19 Flora species recorded Quadrat 5 [Shire] (Red Gum Swamp) Kinnairds Swamp.....	55
Table 20 Flora species recorded Quadrat 6 [Shire] (Red Gum Swamp) Kinnairds Swamp.....	57
Table 21 Flora species recorded Quadrat 7 [Shire] (Riverine Swampy Woodland) Kinnairds Swamp	59
Table 22 Details of bird survey activities at Kinnairds Swamp	62
Table 23 Details of frog survey activities at Kinnairds Swamp.....	62

LIST OF FIGURES

Figure 1 Overview of study area within Goulburn Broken Catchment Management Authority Region	2
Figure 2 Location of Kinnairds Swamp, Skidmore Road Numurkah	4
Figure 3 Flora and fauna survey sites at Kinnairds Swamp, Skidmore Road Numurkah.....	7
Figure 4 Temporal change in floristic species richness and water depth at Kinnairds Swamp	26
Figure 5 Temporal change in bird species richness and water depth at Kinnairds Swamp	33

1.0 INTRODUCTION

1.1 Context

Australian Ecosystems Pty Ltd was engaged by the Goulburn Broken Catchment Management Authority and Moira Shire Council to measure water quality and depth, and to survey understorey vegetation, and waterbird and frog populations, at Kinnairds Swamp in northern Victoria (Figure 1, page 2). Surveys were conducted on three separate occasions between April and July 2010, with three additional surveys conducted between September and December 2010. The purpose of the study was to monitor the ecological response of Kinnairds Swamps to flooding from the delivery of environmental water and from rainfall induced catchment runoff. The findings will inform State Government reporting and ongoing management of the wetlands. The work succeeds previous surveys by Australian Ecosystems that were undertaken in 2008 and 2009 as part of a six month monitoring program.

1.2 Project Objectives

Environmental water delivery (400 ML) commenced at Kinnairds Swamp in mid April 2010, with continued heavy rains during the monitoring period resulting in very little drawn down.

In view of this recent water delivery, the core objectives of the project were to:

- Assess how waterbirds, frogs and aquatic vegetation respond to flooding in the study area;
- Monitor changes in water quality, depth and extent in the study area; and
- Create a pictorial record of ecological responses in the study area to changes in water depth and extent.

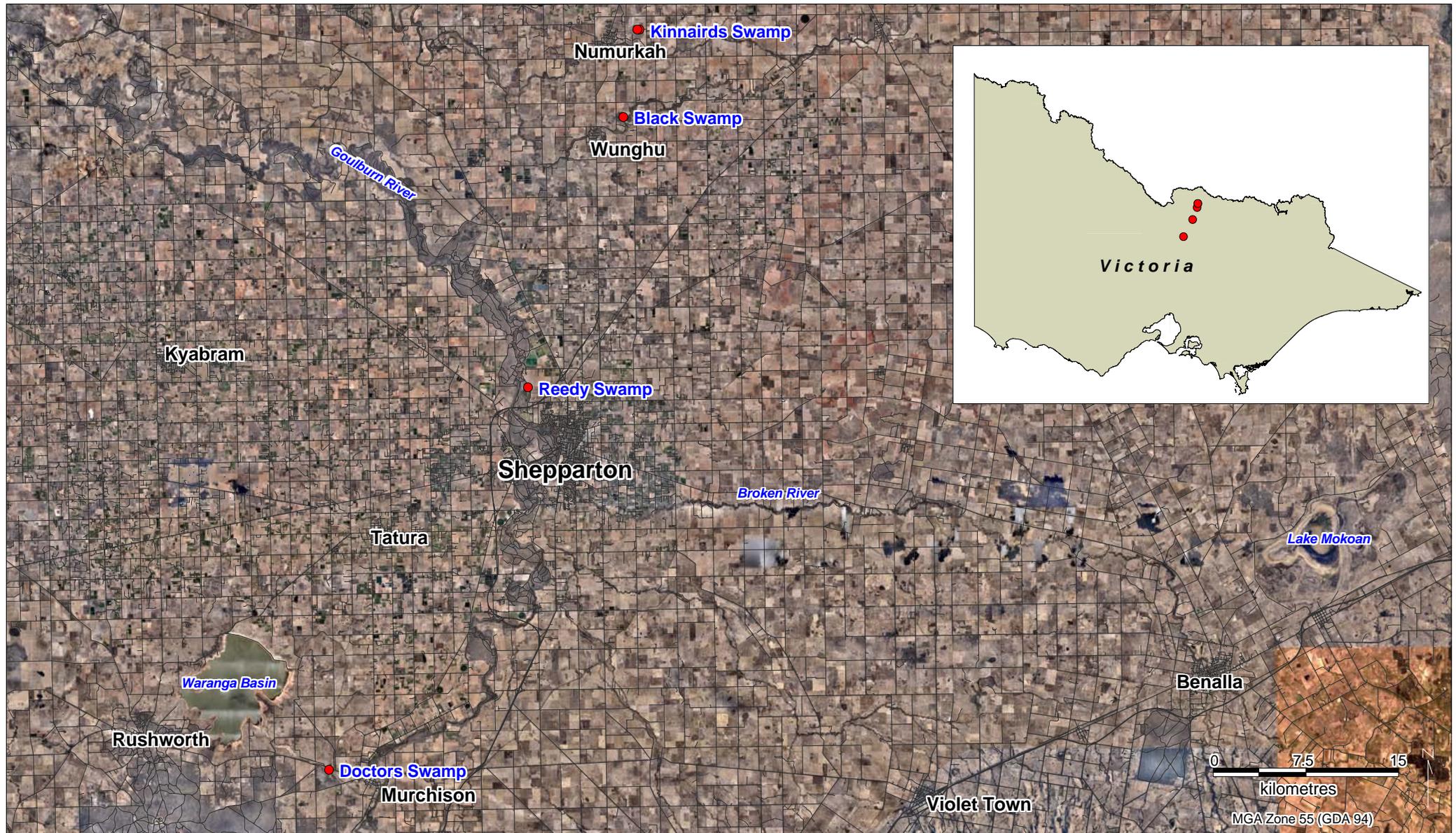


Figure 1 Overview of study area within Goulburn Broken Catchment Management Authority Region

Project: Monitoring Ecological Response to Flooding

Client: Goulburn Broken Catchment Management Authority

Map prepared by Karen Jolly 22 July 2010



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Legend

- Location of survey sites
- Highways/Roads

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1.3 Study Area

The study area lies within the Victorian Riverina bioregion and falls within the Goulburn Broken Catchment Management Authority region.



Photograph 1 Red Gum Swamp at Kinnairds Swamp May and November 2010

Kinnairds Swamp is located on the floodplain of the lower Broken Creek approximately two kilometres north east of Numurkah (Figure 2, page 4). It consists of a natural depression, part of which has been modified into a constructed wetland. The swamp which is 93 hectares in area and occurs on both public and private land, is managed by the Moira Shire and Goulburn-Murray Water respectively. Kinnairds Swamp supports extensive areas of Plains Grassy Wetland (EVC 125) and Red Gum Swamp (EVC 292), both of which are regarded as endangered in the Victorian Riverina bioregion. The swamp also supports localised areas of Plains Rushy Wetland (EVC 961) which is regarded as vulnerable, and Tall Marsh (EVC 821) and Aquatic Herbland (EVC 653) which are regarded as endangered. Kinnairds Swamp is surrounded by Riverine Swampy Woodland (EVC 815) and Plains Grassy Woodland (EVC 55), which are regarded as vulnerable and endangered respectively.



Figure 2 Location of Kinnairds Swamp, Skidmore Road Numurkah

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Client: Goulburn Broken Catchment Management Authority

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Legend

-  Watercourse/drainage line
-  Road/Track

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2.0 METHODOLOGY

2.1 Field Survey

Three monitoring events were undertaken at approximately one month intervals between autumn and winter 2010, with a further three events undertaken at the same frequency between spring 2010 and summer 2011 (Table 1). The wetland was independently surveyed, with floristic diversity and abundance sampled using quadrats, and frog and waterbird diversity and abundance sampled using timed transects. Water quality and extent were also measured.

Table 1 Overview of survey effort

Survey Type	Survey Method	Survey Dates		
Vegetation	Quadrats	9/04/2010	25/05/2010	27/07/2010
		14/10/2010	17/11/2010	9/12/2010
	General Inventory	27/07/2010	-	5/01/2011
Birds	Transect	9/04/2010	25/05/2010	27/07/2010
		13/10/2010	17/11/2010	9/12/2010
Frog	Transect	9/04/2010	25/05/2010	27/07/2010
		14/10/2010	17/11/2010	9/12/2010

2.1.1 Water quality

During the field survey each wetland inlet was inspected to estimate flow and functioning of the regulating structures (i.e. identify breakouts, structural failures). Water depth was recorded at the south west corner of each flora quadrat, and where water depth permitted, parameters such as Electrical Conductivity ($\mu\text{S}/\text{cm}$), pH, temperature ($^{\circ}\text{C}$) and turbidity (NTU) were measured. Measurements were made using a Eutech EC Tester 11 Dual Range with Temp Display, a Eutech pH Tester 10 \pm 0.1pH, and turbidity tubes; all equipment was calibrated prior to sampling. Parameters were compared with suggested guidelines as described by ANZECC and ARMCANZ (2000). As wetland data is not provided in the guidelines, comparison was made to freshwater lakes and reservoirs for South-east Australia (Chapter 3, pages 3.3-10 and 3.3-11). Parameters were also compared to the guidelines stipulated by the EPA (2003) *Water Quality Objectives for*

Rivers and Stream – Ecosystem Protection; these regional parameters more accurately reflecting local conditions for the Goulburn Broken Catchment.

2.1.2 Flora survey

The permanent 10 X 10 metre vegetation quadrats established at Kinnairds Swamp in 2008/2009 were resurveyed, and the projected foliage cover was recorded for all overstorey and understorey species occurring within each quadrat based on the categories: 1% = 1 – few individuals, 2% = few to up to 5% cover of an individual species, 5% = 5% cover for an individual species, and in increments of 5% thereafter. At the request of Moira Shire Council three additional quadrats were established, and general floristic inventory of this site undertaken in July and December 2010. Notations of rare and threatened flora observed outside of the quadrats were made, and where possible the size and distribution of populations was documented.

Sampling efforts are depicted spatially in Figure 3 (page 7), and monitoring coordinates provided in Appendix 1. Quadrat data are presented in Appendix 2. Photographs were taken from the south-west corner of each quadrat to provide a pictorial representation of ecological change. Two general photographs of the wetland, best capturing the wetland's features, were also taken. This pictorial record is presented in Appendix 4.

2.1.3 Fauna survey

A 30 minute timed transect was conducted over approximately 250 metres (commencing from an established point) to record waterbird species, their numbers and breeding activity such as courtship, nest building or chick feeding. The length of each transect was traversed in a slow, silent manner, taking care not to disturb nesting birds. Bird species and their numbers observed within visual range of each transect were recorded. Birds that were observed within visual range, but not within the habitat being surveyed, were recorded as incidental observations. Breeding activities such as courtship, nest building, or chick feeding were recorded. Birds sighted flying over the study area were also noted. Binoculars and a spotting scope were used to aid in bird identification, as was recognition of calls. Weather conditions (wind, rain and cloud cover) were documented for each survey, as was survey start and finish time.



Figure 3 Flora and fauna survey sites at Kinnairds Swamp, Skidmore Road Numurkah

Project: Monitoring Ecological Response to Flooding

Client: Goulburn Broken Catchment Management Authority

Map prepared by Karen Jolly 22 July 2010

Legend

- Flora quadrat (10m x 10m)
- Bird and frog transect (250m)
- Photo-monitoring point
- Inlet location



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A 30 minute timed frog transect was carried out over approximately 250 metres (commencing from an established point), with focus on identifying calling frogs and attempts to estimate approximate numbers of each species heard. The size of the frog populations were grouped as - less than 10 calling males, between 10 and 100 calling males or over 100 calling males.

As time permitted, a 30 minute active search for frogs and reptiles in suitable habitats around the wetland, such as under debris or at the base of tussocks, was also undertaken. All species detected during the active search were recorded under incidental observations. Details of the fauna survey activities are presented in Appendix 3. Weather observations from the Bureau of Meteorology for the survey period are presented in Appendix 5.

2.1.4 Incidental observations

Incidental flora species observed outside of quadrats were recorded, and overall plant lists for the wetland collated. Similarly, incidental fauna species observed outside of timed transects were also recorded, and overall fauna lists for each wetland are provided.

2.2 Taxonomy

Plant taxonomy in this report follows the Flora Information System (DSE, 2009b), with consideration to the Census of Victoria Vascular Plants (Walsh and Stajsic, 2007). An asterisk (*) denotes exotic species and a hash sign (#) denotes indigenous species occurring outside of their natural range. Fauna taxonomy follows the Atlas of Victorian Wildlife (DSE, 2009a).

The status of flora as listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Flora and Fauna Guarantee Act 1988* (FFG Act) and the Department of Sustainability and Environment rare or threatened species advisory lists was noted (DSE, 2007; DSE, 2005).

Status under the *Flora and Fauna Guarantee Act 1988* (FFG Act)

L Listed as threatened

Conservation Status in Victoria (DSE Advisory List of Rare and Threatened Flora)

- e** Endangered in Victoria: at risk of disappearing from the wild state if present land use and other casual factors continue to operate
- v** Vulnerable in Victoria; rare, not presently Endangered but likely to become so soon due to continued depletion of; taxa where populations are so low that recovery from a local natural disturbance is doubtful
- r** Rare in Victoria but not considered otherwise threatened - there are relatively few known populations or the taxon is restricted to a relatively small area
- k** Poorly known and suspected, but not definitely known to belong to the one of the categories Presumed extinct, Endangered, Vulnerable or Rare in Victoria

Status under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

- EN** Endangered in Australia: A taxon is endangered when it is not critically endangered but is facing a very high risk of extinction in the wild in the near future.
- VU** Vulnerable in Australia: not presently endangered but at risk of disappearing from the wild over a longer period (20 to 50 years) through continued depletion

Status under the *Flora and Fauna Guarantee Act 1988* (FFG Act)

L Listed as threatened

Conservation Status in Victoria (DSE Advisory List of Rare and Threatened Fauna)

- cr** Critically endangered in Victoria: a taxon is critically endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Species Survival Commission 2001), and is therefore considered to be facing an extremely high risk of extinction in the wild
- en** Endangered in Victoria: a taxon is endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Species Survival Commission 2001), and is therefore considered to be facing a very high risk of extinction in the wild
- vu** Vulnerable in Victoria: a taxon is vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Species Survival Commission 2001), and is therefore considered to be facing a high risk of extinction in the wild
- nt** Near Threatened in Victoria: a taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered, or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the future

Status under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

- EN** Endangered in Australia: a taxon is endangered when it is not critically endangered but is facing a very high risk of extinction in the wild in the near future.
- VU** Vulnerable in Australia: a taxon is vulnerable when it is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future.

The noxious status of recorded weeds under the *Catchment and Land Protection Act 1994* (CaLP Act) was determined, and their rankings on the DSE Advisory list of environmental weeds of the inland plains bioregions of Victoria were noted. The DSE Advisory list of environmental weeds is a non-statutory classification system that ranks environmental weeds on the basis of five attributes: potential for invasion; impact on natural systems; area of potential distribution; range of susceptible habitat; and rate of dispersal. Its purpose is to provide an indication of the level of risk posed by individual species within a defined bioregion.

2.3 Limitations

Due to the cryptic nature and seasonal growth cycles of certain plants and animals, ecological surveys are often unable to detect all species present at a particular site. As fieldwork for this study was carried out from April to December 2010, only flora and fauna that were physiologically active or present within the wetlands over this period were recorded. Ecological surveys can also be limited by project constraints including short survey timeframes, and it is probable that additional flora and fauna species would be recorded given a greater sampling effort, as would have smaller nuances in temporal vegetation change.

Continued heavy rains during the monitoring period resulted in very little drawn down, and it is likely that some flora species were obscured from view by water depth, and thus were not identified. As the wetlands were quite large and supported areas of dense cover it was also difficult to accurately estimate bird numbers and detect all cryptic bird species, particularly if they were not calling.

3.0 KINNAIRDS SWAMP

3.1 Water quality, depth and extent

All seven quadrats at Kinnairds Swamp were dry when sampled during the first monitoring event in April. Four hundred megalitres of water was delivered to Kinnairds Swamp between 12th April and 26th May 2010, thus coinciding with the interval between the first and second monitoring events. Consequently water depth across the quadrats sampled at Kinnairds Swamp ranged from 230 mm to 640 mm during the second monitoring event in May 2010, with the wetland also having filled from recent rains (Table 2). At a distance of 300 mm from culvert 2, water depth was 300 mm, with water having filled the wetland and back flowing to the north over the path through breaks in the levee. While Quadrat 7 remained dry throughout the monitoring period, all other quadrats held water from May to December with the water depth of several quadrats peaking in December.

When sampled from May to December, electrical conductivity ranged from 80 to 416 $\mu\text{S}/\text{cm}$, well exceeding the ANZECC and ARMCANZ (2000) guidelines of 20 – 30 $\mu\text{S}/\text{cm}$ for Lakes and Reservoirs, but falling within the EPA (2003) guidelines of < 500 $\mu\text{S}/\text{cm}$ for the region. Electrical conductivity increased markedly from May to July 2010 and then again between July and October.

pH across the survey period ranged from 6.6 to 7.8 at Kinnairds Swamp with all measurements falling within guidelines of 6.50 – 8.0 for slightly disturbed ecosystems as described by ANZECC and ARMCANZ (2000), and within the EPA (2003) guidelines of 6.4 – 7.7 for the region.

Turbidity across the survey period was consistently sampled at < 10 NTU in May and July, however was much higher in October and November, ranging between 20 and 150 NTU. In May and July turbidity at Kinnairds Swamp fell within the ANZECC and ARMCANZ (2000) guidelines of 1 – 20 NTU for Lakes and Reservoirs, and within the EPA (2003) guidelines of < 30 NTU for the region. Turbidity measurements exceeded both sets of guidelines in October and November; however results were influenced by the difficulty in obtaining samples due to the high *Azolla* cover. There was a further increase between October and November with measurements ranging between 20 and 150 NTU in the latter month.

During sampling water temperature at Kinnairds Swamp ranged between 10.3 °C and 29.5 °C.



Table 2 Temporal change in water quality at Kinnairds Swamp autumn to spring/summer 2010/11

Site	Quadrat 1						Quadrat 2					
Survey Number and Date	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6
	9/04/10	25/05/10	27/07/10	14/10/10	17/11/10	9/12/10	9/04/10	25/05/10	27/07/10	14/10/10	17/11/10	9/12/10
Depth (mm)	dry ^	300	300	120	120	360	dry ^	400	180	170	210	460
Extent (%)	-	85	55	1	1	85	-	95	30	2	-	2
Ec (µS/cm)	-	110	155	416	382	398	-	80	114	371	333	407
pH	-	6.8	*	6.6	6.8	6.7	-	6.7	*	6.6	6.8	-
Temp (°C)	-	13.5	11.0	16.9	22.0	25.0	-	12.7	12.5	16.2	20.0	28.0
Turbidity (NTU)	-	<10	<10	60 - 80	80 - 100	-	-	<10	<10	50 - 60	20 - 30	-

Site	Quadrat 3						Quadrat 4					
Survey Number and Date	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6
	9/04/10	25/05/10	27/07/10	14/10/10	17/11/10	9/12/10	9/04/10	25/05/10	27/07/10	14/10/10	17/11/10	9/12/10
Depth (mm)	dry ^	640	510	510	420	600	dry ^	420	210	250	250	550
Extent (%)	-	45	5	2	1	60	-	55	30	30	-	100
Ec (µS/cm)	-	80	163	336	370	405	-	80	171	328	386	371
pH	-	6.7	*	6.9	6.8	7.0	-	7.0	*	6.9	7.0	7.8
Temp (°C)	-	12.9	10.3	16.4	20.0	29.5	-	13.4	13.3	16.3	21.5	26.0
Turbidity (NTU)	-	<10	<10	50 - 60	60 - 80	-	-	<10	<10	20 - 30	100 - 150	-

turbidity measurements during October and November were affected by the extent of *Azolla* within the swamp; *Azolla* cover within the quadrats impeded the collection of a vegetation free water for analysis

Quadrat 4 surface covered by *Azolla* during Survey 5



Site	Quadrat 5						Quadrat 6					
	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6
	9/04/10	25/05/10	27/07/10	14/10/10	17/11/10	9/12/10	9/04/10	25/05/10	27/07/10	14/10/10	17/11/10	9/12/10
Depth (mm)	dry ^	230	460	490	520	620	dry ^	380	330	600	600	710
Extent (%)	-	90	85	70	15	100	-	95	65	70	-	100
Ec (µS/cm)	-	160	267	330	320	327	-	140	268	-	335	276
pH	-	6.8	*	7.1	7.0	7.3	-	7.1	*	7.1	7.0	7.4
Temp (°C)	-	12.3	12.1	18.1	24.0	24.0	-	13.0	12.1	17.8	21.0	28.2
Turbidity (NTU)	-	<10	<10	40 - 50	60 - 80	-	-	<10	<10	40 - 50	100 - 150	-

Site	Quadrat 7					
	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6
	9/04/10	25/05/10	27/07/10	14/10/10	17/11/10	9/12/10
Depth (mm)	dry ^	dry	dry	dry	dry	dry
Extent (%)	-	-	-	-	-	-
Ec (µS/cm)	-	-	-	-	-	-
pH	-	-	-	-	-	-
Temp (°C)	-	-	-	-	-	-
Turbidity (NTU)	-	-	-	-	-	-

^ 10 mm rain three nights prior to survey 1

+ 41 mm of rain on the day of survey 2

* equipment malfunction

3.2 Vegetation

Ecological Vegetation Classes

Five EVCs were sampled at Kinnairds Swamp: Plains Grassy Wetland (EVC 125); Plains Rushy Wetland (EVC 961); Red Gum Swamp (EVC 292); Riverine Swampy Woodland (EVC 815); and Tall Marsh (EVC 821).

Plains Grassy Wetland, a typically treeless EVC, has a sparse shrub component and an understorey dominated by grasses, small sedges and herbs (DSE, 2010). This EVC is generally species-rich on the outer verges, although species-poor in the wetter central areas. Ground cover species characteristic of Plains Grassy Wetland that were recorded at Kinnairds Swamp include graminoids such as *Amphibromus nervosus* (Common Swamp Wallaby-grass), *Eleocharis acuta* (Common Spike-sedge) and *Juncus flavidus* (Gold Rush), and herbs such as *Marsilea drummondii* (Common Nardoo). Plains Grassy Wetland recruits by episodic floods with five years the desirable period between episodes of disturbance.

Plains Rushy Wetland is rush dominated wetland with floristic affinities to Plains Grassy Wetland. Species characteristic of Plains Rushy Wetland recorded at Kinnairds Swamp include *Eleocharis acuta* (Common Spike-sedge), *Juncus flavidus* (Gold Rush) and *Lachnagrostis filiformis* (Common Blown-grass). High threat weeds typical of this EVC that were recorded at Kinnairds Swamp include **Rumex crispus* (Curled Dock).

Red Gum Swamp is an open woodland to 15m tall with a diverse understorey dominated by sedgy or grassy-herbaceous aquatics and species tolerant of intermittent to seasonal inundation (DSE, 2010). Understorey species characteristic of Red Gum Swamp that were recorded at Kinnairds Swamp include graminoids such as *Eleocharis acuta* (Common Spike-sedge), *Juncus flavidus* (Gold Rush) and *Lachnagrostis filiformis* var. *filiformis* (Common Blown-grass) and herbs such as *Marsilea drummondii* (Common Nardoo), *Marsilea hirsuta* (Short-fruit Nardoo) and *Myriophyllum crispatum* (Upright Water-milfoil). Red Gum Swamp recruits by episodic floods with five years the desirable period between episodes of disturbance. The period of inundation may range from two to six months (DSE, 2010).

Riverine Swampy Woodland *is Eucalyptus camaldulensis* (River Red Gum) woodland to 15m tall, and is comprised of a grassy to sedgey herbaceous ground layer, with species indicative of periodic water-logging (DSE, 2010). Riverine Swampy Woodland occurs in areas subject to shallow inundation, and recruits by episodic floods with five years the desirable period between episodes of disturbance. Understorey species characteristic of this EVC that were recorded at Kinnairds Swamp include graminoids such as *Austrodanthonia duttoniana* (Brown-back Wallaby-grass) and *Walwhalleya proluta* (Rigid Panic), and herbs such as *Lobelia concolor* (Poison Pratia), *Wahlenbergia fluminalis* (River Bluebell), *Alternanthera denticulata* (Lesser Joyweed), *Asperula conferta* (Common Woodruff) and *Haloragis aspera* (Rough Raspwort).

Tall Marsh is dominated by tall emergent rushes, sedges and reeds, occurring typically as species-poor swards (DSE, 2010). Dominant species are tolerant of relatively deep and sustained inundation, with optimal recruitment via episodic floods occurring at yearly intervals. Species characteristic of Tall Marsh that were recorded at Kinnairds Swamp include *Juncus ingens* (Giant Rush), *Eleocharis acuta* (Common Spike-sedge) and *Azolla filiculoides* (Pacific Azolla).

Vegetation Condition

Vegetation at Kinnairds Swamp was observed to be in reasonable condition, with the wetland areas which have been inundated periodically in recent years having good structure and a moderate species diversity. In some wetland areas it was difficult to assess vegetation health, as these areas have not previously been surveyed following a period of inundation. Given that other areas of the site are in reasonable condition, it can be inferred that these areas will also respond well, with a similar pattern applicable to the terrestrial areas.

Kinnairds Swamp also comprises areas supporting mature *Eucalyptus camaldulensis* and a reasonably diverse understorey. Other areas of the site have dense *Eucalyptus camaldulensis* regeneration which inhibits ground layer vegetation establishment beyond sparse grass or herb cover, and is an indicator of altered ecological process.

Issues that threaten the ecological integrity of the site include environmental weed incursion, although the impact is minimal, and many of the weeds present are difficult to manage. While no discernable change in vegetation condition occurred during the monitoring period, there was evidence of significant floristic change.

Floristics

One hundred and thirty-seven flora species were recorded across the six survey events at Kinnairds Swamp, 90 (65%) of these indigenous, including 46 wetland species that respond to flooding (Tables 3 and 4). A moderate decline in species richness was observed from April to December within the quadrats sampled.

Table 3 Summary of floristic data collected at Kinnairds Swamp autumn to spring/summer 2010/11

Parameter	Record Type	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	All Surveys
		April	May	July	Oct	Nov	Dec	
Total Species	All Records	58	51	99	44	39	70	137
	Quadrat	57	51	44	44	39	42	87
	Incidental	1	-	55	-	-	28	74
Indigenous Species	All Records	40	38	70	31	29	52	90
	Quadrat	39	38	34	31	29	33	59
	Incidental	1	-	36	-	-	19	48
Indigenous Wetland Species	All Records	24	22	39	19	18	27	46
	Quadrat	23	22	23	19	18	18	33
	Incidental	1	-	16	-	-	9	22

Overall, species composition changed following the delivery of environmental water to Kinnairds Swamp between the first and second monitoring events. A number of terrestrial weed species were recorded during the first monitoring event in April when all quadrats were dry, however many of these species drowned when the wetland filled, and a large proportion were no longer present at the last monitoring event. Comparatively, the cover of indigenous wetland species such as *Marsilea drummondii* (Common Nardoo) increased markedly following watering.

Initially the high water levels prompted a significant recruitment event for this species, such that it was the dominant species in some quadrats, for example in the Plains Grassy Wetland sampled in Quadrat 4. The abundance of other species such as *Eleocharis acuta* (Common spike-sedge) and *Amphibromus nervosus* (Common Swamp Wallaby-grass) also increased.



Table 4 Vascular flora recorded at Kinnairds Swamp autumn to spring/summer 2010/11

Wetland Species	Status	Origin	Species	Common Name	April	May	July	October	November	December
			<i>Acacia acinacea</i>	Gold-dust Wattle			x			
			<i>Acacia dealbata</i>	Black Wattle			x			
			<i>Acacia paradoxa</i>	Hedge Wattle			x			
			<i>Acacia pycnantha</i>	Golden Wattle			x			
w		*	<i>Alisma lanceolata</i>	Water Plantain			x			
w			<i>Alternanthera denticulata</i>	Lesser Joyweed	x	x	x	x	x	x
	k		<i>Alternanthera sp. 1 (Plains)</i>	Plains Joyweed	x	x				
w			<i>Amphibromus nervosus</i>	Common Swamp Wallaby-grass	x	x	x	x	x	x
		*	<i>Anagallis arvensis</i>	Pimpernel	x					
		*	<i>Arctotheca calendula</i>	Cape Weed			x	x		
			<i>Arthropodium sp.2</i>	Lily						x
w			<i>Asperula conferta</i>	Common Woodruff	x	x	x	x	x	x
w		*	<i>Aster subulatus</i>	Aster-weed	x	x	x			
			<i>Atriplex semibaccata</i>	Berry Saltbush	x		x		x	x
			<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass	x	x	x	x	x	x
w			<i>Austrodanthonia duttoniana</i>	Brown-back Wallaby-grass	x	x	x			x
			<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass			x	x	x	x
			<i>Austrostipa aristiglumis</i>	Plump Spear-grass						x
			<i>Austrostipa scabra</i>	Rough Spear-grass	x	x	x	x	x	x
		*	<i>Avena barbata</i>	Bearded Oat			x	x	x	x
		*	<i>Avena sp.</i>	Oat	x					
w			<i>Azolla filiculoides</i>	Pacific Azolla		x	x	x	x	x
		*	<i>Bromus diandrus</i>	Great Brome	x	x	x	x	x	x
			<i>Bursaria spinosa</i>	Sweet Bursaria			x			
w		*	<i>Callitriche hamulata</i>	Thread Water-starwort		x	x	x		
w	r		<i>Cardamine moirensis</i>	Riverina Bitter-cress			x			
w			<i>Carex inversa</i>	Knob Sedge	x	x	x	x	x	x
w			<i>Carex tereticaulis</i>	Poong'ort			x			x
w			<i>Centipeda cunninghamii</i>	Common Sneezeweed	x	x				



Wetland Species	Status	Origin	Species	Common Name	April	May	July	October	November	December
		#	<i>Chamaesyce drummondii</i>	Flat Spurge			x			x
			<i>Chenopodium pumilio</i>	Clammy Goosefoot		x				
			<i>Chloris truncata</i>	Windmill Grass	x	x	x			
		*	<i>Cirsium vulgare</i>	Spear Thistle	x	x	x	x	x	x
			<i>Convolvulus erubescens</i> <i>spp. agg.</i>	Pink Bindweed	x	x	x	x	x	x
		*	<i>Conyza bonariensis</i>	Flaxleaf Fleabane						x
		*	<i>Cotula bipinnata</i>	Ferny Cotula			x			
			<i>Crassula decumbens</i> var. <i>decumbens</i>	Spreading Crassula			x			
		*	<i>Cynodon dactylon</i> var. <i>dactylon</i>	Couch						x
		#	<i>Cyperus difformis</i>	Variable Flat-sedge						x
w			<i>Damasonium minus</i>	Star Fruit			x			
	v		<i>Dianella ?tarda</i>	Late-flower Flax-lily			x			
		*	<i>Echinochloa crus-galli</i>	Barnyard Grass	x		x			x
		*	<i>Echium plantagineum</i>	Paterson's Curse						x
w		#	<i>Eclipta platyglossa</i>	Yellow Twin-heads	x	x	x		x	
w			<i>Eleocharis acuta</i>	Common Spike-sedge	x	x	x	x	x	x
w			<i>Eleocharis pusilla</i>	Small Spike-sedge	x		x			x
			<i>Elymus scaber</i> var. <i>scaber</i>	Common Wheat-grass	x	x	x	x		x
			<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush						x
			<i>Enteropogon acicularis</i>	Spider Grass	x	x	x	x		x
			<i>Eriochloa</i> <i>pseudoacrotricha</i>	Early Spring-grass						x
w			<i>Eucalyptus camaldulensis</i>	River Red-gum	x	x	x	x	x	x
			<i>Eucalyptus melliodora</i>	Yellow Box			x			
			<i>Eucalyptus microcarpa</i>	Grey Box			x			
			<i>Euchiton involucratus</i> s.l.	Common Cudweed						x
			<i>Euchiton sphaericus</i>	Annual Cudweed	x	x				
		*	<i>Gazania</i> spp.	Gazania						x
w			<i>Haloragis aspera</i>	Rough Raspwort	x	x	x	x	x	x
	k		<i>Haloragis glauca</i> f. <i>glauca</i>	Bluish Raspwort			x			x
			<i>Heliotropium europaeum</i>	Common Heliotrope						x



Wetland Species	Status	Origin	Species	Common Name	April	May	July	October	November	December
		*	<i>Helminthotheca echioides</i>	Ox-tongue	x		x			
		*	<i>Hordeum spp.</i>	Barley Grass				x		
		*	<i>Hypochoeris glabra</i>	Smooth Cat's-ear		x				
w			<i>Juncus aridicola</i>	Tussock Rush			x			x
w			<i>Juncus flavidus</i>	Gold Rush	x	x	x			x
w			<i>Juncus holoschoenus</i>	Joint-leaf Rush			x			
w			<i>Juncus ingens</i>	Giant Rush	x	x	x	x	x	x
w			<i>Juncus semisolidus</i>	Plains Rush	x	x	x			
w			<i>Juncus subsecundus</i>	Finger Rush			x			
		*	<i>Kickxia elatine</i>	Hairy Toadflax						x
w			<i>Lachnagrostis filiformis</i> var. 1	Common Blown-grass	x	x				x
		*	<i>Lactuca saligna</i>	Willow-leaf Lettuce	x	x			x	x
		*	<i>Lactuca serriola</i>	Prickly Lettuce	x	x	x	x	x	x
w			<i>Lemna disperma</i>	Common Duckweed				x	x	x
		*	<i>Leontodon taraxacoides</i> subsp. <i>taraxacoides</i>	Hairy Hawkbit			x			x
		*	<i>Lepidium africanum</i>	Common Peppercross			x			
w			<i>Lobelia concolor</i>	Poison Pratia	x	x	x	x	x	x
w			<i>Lobelia pratioides</i>	Poison Lobelia			x			
		*	<i>Lolium rigidum</i>	Wimmera Rye-grass	x	x	x	x	x	x
		*	<i>Lotus corniculatus</i>	Bird's-foot Trefoil			x			
w			<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	Clove-strip			x	x	x	x
w			<i>Lythrum hyssopifolia</i>	Small Loosestrife			x			
w			<i>Marsilea costulifera</i>	Narrow-leaf Nardoo	x	x	x			x
w			<i>Marsilea drummondii</i>	Common Nardoo	x	x	x	x		x
		*	<i>Medicago polymorpha</i>	Burr Medic		x	x			
			<i>Mentha satureoides</i>	Creeping mint	x	x	x	x	x	x
w			<i>Muehlenbeckia florulenta</i>	Tangled Lignum	x	x	x	x	x	x
w	L e		<i>Myriophyllum gracile</i> var. <i>lineare</i>	Slender Water-milfoil				x	x	x
w			<i>Myriophyllum papillosum</i>	Robust Water-milfoil						x
w			<i>Myriophyllum spp.</i>	Water-milfoil			x			



Wetland Species	Status	Origin	Species	Common Name	April	May	July	October	November	December
			<i>Oxalis perennans</i>	Grassland Wood-sorrel	x	x	x	x	x	x
w		#	<i>Paspalidium jubiflorum</i>	Warrego Summer-grass			x			
		*	<i>Paspalum dilatatum</i>	Paspalum			x			
w		*	<i>Paspalum distichum</i>	Water Couch	x					
w			<i>Persicaria decipiens</i>	Slender Knotweed			x			x
w			<i>Persicaria praetermissa</i>	Spotted Knotweed			x			
w			<i>Persicaria prostrata</i>	Creeping Knotweed	x	x				
		*	<i>Phalaris aquatica</i>	Toowoomba Canary-grass			x			
w		*	<i>Phalaris paradoxa</i>	Paradoxical Canary-grass					x	
		*	<i>Physalis viscosa</i>	Sticky Ground-cherry	x					
			<i>Pimelea curviflora s.l.</i>	Curved Rice-flower	x	x	x	x	x	x
		*	<i>Polygonum aviculare</i>	Prostrate Knotweed	x	x	x			
w			<i>Potamogeton cheesemanii</i>	Red Pondweed			x	x		
			<i>Pseudognaphalium luteoalbum</i>	Jersey Cudweed	x		x			x
w			<i>Pseudoraphis spinescens</i>	Spiny Mud-grass	x	x	x	x	x	x
w			<i>Pycnosorus chrysanthes</i>	Golden Billy-buttons			x			
w			<i>Ranunculus pumilio</i>	Ferny Small-flower Buttercup				x		
w		*	<i>Ranunculus sceleratus subsp. sceleratus</i>	Celery Buttercup			x			
			<i>Ranunculus sessiliflorus</i>	Annual Buttercup			x			
		*	<i>Reseda spp.</i>	Mignonette			x			
		*	<i>Romulea rosea</i>	Onion Grass			x	x		
			<i>Rumex brownii</i>	Slender Dock			x	x	x	
w		*	<i>Rumex crispus</i>	Curled Dock	x	x	x	x	x	x
w			<i>Rumex tenax</i>	Narrow-leaf Dock	x	x	x	x	x	x
w		*	<i>Sagittaria platyphylla</i>	Sagittaria						x
		*	<i>Scorzonera sp.</i>	Scorzonera	x					
			<i>Scrophularia auriculata?</i>	Water Figwort		x				
			<i>Senecio quadridentatus</i>	Cotton Fireweed	x		x			
			<i>Sida corrugata</i>	Variable Sida			x			x
			<i>Solanum esuriale</i>	Quena		x	x			



Wetland Species	Status	Origin	Species	Common Name	April	May	July	October	November	December
		*	<i>Solanum nigrum</i>	Black Nightshade			x			
		*	<i>Sonchus asper</i>	Rough Sow-thistle			x			
		*	<i>Sonchus oleraceus</i>	Common Sow-thistle	x	x	x	x	x	x
		*	<i>Stellaria media</i>	Chickweed			x			
w			<i>Swainsona procumbens</i>	Broughton Pea	x		x			
			<i>Teucrium corymbosum</i>	Forest Germander						x
			<i>Teucrium racemosum</i>	Grey Germander	x	x	x	x	x	x
		*	<i>Trifolium striatum</i>	Knotted Clover	x					
		*	<i>Trifolium subterraneum</i>	Subterranean Clover	x	x		x	x	
w			<i>Vallisneria spp.</i>	Eel Grass			x			
		*	<i>Vellereophyton dealbatum</i>	White Cudweed			x			
			<i>Vittadinia cuneata</i>	Fuzzy New Holland Daisy			x			
			<i>Vittadinia gracilis</i>	Woolly New Holland Daisy						x
		*	<i>Vulpia bromoides</i>	Squirrel-tail Fescue				x		
			<i>Wahlenbergia fluminalis</i>	River Bluebell	x	x	x	x	x	x
w			<i>Walwhalleya prolata</i>	Rigid Panic	x		x		x	x
w			<i>Wolffia australiana</i>	Tiny Duckweed			x			
		*	<i>Xanthium spinosum</i>	Bathurst Burr			x			x
			Total Species		58	51	99	44	39	70

Wetland species such as *Lemna disperma* (Common Duckweed), *Ranunculus pumilo* (Ferny Small-flower Buttercup) and *Myriophyllum gracile* var. *lineare* (Slender Water-milfoil), were first recorded during October. The cover of *Azolla filiculoides* (Pacific Azolla) had also increased dramatically by this fourth survey.

The consistent high water levels provided optimum conditions for this species, thus enabling it to form large carpets across inundated areas of the swamp between October and December. These dense mats prevented the establishment of many species which had previously been recorded at Kinnairds Swamp, and additionally, caused a reduction in the cover of other species which had been present during the earlier autumn/winter surveys undertaken as part of the current program.

As water levels recede, it is expected that the cover of *Azolla filiculoides* (Pacific Azolla) will decrease, providing an opportunity for other species to establish. In some parts of the wetland there was evidence of a reduction in cover between November and December, although this was observed in response to a further influx of water, rather than recession.



Photograph 2 *Pseudoraphis spinescens* (Spiny Mud-grass) amongst dense carpets of *Azolla filiculoides* (Pacific Azolla) December 2010

Other species favoured by prolonged periods of inundation include *Pseudoraphis spinescens* (Spiny Mud-grass). As documented by Roberts and Marston (2000, p. 22), the optimum flood duration for this species is seven months starting from mid-winter, with a minimum of three months and a maximum of ten. It is likely that some sections of Kinnairds Swamp will meet this requirement, and while not necessarily reflected in quadrat sampling thus far, grassy rafts of

Pseudoraphis spinescens (Spiny Mud-grass) were observed to be beginning to establish. These rafts provided a suitable food source for birds utilising the wetlands.



Photograph 3 *Solanum esuriale* (Quena) Kinnairds Swamp December 2010

Although, due to consistent rains, transition of the wetlands through a drier period was unable to be captured during the monitoring program, further floristic change can be expected as water levels recede. It is likely that many other aquatic herbs, such as the vulnerable *Myriophyllum porcatum* (Rigid Water-milfoil), that have been recorded in previous surveys of Kinnairds Swamp (see Cook *et al.*, 2009) will again emerge.

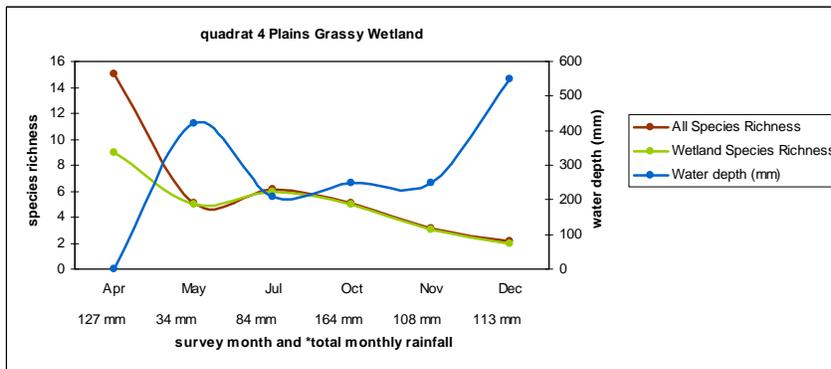
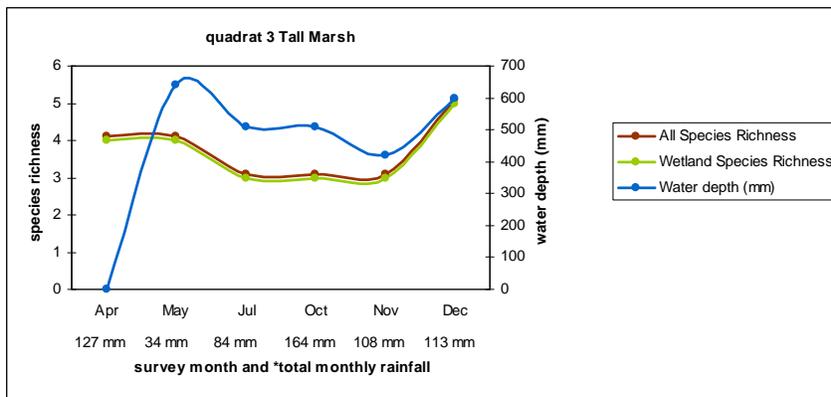
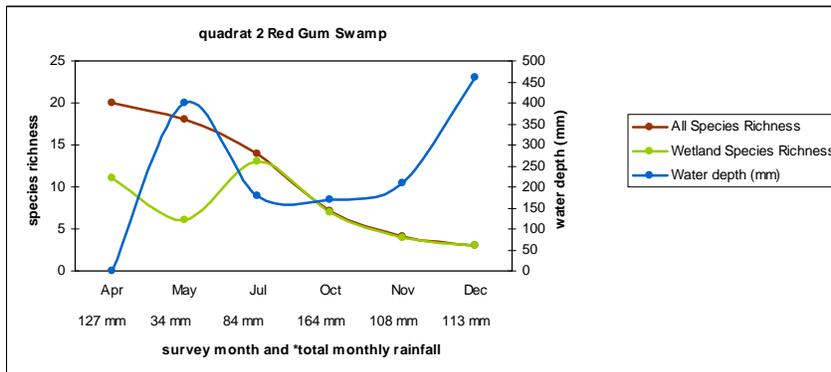
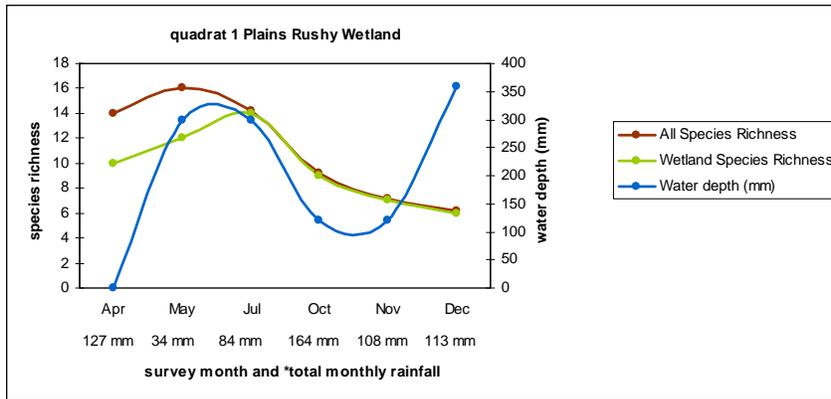
Table 5 Species totals for quadrats sampled at Kinnairds Swamp autumn to spring/summer 2010/11

Quadrat	EVC	Survey 1 April		Survey 2 May		Survey 3 July		Survey 4 October		Survey 5 November		Survey 6 December	
		All	Wetland	All	Wetland	All	Wetland	All	Wetland	All	Wetland	All	Wetland
1	Plains Rushy Wetland	14	10	16	12	14	14	9	9	7	7	6	6
2	Red Gum Swamp	20	11	18	6	14	13	7	7	4	4	3	3
3	Tall Marsh	4	4	4	4	3	3	3	3	3	3	5	5
4	Plains Grassy Wetland	15	9	5	5	6	6	5	5	3	3	2	2
5	Red Gum Swamp	18	10	14	10	6	6	6	6	4	4	5	5
6	Red Gum Swamp	11	7	7	6	8	7	8	8	5	5	5	5
7	Riverine Swampy Woodland	31	10	31	9	23	6	30	7	27	8	33	10
All		57	26	51	25	44	26	44	21	39	20	42	19

^ the tallies for wetland species include both indigenous and exotic species

The total diversity of quadrat 1 (Plains Rushy Wetland) varied little over the first series of surveys (April to July), although an increase in the number of wetland species was evident as the wetland filled (Table 5; Figure 4). Wetland species such as *Eleocharis gracilis* (Slender Spike-sedge), *Lythrum hyssopifolia* (Small Loosestrife) and *Myriophyllum* spp. (Water-milfoil) were observed to be responded positively to the delivery of environmental water at this time. Further flooding during spring and summer led to an increase in the cover of *Azolla filiculoides* (Pacific Azolla), accompanied by a trending decline in species richness.

The total diversity of Quadrat 2 (Red Gum Swamp) decreased upon receipt of environmental water, and continued to do so across the survey period. The cover of wetland species such as *Eleocharis acuta* (Common Spike-sedge) increased markedly between April and July, while species such as *Ludwigia peploides* subsp. *montevidensis* (Clove-strip) and *Myriophyllum* spp. (Water-milfoil) were only recorded during July, once water had started to recede. Further flooding during spring and summer led to the domination of *Azolla filiculoides* (Pacific Azolla), accompanied by a trending decline in species richness.



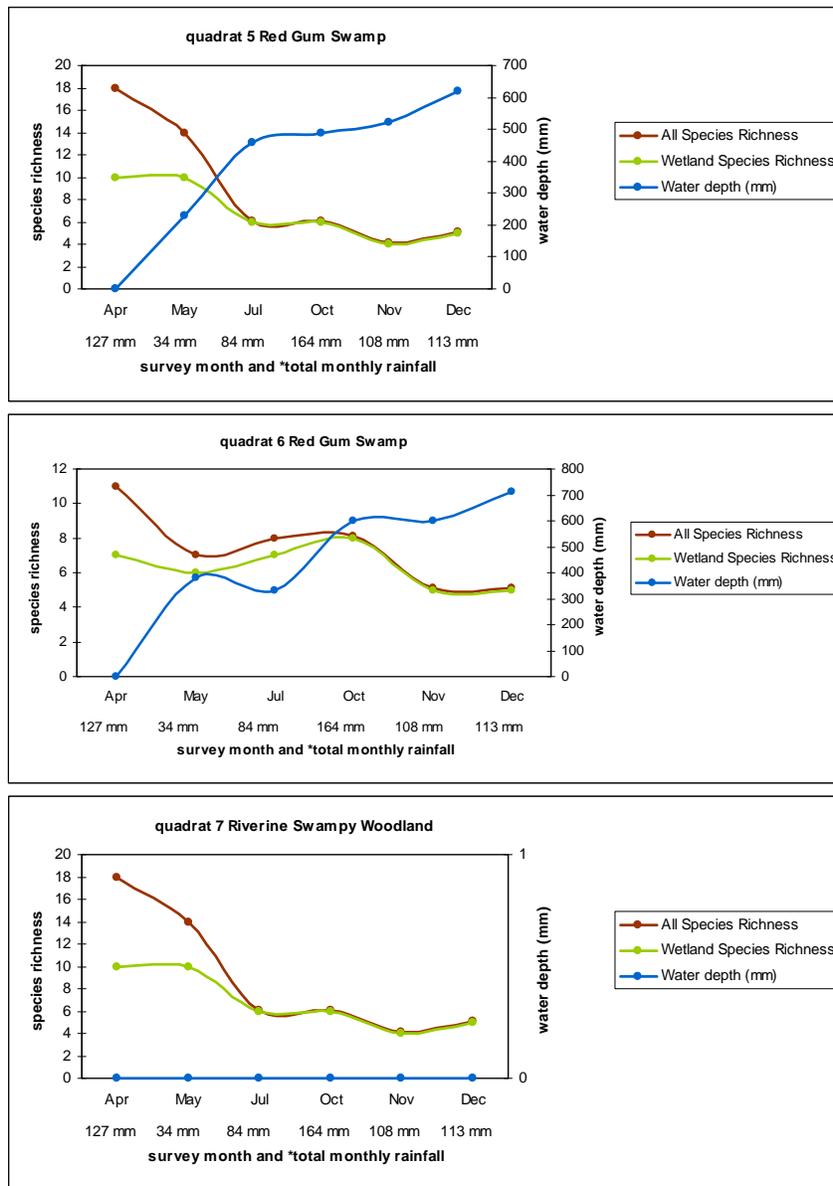


Figure 4 Temporal change in floristic species richness and water depth at Kinnairds Swamp

*total rainfall between survey events as measured at Shepparton (most proximate weather station)

In Quadrat 5, species diversity declined from April to May, and then again from May to July. This more significant decline when compared to Quadrat 2 is likely to be associated with the higher water levels that persisted from May to July. While water levels in all other quadrats sampled decreased from May to July, they increased in Quadrat 5. A similar pattern was evident in Quadrat 6. While water declined in this quadrat from May to July, the decline was only marginal. Further flooding during spring and summer resulted in a continued decline in species richness. The cover of

Azolla filiculoides (Pacific Azolla) peaked in November, before decreasing between November and January with a further influx of water.

The floristic composition of Quadrat 3 (Tall Marsh) changed little over the survey period, with this EVC remaining species poor. The only notable change was the dominance of *Azolla filiculoides* (Pacific Azolla) in November. Comparatively, the diversity of Quadrat 4 (Plains Grassy Wetland) decreased markedly with inundation, as many terrestrial species drowned. Wetland species that emerged with inundation included *Azolla filiculoides* (Pacific Azolla), which dominated the ground cover by July and continued to do so until November.

Quadrat 7 (Riverine Swampy Woodland) remained dry throughout the course of the surveys, and this was reflected in the site's floristics. A terrestrial site for the most part, that experiences less frequent inundation, supported a significantly different suite of species when compared to the other quadrats sampled. This lower frequency of inundation allows terrestrial species such as *Pimelea curviflora* (Curved Rice-flower) to grow alongside species which are tolerant of saturated soils or periodic inundation such as *Muehlenbeckia florulenta* (Tangled Lignum), *Asperula conferta* (Common Woodruff) and *Carex tereticaulis* (Poong'ort).

Significant and threatened flora

Four species listed on the DSE Advisory List of rare and threatened flora, the poorly known *Alternanthera* sp. 1 (Plains) (Plains Joyweed), the rare *Cardamine moirensis* (Riverina Bitter-cress), the vulnerable *Dianella tarda* (Late-flower Flax-lily), and the poorly known *Haloragis glauca* f. *glauca* (Bluish Raspwort), were recorded at Kinnairds Swamp (Table 6). The distribution of all four species appeared restricted to terrestrial EVCs, such as Riverine Swampy Woodland, that occur outside of the core wetland areas.

Alternanthera sp. 1 (Plains) (Plains Joyweed), a prostrate herb that grows mainly on clay soils, was recorded in April and May in Riverine Swampy Woodland (Quadrat 7). *Cardamine moirensis* (Riverina Bitter-cress), an annual herb that grows in low-lying areas adjacent to streams and swamps, was recorded in July as part of the general floristic inventory. *Dianella ?tarda* (Late-flower Flax-lily), a loosely tufted lily, and *Haloragis glauca* f. *glauca* (Bluish Raspwort), a perennial herb that grows on heavy soils along watercourses, were also recorded as part of this inventory; *Dianella tarda*, a planted specimen.

Table 6 Rare and threatened flora recorded at Kinnairds Swamp autumn to spring/summer 2010/11

Status	Species	Common Name	Population/distribution	Location
k	<i>Alternanthera sp. 1 (Plains)</i>	Plains Joyweed	Small; restricted	Quadrat 7
r	<i>Cardamine moirensis</i>	Riverina Bitter-cress	Small; restricted	Incidental
v	<i>Dianella ?tarda</i>	Late-flower Flax-lily	Planted	Incidental
k	<i>Haloragis glauca f. glauca</i>	Bluish Raspwort	Small; restricted	Incidental
L e	<i>Myriophyllum gracile var. lineare</i>	Slender Water-milfoil	-	Quadrat 1; Quadrat 2

The FFG Act listed *Myriophyllum gracile var. lineare* (Slender Water-milfoil), an aquatic or fully emergent perennial herb, was recorded within Plains Rushy Wetland (Quadrat 1) in October and Red Gum Swamp (Quadrat 2) in October and November. The population of this species was much vaster when recorded in 2008 when compared to 2010, with approximately 1000 plants observed in the former year. *Myriophyllum porcatum* (Ridged Water-milfoil) was also recorded in 2008, and at that time covered a number of hectares in the inflow channel and just to the south of the northern bird hide, and comprised many thousands of plants, making it the largest known population of this nationally vulnerable species.



Photograph 4 *Myriophyllum gracile var. lineare* (Slender Water-milfoil) and *Myriophyllum porcatum* (Rigid Water-milfoil) inset and within the field-layer, Kinnairds Swamp 2008



Environmental weeds

Forty-seven environmental weeds, including three CaLP Act listed species, the regionally restricted **Cirsium vulgare* (Spear Thistle) and the regionally controlled **Echium plantagineum* (Paterson's Curse) and **Xanthium spinosum* (Bathurst Burr), were recorded at Kinnairds Swamp. High risk weeds, as designated by the DSE (DSE Advisory List of Environmental Weeds), included **Aster subulatus* (Aster-weed), **Bromus diandrus* (Great Brome), **Helminthotheca echioides* (Ox-tongue), **Lepidium africanum* (Common Peppergrass), **Lolium rigidum* (Wimmera Rye-grass), and **Polygonum aviculare* (Prostrate Knotweed) (Table 7). Three very high risk weeds, **Medicago polymorpha* (Burr Medic), **Phalaris aquatica* (Toowoomba Canary-grass) and **Romulea rosea* (Onion Grass) were also recorded. No Vic Alert, National Alert, or Weeds of National Significance (WONS) were recorded at Kinnairds Swamp during the surveys.

Table 7 Environmental weeds recorded at Kinnairds Swamp autumn to spring/summer 2010/11

Wetland Species	Status	Origin	Species	Common Name	Score	Rank Category	CALP Act	CALP Class
w		*	<i>Alisma lanceolata</i>	Water Plantain	97	Medium Risk		
		*	<i>Anagallis arvensis</i>	Pimpernel	127	Lower Risk		
		*	<i>Arctotheca calendula</i>	Cape Weed	118	Medium Risk		
w		*	<i>Aster subulatus</i>	Aster-weed	52	High Risk		
		*	<i>Avena barbata</i>	Bearded Oat	214	Lower Risk		
		*	<i>Avena sp.</i>	Oat	-	-		
		*	<i>Bromus diandrus</i>	Great Brome	46	High Risk		
w		*	<i>Callitriche hamulata</i>	Thread Water-starwort	121	Lower Risk		
		*	<i>Cirsium vulgare</i>	Spear Thistle	118	Medium Risk	√	Restricted
		*	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	121	Lower Risk		
		*	<i>Cotula bipinnata</i>	Ferny Cotula	130	Lower Risk		
		*	<i>Cynodon dactylon var. dactylon</i>	Couch	81	Moderately High Risk		



Wetland Species	Status	Origin	Species	Common Name	Score	Rank Category	CALP Act	CALP Class
		*	<i>Echinochloa crus-galli</i>	Barnyard Grass	233	Lower Risk		
		*	<i>Echium plantagineum</i>	Paterson's Curse	103	Medium Risk	√	Controlled
		*	<i>Gazania spp.</i>	Gazania	-	-		
		*	<i>Helminthotheca echioides</i>	Ox-tongue	49	High Risk		
		*	<i>Hordeum spp.</i>	Barley Grass	-	-		
		*	<i>Hypochoeris glabra</i>	Smooth Cat's-ear	121	Lower Risk		
		*	<i>Kickxia elatine</i>	Hairy Toadflax	179	Lower Risk		
		*	<i>Lactuca saligna</i>	Willow-leaf Lettuce	127	Lower Risk		
		*	<i>Lactuca serriola</i>	Prickly Lettuce	127	Lower Risk		
		*	<i>Leontodon taraxacoides</i> <i>subsp. taraxacoides</i>	Hairy Hawkbit	109	Medium Risk		
		*	<i>Lepidium africanum</i>	Common Peppercross	47	High Risk		
		*	<i>Lolium rigidum</i>	Wimmera Rye-grass	38	High Risk		
		*	<i>Lotus corniculatus</i>	Bird's-foot Trefoil	98	Medium Risk		
		*	<i>Medicago polymorpha</i>	Burr Medic	20	Very High Risk		
w		*	<i>Paspalum distichum</i>	Water Couch	106	Medium Risk		
		*	<i>Paspalum dilatatum</i>	Paspalum	214	Lower Risk		
		*	<i>Phalaris aquatica</i>	Toowoomba Canary-grass	5	Very High Risk		
		*	<i>Phalaris paradoxa</i>	Paradoxical Canary-grass	152	Lower Risk		
		*	<i>Physalis viscosa</i>	Sticky Ground-cherry	40	High Risk		
		*	<i>Polygonum aviculare</i>	Prostrate Knotweed	41	High Risk		
w		*	<i>Ranunculus sceleratus</i> <i>subsp. sceleratus</i>	Celery Buttercup	233	Lower Risk		
		*	<i>Reseda spp.</i>	Mignonette	-	-		



Wetland Species	Status	Origin	Species	Common Name	Score	Rank Category	CALP Act	CALP Class
		*	<i>Romulea rosea</i>	Onion Grass	29	Very High Risk		
w		*	<i>Rumex crispus</i>	Curled Dock	242	Lower Risk		
w		*	<i>Sagittaria platyphylla</i>	Sagittaria	-	-		
		*	<i>Scorzonera sp.</i>	Scorzonera	-	-		
		*	<i>Solanum nigrum</i>	Black Nightshade	118	Medium Risk		
		*	<i>Sonchus asper</i>	Rough Sow-thistle	109	Medium Risk		
		*	<i>Sonchus oleraceus</i>	Common Sow-thistle	127	Lower Risk		
		*	<i>Stellaria media</i>	Chickweed	121	Lower Risk		
		*	<i>Trifolium striatum</i>	Knotted Clover	40	High Risk		
		*	<i>Trifolium subterraneum</i>	Subterranean Clover	24	Very High Risk		
		*	<i>Vellereophyton dealbatum</i>	White Cudweed	133	Lower Risk		
		*	<i>Vulpia bromoides</i>	Squirrel-tail Fescue	40	High Risk		
		*	<i>Xanthium spinosum</i>	Bathurst Burr	101	Medium Risk	√	Controlled

Environmental Weed Ranking and Ranking Score as per DSE Advisory List of Environmental Weeds of the Inland Plains bioregions (DSE, 2009)

Regionally controlled (C) and Restricted (R) weed species listed under the *Catchment and Land Protection Act 1994* (Vic)

3.3 Birds

Seventy-one bird species were recorded across the six survey events at Kinnairds Swamp, including 35 wetland species, and seven DSE Advisory listed species, the near threatened Brown Treecreeper (*Climacteris picumnus victoriae*), Nankeen Night-heron (*Nycticorax caledonicus*) and Pied Cormorant (*Phalacrocorax varius*), the endangered Australasian Shoveller (*Anas rhynchos*), the vulnerable Hardhead (*Aythya australis*) and Royal Spoonbill (*Platalea regia*) and the vulnerable and FFG listed Blue-billed Duck (*Oxyura australis*) and Eastern Great Egret (*Ardea modesta*) (Tables 8 to 10). Total species richness was similar across the first two survey events in April and May, with richness increasing markedly between the second and third surveys in May and July (Figure 5). Total abundance decreased from April to May, before peaking in July. There was a decrease in both total species richness and total bird abundance from July to October. There was little change in either measure between October and December.

Table 8 Summary of bird richness and abundance at Kinnairds Swamp

		Survey 1 9/04/10	Survey 2 25/05/10	Survey 3 28/07/10	Survey 4 13/10/10	Survey 5 17/11/10	Survey 6 9/12/10	Total
All Species	Richness	26	25	46	34	32	37	71
	Abundance	116	63	206	109	110	62	666
Wetland Species	Richness	2	11	17	21	19	22	35
	Abundance	0	52	145	66	95	53	411
Non-Wetland Species	Richness	24	14	29	13	13	15	36
	Abundance	116	11	61	43	15	9	255

Richness – sum of transect and incidental records

Abundance – transect records only

Wetland species richness increased markedly between April and May, and then again during subsequent months, peaking at 22 species in December (Tables 8 and 9; Figure 5). Wetland species abundance increased from April to July, peaking at 145 individuals in July, before declining in October. The Pacific Black Duck (*Anas superciliosa*) was the only wetland species to be recorded during all six survey events. Black Swan (*Cygnus atratus*) and Grey Teal (*Anas gracilis*) were the most abundant wetland species, with 55 and 35 individuals recorded in November and July respectively. Nankeen Night-heron were first recorded in December.

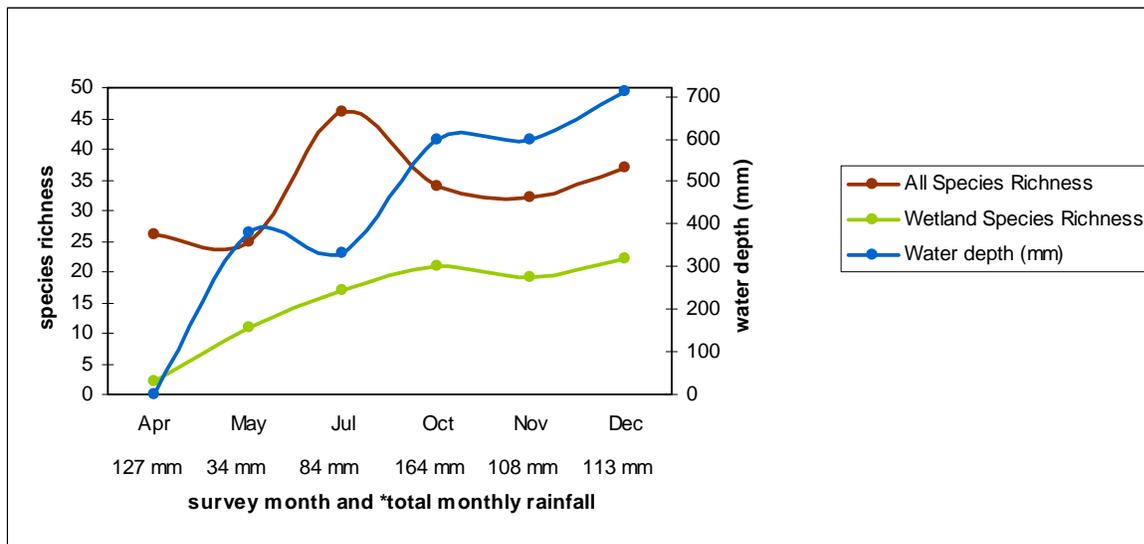


Figure 5 Temporal change in bird species richness and water depth at Kinnairds Swamp

*total rainfall between survey events as measured at Shepparton (most proximate weather station)

Non-wetland species richness decreased from April to May, before peaking at 29 species in July (Tables 8 and 10). Non-wetland species abundance peaked in April with 116 individuals recorded, before declining in May, and then recovering slightly in July. Both species richness and abundance were observed to decrease from July to October, with little change observed between October and December. Little Corella (*Cacatua sanguinea*) and Red-rumped Parrot (*Psephotus haematonotus*) were the most abundant non-wetland species in April, with peaks of 20 and 18 individuals recorded respectively. Galah (*Eolophus roseicapillus*) was the most abundant species in July with 30 individuals recorded.

No courtship or nesting behaviour was observed during the autumn/winter surveys; possibly a consequence of the prevailing weather conditions and as this is when the breeding of many wetland species is less common. Bird abundance is also likely to have been impacted by prevailing weather conditions, particularly during the second survey event, when steady rain fell.

While water fowl were always recorded in low numbers, Black Swan (*Cygnus atratus*) had a very successful breeding year, with juveniles observed in July, October and November. Little Pied Cormorant (*Microcarbo melanoleucos*) were also observed nesting in the latter month. There was an increase in breeding activity in December, with several wetland species, Australasian Shoveller (*Anas rhynchos*), Black Swan (*Cygnus atratus*), Eurasian Coot (*Fulica atra*), Little Pied

Cormorant (*Microcarbo melanoleucos*), Pacific Heron (*Ardea pacifica*), Royall Spoonbill (*Platalea regia*), and Yellow-billed Spoonbill (*Platalea flavipes*) observed nesting.



Photograph 5 Flame Robin (*Petroica phoenicea*) Kinnairds Swamp July 2010

Previous surveys conducted at Kinnairds Swamp in 2008 (see Cook *et al.*, 2009) revealed a correlation between wetland bird richness and water depth, with the greatest diversity of birds occurring after water levels had peaked and begun to recede. At this time wetland bird habitat diversity was highest, and the site supported a combination of deeper water, vegetated shallows and freshly exposed mudflats. Observations from 2010 suggest wetland species richness has increased in parallel with water depth, although water depth is yet to peak. It is possible that wetland species richness will increase further if subsequent surveys were conducted following the recession of water levels.



Table 9 Wetland birds recorded at Kinnairds Swamp autumn to spring/summer 2010/11

Status	Survey Event and Date		Survey 1 9/04/10		Survey 2 25/05/10		Survey 3 28/07/10		Survey 4 13/10/10		Survey 5 17/11/10		Survey 6 9/12/10	
	Survey Time		9:30 PM		4:00 PM		8:00 AM		4:15 PM		3:00 PM		3:00 PM	
	Common Name	Species	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental
	Australasian Darter	<i>Anhinga novaehollandiae</i>								1	1	1		1
	Australasian Grebe	<i>Tachybaptus novaehollandiae</i>			10		3							
en	Australasian Shoveller	<i>Anas rhynchotis</i>								1				12 ^{PR J}
	Australian Pelican	<i>Pelecanus conspicillatus</i>							1					1
	Australian Shelduck	<i>Tadorna tadornoides</i>							1	1				
	Australian White Ibis	<i>Threskiornis molucca</i>									4	1	3 ^{NE}	1
	Australian Wood Duck	<i>Chenonetta jubata</i>			3		21	1					1	1
	Black Swan	<i>Cygnus atratus</i>			7		22 ^J	1	24 ^J	1	55 ^J	1	25	1 ^{J NE}
	Black-winged Stilt	<i>Himantopus himantopus</i>												1
Len	Blue Billed Duck	<i>Oxyura australis</i>								1				
	Chestnut Teal	<i>Anas castanea</i>							1	1				
Lvu	Eastern Great Egret	<i>Ardea modesta</i>					1	1	5	1		1		
	Eurasian Coot	<i>Fulica atra</i>							3	1	1	1	2	1 ^{J NE}
	Grey Teal	<i>Anas gracilis</i>			3		35	1	2	1	4	1	10	1 ^J
vu	Hardhead	<i>Aythya australis</i>							10	1			2	1
	Hoary-headed Grebe	<i>Poliocephalus poliocephalus</i>			2									



Status	Survey Event and Date		Survey 1 9/04/10		Survey 2 25/05/10		Survey 3 28/07/10		Survey 4 13/10/10		Survey 5 17/11/10		Survey 6 9/12/10	
	Survey Time		9:30 PM		4:00 PM		8:00 AM		4:15 PM		3:00 PM		3:00 PM	
	Common Name	Species	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental
	Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>									3	1	1	1
	Little Pied Cormorant	<i>Microcarbo melanoleucos</i>					2		5	1	1 ^{NE}	1	2	1 ^{NE}
	Masked Lapwing	<i>Vanellus miles</i>			4		2	1	2	1	1	1		1
nt	Nankeen Night-heron	<i>Nycticorax caledonicus</i>											1	5
	Pacific Black Duck	<i>Anas superciliosa</i>		2	15		9	1	1	1	8	1	2	
	Pacific Heron (White Necked Heron)	<i>Ardea pacifica</i>					9	1			4	1		1 ^{NE}
nt	Pied Cormorant	<i>Phalacrocorax varius</i>			2									
	Pied Currawong	<i>Strepera graculina</i>				4		1						
	Pink-eared Duck	<i>Malacorhynchus membranaceus</i>							1	1				1
	Purple Swamphen	<i>Porphyrio porphyrio</i>			6		12	1	6	1	3	1	2	1
vu	Royal Spoonbill	<i>Platalea regia</i>										1		1 ^{2NE}
	Rufous Whistler	<i>Pachycephala rufiventris</i>		1				1						
	Sacred Kingfisher	<i>Todiramphus sanctus</i>							2	1	1	1		
	Straw-necked Ibis	<i>Threskiornis spinicollis</i>					28				3	1		
	Swamp Harrier	<i>Circus approximans</i>						1						
	Welcome Swallow	<i>Hirundo neoxena</i>				5		1	1	1		1		
	Whistling Kite	<i>Haliastur sphenurus</i>					1	1		1	1	1		1



Status	Survey Event and Date		Survey 1 9/04/10		Survey 2 25/05/10		Survey 3 28/07/10		Survey 4 13/10/10		Survey 5 17/11/10		Survey 6 9/12/10	
	Survey Time		9:30 PM		4:00 PM		8:00 AM		4:15 PM		3:00 PM		3:00 PM	
	Common Name	Species	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental
	White faced Heron	<i>Egretta novaehollandiae</i>						1	1	1	3	1	1	1
	Yellow billed Spoonbill	<i>Platalea flavipes</i>							1	2	1	1	1	1 ^{NE}
	Species Richness		0	2	9	2	12	14	20	16	16	19	13	21
	Total Bird Abundance		0	3	52	9	145	14	20	66	95	19	53	36

The Welcome Swallow and Whistling Kite are not strictly wetland species; however they are often quite closely associated with wetlands. They have been included in this category as they appeared to have been attracted to the wetlands to prey on species that are reliant on the wetlands containing water, and for this reason could be considered to have directly benefited from the delivery of environmental water.

Table 10 Non-wetland birds recorded at Kinnairds Swamp autumn to spring/summer 2010/11

Status	Survey Event and Date		Survey 1 9/04/10		Survey 2 25/05/10		Survey 3 28/07/10		Survey 4 13/10/10		Survey 5 17/11/10		Survey 6 9/12/10	
	Survey Time		9:30 PM		4:00 PM		8:00 AM		4:15 PM		3:00 PM		3:00 PM	
	Common Name	Species	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental
	Australian Hobby	<i>Falco longipennis</i>												1
	Australian Magpie	<i>Cracticus tibicen</i>	14		2		2	1	6	1	3	1	1	1
	Australian Raven	<i>Corvus coronoides</i>	2			3	7	1	2	1	4	1		
	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>		1				1	2	1			1	1



Status	Survey Event and Date		Survey 1 9/04/10		Survey 2 25/05/10		Survey 3 28/07/10		Survey 4 13/10/10		Survey 5 17/11/10		Survey 6 9/12/10	
	Survey Time		9:30 PM		4:00 PM		8:00 AM		4:15 PM		3:00 PM		3:00 PM	
	Common Name	Species	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental
	Brown Falcon	<i>Falco berigora</i>	1											1
nt	Brown Treecreeper	<i>Climacteris picumnus victoriae</i>						1						
	Common Starling	<i>Sturnus vulgaris</i>	3			3	1	1		1		1		1
	Crested Pigeon	<i>Ocyphaps lophotes</i>	1			6		1						
	Crested Shrike-tit	<i>Falcunculus frontatus</i>						1						
	Eastern Rosella	<i>Platycercus eximius</i>	4		2			1				1		
	Flame Robin	<i>Petroica phoenicea</i>						1						
	Galah	<i>Eolophus roseicapillus</i>		2		30	15	1	4	1	2	1		1
	Golden Whistler	<i>Pachycephala pectoralis</i>						1						
	Grey Fantail	<i>Rhipidura albiscapa</i>		1				1						
	Grey Shrike-thrush	<i>Colluricincla harmonica</i>						1	1		1			
	Laughing Kookaburra	<i>Dacelo novaeguineae</i>		4	2			1	3	1	1	1		
	Little Corella	<i>Cacatua sanguinea</i>	20											1
	Little Raven	<i>Corvus mellori</i>	15					10	1					1
	Magpie-lark	<i>Grallina cyanoleuca</i>	6			4	9		6		1	1	1	1
	Noisy Miner	<i>Manorina melanocephala</i>	1		4	6	5	1	5	1	1	1		1
	Peaceful Dove	<i>Geopelia striata</i>							1					



Status	Survey Event and Date		Survey 1 9/04/10		Survey 2 25/05/10		Survey 3 28/07/10		Survey 4 13/10/10		Survey 5 17/11/10		Survey 6 9/12/10	
	Survey Time		9:30 PM		4:00 PM		8:00 AM		4:15 PM		3:00 PM		3:00 PM	
	Common Name	Species	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental
	Peregrine Falcon	<i>Falco peregrinus</i>			1									
	Pied Butcherbird	<i>Cracticus nigrogularis</i>	1			2	1	1			1	1	1	
	Red Wattlebird	<i>Anthochaera carunculata</i>						1						
	Red-rumped Parrot	<i>Psephotus haematonotus</i>	18			4	2	1		1		1		1
	Restless Flycatcher	<i>Myiagra inquieta</i>		1 ^J										
	Striated Pardalote	<i>Pardalotus striatus</i>	10			4	1	1	3	1	1	1	1	1
	Varied Sitella	<i>Daphoenositta chrysoptera</i>						1						
	Weebill	<i>Smicronis brevirostris</i>	2											
	Western Gerygone	<i>Gerygone fusca</i>						1						
	White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>		1				1						
	White-winged Chough	<i>Corcorax melanorhamphos</i>	12				6	1	10	1		1		1
	Willie Wagtail	<i>Rhipidura leucophrys</i>	4			1	1	1	2	1	2	1	2	1
	Yellow Rosella	<i>Platycercus elegans</i>						1						
	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>		1				1						
	Zebra Finch	<i>Taeniopygia guttata</i>	2											
	Species Richness		17	7	5	10	13	28	12	10	8	13	8	14
	Total Bird Abundance		116	11	11	63	61	28	12	43	15	13	9	14



3.4 Frogs

A timed frog transect was not undertaken at Kinnairds Swamp in April 2010. Two species of frog, the Plains Froglet (*Crinia parinsignifera*), and Common Froglet (*Crinia signifera*), were recorded at Kinnairds Swamp during May 2010, both during the timed transect (Table 11). An additional species, the Peron's Tree Frog (*Litoria peronii*), was recorded in July 2010, such that in total three species were recorded at Kinnairds Swamp over the first three survey events. The Common Froglet was again recorded in October. No frogs were recorded during the November survey.

Table 11 Frogs recorded at Kinnairds Swamp autumn to spring/summer 2010/11

Status	Survey Event and Date		Survey 1 -		Survey 2 25/05/10		Survey 3 28/7/10		Survey 4 13/10/10		Survey 5 17/11/10		Survey 6 9/12/10	
	Survey Time		-		4:00 PM		8:00 AM		4:15 PM		3:30 PM		3:30 PM	
	Common Name	Species	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental	Transect	Incidental
	Plains Froglet	<i>Crinia parinsignifera</i>			10-100		<10						<10	x
	Common Froglet	<i>Crinia signifera</i>			10-100		10-100		<10					
	Peron's Tree Frog	<i>Litoria peronii</i>					<10							x

cool and raining during Survey 2

Prevailing weather conditions during some of the surveys are likely to have influenced results, as would the time of day that surveys were conducted. Additionally, during the autumn and winter surveys, certain frog species were not active and their presence in the wetlands could not be determined by call recognition or by limited active searching. Low water temperatures are also likely to have restricted breeding activity at this time.

3.5 Other Fauna

Incidental observations were made of five species of butterfly during the course of the vegetation, frog and bird surveys (Table 12). A Water Rat (*Hydromys chrysogaster*) was observed in December (Table 13).

Table 12 Butterflies recorded at Kinnairds Swamp autumn to spring/summer 2010/11

Common Name	Species	Survey 1 9/04/10	Survey 2 25/5/10	Survey 3 28/07/10	Survey 4 13/10/10	Survey 5 17/11/10	Survey 6 9/12/10
Australian Painted Lady	<i>Vanessa kershawi</i>	x					
Common Brown	<i>Heteronympha merope merope</i>	x					
Common Grass Blue	<i>Zizinia labradus</i>	x					
Dainty Swallowtail	<i>Papilio anactus</i>	x					
Meadow Ayrus	<i>Junonia villida</i>	x	x				

Table 13 Mammals recorded at Kinnairds Swamp autumn to spring/summer 2010/11

Common Name	Species	Survey 1 9/04/10	Survey 2 25/5/10	Survey 3 28/07/10	Survey 4 13/10/10	Survey 5 17/11/10	Survey 6 9/12/10
Water Rat	<i>Hydromys chrysogaster</i>						x



Photograph 6 Black Swans (*Cygnus atratus*) at Kinnairds Swamp July 2010

4.0 CONCLUSIONS

The artificial delivery of environmental water allocations can stimulate reproduction and improvements in the ecological health of indigenous vegetation communities, plants, wetland birds and frogs. Although water was delivered to the wetlands between the first and second monitoring events, and the wetland had filled from catchment runoff as a consequence of heavy rainfall, many wetland plants had only just begun to respond to inundation or increased soil moisture by the conclusion of the first series of surveys (April – July), and at this stage of the program it was generally expected that more species were likely to become apparent as water and substrate temperatures increased through spring and summer (September – December). Continued heavy rains during spring and summer resulted in very little drawn down across the wetland, with water generally deepest in December, and thus this trend was for the most part not observed.

Despite recording a high diversity of flora including several rare and threatened species, and vegetation with good structural characteristics, the absence of a spring draw down, impeded the establishment and expansion of species such as *Myriophyllum* (Water-milfoil) and *Amphibromus* (Wallaby-grass) and a plethora of small herbs. Differences in weather patterns in 2010 when compared to those of 2008/09, also meant that many of the rare and threatened species recorded in the later months of 2008 were not recorded during the current study. Similarly, the dramatic increases in species diversity that were evident post environmental water delivery during previous studies of the same wetlands were not matched.

While little discernable change in vegetation condition or floristics was recorded at Kinnairds Swamp during the autumn/winter surveys, significant floristic change occurred between these and the subsequent spring/summer surveys. Typically, with continued flooding in spring, many of the species that had begun to establish in response to the earlier water delivery drowned, and those such as *Azolla* became prevalent and subsequently inhibited the establishment of a diversity of other ground flora. As the *Azolla* died back with a further influx of water, species such as *Ludwigia peploides* (Clove-strip) and *Pseudoraphis spinescens* (Spiny mud-grass), a species that given its necessity for long wet periods in order to establish was infrequent during previous studies of the same wetlands, began to establish. In December, by the conclusion of the surveys, the cover of *Ludwigia peploides* and *Pseudoraphis spinescens* had expanded, and a moderate diversity of

Carex spp. (Sedges), *Eleocharis* spp. (Spike-sedges) and *Juncus* spp. (Rushes) had begun to regenerate around the wetland margins.

Documentation of bird and frog populations yielded similar results. Despite recording a reasonable diversity of wetland and non-wetland bird species, including several rare and threatened species, correlation between water depth and species richness that was evident in previous studies (see Cook *et al.*, 2009), was not apparent at the conclusion of the first series of surveys (April – July). As the wetlands are quite large and support areas of dense cover it was difficult to accurately estimate bird numbers and detect all cryptic bird species, particularly if they were not calling. The rainy and windy conditions on a number of the survey days impeded visibility, and is likely to have influenced the identification of some birds and total bird counts.

Utilisation of the wetlands by different species varied significantly over the monitoring period. During the autumn/winter surveys migratory bird species were only just beginning to arrive in the region and the courtship or nesting behaviour of some bird species had only just begun, and was yet to commence in other species. Although the trend is not strongly reflected in the small sampling effort, birds proved more abundant during the spring/summer surveys, and a different suite of species, including several rare and threatened species, were observed utilising the wetlands. Numerous species were observed nesting or exhibiting breeding behaviour in the final surveys, and many young were recorded, indicative of a successful breeding season. Birds utilised a variety of vegetation types, but were most abundant in areas where there was a reliable food source such as *Pseudoraphis spinescens* (Spiny mud-grass).

Similarly, during the autumn/winter surveys, many frog species were not active and their presence in the wetlands could not be determined by call recognition or by limited active searching. Prevailing weather conditions, and the time of day at which surveys were conducted, also influenced the number of species detected and their abundance, and continued to do so during the spring/summer surveys. Although there was evidence of some species having bred, a greater sampling effort is likely to reveal more breeding, and a higher diversity of frog species.

Continued heavy rains post the final survey (late January and February) suggest that the wetland is unlikely to draw down for some time. As this occurs it is expected that aquatic perennial grasses and species typical of Aquatic Herbland will begin to develop. In order to comprehensively

document this process, along with other responses attributable to prolonged inundation resulting from environmental water delivery coupled with spring and summer flooding, it is proposed that the monitoring program be extended to include post drawn down surveys.

5.0 REFERENCES

ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Canberra, Australian and New Zealand Environmental Conservation Council and Agriculture and Resource Management Council of Australia.

Cook, D, Bayes, E, Jolly, K, and Backstrom, A (2009) *Ecological response of four wetlands to the application of environmental water: final report on monitoring from May to December 2008*. Report prepared for Goulburn Broken Catchment Management Authority. Australian Ecosystems Pty Ltd, Patterson Lakes, Victoria.

DSE (2010) Ecological Vegetation Class (EVC) Benchmarks by Bioregion – Victorian Riverina. Available:
<http://www.dse.vic.gov.au/dse/nrence.nsf/LinkView/6FB4886C86D894CACA256F1F00224A8C8062D358172E420C4A256DEA0012F71C>

DSE (2009a) Victorian Fauna State Database, The State of Victoria, Department of Sustainability and Environment (accessed via the 'Atlas of Victorian Wildlife', [2010, July] - © Viridans Biological Databases).

DSE (2009b) Victorian Flora State Database, The State of Victoria, Department of Sustainability and Environment (accessed via the 'Flora Information System', [2009, July] - © Viridans Biological Databases). The contribution of the Royal Botanical Gardens to the database is acknowledged.

DSE (2007) Advisory List of Rare or Threatened Vertebrate Fauna in Victoria - 2007. Victorian Department of Sustainability and Environment, East Melbourne, Victoria.

DSE (2005) Advisory List of Rare or Threatened Plants in Victoria - 2005. Victorian Department of Sustainability and Environment, East Melbourne, Victoria.

EPA Victoria (2003) Water Quality Objectives for Rivers and Stream – Ecosystem Protection. Scientific Support and Freshwater Sciences, EPA Victoria.

Roberts, J and Marston, F (2000) Water regime of wetland and floodplain plants in the Murray Darling Basin: A source book of ecological knowledge. CSIRO Land and Water. Technical Report 30/00. October 2000. Canberra.



Walsh, N.G. and Stajsic, V. (2007) A census of Vascular Plants of Victoria, 8th Edition. National Herbarium of Victoria, Royal Botanic Gardens, Victoria.

Appendix 1 GPS Coordinates for Vegetation Monitoring Sites

Table 14 GPS coordinates for vegetation monitoring sites (easting and northing format, map datum GDA94)

Site Name	EVC	Quadrat	Easting #	Northing
Kinnairds Swamp	Plains Rushy Wetland	Quadrat 1	362 705	6006 014
Kinnairds Swamp	Red Gum Swamp	Quadrat 2	362 680	6005 998
Kinnairds Swamp	Tall Marsh	Quadrat 3	362 658	6005 981
Kinnairds Swamp	Plains Grassy Wetland	Quadrat 4	362 611	6005 975
Kinnairds Swamp	Red Gum Swamp	Quadrat 5 *	361884	6006188
Kinnairds Swamp	Red Gum Swamp	Quadrat 6 *	362192	6006207
Kinnairds Swamp	Riverine Swampy Woodland	Quadrat 7 *	362533	6006255

GPS coordinates are provided for the south-west corner of the quadrat

* Additional quadrats commissioned by Moira Shire Council

Appendix 2 Quadrat Data Kinnairds Swamp



Photograph 7 Quadrat 1 (Plains Rushy Wetland) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)

Table 15 Flora species recorded Quadrat 1 (Plains Rushy Wetland) Kinnairds Swamp

Wetland Species	Status	Origin	Species	Common Name	% Cover					
					08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
w			<i>Alternanthera denticulata</i>	Lesser Joyweed	2	1	2	1		
w			<i>Amphibromus nervosus</i>	Common Swamp Wallaby-grass	2	2	2	2	2	1
w		*	<i>Aster subulatus</i>	Aster-weed	2					
w			<i>Azolla filiculoides</i>	Pacific Azolla		1	2	95	100	15
w		*	<i>Callitriche hamulata</i>	Thread Water-starwort			1			
w			<i>Damasonium minus</i>	Star Fruit			2			
w			<i>Eleocharis acuta</i>	Common Spike-sedge	2	2	10	2	1	2
w			<i>Eleocharis pusilla</i>	Small Spike-sedge	2		2			
w			<i>Eucalyptus camaldulensis</i>	River Red-gum	2	2	2	2	2	2
w			<i>Juncus flavidus</i>	Gold Rush	5	2	1			
w			<i>Juncus semisolidus</i>	Plains Rush	2	2				
w			<i>Lachnagrostis filiformis</i> var. 1	Common Blown-grass		2				
		*	<i>Lactuca saligna</i>	Willow-leaf Lettuce	1					
		*	<i>Lactuca serriola</i>	Prickly Lettuce	2					
w			<i>Lemna disperma</i>	Common Duckweed						2
w			<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	Clove-strip				1	1	
w			<i>Lythrum hyssopifolia</i>	Small Loosestrife			1			
w			<i>Marsilea costulifera</i>	Narrow-leaf Nardoo		1	1			
w			<i>Marsilea drummondii</i>	Common Nardoo		1				
w	Le		<i>Myriophyllum gracile</i> var. <i>lineare</i>	Slender Water-milfoil				2		
w			<i>Myriophyllum</i> spp.	Water-milfoil			1			
			<i>Oxalis perennans</i>	Grassland Wood-sorrel	2	1				



					% Cover					
Wetland Species	Status	Origin	Species	Common Name	08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
		*	<i>Polygonum aviculare</i>	Prostrate Knotweed	5	2				
w		*	<i>Rumex crispus</i>	Curled Dock	5	2	5	2	2	2
w			<i>Rumex tenax</i>	Narrow-leaf Dock	2	1	1	1	1	
			<i>Scrophularia auriculata?</i>	Water Figwort		1				
		*	<i>Sonchus oleraceus</i>	Common Sow-thistle		1				
			Total Flora Species		14	16	14	9	7	6
			Open water			85	55	1	1	85
			Bare ground							
			Algae							5
			Moss							
			Litter				10	1	1	
			Coarse Woody Debris							



Photograph 8 Quadrat 2 (Red Gum Swamp) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)

Table 16 Flora species recorded Quadrat 2 (Red Gum Swamp) Kinnairds Swamp

Wetland Species	Status	Origin	Species	Common Name	% Cover					
					08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
w			<i>Amphibromus nervosus</i>	Common Swamp Wallaby-grass	2	2	2			
		*	<i>Anagallis arvensis</i>	Pimpernel	1					
w		*	<i>Aster subulatus</i>	Aster-weed	2	1	2			
w			<i>Azolla filiculoides</i>	Pacific Azolla			2	90	100	95
w		*	<i>Callitriche hamulata</i>	Thread Water-starwort			2	1		
		*	<i>Cirsium vulgare</i>	Spear Thistle	1	1				
w			<i>Damasonium minus</i>	Star Fruit			2			
		*	<i>Echinochloa crus-galli</i>	Barnyard Grass	1					
w			<i>Eleocharis acuta</i>	Common Spike-sedge	5	5	45	2	2	
w			<i>Eleocharis pusilla</i>	Small Spike-sedge	2		2			
w			<i>Eucalyptus camaldulensis</i>	River Red-gum	20	20	20	20	20	20
w			<i>Juncus flavidus</i>	Gold Rush	1					
w			<i>Juncus semisolidus</i>	Plains Rush	1					
w			<i>Lachnagrostis filiformis</i> var. 1	Common Blown-grass	2					
		*	<i>Lactuca saligna</i>	Willow-leaf Lettuce	2					
		*	<i>Lactuca serriola</i>	Prickly Lettuce	1	2				
w			<i>Lemna disperma</i>	Common Duckweed						2
		*	<i>Leontodon taraxacoides</i> subsp. <i>taraxacoides</i>	Hairy Hawkbit			1			
		*	<i>Lolium rigidum</i>	Wimmera Rye-grass	2					
w			<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	Clove-strip			1	2		
w			<i>Marsilea drummondii</i>	Common Nardoo	2	2	2			
w	L e		<i>Myriophyllum gracile</i> var. <i>lineare</i>	Slender Water-milfoil				1	1	
w			<i>Myriophyllum</i> spp.	Water-milfoil			2			



					% Cover					
Wetland Species	Status	Origin	Species	Common Name	08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
w		*	<i>Rumex crispus</i>	Curled Dock	1	2	2	1		
w			<i>Rumex tenax</i>	Narrow-leaf Dock	2		1			
		*	<i>Sonchus oleraceus</i>	Common Sow-thistle	1					
		*	<i>Trifolium striatum</i>	Knotted Clover	2					
		*	<i>Trifolium subterraneum</i>	Subterranean Clover	2					
			Total Flora Species		20	8	14	7	4	3
			Open water			95	30	2		2
			Bare ground		10		2	1		
			Algae							
			Moss							
			Litter		10		5	5		
			Coarse Woody Debris		2			2		



Photograph 9 Quadrat 3 (Tall Marsh) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)

Table 17 Flora species recorded Quadrat 3 (Tall Marsh) Kinnairds Swamp

Wetland Species	Status	Origin	Species	Common Name	% Cover					
					08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
w			<i>Alternanthera denticulata</i>	Lesser Joyweed	1	1				
w			<i>Azolla filiculoides</i>	Pacific Azolla		1	2	95	100	40
w		*	<i>Callitriche hamulata</i>	Thread Water-starwort			1			
w			<i>Eleocharis acuta</i>	Common Spike-sedge	1					
w			<i>Juncus ingens</i>	Giant Rush	20	15	15	10	10	15
w			<i>Lemna disperma</i>	Common Duckweed						1
w			<i>Ludwigia peploides subsp. montevidensis</i>	Clove-strip				2	2	2
w			<i>Marsilea drummondii</i>	Common Nardoo		1				
w	L e		<i>Myriophyllum gracile var. lineare</i>	Slender Water-milfoil						1
		*	<i>Polygonum aviculare</i>	Prostrate Knotweed	1					
			Total Flora Species		4	4	3	3	3	5
			Open water			45	5	2	1	60
			Bare ground							
			Algae							2
			Moss							
			Litter		80	40	90	5	1	1
			Coarse Woody Debris							



Photograph 10 Quadrat 4 (Plains Grassy Wetland) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)

Table 18 Flora species recorded Quadrat 4 (Plains Grassy Wetland) Kinnairds Swamp

Wetland Species	Status	Origin	Species	Common Name	% Cover					
					08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
w			<i>Alternanthera denticulata</i>	Lesser Joyweed	2				1	
w			<i>Amphibromus nervosus</i>	Common Swamp Wallaby-grass	2	2	2	1		
w		*	<i>Aster subulatus</i>	Aster-weed	1					
w			<i>Azolla filiculoides</i>	Pacific Azolla			20	70	100	2
w		*	<i>Callitriche hamulata</i>	Thread Water-starwort		1	2	2		
w			<i>Eleocharis acuta</i>	Common Spike-sedge	5	2	5	2		
w			<i>Juncus flavidus</i>	Gold Rush	2					
w			<i>Lachnagrostis filiformis</i> var. 1	Common Blown-grass	2					
		*	<i>Lactuca saligna</i>	Willow-leaf Lettuce	2					
		*	<i>Lactuca serriola</i>	Prickly Lettuce	2					
w			<i>Lemna disperma</i>	Common Duckweed						2
w			<i>Marsilea costulifera</i>	Narrow-leaf Nardoo	1	1				
w			<i>Marsilea drummondii</i>	Common Nardoo	30	45	45	2		
w			<i>Myriophyllum spp.</i>	Water-milfoil			2			
w		*	<i>Phalaris paradoxa</i>	Paradoxical Canary-grass					1	
		*	<i>Polygonum aviculare</i>	Prostrate Knotweed	2					
w			<i>Rumex tenax</i>	Narrow-leaf Dock	2					
		*	<i>Scorzonera sp.</i>	Scorzonera	1					
		*	<i>Trifolium striatum</i>	Knotted Clover	2					
		*	<i>Trifolium subterraneum</i>	Subterranean Clover	2					
			Total Flora Species		15	5	6	5	3	2
			Open water			55	30	30		100
			Bare ground		35					



					% Cover					
Wetland Species	Status	Origin	Species	Common Name	08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
			Algae							2
			Moss							
			Litter		10		5	1		2
			Coarse Woody Debris							



Photograph 11 Quadrat 5 (Red Gum Swamp) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)

Table 19 Flora species recorded Quadrat 5 [Shire] (Red Gum Swamp) Kinnairds Swamp

Wetland Species	Status	Origin	Species	Common Name	% Cover					
					08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
w			<i>Alternanthera denticulata</i>	Lesser Joyweed	2	1				
w			<i>Amphibromus nervosus</i>	Common Swamp Wallaby-grass	5	5	2	2		
w			<i>Azolla filiculoides</i>	Pacific Azolla			1	15	75	2
w			<i>Centipeda cunninghamii</i>	Common Sneezeweed	2	2				
		*	<i>Cirsium vulgare</i>	Spear Thistle	1	1				
w			<i>Eleocharis acuta</i>	Common Spike-sedge	5	2	15	5	2	2
w			<i>Eucalyptus camaldulensis</i>	River Red-gum	5	5	5	5	5	5
			<i>Euchiton sphaericus</i>	Annual Cudweed	2	1				
		*	<i>Helminthotheca echioides</i>	Ox-tongue	1					
w			<i>Juncus flavidus</i>	Gold Rush	1					
w			<i>Juncus semisolidus</i>	Plains Rush	2	1				
		*	<i>Lactuca serriola</i>	Prickly Lettuce	2					
w			<i>Lemna disperma</i>	Common Duckweed				5	2	1
w			<i>Marsilea costulifera</i>	Narrow-leaf Nardoo		2				
w			<i>Marsilea drummondii</i>	Common Nardoo	5	5				
		*	<i>Medicago polymorpha</i>	Burr Medic		1				
w			<i>Persicaria prostrata</i>	Creeping Knotweed	2	2				
		*	<i>Polygonum aviculare</i>	Prostrate Knotweed	2	2				
w			<i>Potamogeton cheesemanii</i>	Red Pondweed			5			
			<i>Pseudognaphalium luteoalbum</i>	Jersey Cudweed	2					
w			<i>Pseudoraphis spinescens</i>	Spiny Mud-grass			2	2		2
w		*	<i>Rumex crispus</i>	Curled Dock	2	2				
			<i>Senecio quadridentatus</i>	Cotton Fireweed	1					
		*	<i>Trifolium striatum</i>	Knotted Clover	2					



					% Cover					
Wetland Species	Status	Origin	Species	Common Name	08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
			Total Flora Species		18	14	6	6	4	5
			Open water			90	85	70	15	100
			Bare ground		10					
			Algae							
			Moss							
			Litter		50		2	2		
			Coarse Woody Debris		2					



Photograph 12 Quadrat 6 (Red Gum Swamp) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)

Table 20 Flora species recorded Quadrat 6 [Shire] (Red Gum Swamp) Kinnairds Swamp

Wetland Species	Status	Origin	Species	Common Name	% Cover					
					08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
w			<i>Alternanthera denticulata</i>	Lesser Joyweed	1	1				
w			<i>Amphibromus nervosus</i>	Common Swamp Wallaby-grass	5	5	15	1		
w			<i>Azolla filiculoides</i>	Pacific Azolla				25	100	2
w		*	<i>Callitriche hamulata</i>	Thread Water-starwort			1	1		
w			<i>Eleocharis acuta</i>	Common Spike-sedge	5	2	10	5	1	2
w			<i>Eucalyptus camaldulensis</i>	River Red-gum	5	5	5	5	5	5
		*	<i>Helminthotheca echioides</i>	Ox-tongue	2					
w			<i>Juncus flavidus</i>	Gold Rush	1					
w			<i>Juncus semisolidus</i>	Plains Rush		1	2			
		*	<i>Lactuca saligna</i>	Willow-leaf Lettuce	2					
		*	<i>Lactuca serriola</i>	Prickly Lettuce	2	1				
w			<i>Lemna disperma</i>	Common Duckweed				2	2	2
		*	<i>Leontodon taraxacoides</i> subsp. <i>taraxacoides</i>	Hairy Hawkbit			1			
w			<i>Marsilea drummondii</i>	Common Nardoo			2			
w		*	<i>Paspalum distichum</i>	Water Couch	1					
		*	<i>Polygonum aviculare</i>	Prostrate Knotweed	1					
w			<i>Potamogeton cheesemanii</i>	Red Pondweed				1		
w			<i>Pseudoraphis spinescens</i>	Spiny Mud-grass	5	2		2	1	2
w		*	<i>Rumex crispus</i>	Curled Dock			1			
			Total Flora Species		11	7	8	8	5	5
			Open water			95	65	70		100
			Bare ground							
			Algae							



					% Cover					
Wetland Species	Status	Origin	Species	Common Name	08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
			Moss							
			Litter		70		10	1		2
			Coarse Woody Debris							



Photograph 13 Quadrat 7 (Riverine Swampy Woodland) Kinnairds Swamp April, May, July, October, November and December 2010 (left to right)

Table 21 Flora species recorded Quadrat 7 [Shire] (Riverine Swampy Woodland) Kinnairds Swamp

Wetland Species	Status	Origin	Species	Common Name	% Cover					
					08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
	k		<i>Alternanthera sp. 1 (Plains)</i>	Plains Joyweed	1	1				
		*	<i>Arctotheca calendula</i>	Cape Weed				1		
			<i>Arthropodium sp.2</i>	Lily						1
w			<i>Asperula conferta</i>	Common Woodruff	5	5	5	5	2	1
			<i>Atriplex semibaccata</i>	Berry Saltbush	1				2	
			<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass	2	5	2	2	2	2
w			<i>Austrodanthonia duttoniana</i>	Brown-back Wallaby-grass	1	1				2
			<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass				2	2	2
			<i>Austrostipa aristiglumis</i>	Plump Spear-grass						1
			<i>Austrostipa scabra</i>	Rough Spear-grass	2	2	2	2	2	2
		*	<i>Avena barbata</i>	Bearded Oat				10	5	1
		*	<i>Avena sp.</i>	Oat	2					
		*	<i>Bromus diandrus</i>	Great Brome	2	5	20	35	30	1
w			<i>Carex inversa</i>	Knob Sedge	2	5	5	5	5	5
			<i>Chenopodium pumilio</i>	Clammy Goosefoot		1				
			<i>Chloris truncata</i>	Windmill Grass	1	1				
		*	<i>Cirsium vulgare</i>	Spear Thistle	1	1	1	1	1	1
			<i>Convolvulus erubescens spp. agg.</i>	Pink Bindweed	2	1		1	1	1
w		#	<i>Eclipta platyglossa</i>	Yellow Twin-heads	1	1			1	
			<i>Elymus scaber var. scaber</i>	Common Wheat-grass	2	1	2	2		2
			<i>Enteropogon acicularis</i>	Spider Grass	1	1		1		1
w			<i>Eucalyptus camaldulensis</i>	River Red-gum	20	20	20	20	20	20
			<i>Euchiton involucratus s.l.</i>	Common Cudweed						1
w			<i>Haloragis aspera</i>	Rough Raspwort	1	2		1	1	1



					% Cover					
Wetland Species	Status	Origin	Species	Common Name	08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
		*	<i>Hordeum spp.</i>	Barley Grass				1		
		*	<i>Hypochoeris glabra</i>	Smooth Cat's-ear		1				
w			<i>Juncus flavidus</i>	Gold Rush	1	1				1
w			<i>Lachnagrostis filiformis</i> var. 1	Common Blown-grass						1
		*	<i>Lactuca saligna</i>	Willow-leaf Lettuce	2	1			1	2
		*	<i>Lactuca serriola</i>	Prickly Lettuce	2	2	2	2	5	5
w			<i>Lobelia concolor</i>	Poison Pratia	2	2	1	2	2	2
		*	<i>Lolium rigidum</i>	Wimmera Rye-grass		1	10	10	10	1
			<i>Mentha saturooides</i>	Creeping mint	5	2	5	2	2	5
w			<i>Muehlenbeckia florulenta</i>	Tangled Lignum	2	2	2	2	2	2
			<i>Oxalis perennans</i>	Grassland Wood-sorrel	2	1	1	2	2	1
		*	<i>Physalis viscosa</i>	Sticky Ground-cherry	1					
			<i>Pimelea curviflora s.l.</i>	Curved Rice-flower	2	2	2	2	2	2
w			<i>Ranunculus pumilio</i>	Ferny Small-flower Buttercup				1		
			<i>Ranunculus sessiliflorus</i>	Annual Buttercup			1			
		*	<i>Romulea rosea</i>	Onion Grass			2	1		
			<i>Rumex brownii</i>	Slender Dock			1	1	1	
			<i>Sida corrugata</i>	Variable Sida						1
			<i>Solanum esuriale</i>	Quena		1	1			
		*	<i>Sonchus oleraceus</i>	Common Sow-thistle	1	1	1	2	2	2
			<i>Teucrium racemosum</i>	Grey Germander	2	2	2	2	2	2
		*	<i>Trifolium subterraneum</i>	Subterranean Clover	2	1		2	2	1
		*	<i>Vulpia bromoides</i>	Squirrel-tail Fescue				1		
			<i>Wahlenbergia fluminalis</i>	River Bluebell	2	2	2	2	2	2
w			<i>Walwhalleya proluta</i>	Rigid Panic	1				1	2
w			<i>Wolffia australiana</i>	Tiny Duckweed			2			
			Total Flora Species		31	31	23	30	27	33
			Open water							
			Bare ground		1	2	2	2	2	2
			Algae							



					% Cover					
Wetland Species	Status	Origin	Species	Common Name	08/04/2010	26/05/2010	26/07/2010	14/10/2010	17/11/2010	09/12/2010
			Moss		2	2	2	2		2
			Litter		60	50	35	45	55	70
			Coarse Woody Debris		2	2		1	1	2



Appendix 3 Details of Fauna Survey Effort

Table 22 Details of bird survey activities at Kinnairds Swamp

Survey No.	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6
Date	9/04/2010	25/05/2010	27/07/2010	13/10/2010 14/10/2010	17/11/2010	9/12/2010
Surveyors	EB and DC	DO and DC	DO and RU	DO and RU	DO and RU	DO and RU
Transect - start time	9:30 AM	4:00 PM	8:00 AM	4:15 PM 7:55 AM	3:00 PM	3:00 PM
Transect - duration	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes
Length of transect	250 metres	250 metres	250 metres	250 metres	250 metres	250 metres
Transect - start coordinates	362510 - 6006260	362510 - 6006260	362510 - 6006260	362510 - 6006260	362510 - 6006260	362510 - 6006260
Transect - end coordinates	362270 - 6006250	362270 - 6006250	362270 - 6006250	362270 - 6006250	362270 - 6006250	362270 - 6006250
Transect - weather details	20 °C overcast, light wind	15°C, steady rain	misty, clear	overcast	sunny	sunny, windy

Table 23 Details of frog survey activities at Kinnairds Swamp

Survey No.	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6
Date	-	25/05/2010	27/07/2010	13/10/2010	17/11/2010	9/12/2010
Surveyors	-	DO and DC	DO and RU	DO and RU	DO and RU	DO and RU
Transect - start time	-	4:00 PM	8:30 AM	4:15 PM	3:30 PM	3:30 PM
Transect - duration	-	30 minutes	30 minutes	30 minutes	30 minutes	30 minutes
Length of transect	-	250 metres	250 metres	250 metres	250 metres	250 metres
Transect - start coordinates	-	362510 - 6006260	362510 - 6006260	362510 - 6006260	362510 - 6006260	362510 - 6006260
Transect - end coordinates	-	362270 - 6006250	362270 - 6006250	362270 - 6006250	362270 - 6006250	362270 - 6006250
Transect - weather details	-	15°C, steady rain	misty, clear	overcast	sunny	sunny, windy



Appendix 4 Photo-monitoring Record



Photograph 14 Kinnairds Swamp Photo-monitoring Point 1 (left to right) April, May, July, October, November and December 2010



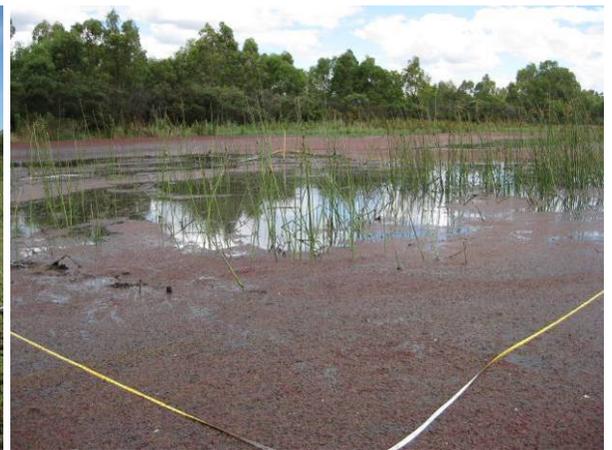
Photograph 15 Kinnairds Swamp Photo-monitoring Point 2 (left to right) April, May, July, October, November and December 2010



Photograph 16 Kinnairds Swamp Quadrat 1 (left to right) April, May, July, October, November and December 2010



Photograph 17 Kinnairds Swamp Quadrat 2 (left to right) April, May, July, October, November and December 2010



Photograph 18 Kinnairds Swamp Quadrat 3 (left to right) April, May, July, October, November and December 2010



Photograph 19 Kinnairds Swamp Quadrat 4 (left to right) April, May, July, October, November and December 2010



Photograph 20 Kinnairds Swamp Quadrat 5 (left to right) April, May, July, October, November and December 2010



Photograph 21 Kinnairds Swamp Quadrat 6 (left to right) April, May, July, October, November and December 2010



Photograph 22 Kinnairds Swamp Quadrat 7 (left to right) April, May, July, October, November and December 2010



Appendix 5 Daily Weather Observations for Shepparton

Shepparton, Victoria

March 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am					3pm						
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Mo	10.9	27.2	0			S	44	19:10	14.0	49		S	30	1019.7	25.6	25		ESE	13	1017.0
2	Tu	10.7	28.7	0	7.6		S	35	17:57	15.3	60		S	17	1020.1	26.2	25		SW	17	1016.3
3	We	10.1	30.9	0	7.6		S	22	23:17	18.3	60		ENE	6	1019.1	28.4	32		SE	7	1014.9
4	Th	14.2	28.5	0	5.2		N	39	15:23	21.5	54		NE	17	1013.5	27.7	40		NNE	19	1010.0
5	Fr	20.2	22.4	1.0	3.6		NE	33	10:57	20.2	82		NNE	17	1007.3	20.2	93		NE	19	1005.6
6	Sa	19.4	29.9	18.4			W	50	17:28	20.4	97		NE	7	1009.8	29.1	54		N	13	1008.8
7	Su	17.2	26.6	21.6			NNW	156	15:38	19.2	88		ESE	13	1012.0	26.1	57		E	11	1007.4
8	Mo	15.3	22.1	59.6			NNW	57	16:23	16.9	86		N	15	1007.9	20.5	58		NNW	30	1006.7
9	Tu	15.2	21.4	3.4	31.4		WSW	41	16:08	15.2	90		W	17	1014.9	20.5	58		W	19	1015.7
10	We	10.0	19.3	0	4.4		SSE	48	10:11	13.3	72		SSW	22	1026.0	18.1	54		SSW	26	1026.2
11	Th	9.1	23.6	0	4.2		S	46	19:06	13.5	66		SSE	15	1032.1	22.2	42		SE	7	1031.2
12	Fr	9.9	24.6	0	4.8		S	26	14:10	14.5	82		SE	7	1036.7	22.6	47		SSE	7	1034.3
13	Sa	10.9	25.2	0			N	31	12:47	17.4	69		ENE	11	1035.3	24.1	43		NE	11	1031.9
14	Su	11.4	26.1	0			NNE	31	09:16	16.8	76		ESE	9	1029.9	25.0	46		NNE	15	1026.2
15	Mo	11.8	27.3	0	12.0		NE	20	10:06	17.5	73		ESE	6	1025.0	26.2	34		SSE	7	1021.9
16	Tu	12.1	29.3	0	3.8		N	69	12:31	18.1	69				1023.1	28.2	33		NE	9	1020.9
17	We	13.4	30.9	0.2	4.8		N	30	13:14	19.7	63		NNE	7	1024.5	29.9	32		NW	9	1023.0
18	Th	16.8	30.9	0	5.0		NNE	31	14:02	20.5	69		ENE	7	1024.9	30.5	30		NNE	17	1021.3
19	Fr	18.0	29.7	0	6.0		NW	28	14:47	19.8	61		NNE	7	1018.8	28.5	39		W	11	1017.0
20	Sa	16.0	30.2	0			W	33	15:30	18.6	86		S	9	1020.0	28.9	45		WSW	15	1018.5
21	Su	15.0	25.6	0			SSW	48	14:22	16.6	82		WSW	13	1020.4	24.8	38		WSW	30	1019.2
22	Mo	9.8	23.8	0	16.0		SSW	39	13:21	14.1	74		SSW	15	1021.9	23.0	37		SW	22	1020.6
23	Tu	10.4	24.1	0	4.2		S	35	16:12	13.8	73		SSW	19	1022.6	22.5	42		SW	19	1020.8
24	We	12.9	26.2	0	5.2		S	35	09:21	16.4	80		S	17	1023.4	25.5	41		SSW	24	1020.7
25	Th	10.0	28.7	0	5.0		N	30	09:38	14.8	85		SSW	4	1021.0	27.9	35		N	13	1017.9
26	Fr	11.0	31.2	0	4.0		SSW	44	19:33	18.1	73		NE	9	1018.6	30.4	27		WNW	13	1016.0
27	Sa	16.2	30.1	0			S	35	20:53	19.2	72		S	13	1019.6	29.5	34		ENE	6	1016.8
28	Su	19.1	26.7	0			WSW	39	17:46	21.9	57		NE	17	1014.6	26.4	48		NE	13	1010.3
29	Mo	17.5	25.3	7.4	13.6		WSW	39	13:13	18.1	97		NW	13	1015.5	23.6	67		WNW	19	1015.1
30	Tu	14.2	24.1	0	3.4		SSW	39	17:27	16.6	72		SSW	13	1020.6	23.1	49		SSW	20	1019.5
31	We	9.9	25.5	0	6.0		NNE	26	11:54	13.1	86		SSE	7	1021.7	23.9	53		N	6	1018.7
Statistics for March 2010																					
Mean		13.5	26.6		7.5					17.2	74			12	1020.7	25.5	43			15	1018.4
Lowest		9.1	19.3		3.4					13.1	49		SSW	4	1007.3	18.1	25		#	6	1005.6
Highest		20.2	31.2	59.6	31.4		NNW	156		21.9	97		S	30	1036.7	30.5	93		#	30	1034.3
Total				111.6	157.8																

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

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Shepparton, Victoria

April 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am					3pm							
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP	
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa	
1	Th	9.3	24.7	0			SSW	28	22:50	13.9	95		S	7	1020.0	23.7	44		SW	13	1018.1	
2	Fr	13.2	24.7	0			SSW	35	17:51	15.9	73		S	15	1019.9	23.9	43		S	15	1018.1	
3	Sa	12.1	25.7	0			ENE	30	12:30	14.3	73		S	17	1020.7	23.3	44		E	15	1018.3	
4	Su	12.4	25.4	0			NE	37	10:16	18.6	60		ENE	9	1021.6	24.9	39		NNE	19	1017.5	
5	Mo	13.6	25.8	0			NE	35	09:09	18.7	57		NE	22	1019.4	24.6	40		NE	17	1015.4	
6	Tu	14.6	23.8	0			NE	46	22:31	18.3	58		ENE	26	1015.9	23.2	44		ENE	20	1011.9	
7	We	17.4	22.5	15.0			N	30	00:01	19.3	90		N	19	1011.6	22.2	65		WNW	13	1010.4	
8	Th	13.7	23.0	0			SSW	33	13:57	17.0	86		WSW	17	1017.2	21.1	60		S	13	1016.5	
9	Fr	9.6	21.4	0.2			E	28	18:22	15.4	77		ENE	2	1015.8	20.1	58		NNW	11	1011.8	
10	Sa	14.5	20.5	1.4			W	30	17:14	15.4	98		NE	13	1010.6	19.4	83		WNW	11	1008.0	
11	Su	12.3	17.7	3.4			W	57	08:17	14.1	83		WNW	19	1009.7	16.9	42		WSW	28	1010.7	
12	Mo	7.2	18.2	0.6			WSW	39	09:36	11.8	78		W	20	1018.7	17.6	52		SW	22	1018.4	
13	Tu	7.5	18.9	0			SSW	43	10:41	12.1	71		SW	17	1024.6	18.5	54		SSW	22	1022.1	
14	We	5.5	20.2	0			SSW	26	15:52	12.5	76		SSE	9	1023.6	19.3	51		SSW	15	1021.0	
15	Th	7.8	21.7	0			S	31	09:16	14.3	68		S	20	1023.3	20.8	51		S	20	1021.5	
16	Fr	6.2	25.2	0			NNE	31	10:00	15.1	75		ESE	11	1026.0	24.9	37		NNE	17	1022.4	
17	Sa	9.8	27.0	0			NNE	28	09:27	18.0	67		NE	15	1026.5	26.7	35		NE	17	1023.3	
18	Su	10.8	26.3	0			NNE	30	09:48	16.0	79		ENE	6	1026.2	24.7	43		NNE	11	1022.7	
19	Mo	13.3	27.0	0			ESE	46	21:10	19.4	63		ENE	9	1024.4	26.9	43		N	11	1021.2	
20	Tu	16.0	27.9	0			ESE	33	15:23	20.2	65		NNE	15	1022.7	27.4	43		N	13	1018.6	
21	We	13.8	26.7	0			SW	28	00:23	18.5	83		E	7	1022.3	24.6	47		WNW	6	1019.6	
22	Th	11.2	28.0	0			NW	26	13:59	19.1	72		NE	11	1022.5	26.6	39		WNW	15	1019.1	
23	Fr	13.4		0						20.1	60		NNE	15	1018.1							
24	Sa		20.1				W	50	13:36	17.2	98		N	17	1011.6	18.8	83		WNW	19	1007.8	
25	Su	9.7	18.3	13.8			S	35	12:06	12.8	81		SW	15	1017.8	17.7	48		SW	20	1019.2	
26	Mo	3.7	18.0	0			ENE	52	16:38	10.5	86			Calm	1026.3	17.2	50		NNW	9	1022.7	
27	Tu	9.7	18.8	0			WNW	39	16:14	11.5	78		NNE	11	1019.7	18.0	57		WNW	11	1016.7	
28	We	4.3	16.9	0.6			W	35	12:48	9.9	95		N	11	1021.5	15.9	58		WNW	17	1019.4	
29	Th	9.8	17.5	0			WNW	31	01:50	13.8	95		WNW	15	1021.7	16.2	65		SW	24	1021.2	
30	Fr	8.9	18.9	0			SSW	30	10:39	13.4	73		SSW	17	1027.2	18.0	60		SSW	13	1025.0	
Statistics for April 2010																						
Mean		10.7	22.4							15.6	77			13	1020.2	21.5	50			15	1017.9	
Lowest		3.7	16.9							9.9	57			Calm	1009.7	15.9	35		WNW	6	1007.8	
Highest		17.4	28.0	15.0			W	57		20.2	98		ENE	26	1027.2	27.4	83		WSW	28	1025.0	
Total				35.0																		

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

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Shepparton, Victoria

May 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am					3pm							
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP	
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa	
1	Sa	4.3	19.7	0			NNE	26	15:48	11.4	88		NNE	9	1027.3	19.1	50		N	15	1023.7	
2	Su	5.3	22.3	0			S	26	19:31	12.2	85		NE	9	1026.0	21.4	46		NW	11	1023.6	
3	Mo	6.3	22.7	0			N	31	15:18	13.3	76		E	7	1026.0	22.5	41		N	19	1021.0	
4	Tu	7.7	24.5	0			WSW	57	17:38	16.6	72		NNE	17	1015.4	23.8	32		NW	22	1009.4	
5	We	5.2	15.1	1.6	3.6		W	37	14:16	7.8	88		W	19	1017.1	14.8	55		WSW	20	1016.7	
6	Th	7.0	16.7	0	2.2		WSW	26	12:22	10.0	94		WNW	13	1022.0	15.5	66		WSW	15	1021.3	
7	Fr	5.8	18.9	0	0.8		W	31	14:28	10.8	89		N	9	1024.2	17.9	61		W	17	1020.9	
8	Sa	10.8	20.1	0.2			WSW	30	12:51	14.3	93		W	11	1023.5	19.2	55		WNW	11	1021.1	
9	Su	4.4	20.2	0			N	24	12:26	10.5	99		ESE	4	1023.0	18.8	57		NNW	7	1019.4	
10	Mo	5.8	21.4	0	4.0		N	39	15:52	12.7	80		NE	17	1019.4	20.6	44		N	24	1013.5	
11	Tu	6.3	14.8	0.2	3.0		SW	59	06:14	9.9	72		WSW	20	1014.3	13.9	46		WSW	22	1015.4	
12	We	1.1	15.0	0	2.4		SSW	33	11:26	6.5	85		W	11	1023.9	13.7	55		SSW	19	1023.5	
13	Th	2.8	16.1	0	1.6		S	33	15:37	9.1	86		WSW	13	1025.5	15.4	62		S	17	1022.0	
14	Fr	3.7	17.2	0	1.0		SW	31	14:59	11.0	90		SSW	19	1021.6	16.2	61		SW	24	1018.1	
15	Sa	1.7	17.8	0			SSW	13	12:01	6.9	99		SE	6	1020.2	17.0	53				Calm	1017.4
16	Su	1.0	17.7	0.2			NNE	24	14:32	7.3	98		SE	7	1021.5	16.3	53		NE	9	1018.9	
17	Mo	5.4	17.2	0	4.0		SW	20	15:07	9.4	91		SSE	15	1020.9	17.0	49		SW	11	1018.8	
18	Tu	1.4	18.9	0	1.0		W	28	14:49	8.1	90			Calm	1021.1	18.1	40		SSW	11	1019.5	
19	We	0.6	17.7	0	1.8		SSW	19	13:48	6.3	95			Calm	1024.1	17.3	43		WSW	11	1021.8	
20	Th	2.0	17.0	0	0.8		SW	19	13:53	7.0	88			Calm	1023.7	16.6	55		W	7	1020.8	
21	Fr	3.4	17.3	0	1.4		SSW	28	14:59	9.0	99		SSW	7	1022.7	16.4	49		SW	17	1020.1	
22	Sa	0.2		0						5.8	94		SSE	2	1023.3	15.3	45		SE	9	1020.7	
23	Su		17.4							8.0	76			Calm	1022.6	16.7	38		N	19	1018.6	
24	Mo	6.8	15.1	0	4.8		NE	35	09:57	12.4	65		ENE	11	1016.2	14.8	70		NE	9	1012.2	
25	Tu	11.5	13.5	11.6	0.4		ENE	31	01:31	12.4	99		ENE	19	1007.4	13.3	98		E	19	1004.3	
26	We	8.8	20.7	8.6	0.6		S	17	10:08	12.0	93		S	9	1009.6	20.1	52		E	2	1010.4	
27	Th	9.3	16.9	0.2	1.3		N	24	13:44	12.5	89		NNE	6	1018.9	16.5	64		NNE	13	1018.1	
28	Fr	10.2	16.8	0.6	1.0		NNE	39	13:46	11.6	89		NE	17	1017.8	15.2	74		NE	20	1012.9	
29	Sa	11.5	14.7	11.2			NE	30	02:15	12.1	97		E	20	1004.5	14.0	90		ESE	17	1002.9	
30	Su	10.3	17.8	2.4			S	43	16:48	12.0	94		SSW	13	1007.1	17.0	69		S	28	1007.5	
31	Mo	8.7	17.4	0			SSW	35	00:24	11.2	82		S	13	1016.4	17.0	60		S	9	1015.6	
Statistics for May 2010																						
Mean		5.6	18.0		2.0					10.3	88			10	1019.6	17.1	55			14	1017.1	
Lowest		0.2	13.5		0.4					5.8	65			Calm	1004.5	13.3	32			Calm	1002.9	
Highest		11.5	24.5	11.6	4.8		SW	59		16.6	99		#	20	1027.3	23.8	98		S	28	1023.7	
Total				36.8	35.7																	

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

IDCJDW3074.201005 Prepared at 13:16 GMT on 3 Aug 2010
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Shepparton, Victoria

June 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am					3pm						
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Tu	3.4	16.9	0	0.8		NE	19	10:37	7.3	99			Calm	1019.8	16.1	67		NNE	11	1017.9
2	We	5.3	17.8	0	1.2		SSW	17	15:16	9.5	95			Calm	1022.0	16.2	69		SSW	11	1021.3
3	Th	2.2	17.1	0	1.0		S	13	10:03	7.2	99		SSE	6	1026.6	16.7	57		SSE	2	1024.2
4	Fr	1.4	12.4	0.2	0.6		SW	20	19:34	4.2	99		S	6	1024.0	11.8	79		WSW	11	1020.8
5	Sa	0.7	14.8	0.2			SSW	39	20:54	5.7	99		SSW	9	1019.2	14.5	65		SSW	24	1016.6
6	Su	5.5	14.5	0.2			S	43	13:53	9.2	85		SSW	17	1022.2	13.0	65		SSW	30	1022.3
7	Mo	3.1	12.8	0	3.4		S	22	00:43	7.6	95		S	6	1026.8	11.6	62		SW	9	1024.7
8	Tu	3.6	12.7	0.4	1.0		NNW	24	13:50	6.7	91		NNE	6	1023.4	11.2	61		NW	9	1019.3
9	We	5.8	11.3	1.0	1.2		WSW	43	15:35	6.6	93		N	9	1012.4	10.4	76		W	15	1011.3
10	Th	4.5	12.9	2.0	1.2		W	39	00:04	6.7	87		WSW	15	1022.7	12.2	64		W	11	1022.1
11	Fr	6.7	13.9	0	1.4		WSW	39	11:22	9.8	81		WNW	13	1023.1	13.5	64		WSW	24	1020.5
12	Sa	0.7	12.0	1.0			SSW	31	12:48	6.0	89		SW	9	1026.6	10.6	74		SW	19	1026.2
13	Su	0.0	12.8	0			S	48	21:45	5.6	96			Calm	1032.0	11.9	55		SSW	7	1030.9
14	Mo	-2.2	12.9	0			NE	19	12:22	2.6	98		SE	6	1034.8	12.0	53		NE	7	1032.0
15	Tu	1.0	13.5	0	4.4		NNE	17	10:49	5.8	89		NE	2	1031.4	13.2	57		NW	2	1027.9
16	We	2.3	14.7	0	0.4		NNE	41	19:14	8.7	88		NE	15	1025.3	13.7	80		NNE	17	1019.4
17	Th	8.7		5.0	2.2					12.6	83		NW	26	1008.4	13.2	60		W	24	1009.5
18	Fr		12.0		2.0		NNW	30	23:23	4.2	99			Calm	1019.4	11.3	78		N	11	1017.2
19	Sa	4.2	15.3	0.6			NW	43	22:23	11.1	95		WNW	13	1019.8	14.1	68		W	11	1019.7
20	Su	6.1	15.5	0			NNW	20	15:57	10.2	99			Calm	1027.0	14.8	72		NW	13	1026.5
21	Mo	8.3	12.8	2.6	2.0		S	15	14:02	8.4	100		S	7	1034.7	12.3	76		SSE	4	1034.2
22	Tu	1.2	14.0	0.2	0.6		E	20	14:12	5.0	99		E	2	1037.2	13.5	70		NE	9	1035.2
23	We	4.8	15.6	0	0.4		NE	37	12:22	9.0	86		E	7	1035.8	15.6	61		NE	20	1032.0
24	Th	9.0	15.9	0.2	1.4		NE	41	11:08	10.8	83		NE	19	1028.3	14.8	69		NNE	15	1023.6
25	Fr	10.8	12.2	6.4	1.8		SW	52	22:12	11.3	97		NE	19	1019.9	12.0	99		NNE	19	1016.6
26	Sa	4.0	11.5	20.8			SSW	39	13:02	5.8	83		SW	13	1022.7	10.8	68		S	19	1022.4
27	Su	0.3	11.6	0			S	24	10:57	3.3	99			Calm	1025.3	11.0	61		SW	13	1023.1
28	Mo	-2.5	9.6	0.2	4.4		N	28	15:04	1.6	99		NE	7	1022.1	9.1	58		N	19	1019.3
29	Tu	1.6	10.3	0	0.9		N	37	11:43	5.3	77		N	17	1019.6	10.2	64		N	24	1017.4
30	We	5.3	10.9	0.4	1.0		NNE	33	01:54	6.3	81		NNE	13	1019.4	10.3	76		NNE	9	1018.6
Statistics for June 2010																					
Mean		3.6	13.5		1.6					7.1	92			8	1024.4	12.7	67			13	1022.4
Lowest		-2.5	9.6		0.4					1.6	77			Calm	1008.4	9.1	53		#	2	1009.5
Highest		10.8	17.8	20.8	4.4		SW	52		12.6	100		NW	26	1037.2	16.7	99		SSW	30	1035.2
Total				41.4	33.3																

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

IDCJDW3074.201006 Prepared at 16:16 GMT on 2 Aug 2010
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Shepparton, Victoria

July 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Th	2.2	11.0	0.2	0.2		N	20	13:16	6.6	97		NNE	11	1025.0	10.7	76		N	9	1024.1
2	Fr	6.6	12.4	0	0.4		NNE	20	08:05	7.6	86		NNE	13	1026.7	11.1	62		NNE	7	1023.6
3	Sa	2.1	13.2	0			SW	26	12:53	5.6	99			Calm	1030.8	12.0	62		SSW	15	1030.6
4	Su	-0.3	11.4	0			N	17	17:50	2.7	99			Calm	1032.5	10.3	81		NNE	7	1029.2
5	Mo	2.1	7.0	0.2	2.6		SSW	19	22:15	4.1	99		ENE	9	1027.4	6.3	98		ESE	2	1023.5
6	Tu	1.7	12.4	1.0	0.2		S	28	10:52	5.6	99		SW	9	1022.4	11.9	67		SW	13	1020.8
7	We	-1.0	13.6	0	1.0		SSE	26	14:23	3.8	95			Calm	1027.3	13.4	72		SSW	15	1026.0
8	Th	-0.3	13.6	0	0.6		SE	11	14:24	1.2	99		WNW	2	1029.6	12.9	56		SSE	2	1027.2
9	Fr	-1.6	14.2	0.2	0.8		NNE	33	12:10	3.6	99			Calm	1030.1	13.6	62		NE	15	1027.0
10	Sa	3.6	12.8	0			NNE	48	13:27	10.8	74		NE	28	1021.8	12.2	82		N	24	1017.4
11	Su	5.0	15.0	4.8			W	26	11:55	7.1	100		N	7	1020.2	14.6	70		NW	13	1019.1
12	Mo	4.0	15.0	0	2.6		N	28	14:26	8.4	92		NE	11	1023.4	14.0	65		N	19	1020.8
13	Tu	5.6	14.7	0	1.8		W	56	23:09	9.1	80		NE	17	1014.3	12.6	95		NE	19	1005.8
14	We	6.3	10.4	8.2	0.8		WNW	46	19:25	7.4	89		WNW	20	1008.5	9.4	92		NNW	22	1007.2
15	Th	3.0	12.6	1.6	1.0		W	35	00:30	5.3	94		W	13	1021.6	12.0	71		W	13	1023.1
16	Fr	4.1	11.8	0	1.0		SSE	24	12:13	8.5	82		S	13	1028.8	10.9	64		SSW	11	1027.4
17	Sa	-0.4	10.7	0			N	17	15:48	3.7	99			Calm	1029.1	10.3	61		NNW	7	1025.7
18	Su	3.6	12.0	0			N	30	12:00	6.9	85		NNE	19	1021.8	11.8	64		N	15	1017.4
19	Mo	5.6	12.4	3.4	3.4		SW	30	12:52	6.1	99		SSW	7	1019.5	12.0	60		SW	17	1019.3
20	Tu	-1.7	10.3	0.2	1.0		NNE	15	10:35	2.4	99		N	4	1025.6	9.2	77		W	7	1024.7
21	We	-0.2	13.5	0	0.6		SSW	28	13:02	4.9	99		SSW	2	1029.6	12.4	68		SSW	19	1028.1
22	Th	0.6	14.0	0	1.0		S	24	15:18	5.9	99		SSW	11	1033.1	13.2	72		SSW	15	1031.4
23	Fr	0.6	15.2	0.2	0.6		S	20	16:09	5.7	99			Calm	1035.5	13.4	72		SSE	2	1032.9
24	Sa	0.0	12.9	0			SSW	20	14:12	1.4	99			Calm	1032.6	11.3	68		SSW	7	1029.7
25	Su	0.7	14.4	0			S	31	14:13	5.4	93			Calm	1031.9	14.0	63		SSW	19	1030.0
26	Mo	-1.4	14.1	0	3.4		S	26	14:52	3.0	99			Calm	1036.5	13.9	53		S	17	1034.6
27	Tu	-2.2	14.4	0	1.0		ENE	22	13:01	3.2	96		ESE	2	1035.8	14.1	47		NE	11	1031.5
28	We	2.2	12.2	0	1.4		ENE	22	20:19	8.9	75		ENE	9	1026.8	10.3	93		E	11	1022.0
29	Th	8.9	14.0	6.8	0.6		NE	19	02:03	10.2	100		N	7	1018.1	13.5	81		NNE	11	1014.2
30	Fr	9.5	15.0	1.2	0.6		NE	24	07:06	11.1	99		NNE	13	1014.0	14.1	81		N	11	1012.7
31	Sa	8.7	14.6	5.4			WSW	43	12:36	9.9	94		WNW	17	1014.0	13.9	61		W	28	1015.2

Statistics for July 2010

Mean	2.5	12.9		1.2						6.0	94			7	1025.6	12.1	70			13	1023.3
Lowest	-2.2	7.0		0.2						1.2	74			Calm	1008.5	6.3	47		#	2	1005.8
Highest	9.5	15.2	8.2	3.4			W	56		11.1	100		NE	28	1036.5	14.6	98		W	28	1034.6
Total				33.4	26.6																

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

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Shepparton, Victoria

August 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am					3pm						
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Su	7.8	11.9	5.2			W	52	12:47	9.4	88		NW	26	1014.5	10.9	65		W	30	1014.5
2	Mo	6.4	14.2	3.8	6.6		SSW	59	04:36	9.9	78		SW	22	1021.7	13.6	58		SSW	33	1022.3
3	Tu	5.0	12.7	0	1.8		SW	35	11:28	9.3	86		SSW	17	1024.5	11.5	69		SW	22	1022.0
4	We	3.8	11.2	0	1.4		NW	31	14:31	7.7	91		NNE	4	1019.3	9.6	84		NNW	13	1016.2
5	Th	5.4	12.5	2.6	0.8		SSW	31	12:17	5.5	99		WSW	11	1020.3	11.1	68		WSW	13	1019.5
6	Fr	0.5	12.5	0.4	1.2		SSW	26	10:54	6.3	93		SW	15	1025.4	11.8	61		SSW	15	1024.0
7	Sa	-0.5	12.9	0			NNE	19	10:29	4.7	99			Calm	1027.0	12.3	57		WNW	9	1023.0
8	Su	1.3	13.1	0			NNE	31	12:24	6.2	85		NE	13	1021.5	11.2	56		NE	13	1018.5
9	Mo	1.9	14.2	0	4.0		ENE	33	15:37	7.8	75		E	11	1021.6	13.6	52		E	22	1018.8
10	Tu	2.9	14.0	8.2	2.2		E	41	08:34	9.1	92		E	20	1012.3	12.7	78		ESE	15	1007.7
11	We	6.8	10.8	7.8	2.4		SSE	35	21:38	8.3	97		NE	15	1004.5	10.3	85		W	7	999.6
12	Th	6.7	13.8	5.0	1.6		SSW	65	09:09	10.3	69		SSW	35	1008.8	13.1	67		SSW	33	1011.7
13	Fr	5.8	14.5	0	3.0		SSW	24	10:33	9.9	84		SW	13	1017.0	14.3	62		SSW	6	1013.7
14	Sa	7.3	14.0	0			NE	52	12:44	9.5	85		NNE	19	1012.0	13.5	69		NNE	30	1004.2
15	Su	8.2	14.0	1.4			W	37	21:05	9.9	90		NNW	17	1002.9	12.2	93		WSW	17	1004.4
16	Mo	5.1	12.1	3.0	4.2		WSW	50	13:25	8.1	98		WNW	19	1013.1	11.2	56		SSW	28	1015.6
17	Tu	-1.0	11.5	0.6	2.4		ENE	19	16:32	5.1	81			Calm	1024.4	11.0	60		E	9	1020.7
18	We	3.2	11.4	0	1.6		ENE	43	13:13	6.8	82		NE	22	1013.6	7.7	97		NE	22	1003.8
19	Th	6.7	13.7	15.0	1.2		W	61	21:17	11.4	79		WNW	20	1007.4	11.3	75		NW	30	1007.8
20	Fr	3.3	11.6	0.8	2.4		W	43	12:32	6.0	86		WNW	19	1015.3	10.5	67		WNW	20	1014.3
21	Sa	4.7	13.5	0.4			WNW	33	11:39	6.3	94		W	19	1018.6	12.7	61		W	24	1017.7
22	Su	0.4	15.0	0.6			NNE	28	14:52	5.8	96		ENE	11	1023.1	13.4	60		N	19	1019.6
23	Mo	3.8	13.0	0	4.2		NNW	28	10:29	8.9	82		NNE	13	1016.2	13.0	60		NNW	15	1012.5
24	Tu	7.1	12.6	1.2	1.4		W	59	20:34	8.5	84		NW	15	1013.3	11.6	63		NNW	24	1008.6
25	We	1.3	10.0	6.4	3.0		W	50	18:29	5.7	85		NW	20	1009.6	8.2	89		NW	22	1004.0
26	Th	5.6	12.2	13.2	2.0		WNW	37	03:56	6.5	93		WNW	19	1002.2	10.4	82		NW	9	1000.9
27	Fr	5.4	12.8	1.6	0.6		WSW	44	14:39	8.5	79		WSW	20	1010.9	11.6	65		WSW	28	1013.4
28	Sa	1.7	13.2	0.4			SSW	26	13:12	7.9	83		SSW	7	1024.9	12.5	64		SSW	13	1025.2
29	Su	2.6	14.8	0			WNW	19	15:32	7.9	97			Calm	1029.8	14.4	54		WSW	9	1027.5
30	Mo	0.5	15.4	0	4.6		WSW	20	12:51	7.5	89		ESE	4	1029.1	14.8	55		WSW	6	1025.7
31	Tu	4.3	12.8	0.2	2.6		NNE	44	22:56	8.2	84		NE	7	1024.7	12.7	70		NE	22	1018.4
Statistics for August 2010																					
Mean		4.0	13.0		2.5					7.8	87			14	1017.1	11.9	67			18	1014.7
Lowest		-1.0	10.0		0.6					4.7	69			Calm	1002.2	7.7	52		#	6	999.6
Highest		8.2	15.4	15.0	6.6		SSW	65		11.4	99		SSW	35	1029.8	14.8	97		SSW	33	1027.5
Total				77.8	55.2																

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

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Shepparton, Victoria

September 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am					3pm						
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	We	8.1	13.1	0	0.4		NNE	35	03:19	10.9	86		NNE	9	1015.7	12.3	91		W	9	1014.7
2	Th	9.1	15.0	2.8	0.6		S	46	14:01	10.8	83		SSW	19	1018.1	14.1	55		S	31	1018.3
3	Fr	2.6	15.4	0			NE	44	23:23	7.6	77		ESE	9	1021.8	14.8	65		NE	24	1016.5
4	Sa	7.6	16.8	28.2			N	69	18:02	15.2	100		NNE	26	1000.7	15.4	85		N	37	994.9
5	Su	9.3	15.0	13.6			WNW	54	02:00	10.4	82		WNW	26	1012.1	14.7	57		WNW	19	1013.7
6	Mo	7.2	14.3	0.2	9.4		SW	44	16:57	9.6	89		SW	11	1020.1	13.6	54		SW	22	1019.1
7	Tu	3.8	14.9	1.0	2.2		S	22	11:20	9.5	81		SSW	15	1027.0	14.2	52		SE	9	1025.1
8	We	2.4	15.5	0	2.2		NNE	39	13:04	8.9	82		ENE	13	1026.1	15.0	58		NNE	24	1021.6
9	Th	8.9	14.9	2.2	2.8		ENE	33	11:37	9.9	91		ENE	15	1014.2	14.2	80		ENE	9	1008.2
10	Fr	8.5	14.2	10.0	1.4		W	59	12:12	10.5	80		WNW	28	1005.1	13.4	65		WSW	30	1006.6
11	Sa	1.9	15.1	3.6			WNW	24	13:17	10.7	80			Calm	1019.8	13.6	59		NW	15	1019.4
12	Su	5.6	15.2	0			NE	43	03:59	9.1	85		NE	15	1021.8	15.0	66		NNE	17	1017.0
13	Mo	4.0	17.9	1.6	6.2		W	24	11:18	11.6	77			Calm	1016.8	17.0	57		W	13	1015.2
14	Tu	5.9	16.5	0	3.2		SSW	31	21:29	11.1	76		S	17	1015.2	16.2	65		SW	13	1011.9
15	We	4.7	14.9	0	2.2		WSW	41	10:25	8.7	70		W	19	1017.1	13.4	63		W	17	1015.7
16	Th	6.4	14.2	0.2	3.0		WSW	44	11:58	9.3	70		W	22	1020.0	13.0	58		WSW	24	1018.2
17	Fr	3.2	13.6	0	3.2		SSW	43	09:50	9.9	70		SW	19	1025.0	13.0	57		SSW	15	1023.7
18	Sa	2.9	14.5	0.2			WSW	26	11:50	8.9	78		W	13	1022.9	13.4	65		W	11	1019.9
19	Su	5.0	14.9	0			W	48	04:01	11.5	75		S	20	1023.6	13.7	59		SSW	20	1022.8
20	Mo	6.4	16.5	0	6.0		S	43	10:19	12.0	78		SSW	24	1027.1	15.8	67		SSW	24	1024.9
21	Tu	7.7	17.4	0	4.6		S	46	10:58	12.8	75		S	30	1026.4	15.9	60		SSW	30	1025.0
22	We	6.2	17.4	0	1.8		S	39	16:04	12.4	70		S	20	1026.5	17.0	61		SW	24	1023.7
23	Th	6.4	16.1	0	3.2		SW	39	14:29	11.6	66		S	22	1025.5	16.0	59		SW	19	1023.6
24	Fr	2.5	15.7	0	3.2		NW	26	14:53	9.5	75		SSW	6	1023.7	15.1	60		WNW	15	1021.1
25	Sa	6.3	20.1	0			WNW	39	12:46	12.5	80		N	20	1017.2	18.9	56		W	26	1014.9
26	Su	3.2	20.5	0			WNW	28	14:05	13.2	72		NNE	7	1020.4	19.9	44		NNW	17	1017.0
27	Mo	7.6	18.0	0	9.2		WNW	37	12:48	13.3	72		WNW	15	1013.9	17.3	58		WNW	20	1011.1
28	Tu	3.9	15.4	0.6	3.0		WNW	44	13:59	9.2	80		WSW	15	1016.6	13.2	51		W	24	1015.2
29	We	2.2	14.7	0	2.7		S	46	10:52	8.5	67		SW	15	1023.7	13.4	46		S	24	1022.5
30	Th	-0.4	14.7	0	3.0		W	30	11:07	9.1	73		SSE	4	1026.9	13.9	43		WSW	11	1024.6
Statistics for September 2010																					
Mean		5.3	15.7		3.5					10.6	78			15	1019.7	14.9	60			19	1017.5
Lowest		-0.4	13.1		0.4					7.6	66			Calm	1000.7	12.3	43		#	9	994.9
Highest		9.3	20.5	28.2	9.4		N	69		15.2	100		S	30	1027.1	19.9	91		N	37	1025.1
Total				64.2	73.5																

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

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Shepparton, Victoria

October 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Fr	1.1	17.1	0	2.8		SSW	30	14:29	10.5	69		E	6	1027.5	16.2	41		WSW	6	1025.1
2	Sa	1.7	21.7	0			NE	39	11:48	13.3	65		E	13	1027.8	20.3	51		NE	19	1024.4
3	Su	5.7	23.2	0			ENE	39	09:05	16.0	68		E	11	1027.5	21.0	52		NNE	22	1024.9
4	Mo	9.1	23.3	0	11.0		NNE	41	09:18	15.5	73		NE	19	1023.6	22.4	52		N	19	1019.8
5	Tu	11.4	26.3	0	3.7		NNE	28	08:26	16.5	78		NNE	17	1020.9	24.0	54		NW	11	1019.0
6	We	11.0	20.8	0	5.0		WSW	57	22:03	17.1	83		ENE	11	1018.5	17.3	93		W	22	1015.9
7	Th	4.2	16.1	8.6	3.4		S	43	09:09	9.0	74		SW	17	1022.9	14.3	46		S	19	1022.7
8	Fr	5.7	17.8	0.2	3.2		S	35	10:19	10.9	76		SW	15	1026.6	16.9	50		SSW	20	1024.7
9	Sa	5.6	20.2	0			S	24	08:37	11.4	76		S	15	1026.0	19.6	47		SSE	9	1024.1
10	Su	5.0	23.7	0			N	46	10:49	13.2	80		ESE	9	1028.7	23.2	45		NNE	22	1027.5
11	Mo	9.6	24.1	0	12.4		NNE	54	12:10	14.5	62		NE	15	1030.4	21.6	48		NNE	24	1026.4
12	Tu	14.5	21.7	0	4.6		NE	39	09:02	17.2	68		NE	24	1025.9	19.6	75		NNE	17	1022.1
13	We	14.7	18.2	10.6	4.0		SE	33	23:01	16.5	96		ENE	6	1016.9	18.1	86		SW	11	1013.4
14	Th	11.3	19.6	6.8	1.8		NNE	28	15:45	12.8	99		NNE	7	1013.4	18.0	68		NNW	17	1009.7
15	Fr	12.7	14.6	10.0	2.8		SSW	67	16:52	14.5	99		E	9	990.6	11.4	92		SW	35	989.2
16	Sa	2.9	13.9	16.2			WSW	52	15:14	6.5	76		WSW	28	1006.7	12.3	50		WSW	28	1009.4
17	Su	6.3	15.1	0.2			W	33	07:55	10.2	79		W	24	1016.8	14.2	60		W	15	1016.7
18	Mo	6.2	17.4	0	7.8		SW	39	10:00	11.2	79		SSW	13	1020.9	15.7	53		SW	17	1020.7
19	Tu	4.4	17.0	0	4.0		S	30	08:17	10.5	68		S	19	1027.3	15.5	52		SSW	17	1026.5
20	We	3.5	20.4	0	3.2		SE	19	15:32	10.8	76		ENE	6	1028.6	19.5	50		S	6	1025.3
21	Th	5.1	24.0	0	3.6		WNW	31	13:13	14.2	81		ENE	6	1024.1	22.3	46		N	17	1020.5
22	Fr	9.2	27.4	0	4.0		ENE	30	11:45	17.4	71		NE	17	1018.8	26.2	39		NNW	20	1015.5
23	Sa	14.3	19.5	2.2			S	43	15:42	14.4	95		WNW	11	1017.4	18.4	63		SSW	26	1017.2
24	Su	7.0	20.5	0.4			SW	35	14:34	11.9	63		S	20	1021.5	18.8	51		SSW	9	1019.9
25	Mo	6.1	22.9	0	14.2		SSW	43	19:35	12.5	77		ESE	7	1021.7	21.1	50		NNW	11	1018.3
26	Tu	5.4	25.1	0	4.0		NW	39	13:30	15.5	64		N	7	1017.6	24.3	31		WNW	26	1014.5
27	We	10.3	20.3	0.2	5.0		SSW	41	16:05	14.1	69		S	22	1018.0	19.5	39		SW	22	1017.6
28	Th	5.3	23.6	0	5.4		N	35	13:11	14.0	69		NE	15	1019.0	21.9	36		N	17	1016.6
29	Fr	12.2	26.9	0	4.4		NE	52	13:02	16.9	67		NNE	30	1015.5	26.0	45		NNE	30	1010.6
30	Sa	16.9	20.3	0.2			NNE	56	14:55	18.8	84		NE	24	1007.8	19.3	92		NNE	24	1005.4
31	Su	12.5	17.3	48.8			NE	44	23:49	13.6	96		NNW	15	1008.4	16.2	68		W	22	1011.9
Statistics for October 2010																					
Mean		8.1	20.6		5.3					13.6	76			14	1019.9	19.2	55			18	1017.9
Lowest		1.1	13.9		1.8					6.5	62		#	6	990.6	11.4	31		#	6	989.2
Highest		16.9	27.4	48.8	14.2		SSW	67		18.8	99		NNE	30	1030.4	26.2	93		SW	35	1027.5
Total				104.4	110.3																

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

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Shepparton, Victoria

November 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am					3pm						
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Mo	7.5	17.1	2.4	14.8		SSW	37	11:10	11.3	74		SSW	17	1018.0	15.9	52		SW	22	1015.8
2	Tu	6.8	19.9	0			W	41	16:20	12.8	77		W	19	1018.2	18.8	55		WSW	20	1016.6
3	We	7.4	16.7	0	7.8		SSW	37	16:27	12.0	66		SSW	19	1021.0	15.5	50		SW	24	1020.0
4	Th	6.9	18.9	0	3.8		S	41	14:59	10.6	68		S	22	1022.0	16.8	47		SSW	7	1020.0
5	Fr	6.2	21.6	0	4.0		ESE	28	11:15	14.5	60		SE	9	1023.4	20.4	42		NE	11	1020.1
6	Sa	8.0	22.4	0			NE	44	14:30	15.5	60		E	15	1022.3	21.5	37		ENE	17	1018.5
7	Su	10.7	25.8	0			N	48	15:56	15.4	67		NNE	31	1016.4	24.0	49		N	26	1011.5
8	Mo	13.1	23.9	0	15.8		W	44	12:43	16.1	81		WNW	13	1013.5	22.9	39		NW	17	1014.7
9	Tu	9.0	27.9	0	5.2		NNW	52	16:48	17.7	66		E	4	1024.0	27.3	33		NNE	6	1020.7
10	We	15.6	30.5	0	4.8		SW	46	15:46	21.9	71		N	19	1017.8	29.2	30		W	24	1013.9
11	Th	10.6	32.6	0	6.4		NNE	48	14:10	20.5	68		NE	11	1013.6	30.7	35		NNE	11	1008.4
12	Fr	18.6	34.6	0	6.6		NNW	54	13:59	22.7	69		NE	20	1010.0	34.0	24		N	35	1005.3
13	Sa	18.0	27.7	0.4			SW	46	19:16	18.0	91		SSE	13	1012.3	26.8	58		S	9	1009.5
14	Su	13.2	23.2	9.2			NW	30	15:16	16.1	83		N	2	1014.4	22.2	67		WNW	17	1013.2
15	Mo	11.3	22.7	0	14.6		SW	44	14:00	15.4	71		SW	9	1015.5	21.5	37		SW	22	1012.7
16	Tu	8.9	21.4	0	6.4		WSW	39	12:31	14.1	62		S	11	1016.4	20.5	39		WSW	22	1014.5
17	We	7.1	23.5	0	4.6		WNW	33	13:48	15.1	58		Calm		1018.1	22.8	32		W	20	1015.0
18	Th	7.8	23.7	0	5.2		SSW	50	15:32	15.4	68		WSW	9	1015.5	21.7	45		SSW	19	1014.6
19	Fr	8.2	24.9	0	6.6		SSW	43	00:39	14.3	48		S	22	1021.9	23.8	34		SSE	11	1020.8
20	Sa	7.9	29.5	0			NE	30	06:51	18.0	64		NE	19	1025.6	27.7	35		NE	11	1021.3
21	Su	12.1	31.4	0			S	26	18:42	19.0	63		SE	9	1021.5	29.8	26		WSW	11	1018.2
22	Mo	15.3	32.8	0	19.4					22.5	51		NE	22	1020.9	31.8	28		N	13	1018.4
23	Tu	16.2	31.2	0	7.8		NE	46	14:46	23.2	50		NNE	24	1021.7	30.5	26		N	33	1018.9
24	We	20.1	31.8		7.6		N	44	16:31	25.4	51		N	11	1020.3	29.7	33		NNW	19	1017.6
25	Th	18.9	23.3	0	6.8					18.9	87		WNW	11	1018.0	22.9	74		NNW	17	1016.7
26	Fr	18.3	27.4	3.0	2.2					20.8	84		ENE	11	1016.8	25.4	59		N	22	1014.4
27	Sa	15.8	26.4				N	39	10:22	22.8	64		NNE	17	1010.5	20.8	83		NNW	9	1008.6
28	Su	13.2	20.5	44.4			S	65	14:43	15.7	75		SSW	26	1009.1	18.9	54		S	41	1010.1
29	Mo	11.2	24.1	0	19.6		S	37	23:50	16.3	63		S	26	1014.2	22.6	48		ESE	19	1012.7
30	Tu	13.2	24.4	0.6	4.4		N	33	13:50	18.5	70		SSE	17	1015.4	20.4	68		N	24	1013.9

Statistics for November 2010

Mean	11.9	25.4		8.3						17.4	67			15	1017.6	23.9	44			18	1015.2
Lowest	6.2	16.7		2.2						10.6	48			Calm	1009.1	15.5	24		NNE	6	1005.3
Highest	20.1	34.6	44.4	19.6			S	65		25.4	91		NNE	31	1025.6	34.0	83		S	41	1021.3
Total			60.0	174.4																	

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

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Shepparton, Victoria

December 2010 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am						3pm						
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP	
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa	
1	We	16.1	23.1	9.4	2.4		NE	46	12:01	18.5	83		ENE	7	1014.8	19.2	84		ENE	19	1013.6	
2	Th	15.7	25.8	0	3.0		NNE	70	11:26	22.1	64		NNE	20	1014.4	24.3	56		NE	17	1011.7	
3	Fr	14.1	30.1	14.8	5.8		NNE	43	13:38	20.1	81		NE	22	1013.7	24.5	57		SW	20	1010.3	
4	Sa	16.0	30.5	7.8			NNE	31	08:16	21.7	76		NNE	22	1011.8	28.1	51		ESE	9	1009.2	
5	Su	16.1	32.4	0			SSE	39	13:48	24.7	62		NE	9	1011.4	31.7	29		SSE	17	1008.6	
6	Mo	19.2	31.4	0	18.2		E	43	00:19	24.9	54		NE	20	1011.8	30.2	41		NE	19	1008.0	
7	Tu	20.6	28.7	0	7.8		WNW	65	13:45	24.5	58		NNE	31	1009.1	19.1	98		N	17	1008.3	
8	We	18.8	26.4	32.2	4.0		W	69	11:17	22.8	82		NNE	28	1006.3	20.5	93		SW	19	1004.9	
9	Th	16.5	25.3	40.6	2.0		WNW	39	16:13	19.1	84		WSW	7	1009.9	23.9	53		NW	20	1007.6	
10	Fr	14.6	20.4	0	6.4		W	52	12:36	16.7	66		WSW	15	1011.3	19.8	45		W	26	1009.8	
11	Sa	11.5	22.7	0			NW	41	13:30	15.8	66		WNW	19	1008.8	20.3	44		W	24	1004.2	
12	Su	12.8	21.9	0			WSW	39	09:48	15.2	64		W	19	1006.5	19.7	42		WNW	24	1007.0	
13	Mo	11.7	24.0	0	18.2		W	28	13:39	16.7	52		S	15	1015.0	21.7	46		W	19	1013.7	
14	Tu	12.1	27.7	0	6.8		WNW	24	14:38	18.8	59		SSE	6	1015.0	26.0	44		W	11	1011.0	
15	We	16.4	27.3	0	4.8		NNE	39	07:57	22.6	69		NNE	26	1006.5	22.0	78		E	7	1004.7	
16	Th	11.8	23.1	0.8	4.4		SSW	41	01:27	15.4	61		SW	26	1007.5	21.2	36		SSE	17	1005.9	
17	Fr	8.8	24.3	0	7.0		W	65	16:26	17.2	63		NW	15	1005.2				NW	26		
18	Sa	13.0	21.2				W	65	10:02	13.0	78		W	24	1003.1	19.3	49		WSW	22	1002.9	
19	Su	11.2	18.5	5.8			WNW	63	12:10	12.6	83		NW	9	999.1	12.2	84		WNW	31	995.1	
20	Mo	7.8	20.5	11.0	14.6		SW	50	09:26	12.9	73		WSW	22	1004.0	20.3	46		WSW	26	1005.5	
21	Tu	8.3	21.2	0.4	5.2		S	35	17:45	13.6	70		WSW	13	1011.4	20.2	43		SW	20	1011.6	
22	We	7.4	25.0	0	4.6					15.1	53		SE	4	1018.7	22.8	39		NW	13	1016.1	
23	Th	10.5	24.4		5.2					17.5	66		S	15	1019.4	23.3	38				1020.1	
24	Fr	9.8	30.8		8.6					17.8	54		SSE	11	1022.5	28.8	34		NNE	9	1018.0	
25	Sa	15.2	30.3							22.8	68		NNE	17	1012.6	30.1	27		WSW	20	1009.0	
26	Su	15.5	26.1																			
27	Mo	9.7	19.9													18.4	37		S	43	1011.3	
28	Tu	6.4	26.2																			
29	We	11.1	31.1		32.0											29.8	21		SW	19	1012.9	
30	Th	12.9	33.4		8.0								SSE	9								
31	Fr	14.9	39.2		7.2														NNW	26		
Statistics for December 2010																						
Mean		13.1	26.2		8.4					18.5	67			16	1010.8	23.0	50			20	1009.3	
Lowest		6.4	18.5		2.0					12.6	52		SE	4	999.1	12.2	21		E	7	995.1	
Highest		20.6	39.2	40.6	32.0		NNE	70		24.9	84		NNE	31	1022.5	31.7	98		S	43	1020.1	
Total				122.8	176.2																	

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

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Shepparton, Victoria

January 2011 Daily Weather Observations

Most observations taken from Shepparton, evaporation taken from Tatura.



Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain mm	Evap mm	Sun hours	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C					km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Sa	23.5	35.5																		
2	Su	13.9	27.0																		
3	Mo	10.8	25.5				SSW	46	19:16												
4	Tu	9.0	29.3	0	34.6		S	31	00:38	17.7	59		ENE	9	1012.2						
5	We	13.2	28.1	0	6.2		S	46	16:32	17.1	66		SSW	19	1007.3	28.0	25		SSW	26	1006.0
6	Th	12.6	31.9	0	8.0		S	39	23:04	20.9	52		ESE	9	1009.7	29.9	32		NNE	9	1007.2
7	Fr	19.3	32.4	0	7.8		NE	35	09:40	23.5	57		NNE	20	1011.5	30.0	34		NNE	17	1009.7
8	Sa	20.1	34.4	0			NNE	39	07:05	24.8	59		NNE	26	1010.9	32.7	32		ENE	13	1007.9
9	Su	19.8	27.6	0			SW	44	14:45	19.8	77		S	31	1014.9	26.5	55		SW	28	1013.0
10	Mo	19.4	29.5	26.4	19.4		E	30	14:43	20.9	89		SSE	13	1014.0	24.2	77		W	22	1010.8
11	Tu	20.5	25.1	23.8	3.0		NE	33	22:55	20.8	85		NE	17	1011.6	23.1	91		ENE	11	1008.1
12	We	19.6	27.3	7.2	1.2		NNE	44	08:15	24.3	73		NNE	28	1004.9	26.2	80		N	15	1004.2
13	Th	22.4	29.9	14.2	3.0		NE	56	16:04	23.0	93		ENE	17	1008.1	29.5	69		NE	28	1003.6
14	Fr	20.7	27.1	18.0	4.8		NE	48	02:50	20.7	97		NNE	26	1003.5	23.0	84		WNW	15	1004.5
15	Sa	16.6	30.7	11.0			WSW	28	16:34	21.9	87		NE	2	1009.6	28.8	48		SW	11	1008.2
16	Su	17.6	32.7	0			WNW	35	14:03	24.5	68		E	7	1009.2	31.0	38		WNW	13	1006.0
17	Mo	15.2	24.8	0	17.0		SSW	46	11:19	17.1	63		SSW	30	1007.3	22.7	47		SW	17	1006.3
18	Tu	12.4	23.8	0	6.6		SW	43	09:39	16.9	67		SSW	20	1009.8	22.3	50		SW	22	1007.9
19	We	12.8	26.1	0	7.0		SW	39	16:12	17.3	63		S	20	1009.9	24.6	40		SW	22	1009.4
20	Th	11.4	30.8	0	6.8		NNE	26	09:56	19.2	68		ESE	9	1011.7	28.6	46		NW	9	1009.6
21	Fr	16.9	33.3	0	4.6		NNE	46	08:45	23.7	69		NNE	20	1010.6	31.7	38		NE	6	1009.3
22	Sa	16.6	33.5	0			SSW	33	19:56	23.7	70		E	11	1012.7	32.5	38		NNW	19	1010.1
23	Su	18.6	32.3	0			ENE	26	07:56	23.1	71		NE	17	1009.8	30.5	39		NNW	11	1005.8
24	Mo	19.5	26.5	0	21.2		SSW	39	12:40	21.6	67		SW	20	1003.3	24.4	50		SSW	20	1004.0
25	Tu	12.2	30.1	0			NW	24	13:14	19.2	60		SE	6	1008.2	28.6	34		NNW	11	1006.7
26	We	18.6	29.2	0.2			S	54	01:08	22.4	75		SSW	19	1010.8	27.7	51		SW	26	1012.2
27	Th	13.4	29.8	0	13.8		SSW	35	13:34	18.4	72		SW	17	1015.8	27.9	37		SSW	19	1015.9
28	Fr	13.2	28.8	0	7.2		S	39	09:22	17.7	59		S	26	1020.0	27.1	36		SW	22	1017.8
29	Sa	11.0	31.9	0			NE	52	08:20	18.9	66		E	11	1018.8	29.0	36		NW	11	1017.4
30	Su	15.4	36.7	0			NNW	31	13:16	24.3	59		NNE	11	1017.6	35.0	22		NNW	15	1015.2
31	Mo	18.6	39.4	0	22.0		NNW	35	15:19	27.5	53		NNE	15	1013.7	38.3	24		NW	13	1010.6
Statistics for January 2011																					
Mean		16.3	30.0		10.8					21.1	69			17	1011.0	28.3	46			16	1009.2
Lowest		9.0	23.8		1.2					16.9	52		NE	2	1003.3	22.3	22		NE	6	1003.6
Highest		23.5	39.4	26.4	34.6		NE	56		27.5	97		S	31	1020.0	38.3	91		#	28	1017.8
Total				100.8	194.2																

Temperature, humidity, wind, pressure and rainfall observations are from Shepparton Airport (station 081125). Evaporation observations are from Tatura Inst Sustainable Ag (station 081049)

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