

Overland Corner Wetland Management Plan

February 2007



This wetland management plan was written by Hugh Robertson (Earth Ecology & Conservation) for the Overland Corner Wetland Group (including the National Trust of South Australia) and the Berri Barmera Local Action Planning Committee. This wetland management plan was reviewed and endorsed by the SA River Murray Wetland Technical Group.

Funding was provided by the National Action Plan for Salinity and Water Quality, the National Heritage Trust, and the South Australian Murray-Darling Basin Natural Resources Management Board.

The management plan has been prepared according to the *Guidelines for developing wetland management plans for the River Murray in South Australia 2003* (DWLBC 2003) and as such fulfils obligations under the Water Allocation Plan for the River Murray Prescribed Watercourse.

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Acknowledgements:

This wetland management plan has been developed with the support of a number of organisations, community groups and individuals. The contributions of the Overland Corner Wetland Group, National Trust of South Australia, SA Water, South Australian Murray-Darling Basin Natural Resources Management Board, Department for Water, Land and Biodiversity Conservation and the members of the SA River Murray Wetland Technical Group are especially acknowledged.

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Cover photos:

Inundated wetland habitat at Overland Corner (Photos: H. Robertson, June 2006)

Community endorsement of the Overland Corner Wetland Management Plan

Since 1997 the Overland Corner Wetland Group have been implementing management actions to conserve floodplain wetland habitat at Overland Corner.

The Overland Corner Wetland Group have been working in collaboration with the National Trust of South Australia, Berri Barmera Local Action Planning Committee (LAP), SA Water, South Australian Murray-Darling Basin Natural Resources Management Board and the Department for Water, Land and Biodiversity Conservation to develop this Wetland Management Plan.

The following stakeholders and community representatives are pleased to present the Overland Corner Wetland Management Plan for review and accreditation by the SA River Murray Wetland Technical Group.

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Name
Position
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Paul Stribley
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Other key stakeholder?

Note:

This Wetland Management Plan encompasses both the floodplain and wetland areas of Overland Corner.

Within the text 'Overland Corner' refers to the wetland-floodplain complex as a whole, whereas 'wetland' and 'lagoon' typically refer to the low-lying wetland areas. 'Floodplain' refers to the areas of higher elevation inundated during major flood events.

TABLE OF CONTENTS

INTRODUCTION	5
MISSION STATEMENT	7
VISION STATEMENT	7
MANAGEMENT OBJECTIVES	7
OVERLAND CORNER MANAGEMENT ACHIEVEMENTS	8
SITE DESCRIPTION	9
LOCATION	9
PHYSICAL FEATURES	10
HISTORICAL & CURRENT WATER FLOWS	12
WATER FLOW INFRASTRUCTURE	16
PROPOSED UPGRADES TO INFRASTRUCTURE	18
FLOOD INUNDATION MODEL	19
WETLAND VOLUME	19
GROUNDWATER	21
WATER QUALITY	23
ECOLOGICAL FEATURES	26
LAND TENURE, JURISDICTION & MANAGEMENT ARRANGEMENTS	31
THREATS TO THE WETLAND	32
MANAGEMENT OBJECTIVES	34
WETLAND OPERATIONAL PLAN (WATER REGIME)	36
DESCRIPTION OF THE WETLAND OPERATIONAL PLAN	36
PUMPING WATER INTO OVERLAND CORNER	36
MODIFYING THE WETLAND OPERATIONAL PLAN	39
FLOOD EVENTS	40
PROPOSED ON-GROUND WORKS	41
UPGRADES TO INFRASTRUCTURE	41
STOCK MANAGEMENT.....	41
MONITORING	42
EVALUATION & REVIEW	44
REPORTING	44
REFERENCES	45
APPENDICIES	47
APPENDIX 1. Groundwater table elevation and groundwater salinity levels	47
APPENDIX 2. Map of groundwater table levels at Overland Corner (Baseline Survey)	48
APPENDIX 3. Vegetation Map of Overland Corner	49
APPENDIX 4. List of flora recorded at Overland Corner	50
APPENDIX 5. Examples of photopoints used during monitoring at Overland Corner.	53
APPENDIX 6. List of fauna recorded at Overland Corner	55
APPENDIX 7. Key stages in water regime management	56
APPENDIX 8. Wetland inundation map for Overland Corner	57
APPENDIX 9. Water volume calculation	58
APPENDIX 10. Monitoring Sites - Community Monitoring	59
APPENDIX 11. Monitoring Sites - Baseline Survey	60

LIST OF FIGURES

FIGURE 1.	Water level in the River Murray between a) 1986 and 1995 and b) 1996 and 2006	13
FIGURE 2.	Number of flood peaks greater than 7.0 mAHD, 8.0 mAHD and 10.0 mAHD at Overland Corner in 10-year intervals between 1926 and 2006	14
FIGURE 3.	Photograph of the Overland Corner regulating structure	16
FIGURE 4.	Photographs of the infrastructure used to pump water into Overland Corner	16
FIGURE 5.	Flood Inundation Model for Overland Corner, showing the floodplain area inundated under different river flows	20
FIGURE 6.	Wetland salinity levels during the pumping projects undertaken in a) 2004 and b) 2006	24
FIGURE 7.	Photographs of vegetation communities in Overland Corner	27
FIGURE 8.	Number of frog species and abundance of frogs recorded between 2003 and 2006	30
FIGURE 9.	Diagram showing the Wetland Operation Plan for Overland Corner	37

LIST OF MAPS

MAP 1.	Location of Overland Corner on the River Murray near Kingston-on-Murray, South Australia	9
MAP 2.	Map showing the location of wetlands, channels and flow control structures at Overland Corner	11
Map 3.	Land tenure at Overland Corner	31

LIST OF TABLES

TABLE 1.	Monthly average temperature, rainfall and evaporation recorded at Berri	10
TABLE 2.	Geographic coordinates, sill levels and commence to flow rates for regulating structures in Overland Corner	17
TABLE 3.	Surface area, maximum depth and volume of inundation for different water levels	19
TABLE 4.	Surface water quality in Overland Corner recorded during community monitoring	23
TABLE 5.	Physical, biological and management-related threats to the values of Overland Corner	33
TABLE 6.	Management objectives for Overland Corner, including specific management aims, management actions and priorities	35
TABLE 7.	Wetland Operational Plan for Overland Corner	38
TABLE 8.	Monitoring Program for Overland Corner	43

INTRODUCTION

A preliminary management plan for Overland Corner was produced in 2001 (Wetland Care Australia 2001), which provided an initial focus for local community to manage Overland Corner. The Overland Corner Wetland Group has successfully implemented many of the management objectives that were recommended in the 2001 plan.

On the 1st July 2002, the Minister for the Environment and Conservation adopted the *Water Allocation Plan for the River Murray Prescribed Watercourse*. In doing so, a water allocation of 200 GL of South Australia's entitlement flow of 1850 GL per annum was endorsed for wetlands along the River Murray. To obtain a water allocation, individual community groups are required to submit a Wetland Management Plan that meets the criteria in the *Guidelines for Developing Wetland Management Plans for the River Murray in South Australia* ('Guidelines') (DWLBC 2003).

This Overland Corner Wetland Management Plan has been upgraded to meet the criteria set out in the 'Guidelines'.

Overland Corner contains a number of temporary wetlands, which are not connected to the River Murray under normal flow conditions (i.e. wetlands not connected at pool level). However, the commitment of local community and government to wetland conservation has resulted in artificial flood events by pumping environmental water into Overland Corner. While there is a need for clarity about whether 'above pool wetlands' can use the 200 GL of water set aside for River Murray wetlands, there is little doubt that floodplain wetlands such as Overland Corner require environmental water to maintain their ecological condition.



What are the environmental, social and cultural significances of Overland Corner?

Overland Corner represents a site with very high social and cultural values. Local community and visitors regularly use the National Trust section of Overland Corner for camping, bushwalking, bird watching, fishing and boating. Overland Corner also represents a site where there has been significant investment in wetland conservation and management by local community, particularly by the Overland Corner Wetland Group.

Visitors and local community are also attracted to the historic Overland Corner Hotel, which is located on the edge of the floodplain. The National Trust of SA owns the heritage-listed Hotel, which was established in 1860 during the pioneering days in the Riverland.

Overland Corner is also a site of significant cultural value to the local indigenous community. Historically, indigenous groups and individuals would have utilised the area for camping and lived on

the resources provided by the wetlands and river. Canoe trees and other artefacts have been observed in the area.

The wetland and floodplain habitat in Overland Corner is considered to be of high ecological value, due to its size and for native flora and fauna communities it supports (Jensen *et al.* 1996, SKM 2006). Overland Corner was identified as a wetland of high priority for management in the *Wetlands Atlas of the South Australian Murray Valley* (Jensen *et al.* 1996) and in *River Murray Wetlands: their characteristics, significance and management* (Thompson 1986).

Overland Corner is also included within the Riverland Biosphere Reserve (previously known as the Bookmark Biosphere Reserve).

A number of threatened fauna and flora species occur in Overland Corner, including the nationally vulnerable Southern Bell Frog (*Litoria raniformis*) and Regent Parrot (*Polytelis anthopeplus*) (refer 'Ecological Features').

Why does Overland Corner need a Wetland Management Plan?

There are a number of threats to the ecological sustainability of Overland Corner. The lack of frequent flood events in particular threatens the long-term survival of trees including River Red Gums (*Eucalyptus camaldulensis*). Accumulation of salt on the floodplain is also a threat to the wetland. These issues highlight the need for a coordinated and scientifically informed approach to the management of Overland Corner.

The Overland Corner Wetland Group has implemented a number of actions, including installation of a regulating structure to control water levels and the management of two artificial flood events. Future management of flood events is considered important for wetland conservation, but the lack of a detailed management plan limits the capacity for local community to coordinate activities over the next 5-10 years.

This Wetland Management Plan establishes clear management objectives that aim to maintain the ecological condition of Overland Corner. The Plan also includes a list of on-ground actions and describes the recommended monitoring program.



Some of the members of the Overland Corner Wetland Group (2006).

MISSION STATEMENT

To maintain and enhance the ecological values of Overland Corner through the management of flood events and grazing in the wetlands, and to continue to involve local community in wetland management and encourage public enjoyment of the wetlands, plants and wildlife.

VISION STATEMENT

The 5-year vision for Overland Corner is to have managed a number of natural and artificial flood events, by allowing natural flows to inundate the wetlands and by pumping environmental water from the River Murray. The vision is also to have maintained the condition of floodplain wetland vegetation, particularly River Red Gums, and provided habitat for native fauna such as waterbirds and frogs.

The 5-year vision is also to continue the involvement of the Overland Corner Wetland Group, National Trust of South Australia, landholders, local community, and government and non-government partners in the management and monitoring of Overland Corner.

MANAGEMENT OBJECTIVES

- Implement flood events in Overland Corner every 2 in 3 years by allowing natural floods to occur and/or by artificially pumping water from the River Murray, which aims to provide habitat for native fauna and promote the regeneration of native vegetation (including River Red Gums).
- Install a new regulation structure across the upstream inlet (near Lock 3), which will provide greater flexibility of management during natural and artificial flood events.
- Investigate a range of other infrastructure options to improve the management of surface water and groundwater. This includes options to the move the location of the wetland pump, and investigation of the potential to expand the Woolpunda Salt Interception Scheme.
- Limit the access and impact of cattle grazing in the Overland Corner wetlands to maintain and enhance the condition of wetland plants and improve water quality.
- Monitor surface water salinity levels and groundwater levels, and investigate options to flush stored salt from the wetlands.
- Continue to implement a revegetation program in Overland Corner.
- Control the abundance of noxious weeds and other pest plants.
- Control the abundance of pest animals.
- Maintain the Overland Corner Wetland Group, which has the capacity to undertake wetland management and monitoring.
- Continue to support the use of the National Trust section of Overland Corner for recreation, camping and other activities by local community and visitors.

OVERLAND CORNER MANAGEMENT ACHIEVEMENTS

- 1997 ▪ National Trust of SA and local community became actively involved in wetland management at Overland Corner
- 2001 ▪ Initial Overland Corner Wetland Management Plan completed by Wetland Care Australia
- 2003 ▪ Downstream regulating structure installed at Overland Corner
- 2003-2006 ▪ Wetland monitoring undertaken by the Overland Corner Wetland Group, with support from SA Murray-Darling Basin NRM Board and the Berri Barmera LAP
- 2004 ▪ ~400 ML of environmental water pumped into Overland Corner
- 2005 ▪ Baseline Survey undertaken in Overland Corner to describe the physical and ecological features of the wetlands and floodplain.
- 2006 ▪ ~500 ML of environmental water pumped into Overland Corner as part of *River Red Gum Rescue Project*
 - Field day held to celebrate the inundation of Overland Corner with stakeholders, including representatives from SA Water and National Trust



Overland Corner Wetland Group members installing a water level gauge near the downstream regulator.

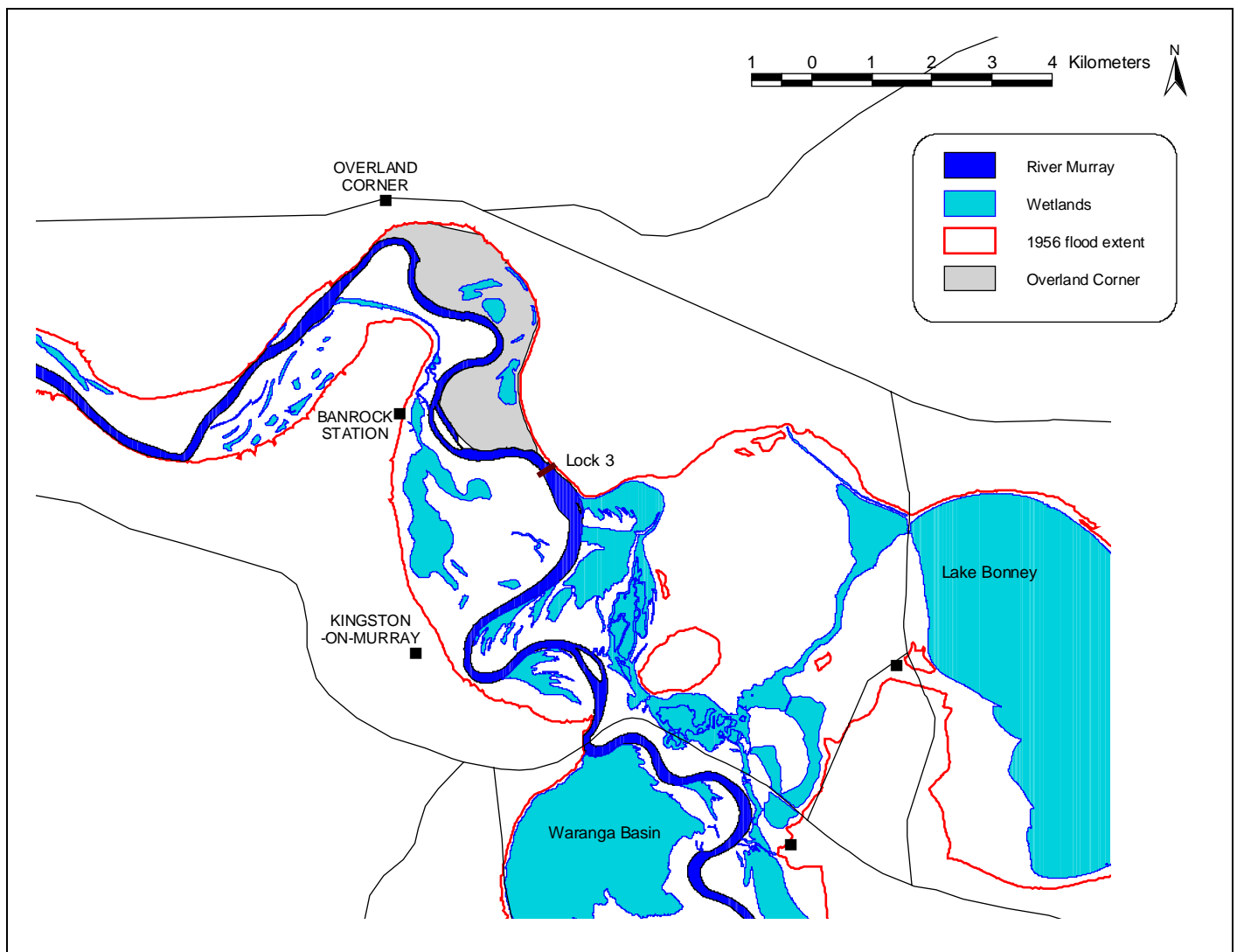
SITE DESCRIPTION

LOCATION

Overland Corner is located adjacent to the River Murray immediately downstream of Lock 3, and is approximately 5 km north of Kingston on Murray (Map 1).

Overland Corner can be found on the 1:50,000 map sheet 'Overland Corner - 6929-1' at geographic coordinates 440025 E, 6218758 N (AMG Zone 54).

The wetlands in Overland Corner are described in the *Wetlands Atlas of the South Australian Murray Valley* (Jensen *et al.* 1996) under atlas number S0170.



Map 1. Location of Overland Corner on the River Murray near Kingston-on-Murray, South Australia

PHYSICAL FEATURES

Geomorphology

Overland Corner is situated in an area of natural low depression adjacent to the River Murray. The geomorphology can be classified as including lentic channel forms (SKM 2006) as well as deflation basins and miscellaneous floodplain depressions (H. Robertson pers obs. 2006).

The Overland Corner wetland complex covers a total area of approximately 450 ha, of which 78 ha are temporary wetlands (Map 2).

There are three main wetland areas within Overland Corner, these are:

- Overland Corner Lagoon and the downstream inlet (National Trust property) (23 ha)
- Upstream wetlands and the upstream inlet (Swinstead annual leasehold property) (33 ha)
- Temporary wetlands at higher elevation, identified in River Murray Wetlands Atlas (Map 2) (22 ha)

Soils

In general the soils in the low-lying areas of Overland Corner are dark, heavy clays. Soils at higher elevation on the floodplain have a high sand content (H. Robertson pers. obs. 2006). However, the soils have not been comprehensively mapped.

Soil logs described during the drilling of groundwater bores identified the underlying geology is from the Coonambidgal and Monoman Formations (SKM 2006).

Accumulation of salt on the floodplain, and the lack of flushing events (flood events), is a threat to soil condition of Overland Corner. Although there is limited no data on soil salinity, salt scalds have been observed in discrete sections of the floodplain.

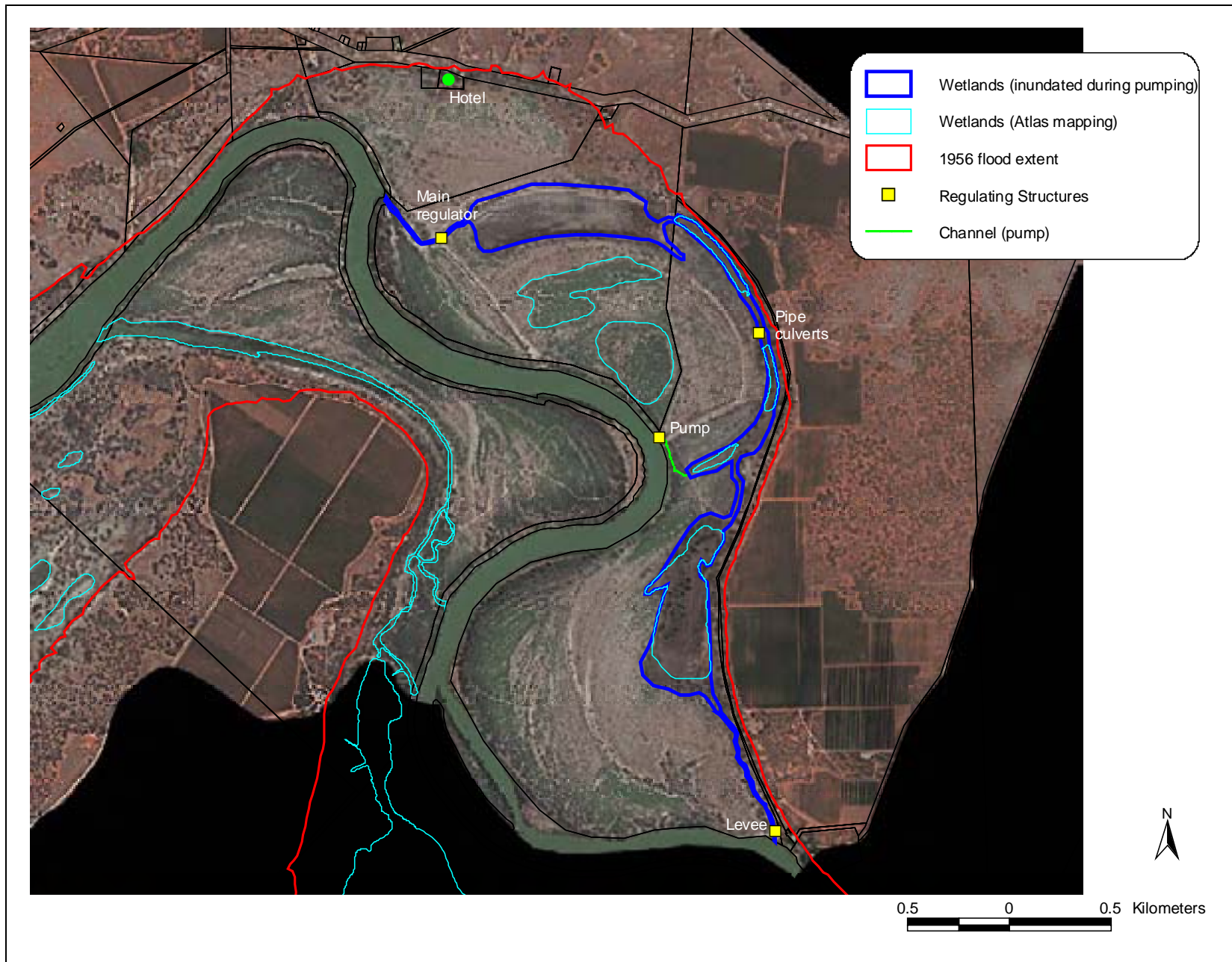
Climate

The Riverland region of South Australia experiences hot dry summers and cool winters. The climate is described as warm (persistently dry). The average maximum daily temperature for Berri is 23 °C, ranging between 31 °C in January and 15 °C in July (Table 1). The average annual rainfall is 260 mm with most falling during the winter months. Evaporation rates are highest during the warmer summer months. In no months does rainfall exceed evaporation (Bureau of Meteorology 2005).

Table 1. Monthly average temperature, rainfall and evaporation recorded at Berri.

	Month												Annual Avg.
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Temp. (max)	31.1	30.2	28.1	22.6	18.9	15.8	15.5	17.2	20.8	23.5	26.9	29.7	23.3
Temp. (min)	15.2	15.0	13.4	10.1	7.9	6.2	5.3	5.9	7.7	10.0	12.1	14.2	10.2
Rainfall (mm)	16.5	22.1	11.4	16.5	27.9	26.0	24.3	27.1	26.8	24.3	19.9	19.2	262
Evap. (mm)	324	288	260	143	97	56	52	95	134	184	271	329	2233

Source: Bureau of Meteorology (2005).



Map 2. Map showing the location of wetlands, channels and flow control structures at Overland Corner.

HISTORICAL & CURRENT WATER FLOWS

A number of temporary wetlands occur in Overland Corner, which are inundated during River Murray flood events (Map 2).

There are three main wetland areas in Overland Corner, specifically:

- Overland Corner Lagoon and the downstream inlet (National Trust property)
- Upstream wetlands and the upstream inlet (Swinstead lease property)
- Temporary wetlands at higher elevation

There are two main natural inlets to Overland Corner, the upstream inlet near Lock 3, and the downstream inlet at the north of the wetland complex (Map 2).

Historical flows

Prior to the regulation of flows in the River Murray and the construction locks and weirs, the wetlands would have had an unpredictable water regime.

The volume, frequency and timing of flood events would have varied considerably depending on flows in the river. The wetlands would also have been periodically dry, during natural periods of low river flows.

Historically, the main source of water for the wetlands would have been the downstream and upstream inlets. Water would typically back up the downstream inlet during low flows, and as the water level increased in the river water would begin to flow into the upstream inlet.

Prior to river regulation, flows of >52,000 ML/day occurred in >75% of years in South Australia (MDBC 2005). This indicates the wetlands in Overland Corner would have been flooded every 3 out of 4 years.

Due to the large volume of water that can be retained in Overland Corner, it is likely that some wetlands would have remained inundated for prolonged periods. The distribution of mature River Red Gum trees around the edge of the main lagoon suggests this lagoon may have been almost permanently inundated. That is, if the lagoon were frequently dry it would be expected to observe some evidence of mature River Red Gums in the bed of the lagoon.

This historical perspective of flooding is important to consider when determining the frequency and duration of future flood events in Overland Corner.

Current flows

Since river regulation and the construction of locks and weirs along the River Murray, the water regime in Overland Corner has been altered. Under current conditions flows of >52,000 ML/day now occur in <30% of years (MDBC 2005).

Following the construction of Lock 3 (in 1925), the weir pool downstream of Lock 3 has been maintained at approximately 6.2 mAHD. At this water level the wetlands in Overland Corner are not connected to River Murray and remain predominantly dry. Thus, the wetlands are classified as 'above pool wetlands'. Only when the river levels increase to 6.4 mAHD does water begin to flow into Overland Corner via the downstream inlet, and at 7.0 mAHD via the upstream inlet.

Figure 1 shows the fluctuation in water level of the River Murray downstream of Lock 3 between 1986 and 1995 (Figure 1a), and between 1996 and 2006 (Figure 1b).

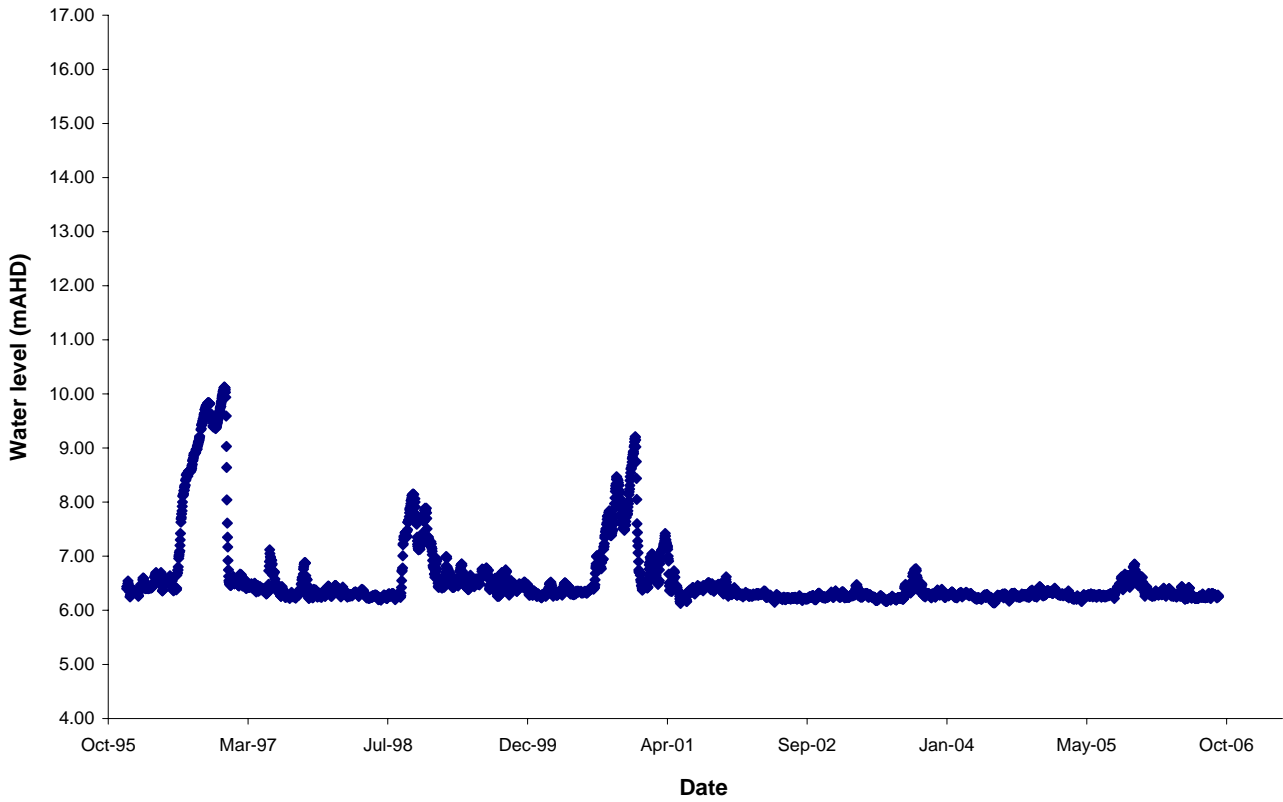
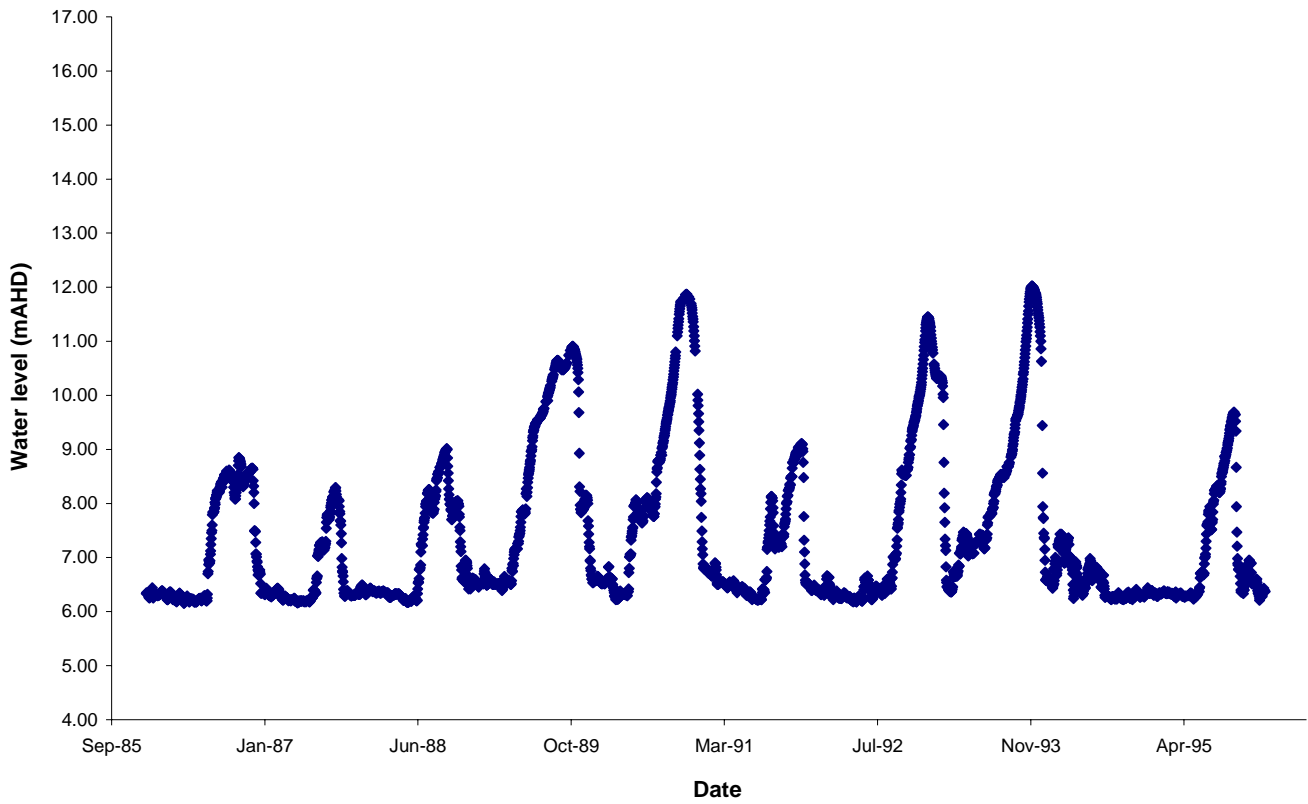


Figure 1: Water level in the River Murray (Downstream Lock 3) between **a)** 1986 and 1995 and **b)** 1996 and 2006 (DWLBC 2006).

Between 1987 and 1995 there were nine flood events at Overland Corner (Figure 1a). However, between 1995 and 2006 there were only three major flood events, and there have been no natural floods since the summer of 2000/2001. This recent decrease in the number of flood events is a significant threat to the ecological values of the wetlands and floodplain.

While the recent decline in floods is largely due to the widespread drought in the Murray-Darling Basin, it is important to note that even before the 1993-2006 drought the frequency of flood events was declining at Overland Corner (Figure 2).

Figure 2 shows the number of floods recorded each decade between 1926 and 2006. For example, between 1926 and 1965 large flood events (with flood peaks >10.0 mAHD) occurred in 5 out of 10 years at Overland Corner. Between 1946 and 1955 there were 14 floods greater than 7.0 mAHD, but there has been a steady decline in the number of small flood events since the 1960s.

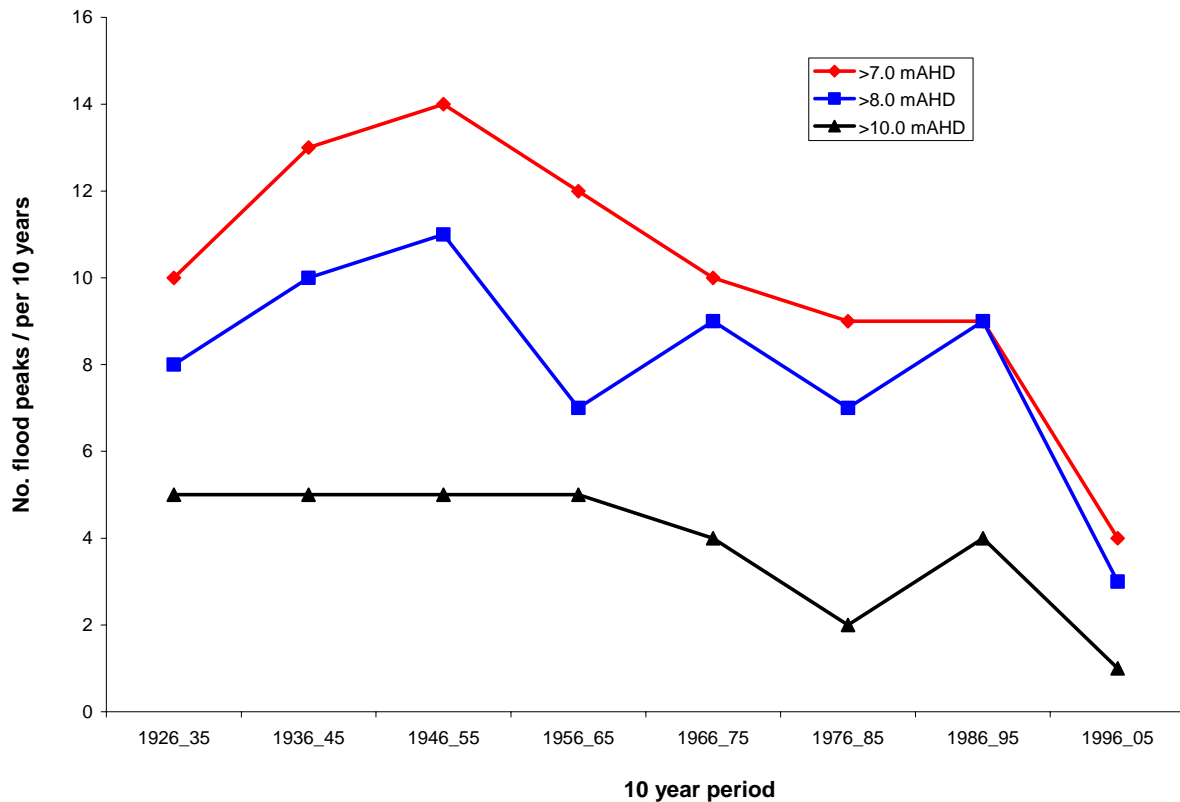


Figure 2. Number of flood peaks greater than 7.0 mAHD, 8.0 mAHD and 10.0 mAHD at Overland Corner (downstream Lock 3) in 10-year intervals between 1926 and 2006. **Note:** Elevation of downstream regulator (invert/base) is 6.3 mAHD.

This analysis of the frequency of flood events since the construction of Lock 3 (1925) can be used to determine the future water regime for Overland Corner.

In the absence of natural floods, the use of pumping infrastructure to deliver environmental water into the wetlands is considered a high priority. Pumping environmental water into Overland Corner has occurred on two occasions to date, in 2004 and 2006.

2004 & 2006 pumping projects

The Overland Corner Wetland Group, with the support of partners such as SA Water, the National Trust and local landholder Richard Swinstead (owner of pump infrastructure) have implemented two environmental pumping projects at Overland Corner, during 2004 and 2006.

The aim of the pumping projects is to artificially flood the wetlands and maintain the ecological values of Overland Corner. The flood events are particularly important to maintain the condition of River Red Gums. The floods also attract numerous waterbirds and frogs to the wetlands, including threatened species such as the Southern Bell Frog.

Approximately 500 ML of water was pumped into the wetlands during 2006, which was a part of the River Red Gum Rescue Project along the River Murray. Map 2 shows the location of the wetlands that were inundated during this flood event.

During the 2006 pumping project the water level in the main lagoon reached 7.5 mAHD. Water levels in the wetlands slowly decreased when the pump was turned off, due to evaporation and minor leaking through the downstream regulator.

Refer to sections on 'Water Quality' and 'Ecological Features' for further description of the impacts of the pumping events in Overland Corner.



Aerial photograph of Overland Corner during the 2006 pumping project. Note the channel diverting water into the wetlands.

WATER FLOW INFRASTRUCTURE

Description of water flow structures

Overland Corner includes a number of structures that are used to manage the water levels in the wetland. These include:

- **Downstream regulator** (Figure 3): Box culvert structure located across downstream inlet. This is the main regulator used to hold water in Overland Corner.
- **Pumping infrastructure and channel** (Figure 4): Old irrigation pump now used to pump environmental water into Overland Corner. A channel adjacent to the pump delivers water into the wetlands (Map 2). Maximum pump capacity is 20 ML/day.
- **Pipe culverts**: Two open pipe culverts under vehicle track (Map 2). Not used to regulate water levels.
- **Upstream levee bank**: Earthen levee bank located across the upstream inlet and adjacent to the River Murray (Map 2). Used to hold water in the wetlands during pumping projects. This levee bank is a barrier to natural flows. *Note: Levee bank is due to be replaced by a box culvert regulating structure. See 'Proposed Upgrades' for further details.*



Figure 3. Photograph of the Overland Corner regulating structure (2004).



Figure 4. Photographs of the infrastructure used to pump water into Overland Corner (2006).

The location (geographic coordinates), sill level and commence to flow level for the downstream and upstream regulating structures is listed in Table 2.

Table 2. Geographic coordinates, sill levels and commence to flow rates (River Murray) for regulating structures in Overland Corner.

Structure	Location (AMG Zone 54)	Structure	Sill level * (mAHD)	Crest * (mAHD)	Commence to flow
Downstream regulator	439130 E 6219964 N	5 box culverts	6.30	7.75	Above pool level (~ 10,000 ML/day)
Upstream Inlet regulator (<i>proposed</i>)	440773 E 6217058 N	5 box culverts	7.10	8.56	Above pool level (~ 17,000 ML/day)

* Pool level downstream of Lock/Weir 3 is approximately 6.2 m AHD.

Recommended Management (Water Regime)

Under current conditions the wetlands in Overland Corner remain predominantly dry.

Artificial inundation of the wetlands by pumping environmental water is strongly recommended in the absence of natural floods. Artificial flood events are considered essential to maintain the condition of native vegetation and to provide habitat for native fauna.

The downstream regulator can manage water levels up to 7.7 mAHD (top of regulating structure), which equates to maximum water depth in the wetlands of 1.9 m. The volume of surface water at a water level of 7.7 mAHD is approximately 410 ML.

It is recommended to vary the extent of inundation in Overland Corner, to promote the regeneration of native plants at different water levels in the wetland. This can be achieved by varying the volume of water that is pumped into Overland Corner.

It is important to prolong the duration of flood events in Overland Corner by keeping the regulator closed (not allowing water to drain back to the river). This allows sufficient time for the regeneration and reproduction (breeding) of wetland plants and animals. However, it is important to monitor salinity levels as water evaporates from the wetlands.

It is also recommended to vary the season of inundation. Most River Murray flood events typically occurred during spring, which coincides with the growth, regeneration and reproduction cycles of native species. Therefore, it is a priority to inundate the wetlands between September-December (*although options currently limited due to the use of the pump infrastructure for irrigation*).

PROPOSED UPGRADES TO INFRASTRUCTURE

There are a number of minor and major upgrades to infrastructure that could be implemented at Overland Corner. The overall aim of the upgrades would be to increase the options for delivering environmental flows to the wetlands.

An outline of the proposed works/upgrades to infrastructure is described below.

1. Downstream regulator

- Minor works are required to reduce the leakage of water through the downstream regulator.
- However, if works are not successful to reduce leakage, complete replacement of the regulator may be required.
- If the regulator is replaced it is recommended to increase the height of the regulator to 8.5 mAHD (currently 7.7 mAHD). This would be equivalent to the height of the proposed upstream regulator.

2. New regulator (upstream inlet)

- Designs have been plans to construct a new box culvert regulator across the upstream inlet, to replace the existing levee bank (which is a barrier to natural flows). This regulator aims to hold water in the wetlands to increase the duration of inundation, and to facilitate natural flood events.
- Construction of the regulator is planned to begin during mid-2007.

Specifications (from designs):

- Length: 7.36m (5 box culverts)
- Width: 4.88m (4 box culverts)
- Invert (base) of regulator: 7.10 mAHD.
- Crest (top) of regulator: 8.56 mAHD.
- Fish passage: Central culvert has grid top to increase light levels

3. Alternative pumping source

- Investigate options to provide an alternative power source for existing pump
- Investigate options to install a pump with greater pumping capacity to replace the existing pump (alternative power source also required)
- Investigate options to install a pump (with power source) adjacent to the downstream regulator, enabling flows to enter the wetlands from the downstream inlet

4. Investigate options for environmental flows from above Lock 3

- Investigate options to install infrastructure that will deliver environmental flows from above Lock 3. This would make Overland Corner similar in hydrological function to Banrock Station (Lock 3) and Nigra Creek (Lock 2), which have inlets upstream and downstream of Lock structures.
- Receiving flows from above Lock 3 may provide managers with the ability to implement regular flood events in Overland Corner and significantly improve the condition of the wetlands.
- Recommend to investigate regional, state and national investment options (such as the National Water Initiative).

FLOOD INUNDATION MODEL

The River Murray Flood Inundation Model (Overton *et al.* 1999) presents hypothetical scenarios of where water would flow in a wetland under different river flow rates. The output from the model can assist management decisions when assessing in-coming river flows, or with manipulating water flow using control structures.

The following diagrams show the extent of inundation in Overland Corner (Figure 5). Until River Murray flows are above 50,000 ML/day, there is little change in the area of the wetland inundated. At 75,000 ML/day, the wetlands and most of the surrounding floodplain is connected to the river channel.

However, the Flood Inundation Model does not capture the inundation of the upstream and downstream inlets. This is due to the small size of the channels (<10m wide) and the large scale of the computer model (30m resolution).

WETLAND VOLUME

Information on the surface area, maximum water depth, and the volume of inundation are required to determine the environmental water requirements of the wetlands in Overland Corner.

Table 3 lists the area, depth and volume of inundation for wetlands in Overland Corner, based on results from the River Murray Wetlands Baseline Survey (SKM 2006). Refer to Appendix 8 for a map of wetland inundation.

Approximately 410 ML of water is required to fill the wetlands to a water level of 7.7 mAHD (top of the downstream regulator) (Table 3).

Table 3. Surface area, maximum depth and volume of inundation for different water levels.

Water Level (mAHD)	Overland Corner wetlands		
	Water Depth (m)	Area inundated (hectares)	Volume of water (ML)
5.95	0.10	0.0	0
6.32	0.47	0.2	2
6.80	0.95	17.8	199
7.27	1.42	41.0	365
7.74*	1.89	61.9	416
8.00	2.15	73.1	440

Source: Based on information in Baseline Survey (SKM 2006).

Notes:

- Pool level downstream of Lock/Weir 3 is approximately 6.2 mAHD
- Crest (top) of downstream regulation structure is 7.74 mAHD*
- Minimum elevation of wetlands in Overland Corner is 5.85 mAHD
- Commence to flow level for downstream inlet is approximately 6.4 mAHD



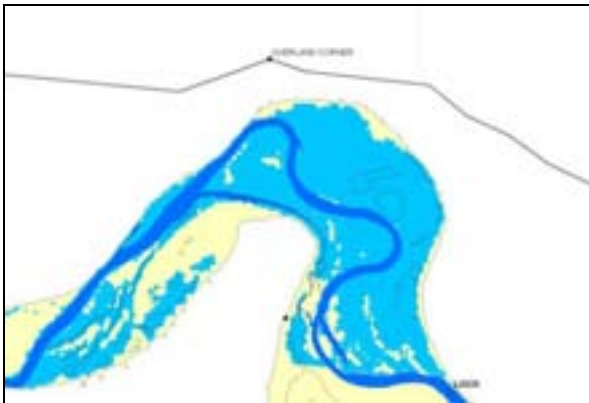
10,000 ML/day flow



25,000 ML/day flow



50,000 ML/day flow



75,000 ML/day flow



100,000 ML/day flow

Legend




-  1956 Flood Level
-  Area inundated
-  Permanent Water

Figure 5. Flood Inundation Model for Overland Corner, showing floodplain area inundated under different river flows.

GROUNDWATER

Groundwater effects surface water hydrology and salinity levels in a number of wetlands along the River Murray in South Australia.

Changes in land use and river regulation have had a significant impact on groundwater hydrology. For example, the construction of locks and weirs and the subsequent creation of permanent weir pools have elevated regional groundwater levels, resulting in the salinisation of some wetlands.

Groundwater at Overland Corner was studied in River Murray Wetlands Baseline Survey (SKM 2006). The Overland Corner wetland group have also been regularly monitoring groundwater since 2003.

Groundwater hydrology

Information on the depth to groundwater was recorded from eight piezometers during the 2005 Baseline Survey (SKM 2006).

Refer to Appendix 1 for groundwater monitoring data. Refer to Appendix 2 for the location of the piezometers.

The groundwater elevation during the Baseline Survey ranged from 5.89 to 6.25 mAHD, compared to the weir pool level of approximately 6.3 mAHD (Appendix 1). The weir pool level appears to have a significant control of groundwater levels on the floodplain, with a groundwater gradient from the river into the wetland (SKM 2006). There is also a groundwater flow gradient from the highland towards the floodplain (Appendix 2).

The depth of the groundwater below ground level (bgl) during the Baseline Survey ranged from 0.20 to 3.74 m bgl (Appendix 1). The elevation of the wetland bed (5.85 mAHD) was close to the lowest groundwater levels that were recorded (5.89 mAHD). This means that during dry conditions there is a high potential for saline groundwater to discharge into the wetland (SKM 2006), leading to the accumulation of salts.

Groundwater management

In Overland Corner the wetland bed is less than 6.0 m AHD, while observed groundwater levels ranged between 5.89 and 6.25 mAHD. This suggests the potential for interaction between surface water and groundwater. During drying events groundwater may discharge into low lying areas, which can result in deposition of salt at and near the soil surface.

Management of groundwater levels is therefore a high priority to maintain low salinity levels. However, effective groundwater management may require actions outside the scope of the Management Plan, such as expansion of the Woolpunda Salt Interception Scheme. It is important to promote natural flood events (and possibly managed floods) in low-lying areas of the floodplain to regularly flush salts from Overland Corner.

It is also recommended to continue the quarterly monitoring of groundwater levels and salinity using the existing piezometers network (SKM 2006).

Groundwater salinity

Groundwater salinity was recorded from a number of piezometers during the Baseline Survey (Appendix 1). The groundwater salinity levels ranged from 15,360 to 44,300 $\mu\text{S}/\text{cm}$ (SKM 2006).

The freshest groundwater was adjacent to the River Murray, suggesting there is a 'flush zone' in regions of the floodplain close to the River Murray. Highest groundwater salinity levels were recorded in the middle of the floodplain, away from the influence of the river.

Surface water salinity levels (in the wetlands) during the 2006 pumping event were generally low (less than 1000 $\mu\text{S}/\text{cm}$). This indicates that the current impact of groundwater discharge (seepage) may not be significant. However, this does not reduce the importance of natural or managed flood events to flush salt from Overland Corner.

Salinity or Electrical Conductivity (EC)?

Electrical conductivity or EC is a measurement used to estimate the concentration of salt (or salinity), which is frequently used in wetland monitoring in Australia.

EC is usually measured in $\mu\text{S}/\text{cm}$ (micro Siemens/cm). A measurement of 5,000 $\mu\text{S}/\text{cm}$ = 5,000 EC

Seawater is approximately 45,000 EC. River Murray water (at Berri) is approximately 250 EC

WATER QUALITY

Surface water quality in Overland Corner was not monitored during the Baseline Survey (SKM 2006).

However, the Overland Corner Wetland Group (community group) has recorded water quality in the wetlands during the 2004 and 2006 pumping events (B. Turner pers. comm. 2006). Table 4 provides a summary of water quality in Overland Corner.

Table 4. Surface water quality data recorded during community monitoring.

Water quality parameter	Monitoring date							
	Jun-04	Nov-04	Apr-06	May-06	Jun-06	Aug-06	Sep-06	
Salinity (EC) ($\mu\text{S}/\text{cm}$)	<i>Min.</i>	484	4500	337	293	365	470	485
	<i>Max.</i>	855	6300	548	553	697	894	1071
	<i>Mean</i>	718	5100	455	450	493	563	669
pH	<i>Min.</i>	7.0				6.5		7.0
	<i>Max.</i>	7.5				7.0		7.0
	<i>Mean</i>	7.3				6.9		7.0
Turbidity (NTU)	<i>Min.</i>	50		0	10	10	30	0
	<i>Max.</i>	100		30	30	40	300	400
	<i>Mean</i>	67		10	20	26	154	160
Temp. ($^{\circ}\text{C}$)	<i>Min.</i>	11.3		16.8	14.2	9.8	13.9	20.7
	<i>Max.</i>	16.3		20.6	18.5	15.7	15.8	23.9
	<i>Mean</i>	13.8		17.9	16.0	12.6	14.7	22.5

Source: Overland Corner Wetland Group community monitoring (B. Turner pers. comm. 2006)

Salinity (Electrical conductivity)

Surface water salinity levels ranging from 450 $\mu\text{S}/\text{cm}$ to 6300 $\mu\text{S}/\text{cm}$ (EC) have been recorded in Overland Corner when the wetlands were flooded (Table 4). Overall, the salinity levels were relatively low, with most observation within the trigger levels set by ANZECC (2000) for water quality in South Central Australia wetlands (300-1,000 $\mu\text{S}/\text{cm}$).

Figure 6 shows the change in salinity levels during the 2004 and 2006 pumping projects.

During both the 2004 and 2006 floods, salinity levels decreased after the wetland was flooded, due to the inflows of fresh River Murray water.

Notably, salinity levels during the 2006 flood were substantially lower than 2004 (Figure 6). This suggests there was little accumulation of salt following the 2004 flood (even though water was allowed to evaporate to dry, leading to some evapoconcentration of salts).

The total salt load in the surface water was approximately 145 tonnes in 2006. That is, based on an average salinity of 600 $\mu\text{S}/\text{cm}$ (1 $\mu\text{S}/\text{cm}$ = 0.6 mg/l TDS) and volume of 400 ML of surface water in the wetlands.

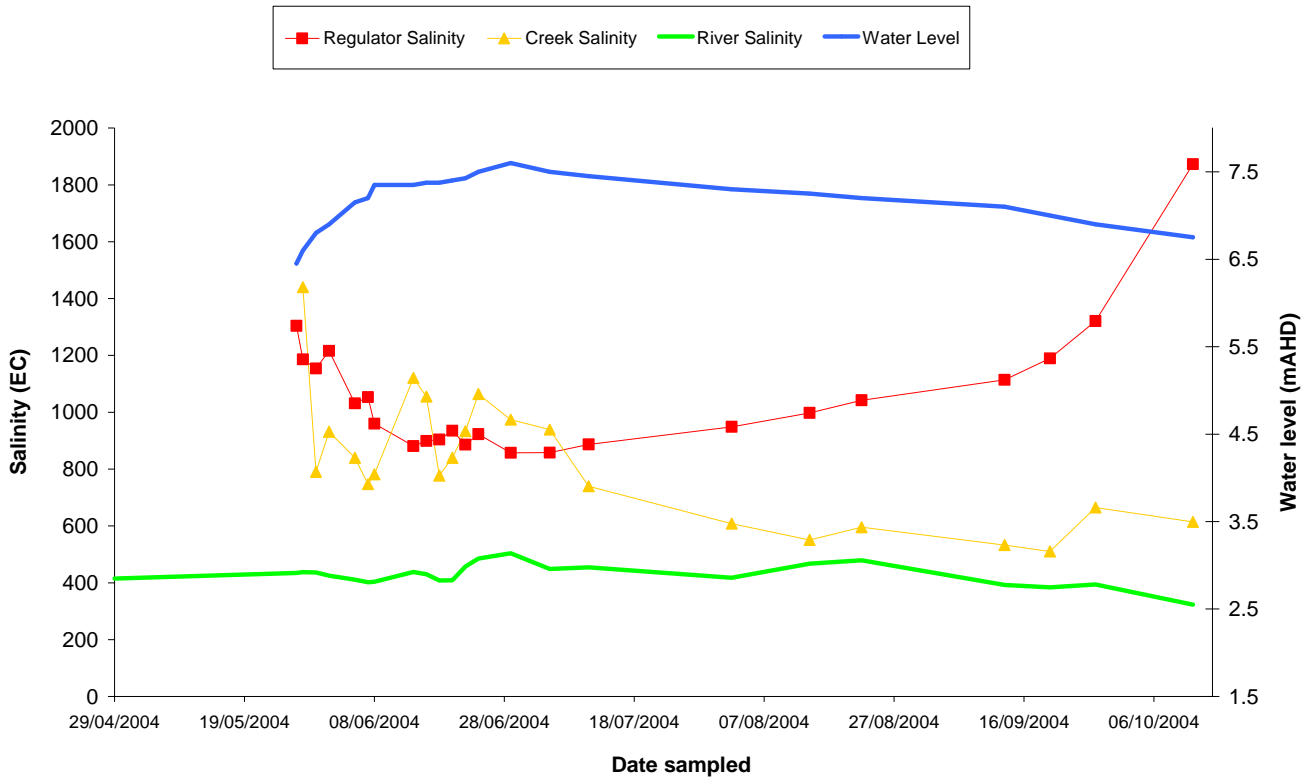


Figure 6. Wetland salinity levels (EC in $\mu\text{S}/\text{cm}$) during the pumping projects undertaken in **a)** 2004 and **b)** 2006. [Source: Overland Corner Wetland Group]

Salinity management

Salinity is a key factor when deciding how to manage the water regime in Overland Corner. Higher salinity levels occur when the water level is decreasing and salts accumulate through evapoconcentration. Lower salinity levels occur when the water level is increasing and salts are diluted.

Notably, salinity levels did not increase between the 2004 and 2006 pumping events. This supports the aim of management to implement further pumping projects for wetland conservation.

There is potential during future flood events to allow the surface water to flow back into the River Murray (by opening regulators). This will reduce the accumulation of salt in the wetlands, and mimics what would have occurred in a natural flood event.

However, salinity impacts to the River Murray resulting from wetland management also need to be considered. To date, no assessment of salinity impacts from Overland Corner to the River Murray has been undertaken, due to the lack of a suitable method for this assessment.

Dissolved oxygen

Dissolved oxygen concentrations have not been previously recorded in Overland Corner.

Low levels of oxygen (e.g. <3 mg/L) can be harmful or kill aquatic organisms, including freshwater fish. It is recommended to include dissolved oxygen as a parameter in future water quality monitoring, particularly following the re-wetting of the wetland.

pH

Moderate to high alkaline pH levels ranging from 6.5 to 7.5 have been recorded in Overland Corner (B. Turner pers. comm. 2006). These pH levels are within the trigger levels defined by ANZECC (2000) for lowland rivers in south central Australia (e.g. maximum pH 9).

Turbidity

Turbidity is an estimate of the 'cloudiness' or 'muddiness' of the water, with high turbidity relating to more 'turbid' water. High levels of turbidity can suppress the growth of aquatic plants by limiting penetration of underwater light. High levels of suspended solids (a factor causing turbidity) can also impact on algae, biofilms and on aquatic fauna.

Turbidity levels ranging from 0 to 400 NTU have been recorded in Overland Corner during community monitoring (Table 4). The maximum turbidity levels exceeded the trigger levels set by ANZECC (2000) for wetlands in south central Australia (1-100 NTU).

High turbidity levels were recorded in the main lagoon near the downstream regulator. The lack of aquatic plants may be a factor contributing to the high levels (>100 NTU).

Nutrients

Nutrient levels have not comprehensively monitored in Overland Corner.

High levels of nutrients (e.g. nitrogen, phosphorus) can affect water quality and alter the wetland ecosystem (e.g. lead to algal blooms).

It is recommended to include nutrients in future monitoring, particularly following flood events. It may also be worth investigating the impacts of cattle grazing on nutrient levels in Overland Corner.

ECOLOGICAL FEATURES

The ecological features of Overland Corner including information on the vegetation, birds, fish and frogs were recorded as part of the Baseline Survey (SKM 2006).

Vegetation

Vegetation mapping

Seven different vegetation communities were identified during the Baseline Survey, these include:

- River Red Gum (*Eucalyptus camaldulensis*) / Black Box (*Eucalyptus largiflorens*) woodland
- River Red Gum (*Eucalyptus camaldulensis*) woodland over Lignum (*Muehlenbeckia florulenta*)
- Samphire (*Halosarcia pergranulata*) shrubland
- Lignum (*Muehlenbeckia florulenta*) shrubland
- Chenopod (*Chenopodium pumilio*) shrubland
- Cumbungi (*Typha* sp.) / Club-rush (*Bolboschoenus caldwellii*) sedgeland
- Spiny Sedge (*Cyperus gymnocaulos*) sedgeland

Refer to Appendix 3 for a map of these vegetation communities in Overland Corner.

Detailed plant surveys have been undertaken during the Baseline Survey and as part of community monitoring. Refer to Appendix 4 for a list of the plant species that have been recorded.

Figure 7 provides photographs of some of the vegetation communities observed at Overland Corner.

Description of vegetation communities

Floodplain vegetation is dominated by tree and shrub species including Black Box (*Eucalyptus largiflorens*), River Red Gum (*Eucalyptus camaldulensis*), Lignum (*Muehlenbeckia florulenta*), Samphire (*Halosarcia* spp.), Saltbush (e.g. *Atriplex semibaccata*), Rats-tail Couch (*Sporobolus mitchellii*) and Spiny Sedge (*Cyperus gymnocaulos*).

The dominance of Samphire on some areas of the floodplain suggests high soil salinity in these areas (Cunningham *et al.* 1992, SKM 2006).

61 plant species were recorded during the Baseline Survey, including 21 exotic plants (Appendix 4).

A few aquatic plants were observed in the upstream wetlands during the 2006 flood, including Water Milfoil (*Myriophyllum* sp.) and Water Buttons (*Cotula coronopifolia*) (B. Turner pers. comm. 2006).

Where the downstream inlet meets the main river channel there are also patches of aquatic vegetation including Ribbonweed (*Vallisneria spiralis*), Azolla (*Azolla filiculoides*) and Water Primrose (*Ludwigia peploides* ssp. *montevidensis*). Emergent plant species included Common Reed (*Phragmites australis*) and Cumbungi (*Typha* sp.) with some stands of Salt Club-rush (*Bolboschoenus caldwellii*) and Spiny Sedge (*Cyperus gymnocaulos*) (SKM 2006).

The upstream section of the floodplain is grazed by cattle. Grazing impacts are evident in the central part of the floodway, for example, where there is a high abundance of exotic plants including Common Sow-thistle (*Sonchus oleraceus*) and Asterweed (*Aster subulatus*). A reduction in grazing intensity and weed control is recommended for this area (SKM 2006).



Inundated wetland habitat dominated by River Red Gum (*Eucalyptus camaldulensis*) and Lignum (*Muehlenbeckia florulenta*).



Riparian habitat dominated by Saltbush (*Atriplex* sp.), Bluebush (*Maireana* sp.) and River Red Gum (*E. camaldulensis*).



Dry wetland bed with stressed River Red Gum (*E. camaldulensis*).



Aerial photograph showing inundated wetlands and floodplain dominated by Lignum (*M. florulenta*).

Figure 7. Photographs of vegetation communities in Overland Corner (2006).

Three species of conservation significance have been recorded in Overland Corner: Dwarf Daisy (*Brachyscome goniocarpa*), Grass Daisy (*Brachyscome graminea*) and Spreading Goodenia (*Goodenia heteromera*), which are all considered 'rare' in South Australia.

A number of introduced plants also occur in Overland Corner, which may need to be controlled. Common introduced plants include: African Boxthorn (*Lycium ferocissimum*), Noogoora Burr (*Xanthium occidentale*), Common Sow-thistle (*Sonchus oleraceus*) and introduced grasses and herbs commonly found on the River Murray floodplain. Many of these introduced species are terrestrial plants and would not tolerate inundation if a flood event occurred.

Tree health

River Red Gum (*E. camaldulensis*) tree health is highly variable across the floodplain (SKM 2006). The Baseline Survey observed that only seven River Red Gum trees along the main flood paths were in excellent health. There are several trees of very poor health adjacent to the large lagoon.

Black Box (*E. largiflorens*) tree health ranges from moderate to excellent health across most of floodplain (SKM 2006).

The pumping events in 2004 and 2006 had a generally positive effect on the condition of River Reed Gum and Black Box. In some of the inundated wetlands, the condition of River Red Gums improved significantly due to flooding. Trees that were already in very poor condition often did not respond following the flood events (B. Turner pers. comm. 2006).

In the absence of natural flood events, the implementation of artificial flood events is considered essential to maintain the condition of native trees in Overland Corner.

It is also important to consider the effect that grazing may have on the regeneration of River Red Gum and Black Box. Future monitoring should investigate the effect of grazing on wetland and floodplain vegetation.

Vegetation management

Although Overland Corner supports a diverse plant community, lack of flood events is likely to have significantly reduced the condition and extent of wetland vegetation.

Increased environmental flows are very important to maintain the condition of River Red Gum, Black Box and other flood-dependent vegetation. Weir pool manipulations and pumping water into flood runners and depressions may result in localised improvement in tree health and floodplain condition.

In the absence of natural floods, it is strongly recommended to continue to pump water into Overland Corner (or other environmental flows) to maintain the condition of trees and other native plants.

Ongoing monitoring of vegetation condition, including tree health is important to observe the response of wetland vegetation to different water regimes.

Fauna

Refer to Appendix 6 for a list of fauna species recorded in Overland Corner.

Birds

A number of wetland and woodland birds were recorded Overland Corner during the Baseline Survey and from other surveys (B. Turner pers. comm. 2006), including threatened and migratory bird species (Appendix 6).

Bird surveys were conducted at four sites in the Baseline Survey (SKM 2006) and at a number of locations during community monitoring.

The most abundant bird species observed in Overland Corner include: Grey Teal, Black Swan, Pink-eared Duck, Hardhead, Australasian Shoveller and Australian Wood Duck. The nationally threatened Freckled Duck was observed in the wetlands during the 2006 pumping project (B. Turner pers. comm. 2006).

Regent Parrot has also been recorded in Overland Corner, which is listed as 'vulnerable' in South Australia and nationally. A Recovery Plan for Regent Parrot is currently being implemented in the Riverland, South Australia (Schultz 2005).

Migratory bird species such as Great Egret have also been observed in the wetland. Migratory species are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Bird management

It is important to protect wetland habitat in Overland Corner to maintain the abundance and diversity of bird species, under wet and dry conditions.

Ongoing management of the water levels in the wetlands is considered important for water bird conservation. Fluctuation of the water levels (during either natural or managed floods) aims to increase the diversity and abundance of wetland plants, providing habitat and food resources for ducks, spoonbills, grebes and other bird species.

Future bird surveys will be conducted during spring months, and during flood events, to record signs of breeding and important bird refuges.

Fish

A fish survey was undertaken during the Baseline Survey in spring 2005 (SKM 2006). Sampling was confined to one small pool near the downstream inlet (floodplain side of the regulator). The recruitment of fish during the artificial pumping projects has not been assessed.

A total of 3 species (79 individuals) were collected in the Baseline Survey, including Carp Gudgeon (77 individuals) and introduced fish species Common Carp (1 individual) and Gambusia (1 individual).

The presence of juvenile Carp Gudgeons and Carp is evidence of relatively recent reproduction, which may have occurred within or adjacent to the wetland. While Carp and Gambusia were recorded in low abundance, the fact that they are on the wetland side of the carp screen indicates that rapid recruitment and establishment of introduced fish is possible during flood events.

Fish management

Overland Corner is likely to provide good habitat for native fishes during natural flood events.

Monitoring is important to identify the fish populations using different parts of the wetlands and to investigate whether the regulating structures inhibit fish passage. If adequate flow is received, the carp screens, stop logs and box culvert (despite the presence of a skylight) may deter the passage of some small native fishes. Reconfiguration of the mesh size, and alteration to an open-top box culvert may improve this situation (SKM 2006).

Future monitoring should be event-based (not seasonal), occurring when the wetland is inundated.

Frogs

Frog surveys were included in the Baseline Survey and have been undertaken during community monitoring.

Seven frog species have been recorded in Overland Corner, these include: Eastern Sign-bearing Froglet, Spotted Grass Frog, Peron's Tree Frog, Painted Frog, Long-thumbed Frog, Eastern Banjo Frog and the Southern Bell Frog. The most common species during these surveys were the Eastern Sign-bearing Froglet and Spotted Grass Frog (B. Turner pers. comm. 2006).

The Southern Bell Frog is listed as vulnerable both in South Australia and nationally (under the EPBC Act). A Recovery Plan for Southern Bell Frog is currently being implemented along the River Murray in South Australia (Schultz 2005).

Figure 8 shows the abundance and number of frogs that were recorded at Overland Corner between 2003 and 2006. Notably, the highest abundance and diversity of frog species coincided with the 2006 pumping, when there was a significant increase in the volume of water in the wetlands.

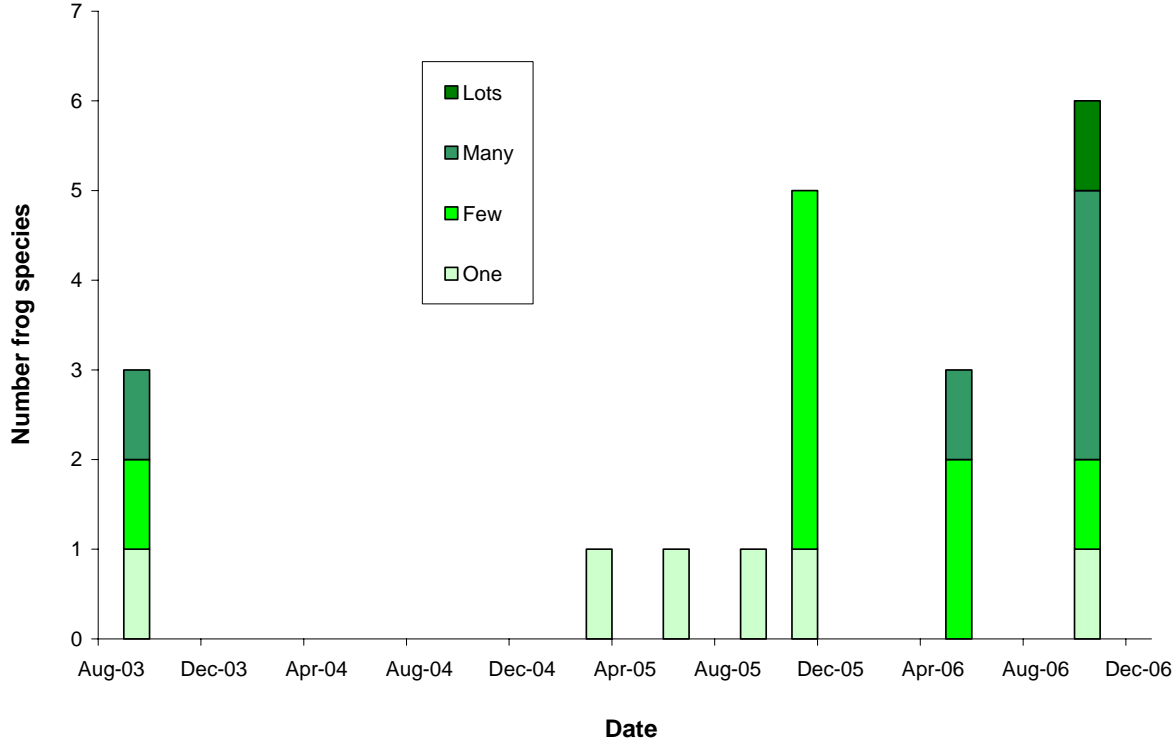


Figure 8. Number of frog species (richness) and abundance of frogs (one, few, many, lots) recorded in Overland Corner between 2003 and 2006.

Frog management

The diversity of frog species at Overland Corner is considered high relative to other wetlands in the Riverland. This may be due to the diversity of wetland habitats and good water quality.

The pumping event in 2006 had a positive effect on the number of frogs calling in Overland Corner, and this type of management should be repeated in the future.

Future surveys will help to determine the importance of different wetland habitat as refuges and help to monitor the impact of wetland management on frog populations.

Macroinvertebrates

Macroinvertebrates have not been monitored at Overland Corner.

Information on the diversity and abundance of macroinvertebrates identifies the food resources that frogs, fish and waterbirds may use in Overland Corner. Macroinvertebrates can also be used as indicators to monitor wetland condition, as some macroinvertebrates are sensitive to changes in salinity, pH and other environmental conditions.

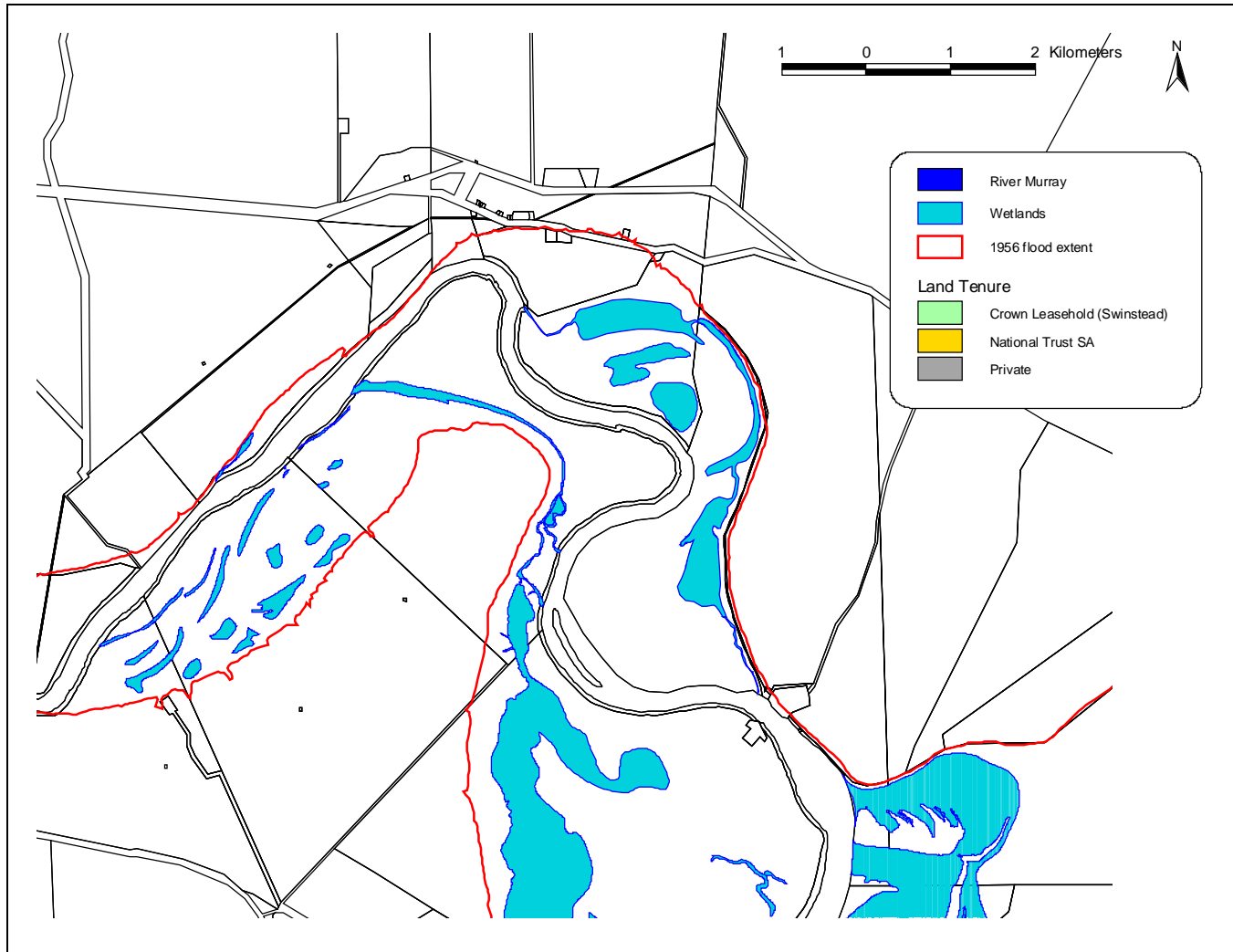
Macroinvertebrate management

It is recommended to undertake macroinvertebrate surveys in Overland Corner after future filling events, to see how the macroinvertebrates respond to wetland management.

LAND TENURE, JURISDICTION AND MANAGEMENT ARRANGEMENTS

Land tenure

Overland Corner occurs predominantly on two forms of land tenure, land that is managed under dedicated lease by the National Trust of South Australia, and Crown land. The area of Crown land is managed as annual leasehold (Map 3). Management activities include nature conservation and grazing.



Map 3. Land tenure at Overland Corner

Jurisdiction authority and management arrangements

Under the *Crown Lands Act 1929* the National Trust have the primary management responsibility for the area of Overland Corner that is included under the dedicated lease.

The Minister for Environment and Conservation has the ultimate jurisdictional authority for Crown land in Overland Corner. The annual leaseholder as occupants of the land also has management responsibility.

Wetland management is undertaken by the Overland Corner wetland group (including the National Trust of SA) with assistance from the South Australian Murray-Darling Basin Natural Resources Management Board and the Berri Barmera LAP.

THREATS TO THE WETLAND

Identifying threats to Overland Corner is important to inform managers of the major issues, and to ensure the management actions themselves do not pose a threat to conservation.

A number of threats to the values of the wetlands and floodplain have been identified. These include **biological threats** such as weed infestations, **physical threats** such as the lack of flood events, and **management-related threats** such as increased vehicle use on the floodplain.

Table 5 lists the major threats at Overland Corner, identifies their cause and potential impact, and describes the actions required to minimise or mitigate the threats.



Drought-stressed River Red Gums (*E. camaldulensis*) in Overland Corner (2006).

Table 5. Physical, biological and management-related threats to the values of Overland Corner.

THREATS		CAUSE	IMPACT	RESPONSE TO REDUCE THREAT	
Physical	Actual	Altered water regime	<ul style="list-style-type: none"> Construction of locks and weirs along the River Murray. Reduced frequency and duration of flood events. 	<ul style="list-style-type: none"> Wetlands dry for prolonged periods due to the pool level maintained in the River Murray. Altered water regime, including lack of flood events, has resulted in the decline of native flora and fauna communities, and contributed to the accumulation of salt on the floodplain. 	<ul style="list-style-type: none"> Implement a water regime to mimic the 'natural' water regime that would have occurred in the past (via pumping or other environmental flow initiatives). Investigate options to upgrade infrastructure to increase frequency of flood events in Overland Corner (e.g. divert water from above Lock 3).
	Potential	Salinisation of wetland and floodplain	<ul style="list-style-type: none"> Elevated groundwater table due to changed land uses in the region and influence of locks/weirs. Reduced frequency and duration of flood events. 	<ul style="list-style-type: none"> Increased surface water salinity levels in the wetlands. Increased accumulation of salts on the floodplain (soils, salt crusts). Reduced diversity of native wetland flora and fauna due to high salt levels. 	<ul style="list-style-type: none"> Implement a water regime that aims to limit the impact of high salinity in the wetland (e.g. allow water to drain from the wetlands back into the River Murray). Investigate options to upgrade infrastructure to increase frequency of flood events in Overland Corner (e.g. divert water from above Lock 3).
Biological	Actual	Increased abundance of pest plants	<ul style="list-style-type: none"> Establishment of introduced weed species and other pest plants on the River Murray floodplain. 	<ul style="list-style-type: none"> A number of introduced pest plants have been observed in Overland Corner, including African Boxthorn (<i>Lycium ferocissimum</i>), Noogoora Burr (<i>Xanthium occidentale</i>). High abundance of pest plants can impact of native vegetation. 	<ul style="list-style-type: none"> Control the abundance of African Boxthorn and other pest plants by physical removal and other control options.
	Actual	Increased abundance of pest animals	<ul style="list-style-type: none"> Invasion of terrestrial pest animals such as foxes and rabbits. 	<ul style="list-style-type: none"> High rabbit abundance impacts on native vegetation, including recruitment of native trees, grasses and herbs. Fox predation on native wildlife. 	<ul style="list-style-type: none"> Monitor rabbit and fox abundance in Overland Corner. Implement pest animal control program as required.
	Potential	Decline in habitat condition due to cattle grazing	<ul style="list-style-type: none"> High intensity of cattle grazing on the floodplain, and cattle access to wetlands. 	<ul style="list-style-type: none"> High cattle stocking rates may impact on the regeneration and establishment of native vegetation across the floodplain. Cattle access to wetlands may impact on water quality and recruitment of aquatic plants. 	<ul style="list-style-type: none"> Manage sustainable cattle stocking rates in Overland Corner. Limit the access of cattle to the wetlands during flood events. Investigate the impact of grazing, and removal of grazing on the diversity, growth and regeneration of River Red Gum and other wetland plants.
Management	Potential	Decline in habitat condition caused by vehicles, and other recreation activities	<ul style="list-style-type: none"> Some areas of Overland Corner are accessible to public, which may promote excessive vehicle use and other threatening activities. 	<ul style="list-style-type: none"> Excessive vehicle may lead to degradation of native vegetation, contribute to soil erosion, and prevent regeneration of native plants. 	<ul style="list-style-type: none"> Rationalise the network of tracks (e.g. block superfluous tracks and revegetate with floodplain species). Promote education of sustainable recreation activities in Overland Corner.
	Potential	Lack of continued community involvement in management of Overland Corner.	<ul style="list-style-type: none"> Lack of community involvement in the management and monitoring of Overland Corner (e.g. due to lack of support from government). 	<ul style="list-style-type: none"> No community ownership of wetland management at Overland Corner. Reduced monitoring of the change in wetland condition due to natural and managed flood events. 	<ul style="list-style-type: none"> Maintain the Overland Corner wetland group, which has capacity to undertake wetland management and monitoring. Undertake capacity building activities to support the long-term management of Overland Corner by local community.

MANAGEMENT OBJECTIVES

The management objectives for Overland Corner were previously listed on page 7. These are summarised below:

- Implement flood events in Overland Corner every 2 in 3 years by allowing natural floods to occur and/or by artificially pumping water from the River Murray.
- Install new regulation structure at the upstream inlet (near Lock 3).
- Investigate infrastructure options to improve the management of surface water and groundwater.
- Limit the access and impact of cattle grazing in the Overland Corner.
- Monitor surface water salinity and groundwater levels, and investigate options to flush salt.
- Continue to implement a revegetation program in Overland Corner.
- Control the abundance of noxious weeds and other pest plants.
- Control the abundance of pest animals.
- Maintain the Overland Corner Wetland Group, which has the capacity to undertake wetland management and monitoring.
- Continue to support the use of the National Trust section of Overland Corner by community and visitors.

Table 6 lists the specific management objectives for Overland Corner, and describes the management actions, resources and timetable to address these objectives.

The management objectives have been developed through consultation with the Overland Corner wetland group, National Trust of South Australia, SA Water and other stakeholders.

The objectives will be reviewed and updated in June 2011 (or before then as required).

Future management objectives for Overland Corner will be guided by an adaptive management approach ('learning by doing'). The ongoing monitoring program will also provide results to inform future management decisions.

Table 6. Management objectives for Overland Corner, including specific management aims, management actions and priorities.

MANAGEMENT OBJECTIVES	SPECIFIC MANAGEMENT AIMS	ACTIONS / ACTIVITIES	RESOURCES	TIMETABLE	PRIORITY
Implement flood events in Overland Corner every 2 in 3 years by allowing natural floods to occur and/or by artificially pumping water from the River Murray, which aims to provide habitat for native fauna and promote the regeneration of native vegetation (including River Red Gums).	<ul style="list-style-type: none"> ▪ Implement a natural or managed flood event in Overland Corner every 2 in 3 years. ▪ Maintain the abundance and diversity of wetland birds. Including at least 500 individual wetland birds during the wetting cycle, and 2 threatened species. ▪ Maintain populations of at least 4 species of frog, with an aim of increasing the abundance of frogs. ▪ Over the next 5 years observe no decline in the tree health of River Red Gums adjacent to wetlands in Overland Corner. 	<ul style="list-style-type: none"> ▪ Implement Wetland Operational Plan. ▪ Monitor the abundance of native fauna at different times of the year in response to wetland management. ▪ Monitor the change in wetland and floodplain vegetation in response to wetland management. 	<ul style="list-style-type: none"> ▪ Require a source of environmental water for pumping projects. ▪ Technical expertise to support monitoring program. 	<ul style="list-style-type: none"> ▪ See Wetland Operational Plan and Monitoring Program for further details. 	1
Install a new regulation structure across the upstream inlet (near Lock 3), which will provide greater flexibility of management during natural and artificial flood events.	<ul style="list-style-type: none"> ▪ Install regulation structure by December 2007. 	<ul style="list-style-type: none"> ▪ Obtain approvals and work with contractors to install the upstream regulation structure by December 2007. 		<ul style="list-style-type: none"> ▪ Structure installed by Dec 2007. 	1
Investigate a range of other infrastructure options to improve the management of surface water and groundwater. This includes options to the move the location of the wetland pump, and investigation of the potential to expand the Woolpunda Salt Interception Scheme.	<ul style="list-style-type: none"> ▪ Consult with wetland ecologists and hydrological engineers about the feasibility of alternative surface water and groundwater management options by December 2007. 	<ul style="list-style-type: none"> ▪ Investigate options to increase frequency of flood events in Overland Corner by delivering environmental flows from above Lock/Weir 3, and by upgrading the pumping infrastructure in Overland Corner (e.g. alternative power source). 	<ul style="list-style-type: none"> ▪ Technical expertise to investigate upgrades to infrastructure. 	<ul style="list-style-type: none"> ▪ Consultation completed by Dec 2007. 	2
Limit the access and impact of cattle grazing in the Overland Corner wetlands to maintain and enhance the condition of wetland plants and improve water quality.	<ul style="list-style-type: none"> ▪ Determine (and implement) sustainable cattle stocking rates by July 2007, in liaison with technical experts. ▪ Investigate options to install additional fencing (e.g. around wetlands) by December 2007. 	<ul style="list-style-type: none"> ▪ Monitor the number of cattle accessing the floodplain. ▪ Discuss options to install additional fencing with land managers and funding organisations. 	<ul style="list-style-type: none"> ▪ Technical expertise to support monitoring program. 	<ul style="list-style-type: none"> ▪ Review cattle grazing by July 2007. 	1
Monitor surface water salinity levels and groundwater levels, and investigate options to flush stored salt from the wetlands.	<ul style="list-style-type: none"> ▪ Observe surface water salinity levels < 1000 µS/cm (EC) for at least 70% of the duration of the wetting cycle in Overland Corner. ▪ Implement at least 2 natural or managed flushing (flood) events by July 2011. 	<ul style="list-style-type: none"> ▪ Implement Wetland Operational Plan. ▪ Investigate options to increase frequency of flood events to flush stored salt. ▪ Monitor change in surface water and groundwater salinity in response to management (e.g. monitor input of saline groundwater when wetlands dry). 	<ul style="list-style-type: none"> ▪ Require a source of environmental water for pumping projects. ▪ Technical expertise to support monitoring program. 	<ul style="list-style-type: none"> ▪ See Wetland Operational Plan and Monitoring Program for further details. 	1
Continue to implement a revegetation program in Overland Corner.	<ul style="list-style-type: none"> ▪ Complete at least 3 hectares of revegetation per year at Overland Corner. 	<ul style="list-style-type: none"> ▪ Identify priority regions of Overland Corner for revegetation. ▪ Select native plants for revegetation that are able to tolerate dry and wet conditions. 	<ul style="list-style-type: none"> ▪ Technical expertise to support revegetation program. 	<ul style="list-style-type: none"> ▪ Revegetation program is ongoing 	2
Control the abundance of noxious weeds and other pest plants.	<ul style="list-style-type: none"> ▪ Control the populations of African Boxthorn, and other pest plants, over 5 years and observe no increase in the abundance of pest plants. 	<ul style="list-style-type: none"> ▪ Monitor the distribution and abundance of pest plants (in conjunction with SAMDB NRMB). ▪ Implement control programs for pest plant populations as necessary (e.g. spray Boxthorn). 	<ul style="list-style-type: none"> ▪ Technical expertise to map pest plants distribution. ▪ SAMDB NRMB to assist. 	<ul style="list-style-type: none"> ▪ See Monitoring Program for further details. 	2
Control the abundance of pest animals.	<ul style="list-style-type: none"> ▪ Investigate options to control rabbits and foxes by July 2007. ▪ Undertake fish monitoring at least 1 x during wetting events to record the abundance of Carp and other introduced fish. 	<ul style="list-style-type: none"> ▪ Monitor the distribution and abundance of pest animals in Overland Corner (in conjunction with SAMDB NRMB). 	<ul style="list-style-type: none"> ▪ Technical expertise to survey pest animal populations. ▪ SAMDB NRMB to assist. 	<ul style="list-style-type: none"> ▪ See Monitoring Program for further details. 	2
Maintain the Overland Corner Wetland Group, which has the capacity to undertake wetland management and monitoring.	<ul style="list-style-type: none"> ▪ Maintain the same level of community involvement at Overland Corner over the next 5 years. ▪ Organise at least 4 wetland monitoring days per year with the Overland Corner wetland group. 	<ul style="list-style-type: none"> ▪ Hold regular meetings and monitoring days with the Overland Corner wetland group. 		<ul style="list-style-type: none"> ▪ See Monitoring Program for further details. 	1
Continue to support the use of the National Trust section of Overland Corner for recreation, camping and other activities.	<ul style="list-style-type: none"> ▪ Develop a strategy to promote recreation and education about nature conservation at Overland Corner by July 2008. 	<ul style="list-style-type: none"> ▪ Establish a long-term strategy to promote sustainable recreation, tourism and education (e.g. may include signage, brochures, website upgrade) 	<ul style="list-style-type: none"> ▪ Apply for external funds for sustainable recreation. 		2

WETLAND OPERATIONAL PLAN (WATER REGIME)

The wetland operational plan outlines the management of the water regime in Overland Corner, based on the management objectives outlined in Table 6.

The wetland operational plans describe the phases of wetting and drying based on the management of regulating structures. These regulation structures enable an environmental water allocation to be managed within Overland Corner.

The operational plan has an initial four-year cycle, between 1 July 2007 and 30 June 2011.

The predicted water allocation for Overland Corner for the period 1 July 2007 to 30 June 2011 is approximately 960 ML (refer Appendix 9 for further details).

DESCRIPTION OF WETLAND OPERATIONAL PLAN

The wetland operational plan (water regime) for Overland Corner is presented in Figure 9. This shows the recommended wetting and drying cycle between July 2007 and June 2011.

It is recommended to implement natural or managed flood events in Overland Corner at least 2 in every 3 years (Figure 9). This aims to promote the regeneration of River Red Gums and other wetland plants and provide habitat for native species of waterbirds, frogs and macro-invertebrates.

In the absence of natural flood events, it is considered essential to implement managed flood events by pumping environmental water into the wetlands. Previous pumping events in 2004 and during 2006 had a positive effect on the ecological values of the wetlands in Overland Corner.

Approximately 410 ML of water is required to inundate the wetlands to maximum capacity (top of the regulator ~ 7.7 mAHD). This excludes the volume of water required to saturate the soil.

It is recommended that the volume of water pumped into Overland Corner is varied in different years, to vary the water level in the wetlands. This is important to promote the growth of wetland plants across a range of elevations, increasing habitat diversity.

A detailed description of the wetland operational plan for Overland Corner, including the timing of pumping events, and key expected responses is provided in Table 7.

Monitoring the response of wetland plants and animals, groundwater and surface water to the wetting and drying cycles will be important (to see if the condition of the wetland improves over time).

Overland Corner wetlands

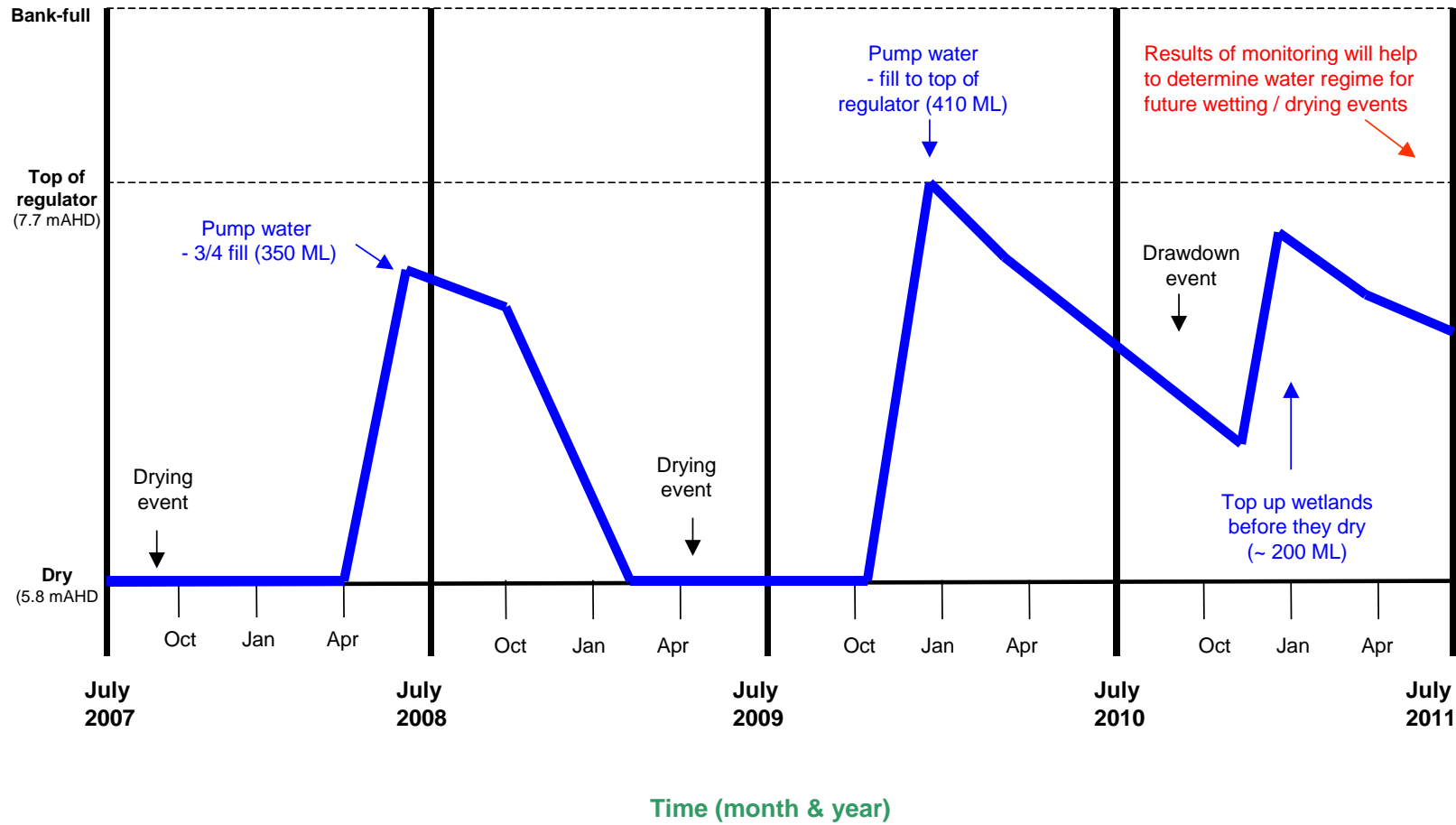


Figure 9. Diagram showing the Wetland Operational Plan for Overland Corner (assuming no natural flood events)

Table 7. Wetland Operational Plan for Overland Corner.

Year	Timing	Action	Activity	Expected response	Water Use	
Year 1	July 2007 - June 2008	1 July 2007 to 31 March 2008	Dry wetland	Wetland dry	<ul style="list-style-type: none"> ▪ Drawdown in water level may increase plant diversity around edge of wetlands. ▪ Consolidation of the wetland bed sediment. ▪ Reduced abundance of aquatic fauna. ▪ Germination of terrestrial plants on wetland bed. 	0 ML
		1 April to 31 May 2008	Inundate wetland to 75% of capacity	Pump ~350 ML of water into the wetlands	<ul style="list-style-type: none"> ▪ Release of nutrients from wetland bed. ▪ Provide habitat for aquatic fauna, particularly waterbirds and frogs. ▪ Germination of wetland plants. ▪ Reduction in surface water salinity level. ▪ Possibly create freshwater lens. ▪ Regeneration of River Red Gum trees 	350 ML
		1 June to 30 June 2008	Dry wetland (drawdown)	Evaporation. Drawdown of water level	<ul style="list-style-type: none"> ▪ As above 'dry event' 	0 ML
Year 2	July 2008 - June 2009	1 July 2008 to 30 June 2009	Dry wetland (drawdown)	Evaporation. Drawdown of water level	<ul style="list-style-type: none"> ▪ As above 'dry event' 	0 ML
Year 3	July 2009 - June 2010	1 July to 31 Sept 2009	Dry wetland	Wetland dry	<ul style="list-style-type: none"> ▪ As above 'dry event' 	0 ML
		1 Oct to 30 Nov 2009	Inundate wetland to 100 % capacity	Pump ~410 ML of water into the wetlands	<ul style="list-style-type: none"> ▪ As above 'inundation events' 	410 ML
		1 Dec 2009 to 30 June 2010	Dry wetland (drawdown)	Evaporation. Drawdown of water level	<ul style="list-style-type: none"> ▪ As above 'dry event' 	0 ML
Year 4	July 2010 - June 2011	1 July to 31 Oct 2010	Dry wetland (drawdown)	Evaporation. Drawdown of water level	<ul style="list-style-type: none"> ▪ As above 'dry event' 	0 ML
		1 Nov to 31 Dec 2010	Inundate wetland to 85 % capacity	Pump an additional 200 ML of water, to top of the water level	<ul style="list-style-type: none"> ▪ As above 'inundation events' 	200 ML
		1 Jan to 30 June 2011	Dry wetland (drawdown)	Evaporation. Drawdown of water level	<ul style="list-style-type: none"> ▪ As above 'dry event' 	0 ML

MODIFYING THE WETLAND OPERATIONAL PLAN

The wetland operational plan is only a guide and should be modified if monitoring results provide evidence to support a change in management. Natural weather patterns may also require the wetland operational plan to be modified, particularly if a natural flood event occurs.

When implementing a water regime it is important to consider the different stages in the wetting and drying cycle of the wetland, and their impacts on the physical and biological values of the ecosystem. These stages and their impact on the wetland are described in *Your Wetland: Hydrology Guidelines* (Tucker *et al.* 2002) and summarised in Appendix 7.

The wetland operational plan is to be reviewed in June 2011, to determine whether or not the plan and management objectives are appropriate for Overland Corner.



Aerial photograph of Overland Corner during 2006 pumping project. Note the River Red Gums being inundated in the wetlands.

FLOOD EVENTS

Flood events impact on Overland Corner during periods of high flow in the River Murray. It is important to have clear objectives and actions for management during flood events.

The inflow of water during floods cannot generally be managed, due to over bank flooding and subsequent inundation of the floodplain and wetlands. When the water level in the River Murray has receded, there are a number of options to manage the water regime in Overland Corner.

After the flood event has passed high water levels may be maintained by closing the Overland Corner regulator (downstream regulator). The maximum water level that can be maintained in the wetland by the regulator is 7.74 mAHD.

The ecological benefits of increasing the water level and prolonging flood duration include: improved health of water-stressed wetland and floodplain vegetation, increased area of habitat for aquatic fauna such as frogs, wetland birds and macroinvertebrates, decreased surface water salinity, and providing conditions for the establishment of a freshwater lens beneath the wetland.

Flood events will also lead to the flushing of salts from the floodplain and wetland into the River Murray. During over bank flows the flushing of salts cannot be controlled. The discharge of salt into the river can only be managed once the water levels in the wetland have receded (below the height of the downstream regulator).

If the regulator is closed to maintain high water levels (described above), this will limit the removal of salt from the system. Therefore, the alternative option to holding floodwaters in the wetlands is to leave the downstream regulator open and allow floodwaters to recede naturally. Given the high salinity levels in wetlands and floodplains along the River Murray the removal of salt from the ecosystem may be considered more important than prolonging the duration of the flood event. However, the salinity impact to the River Murray needs to be considered if this strategy is employed.

It is recommended that during and after flood events, management actions that impact on water levels in Overland Corner be undertaken in consultation with relevant stakeholders and technical experts (e.g. SA MDB NRM Board Wetland Officer).



Photograph of Overland Corner during the 1993 flood (Photo: Bob Cornwell)

PROPOSED ON-GROUND WORKS

UPGRADES TO INFRASTRUCTURE

The proposed upgrades to infrastructure were described on page 18. This includes the installation of an upstream regulating structure, and investigating options to upgrade the pumping infrastructure.

Refer to page 18 for further details.

STOCK MANAGEMENT

Overland Corner has been grazed by sheep and cattle for at least 80 years. Under current land management arrangements usually 30-70 breeding cows (plus calves) have access to the site.

Management of cattle grazing, including stocking rates and cattle access to wetlands, is important for the conservation of wetland ecosystems (LWRRDC 1996, Jansen & Robertson 2001, Reeves & Chapman 2004). Reeves & Chapman (2004) in a comprehensive review of grazing in wetlands noted that the *"effects of grazing are so variable that grazing decisions should be based on conservation objectives specific to each site"*.

The current leaseholders support ongoing conservation at the site and recognise the importance of the sustainable cattle grazing.

It has been recommended to reduce the intensity of grazing in Overland Corner (SKM 2006). This should be considered, as grazing can effect the regeneration of native plants such as River Red Gum. It is also recommended to monitor the change in vegetation in areas where cattle grazing is excluded. On-ground works to manage the movement of cattle into wetlands, such as the establishment of fencing should be investigated.



Cattle grazing on the floodplain in Overland Corner (2006)

MONITORING

Monitoring is a vital component of wetland management. Monitoring allows the collection of physical and biological data that can be used to determine the success or failure of a management action. It can also be used to adjust or change management actions.

Ongoing monitoring in Overland Corner will be undertaken by the Overland Corner Wetland Group with assistance from the South Australian Murray-Darling Basin Natural Resources Management Board and Berri Barmera LAP.

The monitoring program is outlined in Table 8, which includes monitoring of flora, fauna, groundwater and surface water. Notably, there is also the possibility for opportunistic monitoring outside the scope of the monitoring program, such as observations of threatened bird species.

To ensure the data collected are comparable to the Baseline Survey, it is recommended monitoring sites in Overland Corner be based on those used in the Baseline Survey. Locations of the monitoring sites used during the Baseline Survey and from community monitoring are in Appendices 10 & 11.

The techniques for monitoring the physical and biological parameters in Overland Corner should be based on the methods outlined in the *Your Wetland: Monitoring Manual* (Tucker 2004).



Photopoint monitoring at Overland Corner (2006). Note the water level in the main lagoon (background).

Table 8. Monitoring Program for Overland Corner

Monitoring Activity		Technique	Time required	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Priority	Responsibility / Coordination	
Flora	Vegetation	Photopoint assessment	½ day ^			√			√			√			√	HIGH	Overland Corner Wetland Group (OCWG) with support from BBLAP & NRM Board Wetland Officer	
		Quadrat based survey and line intercept	2 days ^										√				LOW	NRM Board Wetland Officer with support from OCWG & BBLAP
		Visual health assessment (e.g. River Red Gums)	1 day			√			√				√			√	HIGH	OCWG with support from BBLAP & NRM Board Wetland Officer
		Mapping of pest plants (e.g. Cumbungi, Burr)	2 days										√				MEDIUM	
Fauna	Birds	Fixed area search	½ day			√							√			MEDIUM	OCWG with support from BBLAP & NRM Board Wetland Officer	
		Colonial nesting	½ day										√			MEDIUM	OCWG with support from BBLAP & NRM Board Wetland Officer	
	Fish	Fyke, dip, seine nets and shrimp traps	2 days ^									√				MEDIUM	NRM Board Wetland Officer with support from OCWG & BBLAP	
	Frogs	Recording frog calls	2 hours										√		√	HIGH	NRM Board Wetland Officer with support from OCWG & BBLAP	
	Macroinvertebrates	Dip net sampling	½ day ^												√	LOW	NRM Board Wetland Officer with support from OCWG & BBLAP	
Management - related	Groundwater	Groundwater depth and salinity from piezometers *	½ day			√			√			√			√	HIGH	OCWG with support from BBLAP & NRM Board	
	Surface water	Water quality (e.g. salinity, pH, turbidity)	½ day			√			√			√			√	HIGH	OCWG with support from BBLAP & NRM Board Wetland Officer	
		Water level monitoring *	1 hour	√	√	√	√	√	√	√	√	√	√	√	√	√	HIGH	OCWG with support from BBLAP & NRM Board Wetland Officer
	Structure management	Log all structure management actions (date, action, reason for action, flow conditions)	1 hour	On going												HIGH	OCWG with support from BBLAP & NRM Board Wetland Officer	
		Maintain structures to ensure adequate free passage for water flow and aquatic organisms	1 day ^	On going												HIGH	OCWG with support from BBLAP & NRM Board Wetland Officer	
Other	Data management	Update and file all data (2 copies kept in separate locations)	1-2 hours per month	On going												HIGH	NRM Board Wetland Officer with support from BBLAP	
		Analyse biological and physical data and relate to management actions	1 day		√				√			√			√		HIGH	NRM Board Wetland Officer
		Update Monitoring Log Book	1 hour	On going												HIGH	NRM Board Wetland Officer with support from BBLAP	
		Review wetland operational plan	1-2 days ^	As required - minimum every 4 years												HIGH	OCWG with support from BBLAP & NRM Board Wetland Officer	
		Report to DWLBC of any changes to the management plan	2 hours	As required												HIGH	OCWG with support from BBLAP & NRM Board Wetland Officer	

Refer to *Your Wetland: Monitoring Manual* (Tucker 2004) for details of monitoring methods.

^ More than one person is required to perform monitoring method

^^ Dependent on the installation of nested piezometers

* Increase frequency of water level monitoring during drawdown and refilling.

Note:
There is also the possibility for opportunistic monitoring outside the scope of the monitoring program, such as observations of threatened species of birds.

EVALUATION AND REVIEW

Evaluation and review of the management objectives and actions is required throughout the period of the Wetland Management Plan. This informs the community and stakeholders of the impact of management actions on the wetland.

Under an adaptive management approach, the results from monitoring can provide evidence to reconsider management objectives and actions. This may include evidence of increased surface water salinity, which threatens aquatic biota and triggers an immediate management response, or evidence that takes longer to become obvious, such as seeing improvements in long-lived vegetation.

The Berri Barmera LAP and the South Australian Murray-Darling Basin Natural Resources Management Board can assist with the analysis and evaluation of the monitoring program.

The wetland operational plan will need to be evaluated after 4 years (30 June 2011). The Overland Corner Wetland Management Plan is also to be reviewed by June 2011.

REPORTING

In order to comply with the water licence from the Department of Water, Land and Biodiversity Conservation (DWLBC), reporting on wetland management is required. DWLBC require that they be informed of any changes to the management objectives or the wetland operational plan. This is to ensure that the changes are in agreement with the wetland management plan guidelines, and to ensure the water allocation for the wetland is still appropriate.

It is important that records be kept of all monitoring data and management actions, indicating important dates, a list of management actions carried out and monitoring results. This data should be stored in an accessible format in a central location.



Aerial photograph of the northern section of Overland Corner during the 1993 flood. Note the Overland Corner Hotel on the edge of the floodwaters.

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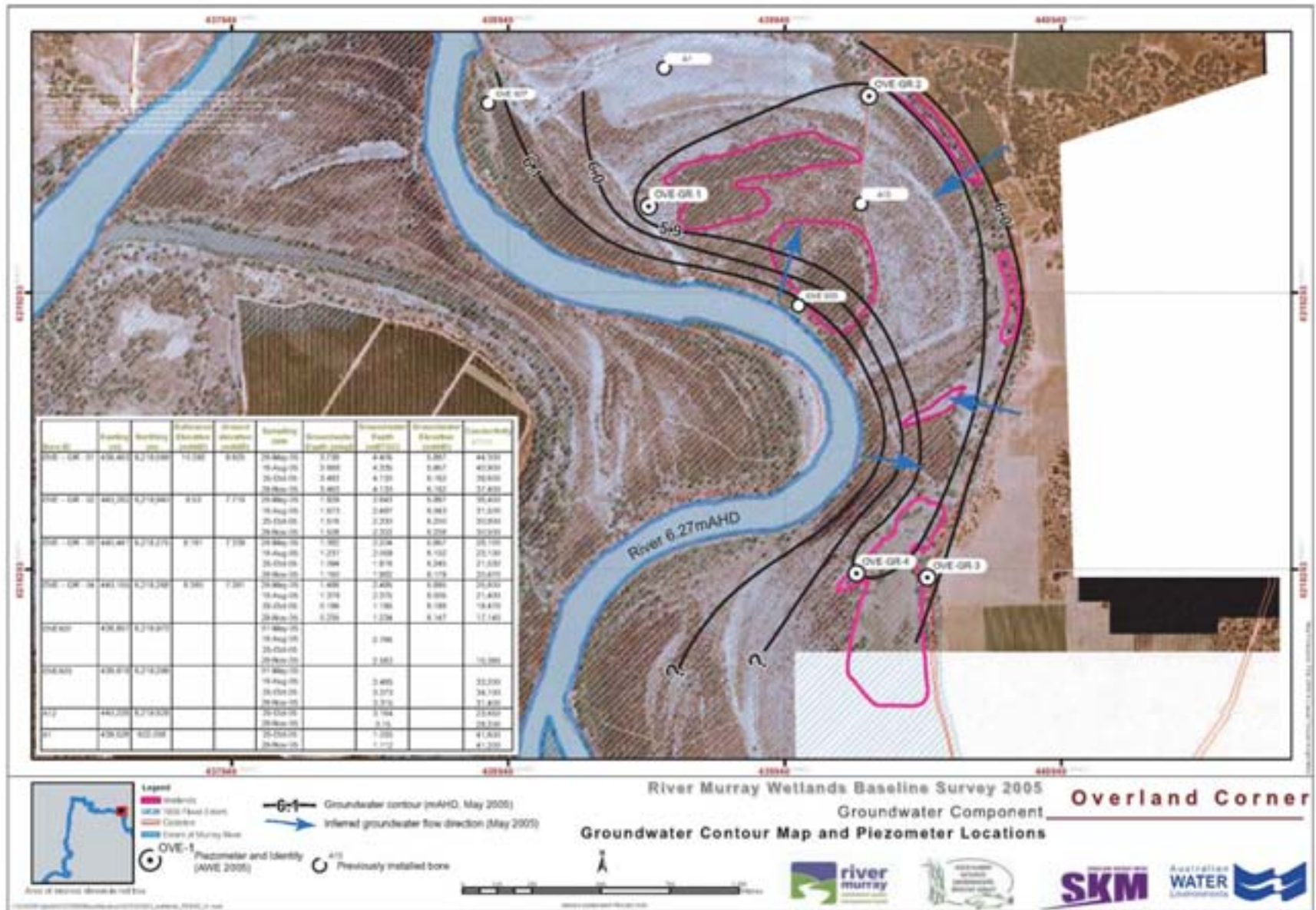
APPENDICES

APPENDIX 1. Groundwater table elevation and groundwater salinity levels

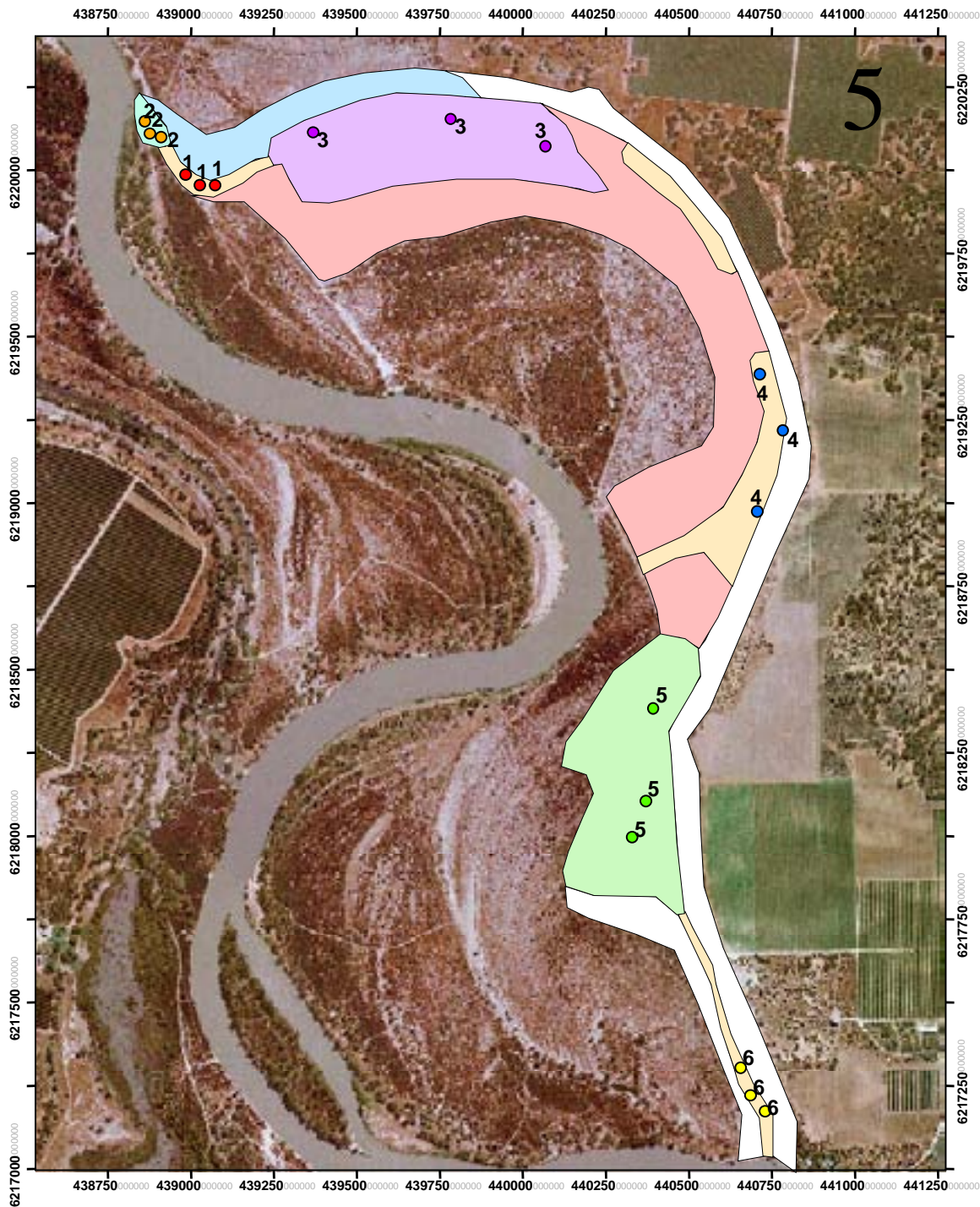
Site	Reference Elevation (mAHD)	Ground Elevation (mAHD)	Date	Groundwater level (mbgL)	Groundwater level (mBTC)	Groundwater level (mAHD)	Salinity (µS/cm)
OVE GR 1	10.29	9.63	26-May-05	3.74	4.41	5.89	44,300
			16-Aug-05	3.67	4.34	5.96	40,900
			25-Oct-05	3.46	4.13	6.16	39,600
			29-Nov-05	3.46	4.13	6.16	37,400
OVE GR 2	8.53	7.72	26-May-05	1.83	2.64	5.89	36,400
			16-Aug-05	1.67	2.49	6.04	31,500
			25-Oct-05	1.52	2.33	6.20	30,800
			29-Nov-05	1.51	2.32	6.21	30,500
OVE GR 3	8.16	7.34	26-May-05	1.38	2.20	5.96	28,100
			16-Aug-05	1.24	2.06	6.10	23,100
			25-Oct-05	1.09	1.92	6.25	21,530
			29-Nov-05	1.16	1.98	6.18	20,470
OVE GR 4	8.38	7.38	26-May-05	1.49	2.49	5.90	25,600
			16-Aug-05	1.38	2.38	6.01	21,400
			25-Oct-05	0.20	1.20	6.19	18,470
			29-Nov-05	0.24	1.23	6.15	17,140
OVE 607			16-Aug-05		2.77		
			29-Nov-05		2.58		15,360
OVE 603			16-Aug-05		3.49		33,200
			25-Oct-05		3.27		34,100
			29-Nov-05		3.32		31,400
A12			25-Oct-05		3.16		23,650
			29-Nov-05		3.15		28,200
A1			25-Oct-05		1.03		41,600
			29-Nov-05		1.11		41,200

Source: River Murray Wetlands Baseline Survey (SKM 2006)

APPENDIX 2. Map of groundwater table levels at Overland Corner [Source: SKM (2006)]



APPENDIX 3. Vegetation Map of Overland Corner [Source: SKM (2006)]



	<p>Surveyed Quadrats</p> <ul style="list-style-type: none"> ● <i>Cyperus gymnocaulos</i> sedgeland ● <i>Bolboschoenus caldwellii</i> sedgeland ● <i>Chenopodium pumilio</i> shrubland ● <i>Cyperus gymnocaulos</i> sedgeland ● <i>Muehlenbeckia florulenta</i> shrubland ● <i>Cyperus gymnocaulos</i> sedgeland 	<p style="text-align: center;">RIVER MURRAY WETLANDS BASELINE SURVEY</p> <p style="text-align: center;"><i>Overland Corner</i></p> <p style="text-align: center;">1:14,800</p> <p style="text-align: center;">03060 120 180240 Metres</p>	<p>Large-scale Vegetation Communities</p> <ul style="list-style-type: none"> <i>Eucalyptus camaldulensis</i> <i>Eucalyptus largiflorens</i> woodland* <i>Chenopodium pumilio</i> shrubland <i>Muehlenbeckia florulenta</i> shrubland* <i>Cyperus gymnocaulos</i> sedgeland <i>Eucalyptus camaldulensis</i> woodland over <i>Muehlenbeckia florulenta</i> <i>Typha</i> sp./<i>Bolboschoenus caldwellii</i> sedgeland <i>Halosarcia pergranulata</i> shrubland*
	<p>* Denotes community not quantitatively surveyed # Denotes area too small to map Quadrat numbers refer to vegetation associations in wetland summary</p>		

APPENDIX 4. List of flora recorded at Overland Corner

Scientific Name	Common Name	Source				Conservation Status		
		1	2	3	4	SA CS	SA PS	NAT
Native species								
<i>Acacia stenophylla</i>	River Cooba	+			+			
<i>Atriplex leptocarpa</i>	Slender-fruited Saltbush		+	+				
<i>Atriplex lindleyi</i>	Baldoo		+	+				
<i>Atriplex muelleri</i>	Muellers saltbush		+					
<i>Atriplex pumilio</i>	Mat Saltbush			+				
<i>Atriplex semibaccata</i>	Berry Saltbush	+	+	+	+			
<i>Atriplex stipitata</i>	Bitter saltbush							
<i>Atriplex suberecta</i>	Lagoon Saltbush		+	+				
<i>Austrodanthonia</i> sp.	Wallaby Grass		+					
<i>Austrodanthonia caespitosa</i>	Wallaby grass	+		+				
<i>Austrostipa</i> sp.	Spear grass	+	+					
<i>Azolla filiculoides</i>	Pacific Azolla	+						
<i>Bolboschoenus caldwellii</i>	Salt Club-rush	+						
<i>Brachyscome basaltica</i>	Swamp Daisy	+	+	+				
<i>Brachyscome goniocarpa</i>	Dwarf Daisy			+		R	R	
<i>Brachyscome graminea</i>	Grass Daisy		+	+		R	R	
<i>Brachyscome lineariloba</i>	Hardheaded Daisy		+					
<i>Calotis scapigera</i>	Tufted Burr-daisy		+	+				
<i>Carpobrotus rossii</i>	Angular Pigface	+						
<i>Centipeda cunninghamii</i>	Common Sneezeweed		+					
<i>Centipeda minima</i>	Spreading Sneezeweed	+						
<i>Chamaesyce drummondii</i>	Caustic Weed		+	+				
<i>Chenopodium desertorum</i>			+					
<i>Chenopodium pumilio</i>	Small Crumbweed	+						
<i>Cotula coronopifolia</i>	Water Buttons				+			
<i>Craspedia glauca</i>	Billy-buttons			+				
<i>Craspedia</i> sp.	Billy-buttons	+						
<i>Crassula sieberiana</i> ssp. <i>tetramera</i>	Australian Stonecrop			+				
<i>Cressa cretica</i>	Rosinweed		+	+				
<i>Cyperus gymnocaulos</i>	Spiny Flat-sedge	+		+	+			
<i>Dissocarpus paradoxus</i>	Ball bindyi	+	+					
<i>Distichlis distichophylla</i>	Emu Grass		+					
<i>Dodonaea attenuata</i>	Narrow-leaf Hopbush	+						
<i>Dodonaea viscosa</i> ssp. <i>angustissima</i>	Sticky Hopbush		+					
<i>Einadia nutans</i> ssp. <i>nutans</i>	Climbing Saltbush		+	+				
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush	+	+					
<i>Eremophila scoparia</i>	Scotia Bush	+						
<i>Eriochiton sclerolaenoides</i>	Woolly-fruit Copperburr		+					
<i>Eucalyptus camaldulensis</i> var. <i>camaldulensis</i>	River Red Gum	+			+			
<i>Eucalyptus largiflorens</i>	Black Box	+			+			
<i>Glycyrrhiza acanthocarpa</i>	Native Liquorice		+	+				
<i>Gnaphalium indutum</i>	Tiny Cudweed			+				
<i>Goodenia fascicularis</i>	Mallee Goodenia		+					
<i>Goodenia heteromera</i>	Spreading Goodenia		+			R	R	
<i>Halosarcia halocnemoides</i>	Grey Samphire			+				
<i>Halosarcia pergranulata</i> ssp. <i>pergranulata</i>	Black-seed samphire	+						
<i>Juncus usitatus</i>	Common Rush	+						
<i>Lachnagrostis filiformis</i>	Common Blown-grass	+	+	+				
<i>Lepidium pseudohyssopifolium</i>				+				
<i>Ludwigia peploides</i> ssp. <i>montevidensis</i>	Water Primrose	+						
<i>Maireana brevifolia</i>	Small-leaved Bluebush		+					
<i>Maireana</i> sp.	Bluebush		+					

Scientific Name	Common Name	Source				Conservation Status		
		1	2	3	4	SA CS	SA PS	NAT
<i>Muehlenbeckia florulenta</i>	Lignum	+		+	+			
<i>Myriocephalus stuartii</i>	Poached-egg daisy	+						
<i>Olearia pimelioides</i>	Showy Daisy-bush		+					
<i>Phragmites australis</i>	Common Reed	+			+			
<i>Pimelea microcephala</i>	Mallee Rice Flower		+					
<i>Plantago drummondii</i>	Sagoweed		+					
<i>Poa labillardieri</i> var. <i>labillardieri</i>	Common Tussock-grass				+			
<i>Potamogeton crispus</i>	Curly Pondweed	+						
<i>Potamogeton tricarinatus</i>	Sago Pondweed	+						
<i>Pseudognaphalium luteo-album</i>	Jersey Cudweed	+	+					
<i>Ptilotus exaltatus</i>	Showy Foxtail	+	+					
<i>Salsola kali</i>	Rolypoly		+					
<i>Scleroblitum atriplicinum</i>	Starry Goosefoot				+			
<i>Sclerolaena decurrens</i>	Green copperburr	+						
<i>Sclerolaena muricata</i>	Five-spined Bassia		+					
<i>Sclerolaena obliquispis</i>	Oblique-spined Bassia		+					
<i>Sclerolaena tricuspis</i>	Three-spined Bassia		+					
<i>Senecio glossanthus</i>	Annual Groundsel				+			
<i>Senecio</i> sp.	Groundsel	+						
<i>Senecio spanomerus</i>	Variable Groundsel		+					
<i>Spergularia marina</i>	Salt Sand-spurrey				+			
<i>Sporobolus mitchellii</i>	Rat-tail couch	+	+	+	+			
<i>Stemodia florulenta</i>	Bluerod		+	+				
<i>Swainsona</i> sp.	Swainsona	+						
<i>Swainsona swainsonoides</i>	Downy Swainsona	+						
<i>Tetragonia tetragonioides</i>	New Zealand Spinach				+			
<i>Teucrium racemosum</i>	Grey Germander				+			
<i>Typha</i> sp.	Cumbungi	+						
<i>Vallisneria spiralis</i>	Ribbon weed	+						
<i>Vittadinia australasica</i>			+					
<i>Vittadinia eremaea</i>			+					
<i>Vittadinia gracilis</i>	Woolly New Holland Daisy				+			
<i>Wahlenbergia fluminalis</i>	River Bluebell	+						+
<i>Wahlenbergia gracilentia</i>	Annual Bluebell				+			
Introduced species								
<i>Alopecurus myosuroides</i>	Slender Fox-tail				+			
<i>Asphodelus fistulosus</i>	Onion Weed		+	+				
<i>Aster subulatus</i>	Aster-weed	+						
<i>Avena barbata</i>	Bearded Oat	+						
<i>Brassica tournefortii</i>	Wild Turnip		+	+				
<i>Bromus diandrus</i>	Great Brome	+	+					
<i>Bromus madritensis</i>	Madrid Brome		+					
<i>Bromus rubens</i>	Red Brome	+	+	+	+			
<i>Bromus</i> sp.	Brome		+					
<i>Carrichtera annua</i>	Ward's Weed	+	+					
<i>Conyza bonariensis</i>	Flax-leaf Fleabane	+						
<i>Conyza</i> sp.	Fleabane		+					
<i>Echium plantagineum</i>	Salvation Jane	+						
<i>Euphorbia terracina</i>	False Caper	+						
<i>Gnaphalium polycaulon</i>	Western Cudweed		+					
<i>Heliotropium curassavicum</i>	Smooth Heliotrope	+	+	+				
<i>Hordeum glaucum</i>					+			
<i>Hordeum marinum</i>	Barley Grass	+						
<i>Hordeum</i> sp.	Barley Grass		+					+
<i>Hypochaeris glabra</i>	Smooth Cat's Ear			+				
<i>Hypochaeris radicata</i>	Flat Weed	+						

Scientific Name	Common Name	Source				Conservation Status		
		1	2	3	4	SA CS	SA PS	NAT
<i>Lactuca saligna</i>	Wild Lettuce	+						
<i>Lepidium</i> sp.	Peppercress		+					
<i>Lolium rigidum</i>	Wimmera Ryegrass			+				
<i>Marrubium vulgare</i>	Horehound		+					
<i>Medicago minima</i>	Woolly Burr-medic		+	+				
<i>Medicago polymorpha</i> var. <i>polymorpha</i>	Burr-medic			+				
<i>Medicago</i> sp.	Medic		+					
<i>Medicago truncatula</i>	Barrel Medic	+	+	+				
<i>Mesembryanthemum crystallinum</i>	Common Iceplant	+						
<i>Onopordum acanthium</i>	Scotch Thistle	+						
<i>Petrorhagia velutina</i>	Velvet Pink			+				
<i>Picris angustifolia</i>	Hawkweed		+					
<i>Plantago coronopus</i>	Bucks-horn Plantain			+				
<i>Polypogon monspeliensis</i>	Annual Beard-grass	+						
<i>Reichardia tingitana</i>	False Sow Thistle	+	+	+				
<i>Rorripa palustris</i>	Yellow Marsh-cress	+						
<i>Sonchus oleraceus</i>	Common Sow-thistle	+		+				
<i>Spergularia rubra</i>	Red Sand-spurrey		+	+				
<i>Vulpia myuros</i>	Fescue			+				
<i>Vulpia</i> sp.	Fecue		+					

Conservation status based on the 2003 Review of the Status of Threatened Species in South Australia (NPWC & DEH 2003) and the Environment Protection and Biodiversity Conservation Act 1999.

Key:

CS - Current status of threatened flora in schedules declared under the *National Parks and Wildlife Act 1972*

PS - Proposed of threatened flora following revisions to the schedules

NAT - National listings

Source:

1 - River Murray Wetlands Baseline Survey (SKM 2006)

2 - Overland Corner Wetland Group monitoring 2005-2006 (B. Turner pers. comm. 2006)

3 - Overland Corner Wetland Group monitoring 2003 (SA MDB NRM Board pers. comm. 2006)

4 - Incidental/miscellaneous records from Overland Corner

APPENDIX 5. Examples of photopoints used during monitoring at Overland Corner



Photopoint: OVE PPO2 (348°)

16/7/2003



16/11/2005



14/3/2006



9/6/2006



Photopoint: NT OC 24

15/12/2003



5/2/2005



11/3/2006



3/6/2006

APPENDIX 6. List of fauna recorded at Overland Corner

Common Name	Scientific Name	Source			Conservation Status		
		1	2	3	SA CS	SA PS	NAT
Mammals							
Western Grey Kangaroo	<i>Macropus fuliginosus</i>			+			
European Rabbit	<i>Oryctolagus cuniculus</i> *			+			
Fish							
Carp Gudgeon Complex	<i>Hypseleotris</i> sp.	+					
Carp	<i>Cyprinus carpio</i> *	+					
Eastern Gambusia	<i>Gambusia holbrooki</i> *	+					
Frogs							
Eastern Banjo Frog	<i>Limnodynastes dumerilli</i>			+			
Eastern Sign-bearing Froglet	<i>Crinia parinsignifera</i>	+	+				
Long-thumbed Frog	<i>Limnodynastes fletcheri</i>	+					
Painted Frog	<i>Neobatrachus pictus</i>			+			
Peron's Tree Frog	<i>Litoria peronii</i>	+					
Southern-bell Frog	<i>Litoria raniformis</i>	+			V	V	Vu
Spotted Grass Frog	<i>Limnodynastes tasmaniensis</i>	+	+				
Birds							
Australasian Shoveller	<i>Anas rhynchotis</i>			+	+	R	R
Australian Magpie	<i>Gymnorhina tibicen</i>			+	+		
Australian Pelican	<i>Pelecanus conspicillatus</i>			+			
Australian Shelduck	<i>Tadorna tadornoides</i>			+	+		
Australian White Ibis	<i>Threskiornis molucca</i>			+			
Australian Wood Duck	<i>Chenonetta jubata</i>			+	+		
Black Swan	<i>Cygnus atratus</i>			+	+		
Black-winged Stilt	<i>Himantopus himantopus</i>			+			
Chestnut Teal	<i>Anas castanea</i>			+			
Freckled Duck	<i>Stictonetta naevosa</i>			+		V	R
Great Egret	<i>Ardea alba</i>			+	+		C
Grey Teal	<i>Anas gracilis</i>			+	+		
Hardhead	<i>Aythya australis</i>			+	+		
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>			+	+		
Magpie-lark	<i>Grallina cyanoleuca</i>			+	+		
Masked Lapwing	<i>Vanellus miles</i>	+	+	+			
Pacific Black Duck	<i>Anas superciliosa</i>			+	+		
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>			+	+		
Regent Parrot	<i>Polytelis anthopeplus</i>	+				V	V
Welcome Swallow	<i>Hirundo neoxena</i>			+	+		
Whistling Kite	<i>Haliastur sphenurus</i>	+					
White-faced Heron	<i>Egretta novaehollandiae</i>						
White-necked Heron	<i>Ardea pacifica</i>			+			
Willie Wagtail	<i>Rhipidura leucophrys</i>			+	+		

South Australian conservation status follows (NPWC & DEH 2003).

Key:

SA CS - Current status of threatened fauna in schedules declared under the *National Parks and Wildlife Act 1972*

SA PS - Proposed status of threatened fauna following revisions to the schedules

NAT - National listings

R - Rare in South Australia

V - Vulnerable in South Australia

Vu - Nationally Vulnerable under the *EPBC Act*

C - Listed under the China Australia Migratory Bird Agreement (CAMBA)

Source:

1 - River Murray Wetlands Baseline Survey (SKM 2006)

2 - Overland Corner Wetland Group community monitoring 2004-2006 (B. Turner pers. comm. 2006)

3 - Incidental/miscellaneous records from Overland Corner

APPENDIX 7. Key stages in wetland water regime management.

Summary of the key stages in wetland water regime management - summarised from *Your Wetland: Hydrology Guidelines* (Tucker *et al.* 2002).

Drying the wetland

Complete drying of the wetland is beneficial to the wetland as it provides ideal conditions for the germination of dry wetland bed plants. These plants then go on to provide shelter for fish and macroinvertebrates once the wetland is re-filled. Nutrients from these plants will also be released into the water to be available for use by other emergent and submerged plants. When the wetland has been dried for six months or longer, the wetland bed sediments can be consolidated and therefore the sediments will not be re-suspended when the wetland is filled. Also with this extended dry period, some native plants are able to complete their life cycles and release their seed into the seed bank for germination on the next drying event. Drying the wetland will also help to reduce carp numbers. Large carp will be stranded by the loss of water and die or be eaten by birds. Carp eggs that are laid around the fringes of the wetland will die when dried out.

Drying of a wetland should best commence in late summer and last until early spring. The decision to dry a wetland should also be dependant on the submerged vegetation. The wetland should contain water until this vegetation has flowered and set seed. Monitoring can determine when is the correct time for drying to begin.

Filling the wetland (pool level)

When wetlands are filled after being dry for a period of time there are a number of benefits to the wetland ecosystem. When water re-enters the wetland the consolidated sediments are not re-suspended, which allows light to penetrate through the water column and support the germination of aquatic plant species. These plants provide food and habitat for aquatic fauna. Re-filling after drying also evokes the release of nutrients from sediment, which are taken up by algae and plants.

Wetlands should be filled slowly, typically during spring. The wetland should remain full for at least one growing season (spring to the end of summer) to allow aquatic plants, to complete their life cycle and set seed. Inundation for two growing seasons is preferable. Filling can also support the longer lived vegetation such as the Black box and River Red Gums as well as creating or improving a freshwater lens under the wetland. Salinity levels in the lagoon can also be lowered through the influx of fresh water diluting the salts.

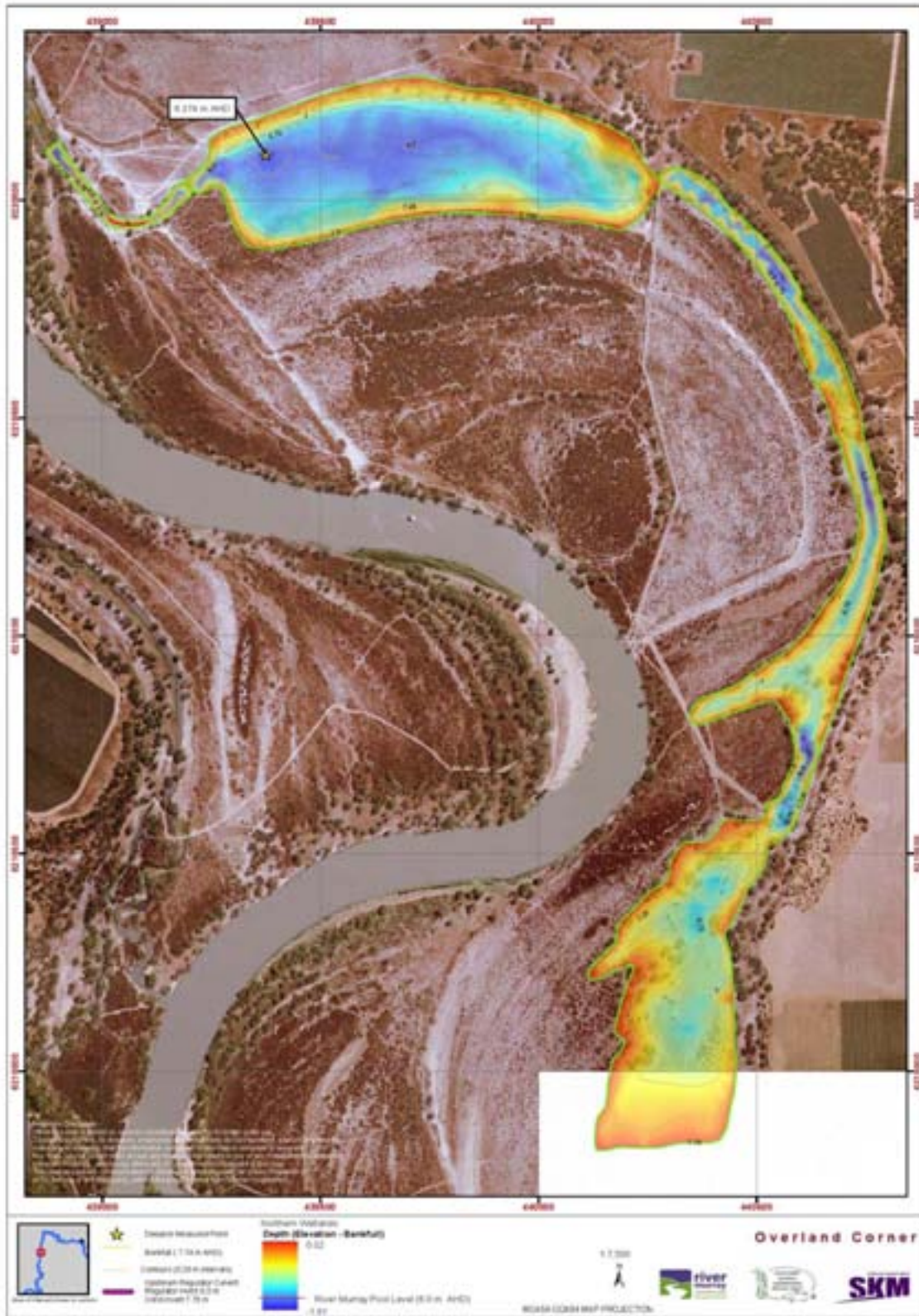
Partial drying of the wetland

Partial drying of the wetland involves lowering the water level in the wetland. The advantage of a partial dry is that by exposing the sediment, emergent vegetation has greater area to grow. Partial drying also favours species that respond to a fluctuating water level. However, reducing the water level can also have negative impacts by promoting the spread of undesired plant species

Over bank flooding

The final management phase is over bank flooding. This involves holding water in the wetland higher than pool level. The affects of flooding are well documented with the most significant impacts being on the riparian zone vegetation such as River Red Gums. Currently, over bank floods only occur in Overland Corner during flood events in the River Murray when the river is significantly higher that the water level maintained by the locks and weirs.

APPENDIX 8. Wetland inundation map for Overland Corner [Source: SKM (2006)]



APPENDIX 9. Water volume calculation

The following calculation was used to determine the volume of water required to inundate the wetlands in Overland Corner over the next 4 years (based on the Wetland Operational Plan).

It is important to note that Overland Corner is above the River Murray pool level. Therefore, wetland management is often dependent on pumping water into the wetlands (unless a natural flood occurs).

BACKGROUND INFORMATION

- **Surface area:** ~ 61 ha (when inundated to a water level of 7.7 mAHD)
- **Volume to fill Overland Corner:** ~ 410 ML (to a water level of 7.7 mAHD)

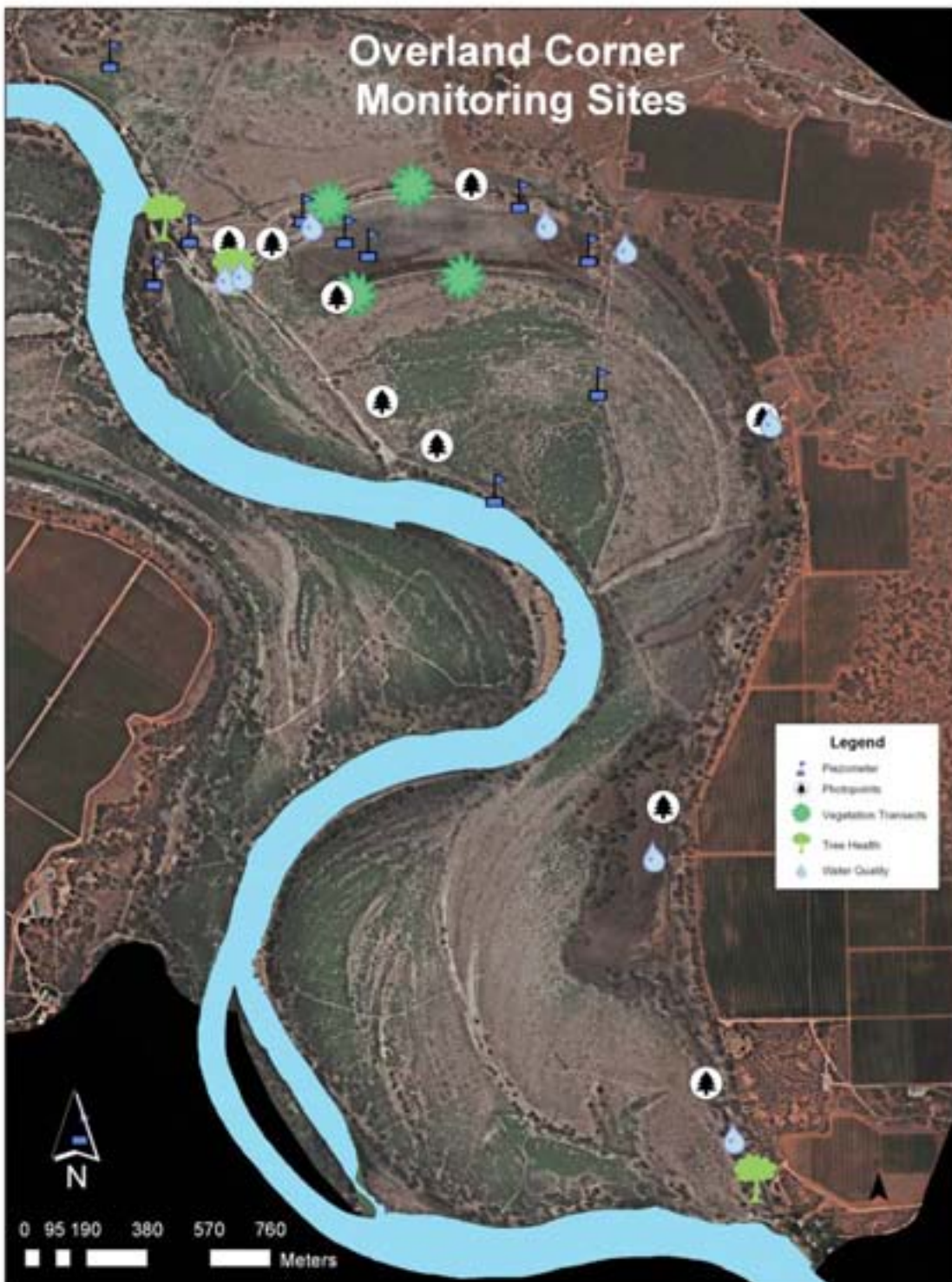
Water Volume Calculation

Year	Period	Action	Details	Water use
2007/2008	1 July 2007 - 31 March 2008	Dry wetland	-	0 ML
	1 April 2007 - 31 May 2008	Inundate wetland	Pumping ~ 20 ML/day	350 ML
	1 June 2008 - 30 June 2008	Dry wetland	-	0 ML
2008/2009	1 July 2008 - 30 June 2009	Dry wetland	-	0 ML
2009/2010	1 July 2009 - 31 Sept 2009	Dry wetland	-	0 ML
	1 Oct 2009 - 30 Nov 2009	Inundate wetland	Pumping ~ 20 ML/day	410 ML
	1 Dec 2009 - 30 June 2010	Dry wetland	-	0 ML
2010/2011	1 July 2010 - 31 Oct 2010	Dry wetland	-	0 ML
	1 Nov 2010 - 31 Dec 2010	Inundate wetland	Pumping ~ 20 ML/day	200 ML
	1 Jan 2011 - 30 June 2011	Dry wetland	-	0 ML
Total water volume (for the period 1 July 2007 - 30 June 2011)				960 ML

Note:

- All figures are approximate based on the volume of the wetland when inundated. The loss of water to the soil during flood events is not included in the calculation.

APPENDIX 10. Monitoring sites – Community monitoring [Source: SA MDB NRM (2006)]



APPENDIX 11. Monitoring sites – Baseline Survey (2005)

River Murray Wetlands Baseline Survey 2005
Sample Site Locations

Overland Corner

