GOOLWA TO WELLINGTON
Local Action Planning Association

Community Frog Monitoring in the Coorong, Lower Lakes & Murray Mouth (CLLMM) region

September 2015 – January 2016

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Report submitted: 18 March 2016
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Australian Government

Government of South Australia

1. Executive Summary

This project is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia and managed by the Goolwa to Wellington Local Action Planning Association Inc. (GWLAP). The project objective was to engage community members to collect data of frog populations in the Coorong, Lower Lakes and Murray Mouth (CLLMM) region from September 2015 up to and including January 2016 as part of the CLLMM Recovery Project.

A series of five community frog monitoring workshops were held throughout the region during early September 2015: at Goolwa, Meningie, Milang, Raukkan and Wellington. In total, 26 community members attended the workshops - with ten participants going on to participate in the project. A number of previous frog monitoring participants also assisted with the project.

Over the five month monitoring period between September 2015 and January 2016, a total of 193 surveys were conducted - across 68 sites by 32 community members, with 10 landholders permitting monitoring to be conducted on their properties. Factors such as volunteer availability and access to loan kits determined that not all sites were able to be surveyed each month.

The GWLAP Project Officer provided assistance to individual landholders and community members/groups as required, with the coordination of eleven frog monitoring loan kits in the region, and assisted with coordination of site visits with participating landholders. All sound files were downloaded and analysed by the GWLAP project officer and assistance was provided to groups with access and monitoring of private properties.

As each species of frog have their own unique call, frog species and abundance can be identified from analysing recordings of frogs calling at each site. By comparing this data on an annual basis, conclusions can be determined if a frog population is increasing or decreasing.

The methodology implemented for the frog surveys was based on the Environment Protection Authority of South Australia's Frog Census, which required a 30 second to 2 minute nocturnal recording of the frog species calling at each site during September. The project methodology was adapted to tie in with previous Frog monitoring in the region coordinated by Natural Resources SA Murray-Darling Basin. This project method consisted of a 5 minute nocturnal recording and recording atmospheric/weather conditions. Frog calls were recorded using a Sony Digital Voice recorder Model ICD-PX312 and Yoga EM-2700 Shotgun Microphone, and a visual search was also conducted at each site.

Seven species of frog were recorded in total across the 68 survey sites over the five month monitoring project. The Common froglet (*Crinia signifera*) was present at 58 sites; the Eastern Banjo frog *(Limnodynastes dumerilii*) identified at 45 sites; the Southern brown tree frog (*Litoria ewingii)* was present at 41 sites; the Barking marsh frog/Long thumbed frog (*Limnodynastes fletcheri*) was recorded at 40 sites; Spotted grass frog (*Limnodynastes tasmaniensis*) at 38 sites; Peron's tree frog (*Litoria peronii*) at 8 sites, and the EPBC Vulnerable listed Southern bell frog (*Litoria raniformis*) was recorded at four sites. Given the proximity between the four sites recording Southern bell frogs: Wellington East and Murrundi south (1.6kms) and only 850 metres between the two sites at Dunn's Lagoon Clayton Bay, it is possible that the same frogs were recorded from both pairs of locations.

Survey effort was related to species records. At three sites, zero frog species were recorded. Those sites were only surveyed once, and late in the season - when most of the common frog species had stopped calling. Of the eleven sites where only one species of frog was recorded, ten of these sites had also only had one survey conducted.

During the monitoring period, environmental water was also received in the region, permitting lake levels to be maintained at greater than 0.75m AHD until mid December 2015, which allowed a number of fringing wetlands around the region to fill. As a result of lower lake level management from mid December and the region experiencing below average rainfall and higher than average temperatures, a number of the monitoring sites began to dry out towards the end of the project.

Recommendations for future frog monitoring projects include:

- extra frog monitoring loan kits being made available for community members
- use of mobile phone voice recorders instead of digital voice recorders
- record barometric pressure at time of monitoring
- provide volunteers with survey results after each round
- documenting if carp or mosquito fish present at wetland
- daytime site photograph of wetland
- recording the timeframes that water is held in the wetland
- Chytrid fungus sampling in the Lower Lakes frog populations

2. Acknowledgements

This project is part of the Coorong, Lower Lakes and Murray Mouth Recovery Project which is jointly funded by the Australian Government and the Government of South Australia and managed by the Goolwa to Wellington Local Action Planning Association Inc. (GWLAP)

The author would like to thank DEWNR staff Paul McEvoy, Coordinator, Environmental Investigations of the Coorong, Lower Lakes and Murray Mouth Recovery Project and Kate Mason Wetlands Project Officer (Lower Murray) Natural Resources, SA Murray-Darling Basin for comments on the draft report and for assistance with the graphing of results.

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Thanks to staff from Coorong District Council, Goolwa Visitor Information Centre, Ibis Siding Garden Centre, Lakes Hubs Milang and Meningie, Milang Fish Café, Ngopamuldi Aboriginal Corporation, Strathalbyn Natural Resource Centre and the Wellington Courthouse Café for allowing the frog monitoring loan kits to be held and distributed from their organisations and to Tracey Reeves for the use of her Southern bell frog image for promotional materials for the project.

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4. Introduction

The ecological services provided by frogs to ecosystems and human society throughout the South Australian Murray Darling Basin (SAMDB) are often underestimated. Beyond the well-adopted understanding of their positive contribution to insect consumption, frogs are now considered to be major contributors to ecosystem functions such as decomposition and nutrient cycling and to ecosystem structure through aquatic bioturbation (interactions between sediment particles and the water column) and soil burrowing (MEA 2005, Hocking & Babbit 2014). Their abundance constitutes an integral element within food webs in the SAMDB, providing services throughout all stages of their dual aquatic and terrestrial life cycles (such as contributing to limiting algae growth; insect consumption and are prey for many water dependant and terrestrial species) (Robinson 2000, Baldwin et Al. 2005, Hocking & Babbitt 2014).

One of the eight species of frog known to occur in the CLLMM region, the Southern bell frog (*Litoria raniformis*) is listed as nationally 'vulnerable' under the Environment Protection and Biodiversity Conservation Act 1999, 'vulnerable' in South Australia and Tasmania and 'endangered' in the Australian Capital Territory, New South Wales and Victoria. The species was formerly common and widespread throughout much of South-Eastern Australia but has suffered noticeable and documented declines in distribution and abundance over the past 25-30 years (Clemann & Gillespie 2010, Stratman 2007). Knowledge of the distribution and abundance of *L. raniformis* in the CLLMM region pre-2009 is limited. Historical records spanning more than 60 years were the basis for an inventory of species conducted in 2009 (Mason 2010). Little was known of the species' status in the region prior to the Millennium drought and the subsequent contraction of their habitats. Following the drought, *L. raniformis* were recorded at six locations in moderate to low abundances (Mason & Hillyard 2011), with site and numbers recorded decreasing yearly since, with only one individual recorded for the season last year (Mason & Durbridge 2015).

This project aimed to determine frog populations in the CLLMM region through an increased number and spatial distribution of monitoring sites by engaging extensive support from community volunteers. Building upon and supporting existing community groups and volunteers is considered to provide longer-term benefits for the conservation of frogs and wetland habitats in the CLLMM region. Community involvement allows a greater spatial area and number of sites to be surveyed than by agency staff alone and in addition raises community awareness of the Southern bell frog and local frog populations.

5. Key Objectives

- Monitor the distribution and abundance of frog species in the CLLMM region
- Encourage community involvement in environmental monitoring
- Raise community awareness of the EPBC vulnerable listed Southern bell frog in the region and the CLLMM Recovery Program

Tasks:

- Up to 30 Community members to undertake monthly frog monitoring at a minimum 30 sites for the period September 2015 up to and including January 2016 to monitor the distribution and abundance of frog species in the CLLMM region.

Questions:

- What species and abundance of frogs were present during the September 2015 to January 2016 period?
- Can any relationship trends be seen when comparing presence of frog species to site characteristics that may explain the results? (E.g. atmospheric conditions).

6. Study site

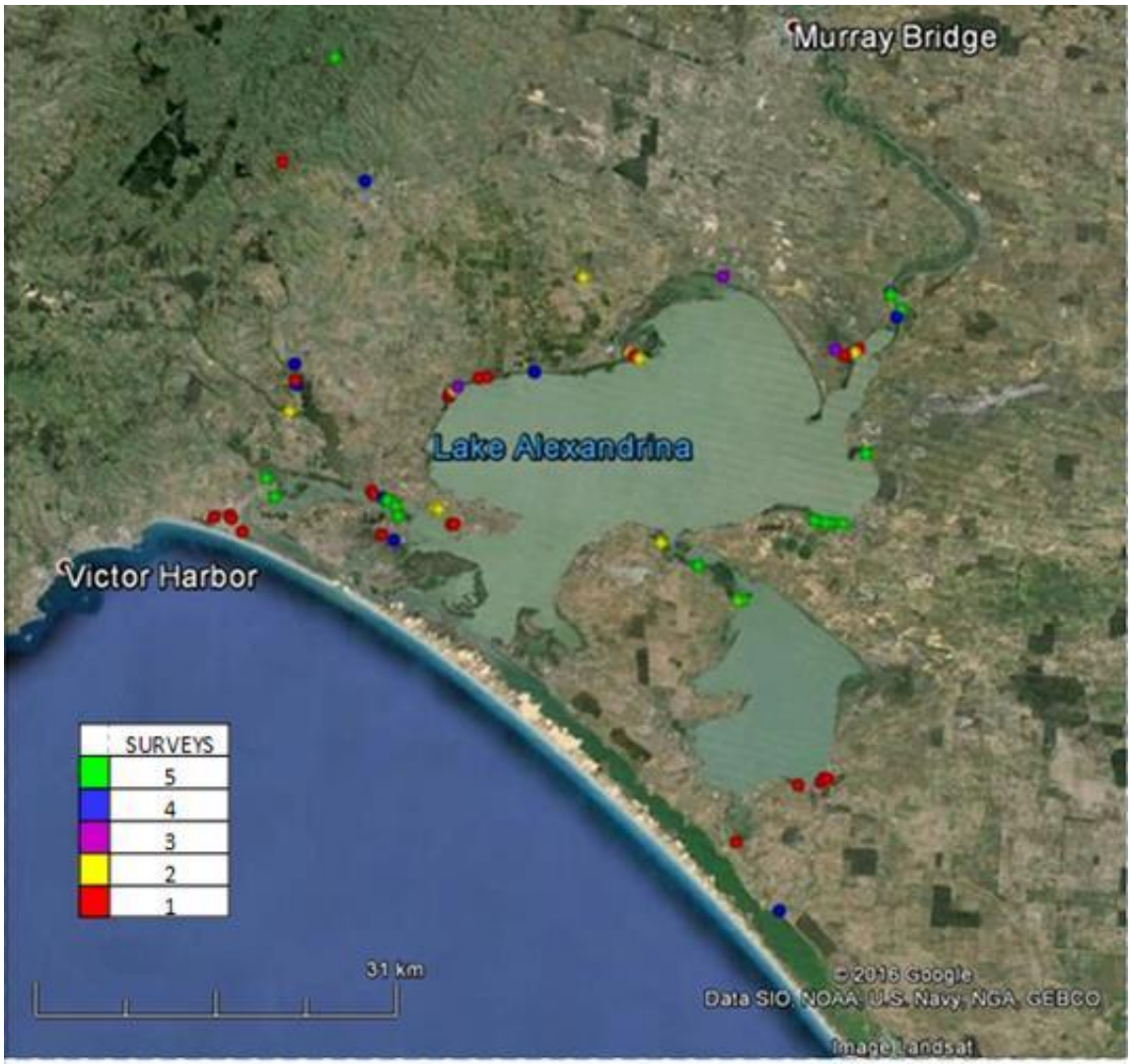

Figure 1. Study region, indicating Community frog monitoring sites and frequency of surveys.

Table 1. Survey sites

Site name	Easting	Northing	Surveys
Alexandrina Station	347639	6071266	5
Alexandrina Station near pump shed	347419	6071309	5
Alison Avenue, Goolwa North	301877	6070094	5
Clayton Bay Boardwalk	311433	6070489	5
Currency Creek rd, Goolwa North	301056	6071614	5
Ducks Hospital, Dunn's Lagoon	312161	6070048	5
edge of Narrung Narrows	341892	6064229	5
Ken & Sally's Swamp, Clayton Bay	310974	6070702	5
Lot 792 Magins Rd	304475	6107117	5
Low Point	351405	6077178	5
Mason Lady Jude paddock	348827	6071188	5
Mason Lady Jude windmill	348812	6071211	5
Masondrina	349862	6071217	5
Murrundi Wetland south	352547	6090514	5
Snug Cove, Clayton Bay	312396	6069224	5
Warneke, Narrung Narrows	337928	6066842	5
Wellington East	353434	6089933	5
Wetlands Beach Clayton Bay	311420	6073708	5
442 Seven Mile Road Meningie	346790	6038507	4
Bank of Middle creek, Strathalbyn	307679	6096988	4
Barnhill Rd swamp	302823	6081311	4
End of Randall Rd, Hindmarsh Island	312194	6067197	4
Milang S.W. Wetland	315995	6079513	4
Murrundi Wetland north	352500	6090745	4
Narrung Narrows Lot 3 Narrung Stud Rd	341493	6064135	5
Red Top Bay, Clayton Bay	311035	6070646	4
Tolmer Rd Wellington	353177	6088730	4
Wally's Landing	303094	6079590	4
Bremer River	323062	6082057	3
Milang Bay Wetland	316661	6080346	3
Milang N.E. Wetland	316318	6080069	3
Mulgundawa Irrigation Channel	338366	6091122	3
Pelican Lagoon Site 1	348163	6085663	3
Tolderol Main channel near pump shed	331334	6083738	3
Gollan's Waterhole	326595	6090227	2
Griffin Site 1	315484	6070128	2
Griffin Site 2	315786	6070032	2
Milang lakeshore in front of pump station	316351	6080047	2
Murrundi Wetland mid site	352513	6090542	2
Narrung Structure lakeside	334673	6068529	2
Pelican Lagoon Site 2	349862	6085522	2
Tolderol Bay 11	331813	3083776	2
Tolderol Bay 7	330926	6084193	2
Watkins, Tookayerta	302650	6077320	2
Angas River	318405	6081201	1
Birchall/Merrett ave, Goolwa	298193	6068308	1
Bird viewing hut Goolwa South	299358	6066990	1
Bottom right of holiday units in Milang	315985	6079514	1
Geralds Hut	342764	6044016	1
Golfview & Pitt Street	296900	6068055	1
Hodgson/Heinicke Ave, Goolwa	298398	6068028	1
Knappsteins A	309991	6071160	1
Knappsteins B	310220	6070872	1
Lake Albert Meningie opposite Uniting Church	349778	6049834	1
Milang Lake foreshore Boatramp	316109	6079819	1
Old Bull Creek Rd	300678	6098111	1
Pelican Lagoon Site 3	350180	6085888	1
Pelican Lagoon Site 4	349868	6085634	1
Pelican Lagoon Site 5	349033	6085223	1
Pelican Path Culvert	349527	6049467	1
Salty's Point Sturt Site 1	317169	6068898	1
Salty's Point Sturt Site 2	316946	6068839	1
Shadows Lagoon, Hindmarsh Island	311160	6067547	1
Swamp 333	350043	6049829	1
Tolderol Bay 6	331310	6083949	1
Turveys Drain, Lake Alexandrina	319095	6081360	1
Warrengie Drive	347635	6049125	1
Watchalunga, Finniss - Nature Foundation	302942	6079967	1

7. Methodology

The methodology for the frog surveys was in-line with the SA Frog Census method, which requires a 30 second to 2 minute nocturnal recording of the frog species calling at each site during September. The methodology used was adapted to tie in with previous Natural Resources SA Murray-Darling Basin Frog Monitoring in the Coorong, Lower Lakes and Murray Mouth (CLLMM) region; which involves a five minute nocturnal recording of the frog species calling and completing a site data sheet recording atmospheric/weather conditions (see Appendix 1, Field data sheet for community frog monitoring). A visual search was also conducted at each survey site.

A five minute recording of the frog species calling was made at each site using a Sony voice recorder Model no ICD-PX312 and Yoga EM-2700 Shotgun directional microphone.

To provide promotion, raise awareness and training, five frog identification and monitoring workshops were held in the region during September 2015; Ibis Siding Garden Centre, Lakes Hub Meningie, Milang Institute, Wellington Courthouse Café and at the Yuntuwarrin Learning Centre at Narrung. In total, 26 community members attended the workshops, with ten of the participants going on to participate in the project. A number of past frog monitoring participants and groups also assisted with this project.

Frog monitoring workshops flyers were produced, and were distributed via *Lakes Hub Bulletin*, Goolwa to Wellington Local Action Planning Association (GWLAP) mailing list and social media, and also through the loan kit centres. See Appendix 2, Frog workshop flyer

A poster on the Southern bell frog was also produced and was on display at the Wellington Ferry and also at the Lakes Hub Milang and via social media; Facebook pages of the GWLAP and Lakes Hub. See Appendix 3, Southern bell frog poster

Eleven frog monitoring loan kits were made available to community members/groups and landholders; however, as one landholder failed to make any recordings, only ten kits were used during the project.

In total 32 volunteers and five community groups contributed approximately 300 hours to the project undertaking frog monitoring at 68 sites (193 recordings between September 2015 and January 2016). Ten landholders provided permission for volunteers to access their properties with the project officer in attendance. See Figure 1, Table 1 for site locations.

8. Community frog monitoring

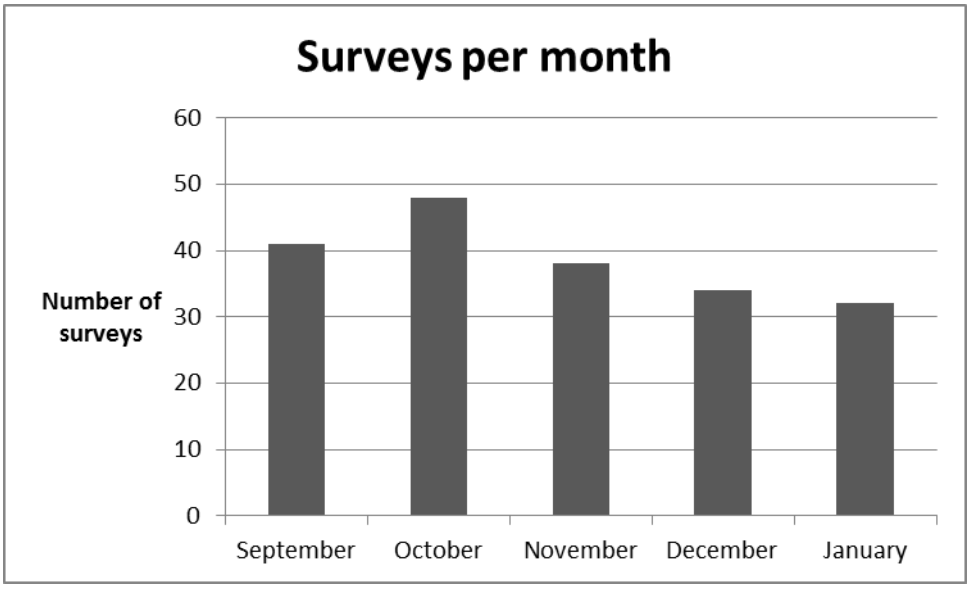

Figure 2. Surveys per month from September 2015 to January 2016

Over the five month monitoring period a total of 193 frog surveys were conducted;

- 41 surveys in September 2015
- 48 surveys in October 2015
- 38 surveys in November 2015
- 34 surveys in December 2015
- 32 surveys in January 2016

Figure 3. Frog monitoring loan kit equipment

9. Results

A total of seven frog species including the EPBC Vulnerable listed Southern bell frog (*Litoria raniformis*) were recorded in the study region in 2015/16. The highest diversity recorded was all seven species at one site, Wellington East wetland. There were three sites at which no frogs were recorded, however these results came from sites at which only one survey had been conducted, and later in the season - when most species stopped calling.

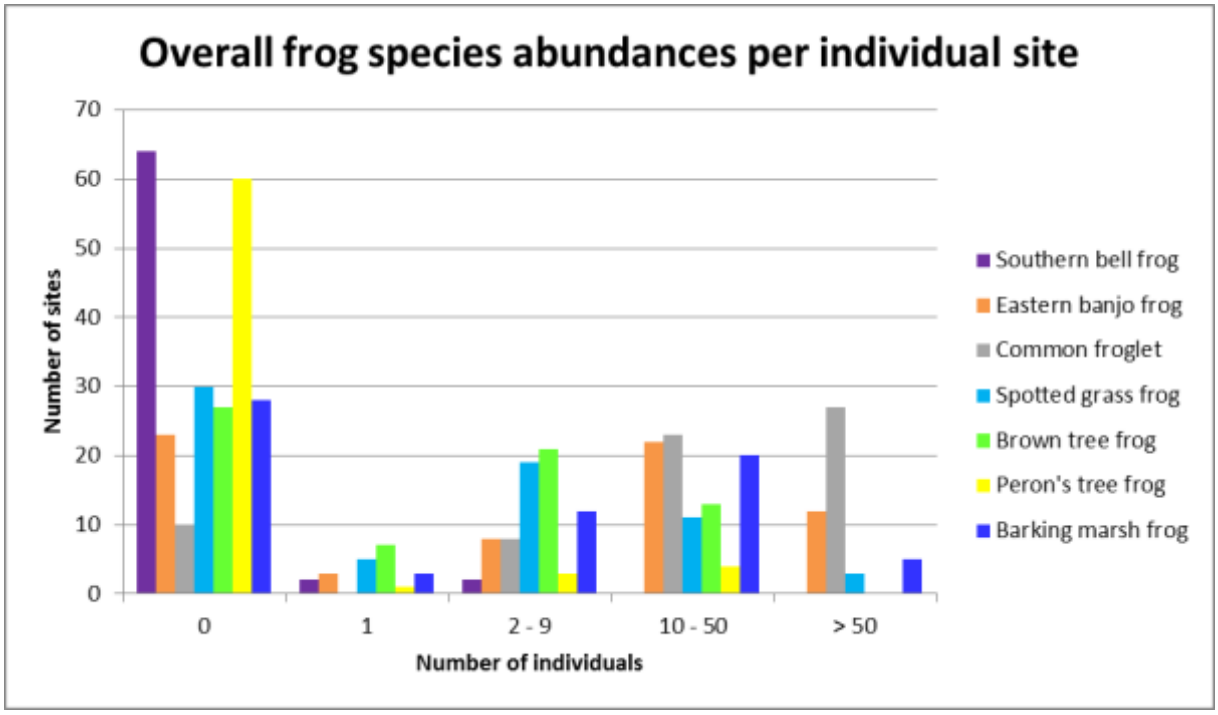

Figure 4. Overall species abundance scores per individual site in 2015/16

Table 2. Maximum overall species abundance scores per individual site in 2015/16

	Southern bell frog	*Eastern banjo frog*	*Common froglet*	*Spotted grass frog*	*Brown tree frog*	*Peron's tree frog*	*Barking marsh frog*
0	64	23	10	30	27	60	28
1	2	3	0	5	7	1	3
2 - 9	2	8	8	19	21	3	12
10 - 50	0	22	23	11	13	4	20
> 50	0	12	27	3	0	0	5

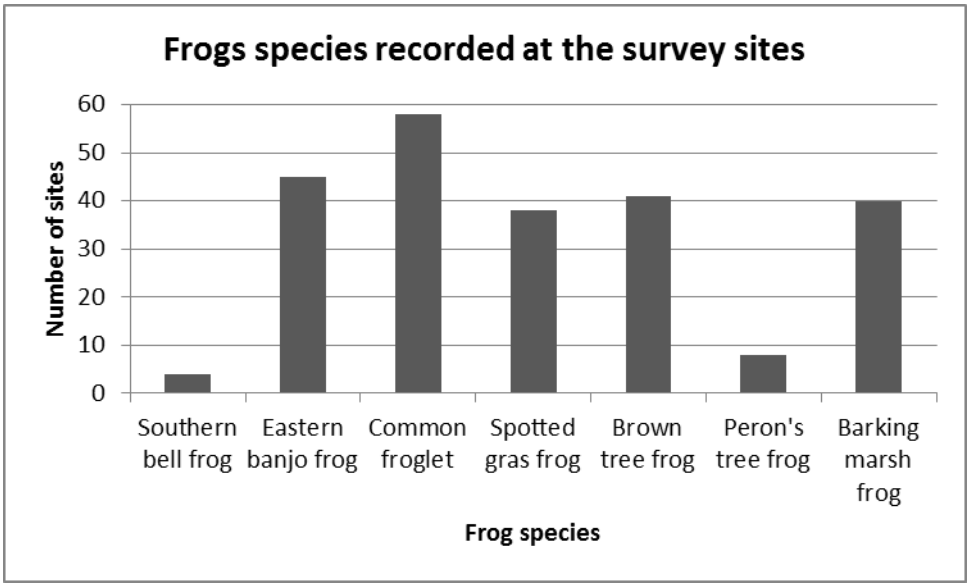

Figure 5. Frog species recorded at the 68 survey sites

Of the 68 sites surveyed, the Southern bell frog (*Litoria raniformis*) was recorded at four sites, however given the proximity of the survey sites and same survey date, the same frogs may have been recorded between the two pairs of sites.

The Common froglet (*Crinia signifera*) was the most widespread and abundant species, and it was recorded at 58 sites (85%) and in abundances of greater than 50 individuals at 30% of these sites.

The Eastern banjo frog (*Limnodynastes dumerilii*) was recorded at 45 sites. Their abundances were greater than 50 individuals at 17% of sites and in abundances of 10 – 50 individuals at 32% of the sites.

The Brown tree frog (*Litoria ewingii*) was recorded at 41 sites - with the highest abundance class represented being 10 – 50 individuals at 19% of sites.

The Barking marsh frog/Long-thumbed frog (*Limnodynastes fletcheri*) was recorded at 40 sites; it was at high abundance (10 – 50 individuals) at 29% of those sites and records of greater than 50 individuals were made at 7% of the sites.

The Spotted grass frog (*Limnodynastes tasmaniensis*) was recorded at 38 sites, with abundances of 10 – 50 individuals at 16% of the sites

The Peron's tree frog (*Litoria peronii*) was recorded at 8 sites (11% of total) in moderate abundances and was not detected at 88% of sites.

A table of the full results for each species per monitoring site can be found in Appendix 4.

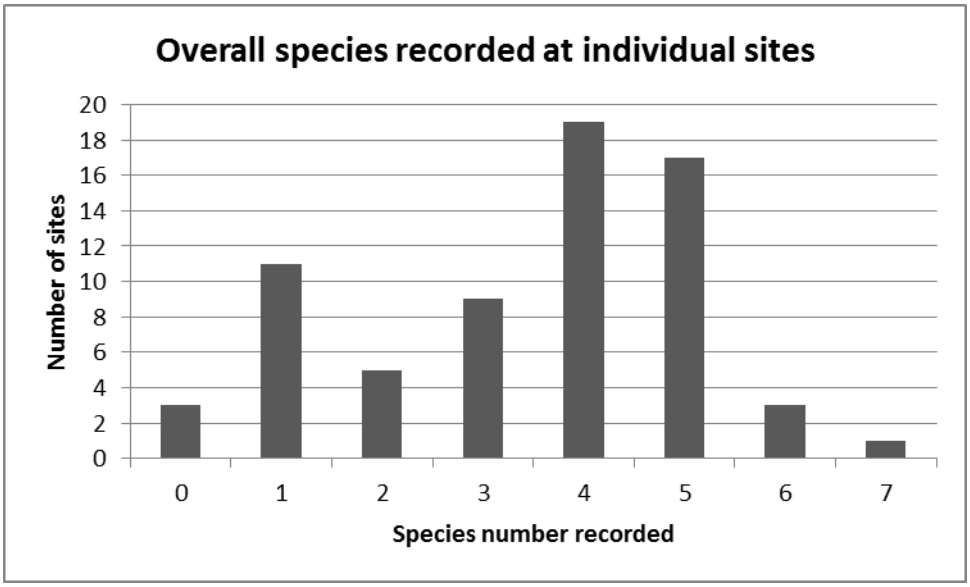

Figure 6. Overall species recorded in 2015/16 across the 68 survey sites

Of the 68 sites surveyed over the five month monitoring period, September 2015 to January 2016;

- Three sites recorded zero species
- Eleven sites recorded one species
- Five sites recorded two species
- Nine sites recorded three species
- Nineteen sites recorded four species
- Seventeen sites recorded five species
- Three sites recorded six species
- One site recorded seven species

Of the three sites to record zero species, these sites only received one survey late in the season when most of the frog species had stopped calling. Of the eleven sites to only record one species, ten of these sites also only had one survey conducted.

Atmospheric conditions

At each survey community members completed atmospheric weather conditions for each site (see Appendix 5, Scores assigned to atmospheric conditions). Due to multiple atmospheric parameters, incomplete data and the limited data set, no strong or clear correlations between frog species and numbers were determined. Site atmospheric conditions recorded for this project are included in Appendix 6.

While on a broad scale frog species do have their seasonal breeding cues, favourable atmospheric conditions (over hours to days) can also increase the numbers calling. For example before, during or after rain, low wind, higher humidity and warmer night time air temperature due to high cloud cover increases calling. (Duellman & Trueb)

While information gaps remain with reference to the CLLMM region, it is understood from studies elsewhere that the Southern bell frog is a species reliant on flooding of temporary wetlands, where individuals move to seasonally flooded or temporary wetlands for breeding (Wassens et al. 2008, Mason and Hillyard 2011). Lake levels were maintained above 0.75m AHD (Australian Height Datum) during the September to December monitoring through the provision of environmental watering, allowing the inundation of fringing wetlands and lakeshore vegetation. Water levels started to decrease from mid December 2015 (see Appendix 7). Applicable average daily water level data (in metres Australian Height Datum) were obtained from telemetry station A4261158 (Lake Alexandrina 4km West Pomanda Point) (water level data source www.waterconnect.sa.gov.au). While there was an increase recorded during the present study in Southern bell frogs recorded in the region ~4 sites - compared to one male at one site for the entire region last year (Mason and Durbridge 2015) it is unknown if the environmental watering period was long enough or if the water level was managed high enough to cue a greater breeding response from Southern bell frogs. Also, the region experienced above average temperatures and received ~67% below average rainfall from September to December 2015 (Seasonal climate summary South Australia spring 2015 – www.bom.gov.au) and this may also have been a contributing factor to low Southern bell frog numbers being recorded. (Refer also Appendix 8, Rainfall figures for Hindmarsh Island 2015). When comparing the rainfall data for spring 2015 to spring 2014, the 2015 spring period was much drier than the 2014 period, so it is probable that the environmental watering did create a breeding response from Southern bell frogs, albeit far less than the 2010 spring period when Southern bell frogs were recorded at six sites. (Mason & Hillyard 2011)

After recording the Southern bell frogs at the Wellington East wetland on 24th November 2015, a community member thought to check the barometric pressure at time of survey which showed a measurement of 1010 hPa which had fallen 10 points in the preceding 24 hours, the barometric pressure then continued to fall a further 10 hPa. On checking the barometric pressures for the date that the Southern bell frog was recorded at the two sites in Dunn's lagoon on 15th December the barometric pressure was also around the 1010 hPa. (See also Appendix 9. Daily weather observations for Hindmarsh Island, November 2015 & December 2015).

10. Discussion

A series of five community frog monitoring workshops were held throughout the region during early September 2015; Goolwa, Meningie, Milang, Raukkan and Wellington. In total 26 community members attended the workshops with ten participants going on to participate in the project. A number of previous frog monitoring participants also assisted with the project.

Over the five month monitoring period between September 2015 and January 2016 a total of 193 surveys were conducted across 68 sites by 32 community members with 10 landholders permitting monitoring to be conducted on their properties. Not all sites were able to be surveyed each month, due to volunteer availability and access to loan kits.

Seven species of frog were recorded in total across the 68 survey sites over the five month monitoring project. The Common froglet (*Crinia signifera*) was present at 58 sites; Eastern Banjo frog *(Limnodynastes dumerilii*) at 45 sites; Southern brown tree frog (*Litoria ewingii)* at 41 sites; Barking marsh frog/Long thumbed frog (*Limnodynastes fletcheri*) at 40 sites; Spotted grass frog (*Limnodynastes tasmaniensis*) at 38 sites; Peron's tree frog (*Litoria peronii*) at 8 sites, and the EPBC Vulnerable listed Southern bell frog (*Litoria raniformis*) was recorded at four sites. Given the proximity between the four sites where recordings of Southern bell frogs were made: Wellington East and Murrundi south (1.6kms) and only 850 metres between the two sites at Dunn's Lagoon Clayton Bay, it is possible that the same frogs were recorded from both pairs of locations.

Survey effort was related to species records. At three sites, zero frog species were recorded. Those sites were only surveyed once, and late in the season - when most of the common frog species had stopped calling. Of the eleven sites where only one species of frog was recorded, ten of these sites had also only had one survey conducted.

During the monitoring period environmental water was also received in the region, permitting lake levels to be maintained at greater than 0.75m AHD, allowing fringing wetlands around the region to fill, water levels began to decrease mid December 2015 and had fallen to approximately 0.6m AHD by the end of January, which saw some of the monitoring sites drying out. While lake levels were high between September and December average temperatures were higher and rainfall was below average for the period.

Research and literature (Duellman & Trueb 1986) suggests that (within their breeding seasons) activity patterns of frogs are highly dependent on local environmental factors such as rainfall, humidity and temperature, and that different species do have favourable individual seasonal breeding cues related to these conditions - which can increase the numbers calling.

While almost all data sheets had some atmospheric conditions completed; moon, rain, rain 24 hrs Yes/No, wind, cloud and temperature description. However, not all parameters were completed for all surveys, thus the data set is incomplete and no degree of certainty can be obtained from the limited data set.

11. Recommendations

With a changing climate and highly regulated river system, it would be beneficial to survey the same sites on an annual basis to assess how our frog populations are tracking which may then guide how future environmental watering is delivered, especially in regards to watering requirements for the EPBC Vulnerable listed Southern bell frog.

While basic atmospheric parameters are recorded at each survey it may also be useful to record barometric pressure at time of monitoring; these can generally be accessed via weather apps on mobile phones. The presence of carp and mosquito fish could also be documented at wetlands.

A photograph taken of the survey sites during the daytime would also be useful in determining the habitat requirements for each species and may assist with interpreting results and what wetland management may be required.

Ongoing water quality and the length of time wetlands hold water may be influencing factors affecting frog numbers from year to year as successful recruitment of frog species will ultimately depend on the success of progeny. Consequently, recording of the timeframes that water is held in the wetlands and detailed vegetation monitoring would contribute to understanding the frog monitoring results at each site.

Recommendations for future frog monitoring projects from feedback received from pariticipants include;

- Extra frog monitoring loan kits being made available for community members, or using voice recorders on mobile phones - as this would give community members much more flexibility in when they choose to do their surveys, rather than have to book a loan kit, collect, survey and return. Voice files could then be emailed through to the project officer for analysis.
- If playback quality poor on recording, disconnect the microphone and record with the digital voice recorder alone, as some community members experienced problems with the microphones which resulted in a couple of recordings being barely audible.
- Provide community members with their individual site results following each survey as time constraints on the project officer did not allow this to occur for each and every site.

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Appendix 1. Field data sheet for community frog monitoring

Field Datasheet

Date of Recording *(eg 23/09/2007)*	**Starting Time** *(eg 21:30)*
Your name:	**Frog Kit Number:**
Your contact number:	**Recording Number:**

Site Name

Details of New Site – *Collect at location data at site with GPS or Map references or ask one of the staff to find the location data for you*

Map / GPS Reference Northing (7 digits) or Latitude:	Easting (6 digits) or Longitude:
Map Zone (52,53 or 54):	
Site description:	

WEATHER *(please circle)*

Rain: No Rain / Drizzle / Showers / Moderate Rain / Heavy Rain **Rain within last 2 days:** Yes / No

Moon-phase: No Moon / Quarter Moon / Half Moon / Three-quarter Moon / Full Moon / Hidden

Wind Speed: No Wind / Slight Breeze / Strong Breeze / Moderate Wind / Strong Wind

Cloud cover: 0% / <5% / 5-25% / 25-50% / 50-75% / >75%

Temperature:

Cold / cool / mild / warm / hot

HABITAT *Please select* ***one*** *habitat type that best reflects the major habitat at the site.*

☐ Dam ☐ Pond ☐ Wetland ☐ Swamp or Flooded Paddock or Marshland

☐ Drain/Channel ☐ River or Floodplain ☐ Stream/Creek ☐ Garden (eg Fernery or Grassy Area)

☐ Lakeshore ☐ Reservoir or Lake ☐ Other_____

WATER QUALITY *If you can see the water, please indicate the condition of the site. Please select all categories that apply.*

Water Appearance: ☐ Clear ☐ Polluted ☐ Foamy ☐ Oily ☐ Stained ☐ Muddy ☐ Other

Describe water appearance:

Could you hear frogs calling? *(please circle)* **Yes** **No**

COMMENTS or OBSERVATIONS *(such as: site is grazed by stock, water is flowing, water has pungent smell etc.)*

Thank you for being involved; we hope you had fun.

Appendix 2. Workshop Flyers

Frog Monitoring Workshops

We are looking for community members and groups to once again Adopt a Frog Monitoring site/s for this year's Frog monitoring season. All it takes is a 5 minute recording of the frog species calling and completing a datasheet once a month from September through to January at your adopted site/s.

Given that lake levels are anticipated to be managed at higher levels this season we are hoping to get a good response from the EPBC Vulnerable listed Southern Bell frog which is known to breed in response to flooding. Last season's frog monitoring only resulted in one male Southern Bell frog being recorded for the entire region.

Come along to one of these free workshops in the region to learn all about our local frog species and how you can help to monitor our frog populations. Participants will receive a Lower Murray Frogs Field Guide and Frog call CD and monitoring information pack. There will also be live frogs on display. All ages welcome!

Milang Institute, Corner Ameroo and Coxe st MILANG
Tuesday 1st September 2015, 4:00pm to 5:30pm

Lakes Hub, Meningie, 79 Princes Highway MENINGIE
Thursday 3rd September 2015, 4:30pm to 6:00pm

Ibis Siding Garden Centre, Corner of Kessell and Cadell St GOOLWA
Saturday 5th September 2015

Wellington Courthouse Café, Mason street, Wellington near the Ferry
Wednesday 9th September 2015 5:00 to 6:30pm

Raukkan Community Centre
September 2015

To register your interest for one of the workshops, Please contact

Regina Durbridge

0427 364 551 or email

regina.durbridge@gwlap.org.au

© Southern Bell frog— Photo courtesy Tracey Reeves

Government of South Australia
Department of Environment, Water and Natural Resources

It's Almost Frog Season!
Adopt a Frog Monitoring Site!

We are looking for community members and groups to once again Adopt a Frog Monitoring site/s for this year's Frog monitoring season. All it takes is a 5 minute recording of the frog species calling and completing a datasheet once a month from September through to January at your adopted site/s.

Given that lake levels are anticipated to be managed at higher levels this season we are hoping to get a good response from the EPBC Vulnerable listed Southern Bell frog which is known to breed in response to flooding. Last season's frog monitoring only resulted in one male Southern Bell frog being recorded for the entire region.

Frog monitoring loan kits will be available and a series of Frog monitoring workshops will be held in the region during September.

To register your interest please contact Regina Durbridge
0427 364 551 or email regina.durbridge@gwlap.org.au

Government of South Australia
Department of Environment, Water and Natural Resources

© Southern Bell frog— Photo courtesy Tracey Reeves

Frog Monitoring Workshop
Lakes Hub Meningie, 79 Princes Highway MENINGIE
Thursday 3rd September, 4:30—6:00pm

Come along to this free workshop and learn all about our local frog species which includes the Vulnerable listed Southern Bell Frog and how you can help this frog monitoring season by "Adopting a Frog Monitoring site" to monitor once a month from September through to January.

All it takes is a 5 minute recording of the frog species calling and completing a datasheet once a month at your adopted site!

Topics covered at this workshop will include frog identification and use of equipment in the frog monitoring loan kits .

To register your interest please contact Regina Durbridge

0427 364 551 or email regina.durbridge@gwlap.org.au

Government of South Australia
Department of Environment, Water and Natural Resources

© Southern Bell frog—Photo courtesy Tracey Reeves

Appendix 3. Southern bell frog poster

Appendix 4. Results of frog surveys at all sites, abundance scores assigned to each species (0=0; 1=1; 2 = 2-9; 3 = 10-50; 4 = >50)

Site	Southern Bell frog	Eastern banjo frog	Common froglet	Spotted grass frog	Brown tree frog	Peron's tree frog	Barking marsh frog	Total Species Recorded	Number of surveys
Wellington East	2	3	3	2	3	3	3	7	5
Ducks Hospital, Dunn's Lagoon	1	2	3	2	2	0	2	6	5
Murrundi Wetland south	2	3	3	0	3	3	3	6	5
Tolmer Rd Wellington	0	3	3	1	2	2	2	6	4
Alexandrina Station	0	3	4	3	3	0	4	5	5
Angas River	0	4	4	2	1	0	2	5	1
Bremer River	0	4	4	4	3	0	3	5	3
edge of Narrung Narrows	0	4	4	3	2	0	3	5	5
End of Randall Rd, Hindmarsh Island	0	2	3	2	1	0	3	5	4
Griffin Site 1	0	4	4	2	1	0	2	5	2
Griffin Site 2	0	4	4	3	2	0	2	5	2
Low Point	0	3	3	2	3	0	3	5	5
Mason Lady Jude paddock	0	3	3	2	3	0	3	5	5
Mason Lady Jude windmill	0	2	3	2	3	0	3	5	5
Masondrina	0	3	3	3	3	0	1	5	5
Mulgundawa Irrigation Channel	0	4	4	3	2	0	3	5	3
Murrundi Wetland north	0	4	2	0	2	3	3	5	4
Narrung Narrows Lot 3 Narrung Stud Rd	0	3	4	3	2	0	3	5	5
Snug Cove, Clayton Bay	1	1	2	0	2	0	2	5	5
Warneke, Narrung Narrows	0	4	4	2	2	0	4	5	5
Watkins, Tookayerta	0	3	4	2	1	0	2	5	2
Alexandrina Station near pump shed	0	2	4	0	3	0	3	4	5
Alison Avenue, Goolwa North	0	3	3	0	2	2	0	4	5
Barnhill Rd swamp	0	4	4	3	3	0	0	4	4
Clayton Bay Boardwalk	0	2	3	0	2	0	2	4	5
Ken & Sally's Swamp, Clayton Bay	0	3	4	3	0	0	2	4	5
Knappsteins A	0	3	3	2	2	0	0	4	1
Knappsteins B	0	4	4	3	2	0	0	4	1
Milang N.E. Wetland	0	4	4	3	3	0	0	4	3
Milang S.W. Wetland	0	3	4	2	1	0	0	4	4
Pelican Lagoon Site 1	0	0	4	1	1	0	4	4	3
Pelican Lagoon Site 4	0	0	4	1	0	1	3	4	1
Red Top Bay, Clayton Bay	0	1	3	0	2	0	3	4	4
Salty's Point Sturt Site 1	0	3	4	2	2	0	0	4	1
Salty's Point Sturt Site 2	0	3	4	2	0	0	2	4	1
Tolderol Bay 11	0	3	4	4	2	0	0	4	2
Tolderol Bay 7	0	0	3	2	1	0	1	4	2
Tolderol Main channel near pump shed	0	3	3	0	2	0	1	4	3
Wally's Landing	0	2	3	1	0	0	2	4	4
Wetlands Beach Clayton Bay	0	3	3	1	0	0	3	4	5
Bank of Middle creek, Strathalbyn	0	2	2	0	0	0	2	3	4
Geralds Hut	0	3	4	0	0	0	3	3	1
Gollan's Waterhole	0	2	0	0	3	2	0	3	2
Milang Bay Wetland	0	3	4	0	3	0	0	3	3
Milang lakeshore in front of pump station	0	3	2	2	0	0	0	3	2
Narrung Structure lakeside	0	0	0	3	2	0	4	3	2
Pelican Lagoon Site 2	0	0	2	0	2	0	4	3	2
Pelican Lagoon Site 5	0	0	3	0	2	0	3	3	1
Turveys Drain, Lake Alexandrina	0	4	4	4	0	0	0	3	1
442 Seven Mile Road Meningie	0	0	0	2	2	0	0	2	4
Birchall/Merrett ave, Goolwa	0	0	4	2	0	0	0	2	1
Currency Creek rd, Goolwa North	0	3	3	0	0	0	0	2	5
Murrundi Wetland mid site	0	0	0	0	0	3	3	2	2
Warrengie Drive	0	1	2	0	0	0	0	2	1
Bottom right of holiday units in Milang	0	0	3	0	0	0	0	1	1
Golfview & Pitt Street	0	0	4	0	0	0	0	1	1
Hodgson/Heinicke Ave, Goolwa	0	0	3	0	0	0	0	1	1
Lake Albert Meningie opposite Uniting Church	0	0	2	0	0	0	0	1	1
Lot 792 Magins Rd	0	0	4	0	0	0	0	1	5
Old Bull Creek Rd	0	0	3	0	0	0	0	1	1
Pelican Lagoon Site 3	0	0	0	0	0	0	3	1	1
Shadows Lagoon, Hindmarsh Island	0	0	0	0	0	0	3	1	1
Pelican Path Culvert	0	0	3	0	0	0	0	1	1
Swamp 333	0	0	0	2	0	0	0	1	1
Watchalunga, Finniss - Nature Foundation	0	0	2	0	0	0	0	1	1
Bird viewing hut Goolwa South	0	0	0	0	0	0	0	0	1
Milang Lake foreshore Boatramp	0	0	0	0	0	0	0	0	1
Tolderol Bay 6	0	0	0	0	0	0	0	0	1

Appendix 5. Scores assigned to atmospheric weather condition parameters and frog abundances

MOON	
No Moon	0
Quarter Moon	1
Half Moon	2
Three-quarter Moon	3
Full Moon	4
Hidden	Hidden

RAIN	
No Rain	0
Drizzle	1
Showers	2
Moderate Rain	3
Heavy Rain	4

WIND	
No Wind	0
Slight Breeze	1
Strong Breeze	2
Moderate Wind	3
Strong Wind	4

CLOUD	
0%	0
< 5 %	1
5 - 25 %	2
25 - 50 %	3
50 - 75 %	4
> 75 %	5

FROG ABUNDANCES	
0	0
1	1
2 - 9	2
10 - 50	3
> 50	4

Appendix 6. Atmospheric weather conditions recorded on datasheets. Scores assigned to each parameter: moon, rain, rain 24 hrs Yes/No, wind, cloud and temperature description

DATE	SITE	Survey time	MOON	RAIN	RAIN 24hrs	WIND	CLOUD	TEMP DESCRIP
3/09/2015	Wellington East	19:00	0	0	yes	1	0	cold
3/09/2015	Bremer River	19:54	0	0	yes	1	1	cold
3/09/2015	Barnhill Rd swamp	20:27	0	0	yes	1	2	cold
6/09/2015	Currency Creek rd, Goolwa North	19:30	0	0	yes	1	2	cool
6/09/2015	Alison Avenue, Goolwa North	19:45	0	0	yes	0	2	cold
7/09/2015	442 Seven Mile Road Meningie	19:00	0	1	yes	2	5	cold
7/09/2015	Narrung Narrows Lot 3 Narrung Stud Rd	18:31	0	1	yes	2	5	cool
8/09/2015	Warneke, Narrung Narrows	18:36	0	0	yes	1	5	cool
8/09/2015	edge of Narrung Narrows	19:14	0	1	yes	1	3	cool
9/09/2015	Tolmer Rd Wellington	18:10	0	0	yes	1	1	cool
9/09/2015	Mulgundawa Irrigation Channel	18:32	0	0	yes	1	1	cold
9/09/2015	Turveys Drain, Lake Alexandrina	19:05	0	0	yes	1	1	cold
10/09/2015	End of Randall Rd, Hindmarsh Island	18:45	0	0	yes	0	1	cool
12/09/2015	Tolderol Bay 11	19:56	0	0	no	0	3	mild
12/09/2015	Tolderol Main channel near pump shed	20:10	0	0	no	0	3	mild
12/09/2015	Knappsteins A	21:00	0	0	no	1	2	cool
12/09/2014	Knappsteins B	21:15	0	0	no	1	2	cool
12/09/2015	Murrundi Wetland north	21:20	0	0	no	0	0	mild
12/09/2015	Murrundi Wetland south	21:57	0	0	no	0	0	mild
16/09/2015	Alexandrina Station near pump shed	19:40	0	0	yes	2	2	cold
16/09/2015	Alexandrina Station	19:50	0	0	yes	2	2	cold
16/09/2015	Mason Lady Jude windmill	20:10	0	0	yes	2	2	cold
16/09/2015	Mason Lady Jude paddock	20:20	0	0	yes	2	2	cold
16/09/2015	Masondrina	21:15	0	0	yes	1	2	cold
16/09/2015	Low Point	21:40	0	0	yes	2	2	cold
17/09/2015	Milang Bay Wetland	21:35	0	0	yes	1	5	cool
17/09/2015	Milang N.E. Wetland	21:45	0	0	yes	1	5	cool
17/09/2015	Milang S.W. Wetland	21:53	0	0	yes	1	5	cool
17/09/2015	Milang S.W. Wetland	22:03	0	0	yes	1	5	cool
18/09/2015	Watkins, Tookayerta	18:30	1	0	yes	0	1	cool
24/09/2015	Ken & Sally's Swamp, Clayton Bay	18:37	3	0	no	3	4	cool
24/09/2015	Red Top Bay, Clayton Bay	18:51	3	0	no	4	4	cold
24/09/2015	Clayton Bay Boardwalk	19:02	3	0	no	3	4	cold
24/09/2015	Snug Cove, Clayton Bay	19:18	3	0	no	4	4	cold
24/09/2015	Ducks Hospital, Dunn's Lagoon	19:34	3	0	no	3	4	cold
26/09/2015	Angas River, near mouth	18:30	3	0		0	1	cool
26/09/2015	Bremer River, near mouth	18:51	3	0		0	1	cool
26/09/2015	Geralds Hut	21:05	3	0		1	2	
26/09/2015	Warrengie Drive	21:32	3	0		1	2	
29/09/2015	Lot 792 Magins Rd	12:48	4 hidden	0	no	1	3	mild

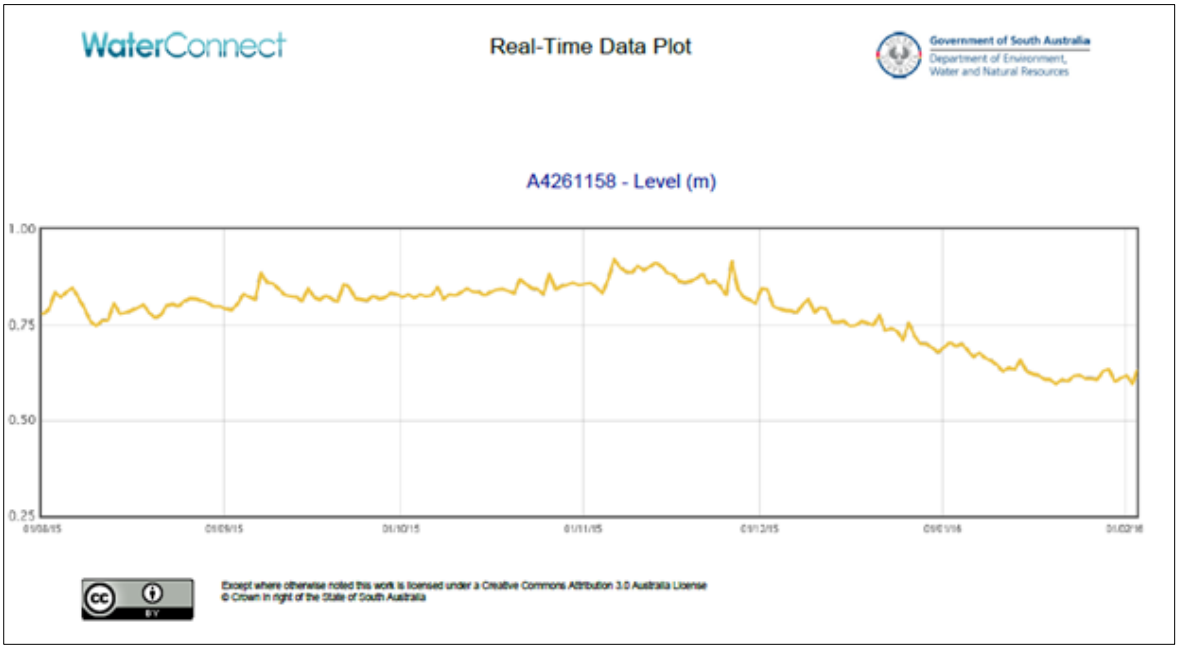
30/09/2015	Bank of Middle creek, Strathalbyn	20:25	3	0	no	0	1	cool
1/10/2015	Golfview & Pitt Street	23:00	0	1		1	4	warm
1/10/2015	Hodgson/Heinicke Ave, Goolwa	21:30	0	0		1	4	mild
1/10/2015	Birchall/Merrett ave, Goolwa	22:00	0	0		1	4	mild
2/10/2015	Salty's Point Sturt Site 2	18:20	0	0		0	1	
2/10/2015	Salty's Point Sturt Site 1	18:40	0	0		0	1	
2/10/2015	Griffin Site 1	19:23	0	0		0	1	
2/10/2015	Griffin Site 2	19:40	0	0		0	1	
2/10/2015	Barnhill Rd swamp	20:40	0	0		0	1	
2/10/2015	Narrung Narrows Lot 3 Narrung Stud Rd	19:23	0	0	no	0	1	mild
2/10/2015	edge of Narrung Narrows	19:48	0	0	no	0	1	mild
2/10/2015	Murrundi Wetland south	21:17	3	0	no	0	0	warm
2/10/2015	Murrundi Wetland north	21:05	3	0	no	0	0	warm
3/10/2015	Warneke, Narrung Narrows	19:18	0	0	no	1	3	warm
9/10/2015	Milang Bay Wetland	20:45	0	0	no	0	2	mild
9/10/2015	Milang N.E. Wetland	20:58	0	0	no	0	2	mild
9/10/2015	Milang S.W. Wetland	21:08	0	0	no	0	2	mild
13/10/2015	Alison Avenue, Goolwa North	20:30	0	0	no	0	0	cool
13/10/2015	Currency Creek rd, Goolwa North	20:55	0	0	no	0	0	cool
15/10/2015	Gollan's Waterhole	23:10		0	yes	0	3	mild
15/10/2015	Low Point	21:00	0	0		2	5	mild
15/10/2015	Mason Lady Jude paddock	19:33	0	0		2	5	warm
15/10/2015	Mason Lady Jude windmill	19:40	0	0		2	5	warm
15/10/2015	Alexandrina Station near pump shed	20:05	0	0		2	5	mild
15/10/2015	Alexandrina Station	20:15	0	0		2	5	mild
15/10/2015	Masondrina	20:30	0	0		2	5	mild
15/10/2015	Wellington East	21:25	0	0		2	5	mild
17/10/2015	Old Bull Creek Rd	22:45	0	0	yes	0	2	mild
17/10/2015	Bottom right of holiday units in Milang	0:05	0	0	no	1	3	mild
18/10/2015	Milang lakeshore in front of pump station	21:50	0	0	no	1	3	warm
18/10/2015	End of Randall Rd, Hindmarsh Island	18:00	1	0	yes	3	0	warm
19/10/2015	Milang lakeshore in front of pump station	19:40	0	1	no	1	4	warm
19/10/2015	Milang Lake foreshore Boatramp	20:20	0	2	no	1	4	mild
19/10/2015	Wetlands Beach Clayton Bay	20:43						
22/10/2015	Ken & Sally's Swamp, Clayton Bay	19:40	2	0		2	0	cool
22/10/2015	Red Top Bay, Clayton Bay	19:52	2	0		2	0	cool
22/10/2015	Clayton Bay Boardwalk	20:02	2	0		2	0	cool
22/10/2015	Snug Cove, Clayton Bay	20:16	2	0		2	0	cool
22/10/2015	Ducks Hospital, Dunn's Lagoon	20:27	2	0		2	0	cool
24/10/2015	Lot 792 Magins Rd	21:40		0	no	1	5	mild
25/10/2015	Wellington East	20:08	3	0	yes	3	5	cool
25/10/2015	Tolmer Rd Wellington	20:25	3 Hidden	0	yes	3	5	cool
25/10/2015	Mulgundawa Irrigation Channel	20:52	3 Hidden	0	yes	4	4	cool
25/10/2015	Tolderol Bay 7	21:25	3	0		3	4	cool

25/10/2015	Tolderol Main channel near pump shed	21:35	3	0		4	4	cool
27/10/2015	Bank of Middle creek, Strathalbyn	20:40	4	0	Yes	1	2	mild
29/10/2015	Pelican Lagoon Site 1	21:15	4 Hidden	0	yes	2	1	warm
29/10/2015	Pelican Lagoon Site 5	21:38	4 Hidden	0	yes	2	1	warm
29/10/2015	Pelican Lagoon Site 4	22:31	4 Hidden	0	yes	2	2	warm
3/11/2015	Wetlands Beach Clayton Bay	20:25						
4/11/2015	Wetlands Beach Clayton Bay	21:20						
7/11/2015	edge of Narrung Narrows	20:35	0	0	no	2	1	mild
7/11/2015	Narrung Narrows Lot 3 Narrung Stud Rd	21:01	0	0	no	2	1	cool
8/11/2015	Wetlands Beach Clayton Bay	20:45			no			
8/11/2015	Warneke, Narrung Narrows	20:42	0	0	no	0	1	warm
10/11/2015	Wally's Landing	20:20	0	0		2	2	cool
11/11/2015	Currency Creek rd, Goolwa North	20:50	0	0		1	3	mild
11/11/2015	Alison Avenue, Goolwa North	21:10	0	0		1	3	mild
17/11/2015	Milang Bay Wetland	20:15	1	0	no	0	0	warm
17/11/2015	Milang N.E. Wetland	20:25	1	0	no	0	0	warm
17/11/2015	Milang S.W. wetland	20:34	1	0	no	0	0	warm
17/11/2015	Mulgundawa Irrigation Channel	22:41	1	0	no	1	0	mild
17/11/2015	Bremer River	23:10	1	0	no	1	0	mild
20/11/2015	Barnhill Rd swamp	21:38	2	0	yes	1	3	cool
24/11/2015	442 Seven Mile Road Meningie	20:45	4	0	no	0	1	mild
24/11/2015	Ken & Sally's Swamp, Clayton Bay	20:29	3	0	no	0	2	cool
24/11/2015	Mason Lady Jude paddock	20:36	3	0	yes	0	2	mild
24/11/2015	Red Top Bay, Clayton Bay	20:42	3	0	no	0	2	cool
24/11/2015	Clayton Bay Boardwalk	20:53	3	0	no	0	2	cool
24/11/2015	Mason Lady Jude windmill	20:56	3	0	no	0	2	mild
24/11/2015	Snug Cove, Clayton Bay	21:06	3	0	no	0	2	cool
24/11/2015	Alexandrina Station near pump shed	21:08	3	0	yes	0	2	mild
24/11/2015	Ducks Hospital, Dunn's Lagoon	21:16	3	0	no	0	2	cool
24/11/2015	Alexandrina station	21:18	3	0	yes	0	2	mild
24/11/2015	Masondrina	21:32	3	0	yes	0	2	mild
24/11/2015	Low Point	22:00	3	0	yes	0	2	mild
24/11/2015	Wellington East	22:28	3	0	yes	0	2	mild
24/11/2015	Tolmer Rd Wellington	22:58	3	0	yes	0	1	mild
24/11/2015	Murrundi Wetland south	23:20	3	0	yes	0	1	cool
25/11/2015	Wally's Landing	0:20	3	0	yes	0	1	cool
26/11/2015	Lot 792 Magins Rd	20:00	4 hidden	0	yes	1	4	cool
26/11/2015	Swamp 333	20:15	4	0	no	1	2	cool
26/11/2015	Pelican Path Culvert	20:30	4	0	no	0	2	cool
27/11/2015	Lake Albert Meningie opposite Uniting Church	20:40	0	0	no	1	2	cool
28/11/2015	Griffin Site 1	20:58	0	0		1	2	cool
28/11/2015	Griffin Site 2	21:10	0	0		2	2	cool
28/11/2015	Watkins, Tookayerta	22:05	0	0		1	3	cool
2/12/2015	Pelican Lagoon Site 1	21:07	0	0	yes	1	1	mild

2/12/2015	Pelican Lagoon Site 2	21:47	0	0	yes	1	1	mild
4/12/2015	Wetlands Beach Clayton Bay	21:30	0	0		1	2	warm
5/12/2015	Murrundi Wetland south	20:35	3	0	no	0	0	hot
5/12/2015	Murrundi Wetland mid site	20:43	3	0	no	0	0	hot
5/12/2015	Murrundi Wetland north	21:56	3	0	no	0	0	hot
9/12/2015	442 Seven Mile Road Meningie	21:00						
12/12/2015	Narrung Narrows Lot 3 Narrung Stud Rd	21:18	0	0	no	2	1	cool
12/12/2015	edge of Narrung Narrows	21:48	0	0	no	2	1	cool
14/12/2015	End of Randall Rd, Hindmarsh Island	20:00	0	1	no	1	4	
15/12/2015	Ken & Sally's Swamp, Clayton Bay	20:15	0	0	yes	1	1	mild
15/12/2015	Snug Cove, Clayton Bay	20:25	0	0	yes	1	1	mild
15/12/2015	Ducks Hospital, Dunn's Lagoon	20:36	0	0	yes	1	1	mild
15/12/2015	Clayton Bay Boardwalk	20:50	0	0	yes	1	1	mild
15/12/2015	Watchalunga, Finniss - Nature Foundation	20:50	1	0	yes	1	0	warm
15/12/2015	Barnhill Rd swamp	21:20	1	0	yes	0	1	warm
15/12/2015	Wally's Landing	21:39	1	0	yes	1	1	warm
15/12/2015	Bird viewing hut Goolwa South	22:15	1	0	yes	1	1	mild
21/12/2015	Currency Creek rd, Goolwa North	21:30	1	0	yes	1		cool
21/12/2015	Alison Avenue, Goolwa North	21:37	1	0	yes	1		cool
22/12/2015	Lot 792 Magins Rd	20:30	3	0	yes	1	1	cool
29/12/2015	Bank of Middle creek, Strathalbyn	20:50	3	0	no		0	warm
30/12/2015	Pelican Lagoon Site 1	22:06	0	0	no	1	3	warm
30/12/2015	Pelican Lagoon Site 2	22:32	0	0	no	1	3	warm
30/12/2015	Pelican Lagoon Site 3	23:05	0	0	no	1	3	warm
30/12/2015	Warneke, Narrung Narrows	21:00	0	0	no	0	5	hot
30/12/2015	Alexandrina Station near pump shed	22:03	0	0	no	0	5	hot
30/12/2015	Alexandrina station	22:15	0	0	no	0	5	hot
30/12/2015	Mason Lady Jude paddock	22:31	0	0	no	0	5	hot
30/12/2015	Mason Lady Jude windmill	22:45	0	0	no	1	5	hot
30/12/2015	Masondrina	23:05	0	0	no	0	3	warm
30/12/2015	Low Point	23:30	0	0	no	0	3	warm
30/12/2015	Narrung Structure lakeside	0:10	2	0	no	0	3	warm
31/12/2015	Gollan's Waterhole	23:20	3	0	no		3	mild
14/01/2016	Ken & Sally's Swamp, Clayton Bay	20:08	1	0		2	3	cool
14/01/2016	Snug Cove, Clayton Bay	20:23	1	0		2	3	cool
14/01/2016	Ducks Hospital, Dunn's Lagoon	20:38	1	0		2	3	cool
14/01/2016	Clayton Bay Boardwalk	20:54	1	0		2	3	cool
14/01/2016	Red Top Bay, Clayton Bay	21:04	1	0		3	3	cool
16/01/2016	Murrundi Wetland south	21:35	2	0	no	0	2	warm
16/01/2016	Murrundi Wetland mid site	21:44	2	0	no	0	2	warm
19/01/2016	Narrung Narrows Lot 3 Narrung Stud Rd	21:16	1	0		0	5	warm
19/01/2016	edge of Narrung Narrows	21:39	1	0		0	5	warm
16/01/2016	Murrundi Wetland north	22:06	2	0	no	0	2	warm
19/01/2016	End of Randall Rd, Hindmarsh Island	21:05	0	0	no	0	5	hot

19/01/2016	Shadows Lagoon, Hindmarsh Island	21:30	0	0	no	0	5	hot
21/01/2016	Narrung Structure lakeside	22:04	3 Hidden	0	no	1	5	warm
21/01/2016	Warneke, Narrung Narrows	22:32	3 Hidden	0	no	1	5	warm
22/01/2016	Bank of Middle creek, Strathalbyn	21:00	4	0	yes	1	1	warm
22/01/2016	Currency Creek rd, Goolwa North	21:20	3	0	yes	1	4	mild
22/01/2016	Alison Avenue, Goolwa North	21:40	3	0	yes	1	4	mild
25/01/2016	442 Seven Mile Road Meningie	21:10	0	0	no	3	2	cool
28/01/2016	Mason Lady Jude paddock	20:33	0	0	yes	3	5	cold
28/01/2016	Mason Lady Jude windmill	20:47	0	0	yes	3	5	cold
28/01/2016	Alexandrina Station near pump shed	21:01	0	0	yes	3	5	cold
28/01/2016	Alexandrina Station	21:10	0	0	yes	3	4	cold
28/01/2016	Masondrina	21:23	0	0	yes	2	3	cold
28/01/2016	Low Point	21:47	0	0	yes	3	2	cold
28/01/2016	Wellington East	21:55	0	0	yes	2	2	cold
28/01/2016	Tolmer Rd Wellington	22:30	0	0	yes	3	2	cold
30/01/2016	Tolderol Bay 11	21:06	0	0	yes	2	1	cool
30/01/2016	Tolderol Bay 6	21:15	0	0	Yes	2	1	cool
30/01/2016	Tolderol Bay 7	21:27	0	0	Yes	2	2	cool
30/01/2016	Tolderol Main channel near pump shed	21:35	0	0	Yes	2	2	cool
30/01/2016	Wally's Landing	22:45	0	0	yes	0	2	cool
30/01/2016	Lot 792 Magins Rd	20:30	0	0	yes	0	2	mild

Appendix 7. Average daily water levels (in metres Australian Height Datum) obtained from telemetry station A4261158 (Lake Alexandrina 4km West Pomanda Point) during the survey period between September 2015 and January 2016 (water level data source www.waterconnect.sa.gov.au).



Appendix 8. Daily weather observations for Hindmarsh Island, November 2015 & December 2015
Source www.bom.sa.gov.au

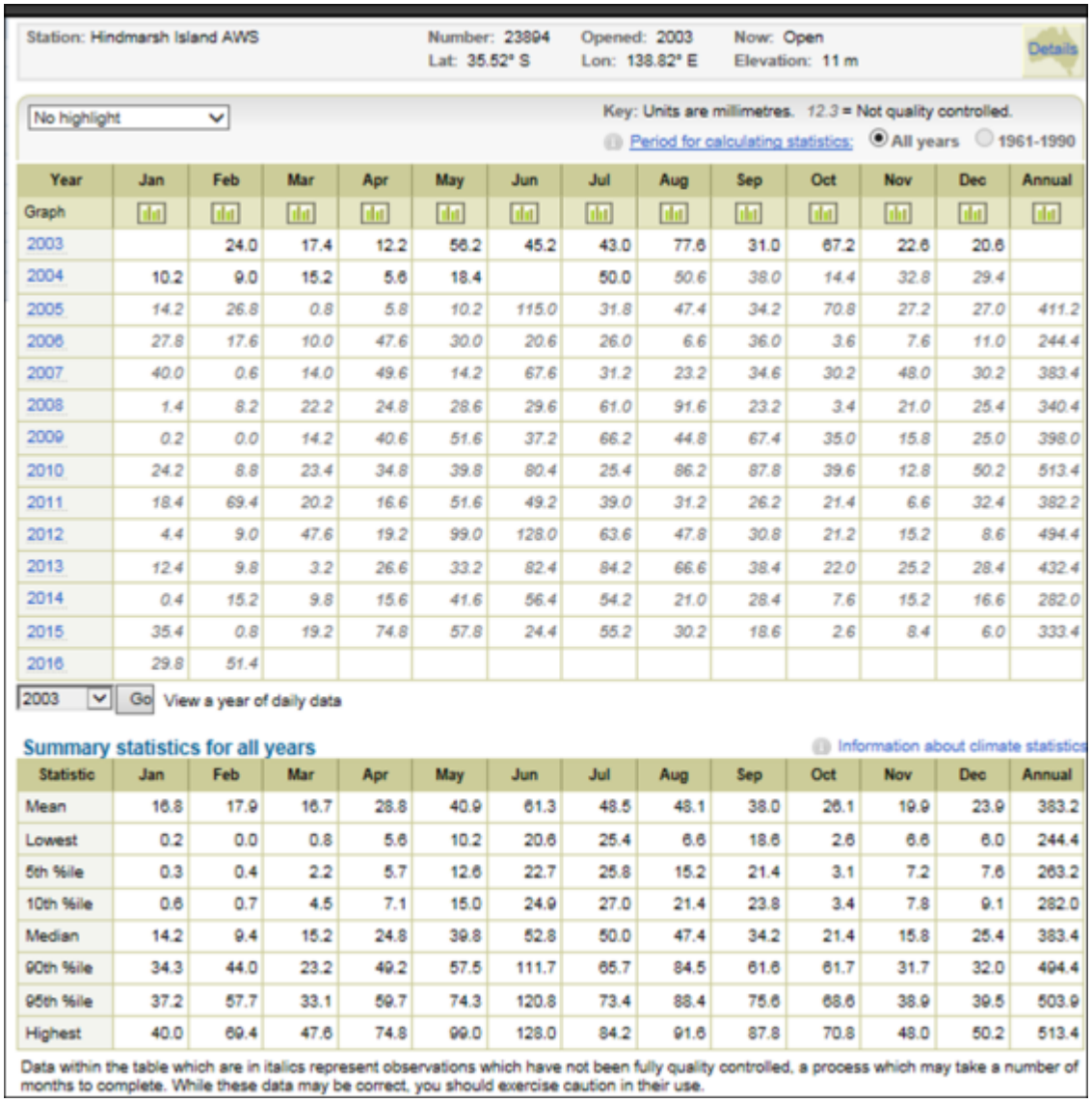
Hindmarsh Island, South Australia
November 2015 Daily Weather Observations

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8th		km/h	hPa	°C	%	8th		km/h	hPa
1	Su	13.7	20.6	0	5.0		SSW	37	15:26	16.1	77	8	S	15	1010.6	19.5	67		SSW	30	1009.3
2	Mo	14.8	19.3	0.2	5.0		S	46	11:01	18.2	72		SW	15	1013.5	16.9	72		S	31	1014.5
3	Tu	12.3	26.4	0	2.4		E	52	14:08	15.0	66		E	24	1015.8	25.1	31		E	31	1011.1
4	We	14.9	26.5	4.4	3.2		WSW	43	21:40	20.8	83	4	NNE	22	1006.9	22.2	70		SE	24	1004.2
5	Th	15.9	18.9	2.0	4.0		SW	44	11:04	16.9	80	8	SW	28	1007.3	16.7	90		WSW	20	1007.9
6	Fr	14.3	19.3	1.8	1.6		SSW	44	14:49	14.6	86	8	SW	30	1015.3	18.1	63		SSW	33	1015.1
7	Sa	13.4	22.3	0	4.2		SSE	33	13:00	15.8	68	8	E	15	1021.2	19.7	59		SE	20	1019.4
8	Su	12.6	34.9	0	4.2			30	08:08	22.2	48	0	NNE	22	1019.6						
9	Mo	18.9	36.2	0	6.4		WNW	57	10:41	28.4	30	4	N	13	1015.1	28.3	36		S	26	1012.6
10	Tu	15.8	18.0	0	7.0		SSW	46	04:59	17.0	79		S	22	1018.9						
11	We	11.3	19.1	0	2.6		SE	43	00:41	14.3	62	8	ESE	22	1020.2	17.7	59		SSE	28	1017.2
12	Th	13.7	20.4	0	3.2		SSW	44	15:41	16.7	79		SSW	26	1017.0	18.2	67		SSW	33	1017.1
13	Fr	14.7	19.2	0	6.0		S	52	14:48	17.1	65	6	S	28	1020.5	18.2	61		S	37	1019.6
14	Sa	13.8	20.4	0	4.2		S	48	18:33	16.8	60	3	S	20	1022.0	17.9	61		S	30	1021.0
15	Su	13.2	18.4	0	5.2		SSE	41	23:32	15.7	60	6	SE	26	1022.7	17.0	59		S	28	1019.9
16	Mo	11.3	29.4	0	4.6		SSW	31	12:58	18.4	65	1	NNE	13	1016.7	23.8	55		SSW	20	1013.5
17	Tu	13.9	33.3	0	5.8		SSW	44	14:51	24.5	29		N	11	1012.8	29.3	26		S	26	1011.0
18	We	13.4	38.8	0	8.0		NW	59	13:23	23.5	40	8	NE	17	1010.8	38.2	14		NW	35	1007.9
19	Th	19.2	23.3	0	8.6		S	44	22:51	20.6	73		SSW	28	1015.7	21.1	71		S	19	1013.6
20	Fr	15.8	21.3	0	6.6		SSW	52	13:08	17.5	72	8	SW	28	1016.3	19.3	58		SW	30	1018.0
21	Sa	14.0	19.6	0	4.8		S	54	02:46	15.5	53	8	SSE	28	1026.0	17.6	52		S	28	1025.0
22	Su	13.8	19.9	0	5.0		SW	44	18:02	15.7	54	8	SW	7	1022.7	18.8	50		SSW	31	1019.8
23	Mo	14.2	21.1	0	5.0		SW	43	03:45	16.6	63	7	SW	22	1021.1	20.1	53		SSW	30	1019.9
24	Tu	10.8	29.1	0	6.0		S	30	10:54	18.3	56		N	9	1018.4	21.0	54		S	20	1014.7
25	We	14.1	33.9	0	5.6		NW	80	12:17	29.1	15	6	NNW	28	1001.5	29.0	21		W	41	998.5
26	Th	12.3	18.0	0	8.2		SSW	78	03:03	15.1	44	4	SSW	44	1014.4	17.8	43		SSW	37	1017.5
27	Fr	11.1	19.2	0	6.0		WSW	39	09:33	14.7	47	6	WSW	19	1020.9	18.2	51		SSW	30	1019.7
28	Sa	10.3	21.8	0	4.0		S	35	16:04	16.6	59	2	NNE	17	1018.9	18.9	52		S	22	1016.9
29	Su	12.4	28.9	0	5.4		SSE	33	12:55	17.1	57	3	S	9	1016.9	19.6	53		SSE	26	1014.3
30	Mo	13.3	33.3	0	5.6		SW	67	12:34	28.9	30	3	N	15	1002.5	20.3	64		SW	50	1003.2

Hindmarsh Island, South Australia
December 2015 Daily Weather Observations

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9 am						3 pm					
		Min	Max				Dir	Spd	Time	Temp	RH	Cld	Dir	Spd	MSLP	Temp	RH	Cld	Dir	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	8th		km/h	hPa	°C	%	8th		km/h	hPa
1	Tu	13.3	17.1	0.4	8.2		SW	65	13:07	14.6	76	8	WNW	30	1011.3	14.5	76		SW	46	1015.3
2	We	12.7	19.1	2.0	5.0		SSW	50	00:13	15.0	52	7	SSW	19	1025.4	18.3	44		SSW	30	1026.8
3	Th	9.5	25.8	0	5.8		SE	39	13:13	16.6	53		NE	22	1027.9	21.8	47		SSE	31	1023.6
4	Fr	12.3	34.4	0	5.6		ESE	35	12:53	22.0	49	8	NNE	17	1020.7	28.9	33		SSE	31	1016.6
5	Sa	16.8	38.0	0	6.8		SE	35	17:41	26.6	27	3	NNE	20	1015.4	29.7	44		SSW	17	1012.3
6	Su	19.0	35.5	0	7.8		SW	41	15:03	29.2	25	8	NNE	13	1011.4	24.8	61		SW	17	1010.1
7	Mo	23.3	36.5	0	10.0		ENE	41	04:14	31.8	21	7	ENE	24	1006.3	35.7	16		NW	28	1003.6
8	Tu	19.1	25.3	1.6	7.6		NW	63	11:52	22.2	58	4	WNW	35	1009.5	24.5	48		WNW	35	1010.1
9	We	16.6	22.3	0	6.8		WSW	43	08:32	19.6	65	6	WSW	26	1016.6	20.7	58		S	26	1016.7
10	Th	13.3	26.2	0	5.2		W	46	15:41	19.2	55		WNW	6	1016.2	23.6	49		S	26	1013.8
11	Fr	14.2	20.2	0	8.0		SW	61	07:44	16.2	73	8	WSW	31	1016.1	19.1	48		SW	37	1017.2
12	Sa	12.0	20.1	0	6.6		S	39	14:24	15.2	52		NNE	11	1020.5	19.2	44		SSE	30	1017.6
13	Su	10.5	24.5	0	5.6		SSE	30	11:17	17.0	51		NE	11	1015.2	22.6	54		SSE	20	1012.3
14	Mo	13.9	26.3	0	5.2		SW	46	15:42	20.6	62		S	9	1013.7	23.5	45		S	20	1012.2
15	Tu	18.0	35.0		5.2		SSE	37	17:14							32.6	26		ENE	15	1011.9
16	We	19.6	35.3	0.2	4.6		ENE	31	10:20	24.7	54	2	SSE	9	1013.4	30.0	41		SSE	20	1010.9
17	Th	20.5	41.2	0	7.8		S	50	12:15	27.7	40	0	NNE	17	1010.1	26.6	55		SSW	15	1008.7
18	Fr	19.4	33.0	0	8.0		SW	35	15:37	21.0	75	7	SSW	24	1010.2	22.9	67		SSW	26	1008.2
19	Sa	19.4	40.2	0	6.4		NW	63	10:47	32.5	29	8	NNE	17	1003.7	38.8	14		WNW	28	1001.2
20	Su	19.2	23.9	0	8.4		SW	57	15:54	19.5	72		SW	41	1006.9	22.7	53		SSW	37	1011.7
21	Mo	16.5	20.7	0.4	7.8		SSE	50	19:50	17.8	59		SE	24	1022.0	19.8	55		SSE	33	1021.7
22	Tu	11.6	23.5	0	5.0					18.9	51	1	ENE	13	1022.1	22.1	53		S	33	1019.1
23	We	16.4	23.6		6.8		S	33	15:11							21.1	59		SSE	22	1016.2
24	Th	13.9	38.5	0	6.6			46	13:27	23.3	46		NNE	20	1012.2	37.5	10		E	30	1007.3
25	Fr	20.9	37.6	0	8.2		SW	65	18:26	31.2	22		N	15	1003.4	35.1	15		WNW	33	1000.1
26	Sa	15.2	21.3	1.4	9.6					18.7	53	8	SSW	43	1013.6						
27	Su	10.7	20.9		7.6		SSE	44	19:23												
28	Mo	10.6	25.1	0	7.2		SSE	41	15:21	18.8	48	0	NE	20	1025.5	21.4	54		SSE	31	1022.8
29	Tu	15.0	27.1	0	6.0		SSE	31	13:28	20.3	58	0	NNE	9	1021.6						
30	We	14.8	39.7	0	7.2		NNW	41	11:02	26.7	31	8	NNE	17	1013.4						
31	Th	19.2	40.9	0	8.8		SSW	56	14:49	31.1	17	1	NNE	11	1010.5						

Appendix 9. Rainfall figures from www.bom.gov.au for Hindmarsh Island weather station 23894



Station: Hindmarsh Island AWS
Number: 23894 Opened: 2003 Now: Open
Lat: 35.52° S Lon: 138.82° E Elevation: 11 m
Details

No highlight
Key: Units are millimetres. *12.3* = Not quality controlled.
Period for calculating statistics: All years 1961-1990

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Graph													
2003		24.0	17.4	12.2	56.2	45.2	43.0	77.6	31.0	67.2	22.6	20.6	
2004	10.2	9.0	15.2	5.6	18.4		50.0	*50.6*	*38.0*	*14.4*	*32.8*	*29.4*	
2005	*14.2*	*26.8*	*0.8*	*5.8*	*10.2*	*115.0*	*31.8*	*47.4*	*34.2*	*70.8*	*27.2*	*27.0*	*411.2*
2006	*27.8*	*17.6*	*10.0*	*47.6*	*30.0*	*20.6*	*26.0*	*6.6*	*36.0*	*3.6*	*7.6*	*11.0*	*244.4*
2007	*40.0*	*0.6*	*14.0*	*49.6*	*14.2*	*67.6*	*31.2*	*23.2*	*34.6*	*30.2*	*48.0*	*30.2*	*383.4*
2008	*1.4*	*8.2*	*22.2*	*24.8*	*28.6*	*29.6*	*61.0*	*91.6*	*23.2*	*3.4*	*21.0*	*25.4*	*340.4*
2009	*0.2*	*0.0*	*14.2*	*40.6*	*51.6*	*37.2*	*66.2*	*44.8*	*67.4*	*35.0*	*15.8*	*25.0*	*398.0*
2010	*24.2*	*8.8*	*23.4*	*34.8*	*39.8*	*80.4*	*25.4*	*86.2*	*87.8*	*39.6*	*12.8*	*50.2*	*513.4*
2011	*18.4*	*69.4*	*20.2*	*16.6*	*51.6*	*49.2*	*39.0*	*31.2*	*26.2*	*21.4*	*6.6*	*32.4*	*382.2*
2012	*4.4*	*9.0*	*47.6*	*19.2*	*99.0*	*128.0*	*63.6*	*47.8*	*30.8*	*21.2*	*15.2*	*8.6*	*494.4*
2013	*12.4*	*9.8*	*3.2*	*26.6*	*33.2*	*82.4*	*84.2*	*66.6*	*38.4*	*22.0*	*25.2*	*28.4*	*432.4*
2014	*0.4*	*15.2*	*9.8*	*15.6*	*41.6*	*56.4*	*54.2*	*21.0*	*28.4*	*7.6*	*15.2*	*16.6*	*282.0*
2015	*35.4*	*0.8*	*19.2*	*74.8*	*57.8*	*24.4*	*55.2*	*30.2*	*18.6*	*2.6*	*8.4*	*6.0*	*333.4*
2016	*29.8*	*51.4*											

2003 Go View a year of daily data

Summary statistics for all years
Information about climate statistics

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	16.8	17.9	16.7	28.8	40.9	61.3	48.5	48.1	38.0	26.1	19.9	23.9	383.2
Lowest	0.2	0.0	0.8	5.6	10.2	20.6	25.4	6.6	18.6	2.6	6.6	6.0	244.4
5th %ile	0.3	0.4	2.2	5.7	12.6	22.7	25.8	15.2	21.4	3.1	7.2	7.6	263.2
10th %ile	0.6	0.7	4.5	7.1	15.0	24.9	27.0	21.4	23.8	3.4	7.8	9.1	282.0
Median	14.2	9.4	15.2	24.8	39.8	52.8	50.0	47.4	34.2	21.4	15.8	25.4	383.4
90th %ile	34.3	44.0	23.2	49.2	57.5	111.7	65.7	84.5	61.6	61.7	31.7	32.0	494.4
95th %ile	37.2	57.7	33.1	59.7	74.3	120.8	73.4	88.4	75.6	68.6	38.9	39.5	503.9
Highest	40.0	69.4	47.6	74.8	99.0	128.0	84.2	91.6	87.8	70.8	48.0	50.2	513.4

Data within the table which are in italics represent observations which have not been fully quality controlled, a process which may take a number of months to complete. While these data may be correct, you should exercise caution in their use.

	June	July	Aug	Winter	Sept	Oct	Nov	Spring	Dec	Jan	Summer
2009	37.2	66.2	44.8	148.2	67.4	35	15.8	118.2	25	24.2	49.2
2010	80.4	25.4	86.2	192	87.8	39.6	12.8	140.2	50.2	18.4	68.6
2011	49.2	39	31.2	119.4	26.2	21.4	6.6	54.2	32.4	4.4	36.8
2012	128	63.6	47.8	239.4	30.8	21.2	15.2	67.2	8.6	12.4	21
2013	82.4	84.2	66.6	233.2	38.4	22	25.2	85.6	28.4	0.4	28.8
2014	56.4	54.2	21	131.6	28.4	7.6	15.2	51.2	16.6	35.4	52
2015	24.4	55.2	30.2	109.8	18.6	2.6	8.4	29.6	6	29.8	35.8