



Office
of Water

Technical Report on the Impacts of Restricting Diversions on the Barwon- Darling River

Issue 3: January 2013

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Introduction

During prolonged low flow periods along the Barwon-Darling Rivers it is NSW's practice to restrict irrigation diversions to maintain river flows that will satisfy critical needs and meet environmental requirements. The most critical need is to ensure sufficient water is stored in Menindee Lakes to supply town water to Broken Hill and Menindee for at least 18 months.

Previously, for modelling purposes these restrictions were seen as a management response to a range of critical needs, much in the same way as when WSPs in other NSW Murray Darling Basin tributaries are suspended during extended drought periods and like the tributaries they were not incorporated into the long-term modelling. However for audit modelling, the actual observed restrictions have always been represented in the Barwon-Darling IQQM.

Following the re-calibration of Barwon-Darling IQQM in early 2011 the model and report (NOW, 2011), were forwarded to Murray Darling Basin Authority (MDBA) for their review.

The review comments of the Independent Auditor are attached at Appendix A. He considered two issues needed resolving before he would be in position to recommend the Cap model for approval to MDBA. This report deals with the first issue *Diversions Embargoes*. In particular issue (1(a)) developing and implementing a method to restrict diversions in the Cap model., Issue (1(b)) calibrating and incorporating late season pre-watering associated with embargoes, has not been addressed at this time as considerable data and information needs to be collected to determine the areal extent and occurrence of this practice.

Background

During the 2002-2007 droughts periods of restricted access to diversions were declared on several occasions for irrigators along the Barwon-Darling Rivers. Restrictions took a number of forms; complete suspension of access for all irrigation licences, which is a very rare occurrence; suspension of access for only major or larger irrigators, which is the more normal occurrence; to restrictions for larger irrigators on the number of days, daily extraction rate, or the volume that can be extracted over a particular time.

There were three sequences of restrictions during the period 2002-2007, totalling six separate periods. There are no recorded instances of restrictions occurring prior to this.

Between February 2003 and October 2004 four separate periods of restrictions were declared to coincide with flow events in the system. Information regarding these restrictions was received verbally several years ago but it is believed that restrictions involved a complete suspension of pumping for major irrigators. Details of the fourth period have been independently verified.

A fifth period of restriction was declared over June to July 2005 which limited major irrigators to 50% the number of days they would have normally be able to divert water. The objective of this sharing of flows was to ensure the volume in the Menindee Lakes could provide enough water for critical human needs for up to 21 months as well as maintaining 100% General Security and releases for water quality needs downstream of Menindee. Details the Regional Manager's announcement are reproduced in Appendix B.

A sixth period of restriction was declared from December 2006 to December 2007, and the official NSW Government notice is reproduced in Appendix C. This restriction mainly involved a complete suspension of pumping for the major irrigators.

- Detailed information about these restrictions is provided at Appendix D.

Issues

A number of issues will provide challenges to developing and implementing restrictions rules for long term modelling purposes. These include the:

- apparent inconsistent basis for determining when the restrictions were implemented, during the 2002–2007 period,
- lack of documentation for the first three restriction periods,
- volumes of metered diversions that occur during most restriction periods, raising doubts about our understanding of how limitations to pumping actually occurred during restriction periods.
- representativeness of the modelled storage behaviour for each of the individual Menindee Lakes (ie Wetherell, Pamamaroo, Menindee and Cawndilla Lakes).

Data Availability

Daily diversion data is available for the whole 2002-2007 period for each individual license based on Time and Event meters installed on each major irrigator's pump(s). In addition, meters were installed on some A Class and Small B Class irrigators which enables an understanding of how these type of irrigators with permanent plantings, small annual crops and without large OFS behaved during restriction periods.

Observed and modelled storage behaviour is available for each the lakes (Wetherell, Pamamaroo, Menindee and Cawndilla) in the Menindee Lakes system. The observed data is daily. The modelled data is simulated data, produced by MDBA's Murray-Lower Darling Monthly Simulation Model (MSM), Cap Model Run 23016000, produced on 21/11/2011.

Methodology

The following steps were undertaken:

- Review observed Menindee Lakes storage behaviour, declared pumping restriction periods and observed daily streamflows together with observed individual irrigator diversions.
- Utilising this information and any advised restriction implementation strategies determine long term modelling strategies for declaring and lifting restriction. Undertake sensitivity studies of these strategies to determine long term average annual Cap diversions.
- Also utilising the above information proposes strategies, suitable for the Cap Audit model, which incorporate any observed exceptions or modification to declared pumping restrictions.

Analysis

Observed Restriction Periods

Summary information is provided in Table 1 below while more complete details are provided at Appendix D.

Table 1: Summary Comments on Restriction Declarations

Date / Event	Volume in Lakes (GL)*	Comments
28/02/2003 First restrictions declared	95.6	Although these 1 st restrictions were applied a year later than when lakes first came under NSW control, limited pumping opportunities limited irrigation diversions to only 16.4 GL during 12 months prior. Although it is believed major irrigators were suspended from pumping during this “restriction” event they still diverted some 16 GL.
18/01/2004 Second restrictions were lifted	38.2	Even during this 2 nd suspension event, a few major irrigators diverted 3.4 GL. From first day of sufficient Barwon-Darling flows, pumping was permitted. It is presumed that the Manager used data from B-D tributaries to ascertain that it was a very significant event. Based on an evaluation of observed Walgett flows, for next 14 days (ie by 01/02/2004) some 190 GL will pass and for another 8 days (ie 22 days by 09/02/2004) a total of 440 GL will pass.
24/02/2004 Third restrictions declared	163	During this “restriction” most irrigators continued to pump and diverted about 100 GL. It is doubtful that major irrigators were suspended from pumping during this event.
19/09/2004 Fourth restrictions declared	311	Given the event’s insignificant size (flows passing Mungindi barely reached Walgett) and lengthy period of previous no flows it would appear that these restrictions were based more on a riparian requirement for Barwon R than any possible filling of the Lakes. However major irrigators still pumped 1.9 GL.
06/12/2004 NO restrictions declared	240	The start of another significant flow event and again it would appear that Manager used knowledge from tributaries to make decision. Based on an evaluation of the flows some 500 GL will pass Walgett over next 21 days (ie by 27/12/2004).
01/07/2005 Fifth restrictions declared	329	This event limited irrigators by the number of pumping days (approx 50% of available). Documentation provided indicates that this restriction was aimed at securing supplies in excess of normal circumstances. Irrigators used all their available days and diverted about 115 GL.
12/2005, 01/2006, 03/2006 NO restrictions declared	407 350 305	During these 3 small events irrigators had access and 35 GL diversions were permitted. CTPs were only exceeded on Barwon R (ie U/S of Beemery) and it would that volumes available to be diverted are quite limited.
15/12/2006 Sixth restrictions declared	175	These restrictions were declared when pumping opportunities were about to occur. During these almost 12 months of restrictions, major irrigators diverted about 3 GL, mainly for purposes other than irrigation.
23/12/2007 Restrictions were lifted	27	Again Manager used knowledge from tributaries to make decision. Based on an evaluation of Walgett and Bourke flows over: Next Period Passing Walgett Passing Bourke 14 days (ie by 06/01/2008) 105 GL 220 GL 21 days (ie by 13/01/2008) 110 GL 415 GL

Note: * only Lakes Wetherell and Pamamaroo considered

A review of this restriction information suggests that combined Lakes volume of around **305–310 GL** are common when applying restrictions. However, because of the range of factors involved in the consideration of a restriction declaration, particularly that a flow event rather than a Lake volume seems to trigger a restriction declaration, then these review trigger volumes are only indicative.

The evidence on lifting the restrictions is even less clear, as the decision appears more dependent on projections of inflows rather than the actual combined Lakes volume at that time. An obvious example of this is lifting of restrictions on 23/12/2007 when Lakes volume was only 27 GL.

It should be noted that in every restriction period irrigators, both small irrigators (ie mainly unmetred A Class and small B Class) and metered irrigators (ie major or large irrigators with OFS) continued to divert water.

Operational Calculations

Information has been obtained from a review of the operational spreadsheets that were utilised in forecasting calculations for Menindee Lakes. These calculations cover a range of demand scenarios for a predicted 18 months without inflows. This review showed that dependent on the relative volumes in Lakes Wetherell and Pamamaroo and the time of year, a volume of up to:

- **150 GL** is required in these Upper lakes to supply critical needs (ie Broken Hill TWS, High Security irrigation and riparian releases) when allocations for General Security irrigation are 0%; and
- **450 GL** is required to supply critical needs and 100% (full) General Security irrigation.

Additional work on the operational spreadsheets was undertaken to mimic a more realistic operational behaviour. This behaviour assumed that releases would initially be maintained to satisfy 100% of general security for the remainder of the water year (ie about 6 -10 months) before being reduced to drought operation (ie 0% general security with Broken Hill TWS plus High Security demand, etc) for the remaining months. These studies showed that combined volumes for Lakes Wetherell and Pamamaroo of **335 – 355 GL** were required to satisfy these more likely demands.

Modelling of Restrictions for Audit Model

Currently the audit CAP IQQM is configured to suspend pumping for B and C Class major irrigators during periods of observed suspensions (ie from a start date to an end date). It is not possible to restrict or limit an individual's capacity to take water over a flow event.

Based on the observed pumping practises of these major metered irrigators over a restriction event, modified periods for modelled suspensions was determined. Individual reach pumping behaviour was examined to create these reach suspension time series files which are used in the audit CAP IQQM to force or suspend irrigators from pumping for defined periods of time. The results (see Table 2) show that during periods of sever restrictions (ie periods 1,2,4 &6) modelled diversions were 88% of observed but for individual events modelled diversions can be quite varied compared to observed.

Table 2: Comparison of Diversions during 2002 – 2007 for Audit Model

Period	Duration (Days)	Restriction Type, Period Number Details	Observed Diversion (GL)	Audit (Forced) Div'ns (GL)	Comments
23/02/02 28/02/03	370	No pumping restrictions	9.5	0	Difference caused by flow replication and irrigators permitted to pump when flows below thresholds (Approved Not-With Standings which are not represented in any models)
01/03/03 19/05/03	80	Restriction Period #1:- Initially believed to be full suspension	16.4	19.3	Evaluation of pumping practises shows partial lifting for 3-12 days for some reaches which are represented in Audit model for major irrigators
20/05/03 09/10/03	143	No pumping restrictions	0.9	6.7	Any difference caused by flow replication differences or model pumping practises of always diverting water no matter how small volume available
10/10/03 18/01/04	99	Restriction Period #2:- Initially believed to be full suspension	3.4	1.8	Evaluation of pumping practises shows partial lifting for 4 days for 7 irrigators. This was represented in Audit model for major irrigators
19/01/04 23/02/04	36	No pumping restrictions	160	102	
24/02/04 19/05/04	85	Restriction Period #3:- Initially believed to be full suspension	100	69	Evaluation of pumping practises shows all irrigators continued to pump without interruption (ie NO restrictions in Audit model)
20/05/04 18/09/04	122	No pumping restrictions	0.2	0.4	
19/09/04 29/10/04	41	Restriction Period #4:- Full suspension	1.3	0	Evaluation of pumping practises shows virtually no irrigators pumped (ALL major irrigators fully suspended in Audit model)
30/10/04 30/06/05	244	No pumping restrictions	145	122	
01/07/05 16/08/05	45	Restriction Period #5:- Irrigators limited to 16 & 9 days B&C Class pumping	112	85	Evaluation of pumping practises shows irrigators largely conformed to rules (ALL major irrigators permitted to pump same number of days in Audit model)
17/08/05 14/12/06	486	No pumping restrictions	35	112	Any difference caused by flow replication differences or model pumping practises
15/12/06 23/12/07	373	Restriction Period #6:- Full suspension for B&C Class	2.9	0	Evaluation of pumping practises shows virtually no irrigators pumped (ALL major irrigators fully suspended in Audit model)
Summary Events					
	593	Restricted Periods # 1,2,4 & 6)	24GL	21.1GL	Partial lifting of restrictions in Audit model has replicated diversions
	1,531	All Other Times	563GL	497GL	Difference attributed to irrigation development
	2,124	Total	587GL	518GL	

Modelling of Restrictions for Long Term Model

Like the Audit model the long term CAP IQQM is unable to restrict or limit an individual's daily pumping capacity or volume diverted over an event, it can only suspend pumping access for defined days. Also, only major irrigators (B and C Class) with large on-farm storages have been modelled to suffer suspensions, all other irrigators (ie A Class, small B Class and water extracted for irrigation from Thalaba Creek, Macquarie and Warrego Rivers) are not affected. This modelled behaviour is based on the observed daily pumping practises of these individual irrigators during restriction periods.

Based on the previous analysis, the following has been adopted for modelling purposes:

- a volume of 150 GL is required in Menindee Lakes to satisfy critical demands (ie Broken Hill TWS, High Security irrigation and riparian releases with General security irrigation at 0% allocation), and
- 300 -350 GL is required to satisfy full 100% General security plus critical demands.

Based on our analysis, the decision for lifting of suspension appears to be even more complex or problematical with predicted inflows not storage trigger volumes being basis for decision making. This forecasting of inflows is a critical process that must be represented in the model process, otherwise there is real likelihood of lifting suspensions when most of the pumping opportunity for the Barwon-Darling irrigators has passed. For modelling purposes the same range of threshold volumes (ie 150 to 350 GL) has been used but this time based on a Upper Lake volume plus predicted inflows for the next 40 days. The 40 day period is based on the time of travel when the flows could be first detected in the upper tributaries and when they arrive at the Lakes.

Utilising the above thresholds, analysis has been undertaken using observed and simulated Menindee Lakes storage volumes and Lake Wetherell inflows, to produce model suspension periods. Using these various time series of suspension periods and an adapted Cap IQQM, a series of calibration and sensitivity studies were undertaken to test their impacts on diversions. The results and the details of the studies undertaken are presented below.

Calibration Studies

For this Study a Cap development level model was used and the defined suspension days for either a 150 or 350 GL trigger threshold. These modelled diversions were tested against observed and modelled diversions using a no suspension and forced (audit) models during the recent drought period (ie 2002 to 2007). Trigger volumes were based on the observed combined volume of Lakes Wetherell and Pamamaroo, with inflows being observed Wilcannia.

Table 3 gives a complete event by event breakdown of the observed and modelled (ie forced, no suspension and trigger thresholds) diversions. What is clear from the results is that there is considerable difference in observed diversions (ie as impacted by pumping restrictions) and modelled diversions produced by threshold pumping suspensions. The results show that the:

- 150 GL trigger threshold for suspensions will produce restriction periods almost twice as long as observed and about 25% or 18 GL less then the observed diversions during these periods (ie For Events 1,2,4 & 6);
- 300 GL trigger threshold model produces restriction periods almost three times as long as observed. These increased restriction periods leads to an overall reduction of about 50% of the volume diverted during the entire 2002-2007 period.

Table 3: Comparison of Diversions during 2002 – 2007 for Calibration

Period	Duration (Days)	Type of Restriction	Diversions by Major Irrigators (GL)				
			Observed	Audit (Forced) Modelled	Modelled NO Trigger	Modelled 150 GL Trigger	Modelled 350 GL Trigger
23/02/02 28/02/03	370	None	9.5	0	48.9	Restriction	Declared
01/03/03 19/05/03	80	Period#1:- partially lifted for most irrigators	16.4	19.3	140.2	0	0
20/05/03 09/10/03	143	None	0.9	6.7	2.8	0	0
10/10/03 18/01/04	99	Period#2:-A few irrigators permitted to pump for 4 days	3.4	1.8	50.4	(655 days) Lifted 07/01/04	(670 days) Lifted 22/01/04
19/01/04 23/02/04	36	None	160	102	80	102	100
24/02/04 19/05/04	85	Period#3:- Irrigators unaffected	100	69	64	64	73
20/05/04 18/09/04	122	None	0.2	0.4	0.4	0.4	Declared 08/06/04
19/09/04 29/10/04	41	Period#4:- Virtually complete	1.3	0	5.9	5.9	0
30/10/04 30/06/05	244	None	145	122	119	119	(178 days) Lifted 02/12/04
01/07/05 16/08/05	45	Period#5:- Irrigators limited to 16 / 9 days B/C Class pumping	112	85	90	90	90
17/08/05 14/12/06	486	None	35	112	112	112	Declared 25/01/06 (687 Days)
15/12/06 23/12/07	373	Period#6:- Yes all but complete	2.9	0	59.6	Declared 22/01/07 (277 days)	0
Summary Events							
	593	Diversions when Irrigators Restricted (ie For Events 1,2,4 & 6)	24GL	21.1GL	256.1 (593 days)	5.9 GL (932 days)	0 GL (1,535 days)
	1,531	All Other Times	563GL	497GL	520GL (1,531 days)	487GL (1,192 days)	264GL (589 days)
	2,124	Total	587GL	518GL	773GL	493GL	264GL

Note: Restriction periods are highlighted by .

Sensitivity Studies

The results of these studies are summarised in Table 4 below and all trigger volumes were based on simulated Lake volumes and simulated inflows. For the **first study series**, the declaration / lifting of restrictions were based on the same threshold volumes. Results from this study indicate that restrictions would occur very frequently (ie between 11 – 31% of the time) and irrigation diversions would be decrease by between 5 – 17%.

During the studies it became apparent that the management practises for the draw down of the Lakes in the Cap MSM appear inconsistent with the trigger thresholds that are being studied. Cap MSM currently draws down Lakes to a total volume of 375 GL before transferring control to NSW . It also causes the combined volume of Lakes Pamamaroo and Wetherell to be drawn down to as low as 100 GL before transferring control. This behaviour, which has similarities with the 2002 behaviour and all the supply problems that occurred during that event, would appear to be inconsistent with both the:

- defined trigger threshold when the Lakes come under NSW control (ie combined lake volume of 480 GL); and
- operating practises as outlined in the 1982 Water Resources Commission report titled “Menindee Lakes Background Report”.

However it is likely that these 1982 Menindee management practises were subsequently changed and those represented in the Cap MSM were actually in place in 1993/94. However, based on recent drought experience, these practises are unrealistic and so should, if possible, be changed in the MSM CAP model to confirm with a revised drought operation. As a consequence of the Cap MSM Menindee management practises a **second series of sensitivity studies** were undertaken where the restrictions were declared based on:

- not just the combined volume of Lakes Pamamaroo and Wetherell but also
- when the Lakes come under NSW control (ie combined volume of all Menindee Lakes < 480 GL).

But the lifting of restrictions remains unaltered. This revised approach doesn’t change modelled Menindee Lakes drought operation but does represent a more realistic process of not declaring an restrictions unless the Lakes are under NSW control. Results from this study indicate that restrictions would occur less frequently (ie between 9 – 24% of the time) as would irrigation diversions (ie between 4 – 13%).

A **third series of sensitivity studies** were undertaken where the lifting of embargoes were based on the 2007 practise of only ensuring sufficient water for Broken Hill TWS and high security irrigators (ie a combined Lakes volume 150 GL) before allowing Barwon-Darling irrigators access to flows. Results from this study indicate that these restrictions would occur about 1-2% less frequently then series two and increase irrigation diversions by around 4 GL/yr.

A **fourth series of sensitivity studies** was undertaken to try and mimic a revised Menindee Lakes drought operation practise where water was maintained in Upper Lakes. This Study didn’t involve any additional MSM modelling; it just reprocessed volumes available in the Lakes by considering not just the Upper Lake volumes but together with the active Lower Lake volumes to be a trigger for restriction declarations. Unfortunately this simple addition of Lake volumes does not overcome other impacts of MSM drought operation practise which causes re striction declarations to occur earlier and extend longer then would occur if revised drought management practises were actually modelled.

Table 4: Summary Modelled Restrictions and Impacts

Model	Combined Lakes Volumes Wetherell + Pamamaroo for		Percentage Time Restricted	Average Annual Metered Diversions	Restricted Avg. Daily Lake Wetherell Inflows *	Comments
	Declaring	Lifting				
LT92_00.sqq	-	-	-	188.4	400	Baseline modified CAP model with restriction capability
Adt_LT14.sqq	150	150	11.0	179.8		Series 1 based on single combined Lake Wetherell & Pamamaroo Volumes for Declaration while Lifting is Lake Volume plus next 40 days of inflows
Adt_LT15.sqq	300	300	25.8	164.0		
Adt_LT16.sqq	350	350	30.6	156.8		
LT92_17.sqq	150+NSW	150	9.3	181.2	500	Series 2 based on the above Declaration volume plus Total Menindee Lakes < 480 GL (NSW control) While the lifting remains the same as above
Adt_LT18.sqq	300+NSW	300	20.9	168.7	680	
Adt_LT19.sqq	350+NSW	350	23.7	164.0	710	
Adt_LT20.sqq	300+NSW	150	19.3	173.0	620	Series 3 based on the above but lifting occurs at this lower volume if volume has been lower
Adt_LT21.sqq	350+NSW	150	22.0	168.8	650	
Adt_LT22.sqq	150ML	150	5.7	183.3	470	Series 4 based on total Menindee Lakes volumes for Declaration while lifting is based on Total Lakes Volume plus next 40 days of inflows.
Adt_LT23.sqq	300ML	300	17.7	171.9	625	
Adt_LT24.sqq	350ML	350	22.5	163.3	695	
LT92_30.sqq	150+NSW	150	9.3	181.5	500	This run is same as LT92_17.sqq but Menindee lakes volumes based on IQQM model inflow (see the section Iteration with Lower Darling Model)

Notes: For this analysis a common restriction period was established based on Model Run Adt_LT19.sqq (ie 350+NSW trigger)

Sensitivity Study Results

The recent drought has seen a considerable range in the triggers for and the severity of restrictions placed on irrigators on the Barwon-Darling. These ranges in the restrictions result from the considerable diversity in the water requirements that Managers have had to consider.

Analysis has shown that for modelling purposes, it appears that the most appropriate trigger threshold indicator for declaring suspensions should be the combined volume of the Upper Lakes (ie Lakes Wetherell and Pamamaroo). While for the lifting of suspensions, a trigger threshold indicator based on both the combined volumes of Upper Lakes and a 40 day predicted inflow volume would appear the more appropriate.

The adoption of a trigger threshold volume of 150 GL appears suitable as:

- this volume ensures sufficient water for Broken Hill TWS and high security irrigators for 18 months without inflows to Menindee lakes; and
- it will overall reproduce observed diversions during the restriction periods of 2002 – 2007 (see Table 3; comparison of observed and modelled 150 Trigger diversions during restriction periods when irrigators impacted) .

During the sensitivity studies it became apparent that there is a significant inconsistency between the modelled drought management practises while Lakes are under MDBA control and what volume is considered necessary when they come under NSW control. Drought management practices in the Cap MSM can cause the Upper Lakes to be drawn down to lower than 100 GL before they come under NSW control (ie combined volume < 480 GL) and demands are then limited to the Lower Darling River.

This inconsistency in modelling will affect the basis for triggering suspensions, in particular they will be triggered more frequently and for longer durations than if the Upper Lakes reserves were protected. The sensitivity studies show that for the existing MDBA modelling (ie first series of sensitivity studies) the trigger threshold of 150 GL occurs 11.0% of time while if water was husbanded in the upper Lakes (ie fourth series of sensitivity studies) they could trigger a lot less frequently (ie around 5.7% of the time).

However as the extent of this inconsistency is yet to be determined, let alone resolved, actual MSM results not re-processing of Lake volumes should be the basis for triggering suspensions. Consequently, Model **LT92_17.sqq** from the second series of sensitivity studies (ie restriction periods based on 150 GL trigger thresholds volumes for the Upper lakes and then under NSW control), has been chosen to produce **interim** results. The diversion results from this model will be conservative (ie lower) because the:

- the additional inflows to Menindee lakes caused by the applications of pumping restrictions has not yet been simulated (ie is not in MSM Cap Model Run 23016000 the basis for determining restriction periods);
- 150 GL trigger underestimates diversions by about 15 GL per an event, as seen in calibration studies and with about 8 major events an average annual reduction of 1 GL/yr could be expected; and
- MSM still has the excessive drawdown of the Upper Lakes and even with the added provision of the Lakes being under NSW control the thresholds will still be triggered some occurs 9% of time. This increase in time over a husbanding approach could lead to a further average annual reduction of up to 2 GL/yr.

Model LT92_17.sqq has an average annual metered irrigation diversion of **181.2 GL/yr**, some 8 GL/yr or 4 % below the Cap model run without any restrictions.

Iteration with Lower Darling Model

The revised Menindee Lake inflows from the interim model (**LT92_17.sqq**) were forwarded to MDBA who re-run their Cap MSM (Model run# 24394000) and supplied revised Menindee Lake storage behaviours, the basis for determining restriction periods.

Analysis was undertaken on these revised storage behaviours to determine revised restriction periods and the model (**LT92_30.sqq**) was re-run. This iteration process caused modelled average annual irrigation diversions to increase by 0.7 GL/yr, less than 0.3 percent to **181.9 GL/yr**.

Recommendations

It is recommended that the revised 1993/94 Cap simulation results from model **LT92_30.sqq** with the following embargo modelling rules adopted until further recommended work outlined below is completed:

1. Embargo declared when combined Lakes Wetherell and Pamamaroo volume less than 150GL and under NSW control.
2. Embargo lifted when combined Lakes Wetherell and Pamamaroo volume plus 40 days predicted inflow greater than 150GL.
3. Lake Volumes are based on IQQM inflows

Further work is recommended as follows:

1. the apparent differences between Federal and State Authorities, in Cap drought management practices of Menindee Lakes needs to be resolved as it affects the frequency and durations of suspension events.
2. utilise the knowledge and expertise of a water manager to review and develop rules that are appropriate for the adaptive drought management of Menindee Lakes and the Barwon-Darling rather than adopting the 150 GL threshold volume. These rules would not only consider practices of the recent past but would have to consider management decisions under Cap conditions as well. They would, if possible, be based on all the information that affect decisions, namely antecedent flow and river conditions and the effects that they have had on water quality, environmental and human demands. Some of the other aspects that would need to be considered are anticipated tributary inflows, time of year and Menindee Lake storage behaviour. Having established a robust set of "rules" they could then be applied to modelled data and a time series of restrictions based on adaptive management practises be produced and in-turn applied to the Barwon-Darling Cap IQQM.
3. If the preceding recommendation cannot be completed then it may be more appropriate to treat the trigger threshold volume as a calibration number and continue to reduce it below 150 GL until simulated diversions match observed diversions when irrigators were restricted during the 2002-2007 period.
4. Post drought irrigator behaviour to incorporate impacts of depleted soil moisture stores and late season watering for next years crops.

Revised 1993/94 Cap Simulation Model Results

Summary of the Revised Cap Scenario Results

The summary results for the previous (ie without suspensions) and interim revised 114 year IQQM Cap simulations are presented in Table 5. While Figure 1, an annual time series of diversions for both models, shows the 9-10 events when significant reductions were caused by the suspensions. Also seen are the less frequent increased diversions in some following years (ie 1897/98 and 1916/17). Barwon-Darling IQQM run number *BD007e.sqq* was previously used to simulate these results, while the revised model is run number *LT92_30.sqq*.

Table 5: Summary of the Long Term Cap scenario results

Summary Aspect	Sub-aspect	Average Annual Figures⁽¹⁾		Maximum Annual Figures	
		Previous (BD007e.sqq)	Revised (LT92_30.sqq)	Previous (BD007e.sqq)	Revised (LT92_30.sqq)
Water Usage	Metered River (i.e. by 'major' irrigators)	187 GL	181.6 GL	272 GL	286 GL
	Un-metered River 'reach' irrigators	8 GL	7.3 GL	10 GL	11 GL
	Sub-Total⁽²⁾	196 GL	189 GL	282 GL	295 GL
	Floodplain Harvesting by 'major' irrigators	12 GL	14 GL	48 GL	57 GL
	Rainfall-runoff Harvesting by 'major' irrigators	13 GL	11 GL	46 GL	35 GL
	Total	221 GL	214 GL	376 GL	368 GL
Planted Areas	Summer Planted area by 'major' irrigators	21,600 Ha	21,150 Ha	22,900 Ha	22,900 Ha
	Summer Planted area by 'reach' irrigators	1600 Ha	1600 Ha	1600 Ha	1600 Ha
	Total	23,150 Ha	22,700 Ha	24,500 Ha	24,500 Ha
River Flows	Barwon River at Walgett	1,576 GL	1,577 GL	14,020 GL	14,020 GL
	Darling River at Bourke	2,212 GL	2,217 GL	22,928 GL	22,928 GL
	Darling River at Wilcannia (Total)	1,807 GL	1,812 GL	16,909 GL	16,909 GL

Notes: (1) Long term average annual figures are based on the (01/07/1895 – 30/06/2009) period.
 (2) This average annual figure is used for long-term Cap assessment in Table 4.6

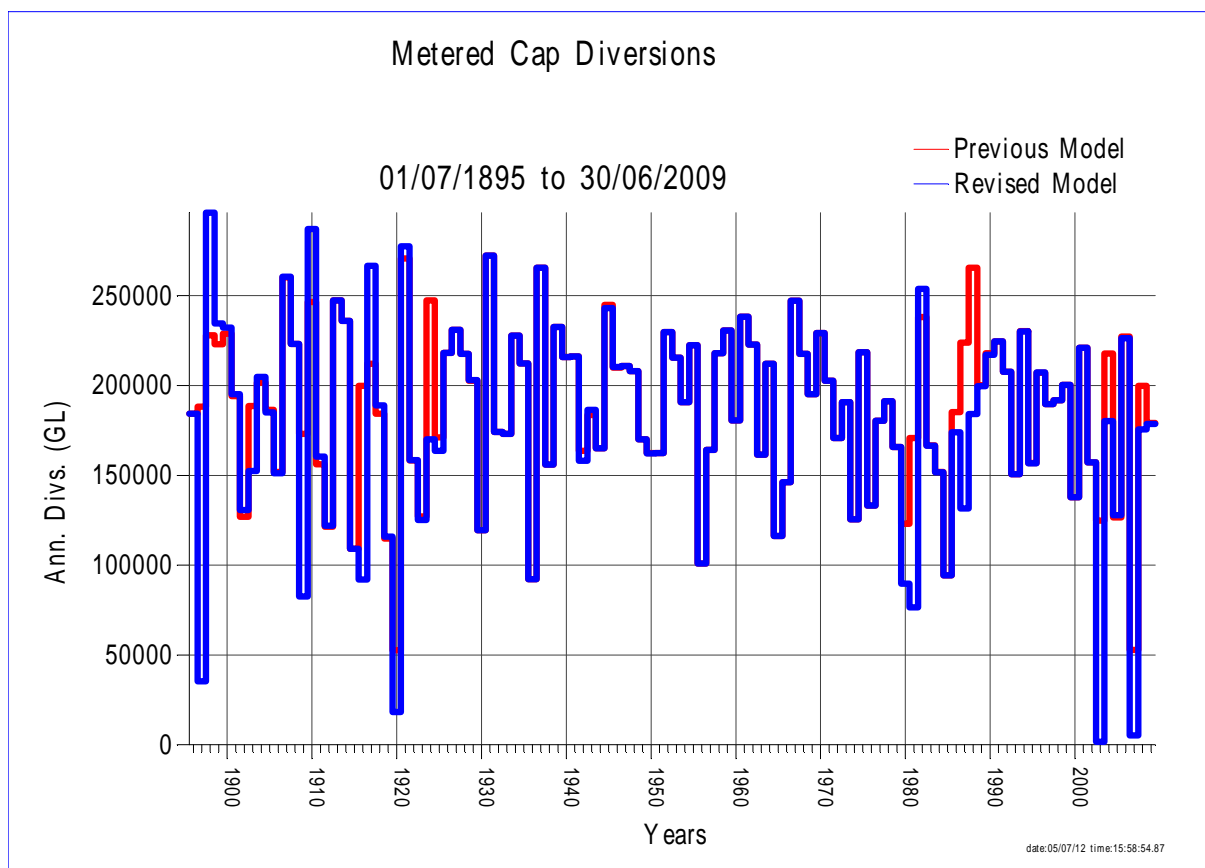


Figure 1: Cap scenarios simulated total metered annual diversions

Cap audit (Schedule E accounting simulation)

To assess Cap performance in each valley designated in Schedule E of the Murray-Darling Basin Agreement (MDBMC, 2000), annual Cap simulations or audits using the relevant IQQM are performed. In the Barwon-Darling Valley, the Cap simulation commenced at the start of the 1997/98 water year (July), with storage levels initialised at observed values. The IQQM then simulates continuously through subsequent water years using the observed climatic data as input and development and management rules fixed at 1993/94 levels. For this analysis observed tributary inflows are used.

To commence the Cap audit scenario, IQQM is started several weeks before the commencement of the 1997/98 water year, to allow for the river system to fill with water and to provide a better starting soil moisture store. Storage levels are set such that, at the commencement of the 1997/98 water year, they are equivalent to observed levels. This is known as hot-starting the model for the 1997/98 water year.

At the commencement of the simulation, IQQM will plant an area based on the resources available at the first available planting date (i.e. 1st of October). For those few irrigators on the Barwon-Darling who do grow winter crops, an inappropriate simulated winter planted areas will occur in the first year (1997/98).

Schedule E accounting for Cap compliance, as presented to the Independent Audit Group is presented in 6 below. Barwon-Darling IQQM run number *Adt2011_11.sqq* was used to simulate these results.

Table 6: Barwon-Darling Valley preliminary Schedule E account

Water year	Previous Estimates			Revised Estimates			
	Observed diversions (GL)	Cap estimate from IQQM ⁽¹⁾ (GL)	Annual Difference (GL)	Observed diversions ⁽²⁾ (GL)	Environ. Cap Adjustment ⁽³⁾ (GL)	Cap est. from IQQM ⁽⁴⁾ (GL)	Annual Difference (GL)
1997/98	198	167	-31	202		179	-23
1998/99	233	219	-14	237		240	2
1999/00	175	165	-10	179		154	-25
2000/01	246	244	-2	252		252	-1
2001/02	76	121	45	78		134	56
2002/03	20	37	17	20		42	22
2003/04	268	180	-89	269		186	-84
2004/05	157	120	-37	157		129	-28
2005/06	157	189	32	158		208	50
2006/07	1	2	1	1		3	1
2007/08	210	160	-50	210	0	168	-42
2008/09	149	160	11	150	11	171	10
2009/10	145	147	2	140	22	153	-8
2010/11				96	8	174	71
Total	2035	1911	-125	2149	41	2192	2
Long-term average Cap estimate:					188		
20% of Long-term average Cap estimate ⁽⁵⁾ :					38		

Note: A negative difference represents a Cap exceedence, or debit.

The long-term average estimate used here does not include floodplain harvesting.

(1) Previous Cap model RC05D.sqq.

(2) Observed diversions now include estimates of the un-metered "small" irrigator diversions.

(3) Cap adjustment for environmental entitlement "usage".

(4) Revised Cap model Adt2011_11.sqq.

(5) The variation permitted before CAP compliance measures are required.

Reports, Data and Models location

Models and Reports

- Previous Models;** The first IQQM for the Barwon Darling was developed prior to 1995, it forms the basis of today's model. The model extended from Mungindi to Wilcannia, all irrigators were represented by reach combinations, little data was available to describe irrigation development and even less usage data available for calibration. Streamflow calibration proved difficult with considerable problems with overbank flows and with the Bourke to Wilcannia reach. Only a hard copy of the report is available:

[Department of Land and Water Conversation, June 1995; Integrated Quality Quantity Model, Barwon-Darling River system Calibration Report \(Report No. TS94.035\)](#)

- Second Generation IQQM's;** The second generation of IQQM's for the Barwon Darling were developed during period 1998-2005. This DOS version of the model continued to represent the Mungindi to Wilcannia section. With the collection detailed data to describe each major irrigation development and the collection of usage data it was possible to calibrate (1995-2000) and represent major irrigators individually. Streamflow calibration was also improved during flood times with the factoring of some tributary inflows during overbank

times. Due to restricted tributary data availability the modelling period remained 1922 -2004. The calibration report is available at:

I:\SOFTWARE\IQQM\Documentation\Valley reports\Calibration report\BarDarling\ bd_calib_V04-4.pdf

- **Extension of IQQM to Menindee;** The DOS version of the model was extended from Wilcannia to Menindee. The calibration report is available at:

<I:\SOFTWARE\IQQM\Documentation\Valley reports\Cap reports\BarDarling\ Wilcannia-Menindee V4-3.pdf>

- **Current Generation IQQM's;** The GUI version of the Barwon Darling IQQM was developed by 2011. With the collection of additional irrigation and usage data it was possible to re-calibrate (1995-2005) the irrigation demand module for each of the major irrigators. The availability of extended tributary inflows permitted the modelling period to be extended from 1895 -2006. The calibration report is available at:

[I:\SOFTWARE\IQQM\Documentation\Valley reports\Cap reports\BarDarling\ Barwon-Darling Cap Report for Submission \(July 2011\).pdf](I:\SOFTWARE\IQQM\Documentation\Valley reports\Cap reports\BarDarling\ Barwon-Darling Cap Report for Submission (July 2011).pdf)

Data Files

- **Daily metered diversions since 1995;** Spreadsheet containing all metered irrigators, data by name and licence numbers. Worksheets are by reach with embargoes highlighted and usage summary. Each reach has daily flows at relevant commence to pump sites. Information available at:

I:\IQQM\DARL\DATA\history\Pumping_Embargoes\ Daily_Extractions& Flow@Gauge.XLS.

- **Metered diversions by restriction event;** Spreadsheet containing all metered irrigators, data by name. Worksheets are by embargo period, individual and usage summary. Information available at:

I:\IQQM\DARL\DATA\history\Pumping_Embargoes\ Embargo Periods RC_Bke-Lth.XLS

- **Menindee Lakes storage behaviour** is available for each of the individual Lakes (ie Wetherell, Pamamaroo, Menindee and Cawndilla Lakes), observed daily data is available from 01/05/1979 and is stored at:

I:\IQQM\DARL\MENINDEE\Data\120227Lakes data frAndy\Analyse\MenideeDailyObserved_work.XLS.

- **Monthly simulated data**, produced by Murray Darling Basin Authority's (MDBA) Murray-Lower Darling Monthly Simulation Model (MSM), is available from 06/1895 and is stored at:

I:\IQQM\DARL\MENINDEE\Data\120227Lakes data frAndy\Analyse\msmStore_23016_Work .XLS.

Appendix A

Independent Audit of Barwon-Darling CAP Model



9 February 2012
Ref: J165L_10

Mr Paul Simpson
Manager, Surface Water Management
NSW Office of Water
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Parramatta NSW 2150

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Epping NSW 1710
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Bewsher Consulting Pty Ltd
ABN 34 212 940 210

By Email: Paul.Simpson@water.nsw.gov.au

Dear Paul

INDEPENDENT AUDIT OF BARWON-DARLING CAP MODEL

As you are aware a large part of the audit is now complete and three issues have arisen that require resolution before I will be in a position to recommend approval to the MDBA. I have described these issues below and presented a tentative resolution for NOW to consider.

Until such time as the matters are addressed I propose that any further auditing of the model be deferred.

1. Diversion Embargos

In Attachment A I have provided a copy of my presentation to the Water Audit Panel on 30 November 2011. Slide 16 is a copy of Figure 8.3 of my draft audit report and compares observed and predicted diversions for the period July 1995 to June 2005.

There was considerable discussion of the poor performance of the model over the 2001/02–2003/04 period due to the impact of various embargos which were in place at that time. In my view the absence of any allowance for such embargos within the current model needs to be rectified. This will influence not only the operation of the model to determine the long term average diversion but also the calculation of annual targets.

Such embargos could occur on average once a decade or so and consequently may have a discernible influence on the long term average diversion. Further it is apparent that the lifting of an embargo in the second half of a season may result in late season diversions to raise soil moisture, which are not being adequately reflected in the annual target model.

I would suggest NOW give consideration to the following potential improvements to the model:

- (a) include allowance for low volumes in Menindee Lakes when running the long term cap model. Introduce an embargo if the Lakes volume drops below say 200GL, and there are insufficient inflows forecast;
- (b) use data from the recent drought period to calibrate a soil moisture type loss to simulate late season watering associated with embargos; and
- (c) continue with the existing procedures which allow the location and duration of actual embargos to be 'forced' when computing annual targets.

Once these procedures or similar procedures have been developed, it is recommended that they be documented in a revised cap report and re-submitted for audit. All the existing time series data sets that have been provided to me to date for auditing would also need to be revised.

2. Replication of Flows

I appreciate that the simulation of flows along the Barwon-Darling and at Menindee is a technically complex task and made difficult by the lack of accurate tributary inflow data. I have reviewed the approach adopted by NOW to date and included comments within Section 6.2 of my draft audit report (see copy reproduced in **Attachment B**).

It is important that further data collection be undertaken and the tributary factoring procedures be updated to reflect recent flow behaviour, nevertheless the extent of potential improvement is unclear. Based on the data currently available, the use of tributary inflow factors is pragmatic and it is difficult to see how the accuracy of this procedure can be improved for the purposes of calculating long term average cap (both within the Barwon-Darling and the Murray/Lower Darling models).

However as discussed in Section 6.2 of **Attachment B**, the present procedure appears inadequate for annual target runs. Further because of these inadequacies the MDBA are not using the Barwon-Darling flows in the Murray/Lower Darling cap model for annual target runs and consequently any influence of upstream diversions is not being accounted in their models.

Following discussions with Ric Cooke concerning potential improvements to the flow simulations for annual target runs, it is suggested that NOW give consideration to the following or similar procedures that could be used annually for target runs:

- (a) reassess tributary factors and losses each yearly based on recorded flow data and best estimates of actual diversions. An objective of this work would be to ensure:
 - (i) the frequency and magnitude of flow thresholds with the Valley are reproduced so that the access of irrigators to these flows can be accurately simulated; and
 - (ii) flow volumes at Wilcannia and Menindee are reproduced (for use in downstream models);
- (b) operate the upstream tributary models under both current and cap conditions and determine the Barwon-Darling inflows for each. Calculate the time series of differences between each of these inflow data sets (i.e. between current and cap conditions);
- (c) apply these differences to the observed inflows to produce a set of inflows under cap conditions; and
- (d) operate the Barwon-Darling model from (a) with these cap inflows under cap levels of development. This run would allow:
 - (i) improved simulation of flow thresholds and irrigation access within the Barwon-Darling;
 - (ii) the differences between current and cap conditions in the upstream tributaries to be reflected in the Barwon-Darling model; and
 - (iii) the differences between current and cap conditions in the Barwon-Darling to be reflected in the Murray/Lower Darling model.

Once the above procedure has been established, it will likely be necessary to recalculate all annual targets since 1997/98. The MDBA might also give consideration to the re-assessment of the Murray/Lower Darling targets using the revised outflows from the Barwon-Darling model.

No doubt your review of the above suggestions will lead to refinements and improvements of the approach. Although it won't alter the long-term average cap diversion, once the preferred approach has been settled I think it important that the procedure should be documented and included within the revised cap report.

3. Inclusion of Intersecting Streams Diversions

This matter was also discussed at the Panel meeting on 8 December 2011. I have suggested that the diversions from the intersecting streams be included within the Barwon-Darling model. As this matter will have to be resolved by June 2012, this may also be an opportune time to include (and report) the diversions in the Barwon-Darling model. This however is a decision for the MDBA and NOW and failure to include these diversions at the current time would not prevent me from progressing the audit of the Barwon-Darling model.

I trust these comments are of assistance in getting approval of the Barwon-Darling Cap model under Schedule E as soon as possible.

Yours sincerely



Drew Bewsher
Director

c.c. Mr Awadhesh Prasad, MDBA

Appendix B

Embargo Period 2005: Documentation

Draft#1 - 5 July 2005 Management of June-August flow event in the Barwon-Darling.

Proposed access rules

Key points:

- Water stores in Menindee are fast approaching a critical situation and without inflows will fall to less than 18mths supply for Broken Hill in the next few weeks.
- The current event has resulted from rainfall in the North West with most of the estimated inflow of ~150GL to the Barwon-Darling coming from the Namoi.
- Supplementary access on the Gwydir and Namoi has been limited through their respective WSPs with the Namoi limited to only 10% of the event volume in that valley.
- It is critical to secure sufficient inflows to the Menindee Lakes to:
 - Extend BH TWS to at least 21 months
 - Ensure 100% AWD to HS in 2006/07 (this is what is provided for in other valleys)Whilst still maintaining d/s water quality releases from Menindee, this will require a volume of ~70GL at Wilcannia from this event.
- Initial analysis indicates that pumping according the current thresholds could see ~100-110 GL of extraction on the Barwon-Darling, with days of opportunity on a fairly short event being the restriction rather than available on-farm storage capacity (currently estimated as 150GL).
- This level of extraction will NOT achieve the desired volume passing Wilcannia.
- However, the outcome can be achieved by limiting B and C Class access by 50%.

The proposal:

- Pumping opportunity (ie days that normal pumping thresholds will be exceeded) for B and C Class will be estimated for each reach as the flow moves down the system.
- Announcements will be broadcast as to the number of days pumping that will be allowed (50% of the above estimate).
- This figure will need to be somewhat conservative, initially 5 days for B Class, but with the understanding that this may increase as initial estimates indicate the opportunity within a reach may be greater than 10 days.
- A class licenses will not be restricted and will be able to extract whilst ever their thresholds are exceeded.
- It is an adaptive plan with the intended outcome being water security for BH and High Security in the Lower Darling whilst trying to achieve equity in access amongst B-D irrigators.
- It may change as circumstances (eg more rainfall) dictate.

Memorandum

To Sheridan Maher, DIPNR
Peter Terrill, DIPNR
Tony Hall, DIPNR
Allan Amos, DIPNR
Derek Everson, DIPNR
Sam Samarawickrama, DIPNR
David Harriss, DIPNR
Randall Hart, DIPNR
Ian Cole, MMAC
Justin McClure, MMAC
Jude Costello, MMAC

From Geoff Wise, Regional Director, Far West Region
Phone 02 6883 3040 Fax 02 6883 3099 Email geoff.wise@dipnr.nsw.gov.au

Date 21 July 2005

Subject **Barwon-Darling Flow Management June/July 2005 Rainfall Event**

Management of the current flows in the Barwon-Darling has been under constant review to ensure, with increasing degrees of confidence, securing essential supplies for Menindee storage.

On 18 July, it was agreed to increase access to:

- B class licence holders from 12 to 16 days
- C class licence holders from 8 to 9 days

On 21 July, it has been agreed to:

- treat the total flows from all the rainfall in June/July (to date) as a single flow event.
- increase access to B class licence holders from 16 to 18 days
- maintain the maximum C class extractions at 9 days.

With the uncertainty of not knowing how many pumps have not been operating for the maximum opportunity when the river has been above threshold conditions, it is highly unlikely that the current periods of approval will be given any further extension during the flows from the rainfall to date.

Geoff Wise
Regional Director, Far West
and Western Lands Commissioner

Appendix C

Embargo Period 2006-7: Documentation

From: Anna Bailey
To: Richard Cooke
Date: 17/09/2008 13:25
Subject: Re: Barwon-Darling knowledge

Richard,

Following is a summary of the gazettes re restrictions on Barwon-Darling Pumping hope it helps.

From this information I interpret it as follows but the summaries of the gazette are below for your information in case I got it wrong.

B and C class no pumping between 15 Dec 2006 to 24 December 2008
 A class have had no pumping from 15 Dec 2006 to 21 Feb 2007 (not sure about this but can't find a gazette notice that restricted them but inferred in notices by omissions)
 B & C restricted pumping from 24 December 2008 to 10 January to 20% of available water only pumped 07/08 year
 B and C no restrictions from 10 January 2008.

Basic landholder right restricted from 11 Jan 07 upstream Bourke Weir to 19 l/s/holding
 BLHR restricted from 25 Sept 07 upstream lake Wetherell to 19 l/s/holding
 BLHR restricted 6 Dec 07 upstream Lake Wetherell to 19 l/s/holding or a greater amount as per Senior Licencing Officers written consent
 BLHR - no restrictions since 2 Jan 2008
 Is this what you were after or did you want the briefs that went with the orders?
 Cheers
 Anna

Restrictions on Basic landholder rights

11 January 2007 - 323 Order WMA 2000 - Restricting basic landholder rights to 19 l/sec/landholding - on Boomi River, Unregulated Barwon river and Unregulated Darling River all upstream of Bourke Weir. (Printed in gazette on 19 January 2007)

25 September 2007 - 323 order WMA 2000 - Restricting basic landholder rights to 19 l/sec/landholding - on Boomi River, Unregulated Barwon river and Unregulated Darling River all upstream of Lake Wetherell.

6 December 2007 - 323 Order WMA 2000- Restricting Basic landholder rights to maximum 19 l/s/landholding or if have written authority from senior licencing officers can pump more if limit expressed in documentation - on Boomi River, Unregulated Barwon river and Unregulated Darling River all upstream of Lake Wetherell. (Printed in gazette on 14 December 2007)

2 January 2008 - 323 Order WMA 2000 - Revocation of temporary water restrictions to basic Landholder rights Unregulated Barwon / Darling River system all upstream of Lake Wetherell. (printed in gazette 4 January 2008)

Restrictions A, B and C Class

15 December 2006 - 22B *Water Act 1912* - pumping restrictions for all holders of permits, authorities and licences issued under Part 2 Water Act 1912 denoted A, B and C class water entitlement from midday 15 December 2006 extraction suspended until further notice - in Boomi River, unregulated Barwon River and Unregulated Darling river all upstream of Lake Wetherell. (Printed in gazette on 15 December 2006)

21 February 2007 - 22B Water Act 1912 - Cancels and replaces 15 Dec 2006 order - Pumping restrictions all holders of permits, authorities and licences issued under part 2 Water Act 1912 denoted B and C class water entitlement from midday 23 February 2007 extraction suspended until further notice - in Boomi River, Unregulated Barwon River and Unregulated Darling River all upstream of Lake Wetherell. (printed in gazette 23 February 2007)

24th December 2008 - 22B Water Act 1912 - Cancels 22B notice of the 23 February 2007 for Boomi River and suspension of B and C class water licences, permits and authorities for Unregulated Barwon River and Unregulated Darling River. (printed in gazette 4 January 2008)

24th December 2008 - 22B notice Water Act 1912 - Pumping restrictions Unregulated Barwon River and Unregulated Darling River - all holders of B and C class permits, authorities and licences until further notice restricted maximum quantity of water pumped / diverted in the 2007/2008 year is equivalent to 20% of the available water as stated on the conditions of the individual licence permit or authority. (printed in gazette 4 January 2008)

10 January 2008 - 22B Water act 1912 - Cancels 22B notice of 4 January 2008 in respect to restrictions imposed on B and C class water licences, permits and authorities for Unregulated Barwon River and Unregulated Darling River.(printed in gazette 18 January 2008)

Appendix D

Time Line of Restriction-Flow Events 2002 - 2007

Date Event details	Volume in Lakes W+P*
23/02/2002 Menindee Lakes comes under NSW control as the combined volume < 480 GL. However by this time Broken Hill TWS is already significantly at risk. During the 12 month interval prior to restriction declaration some 9.5 GL were diverted by major irrigators, another 5.5 GL by other users.	91.7
28/02/2003 Since coming under NSW control this is first real event (from Namoi) and it triggers an Restriction declaration .	95.6
During this embargo it would appear that it was partially lifted from 30/04 when irrigators above Brewarrina and 01/05 below Brewarrina, where permitted to use 1 of their B Class pumps until flows < CTP thresholds. During this 3 -12 day period some 16 GL were diverted . In addition , irrigators were permitted to divert about another 2.5 GL over the whole period for Stock & Domestic (Basic landholder Rights) and permanent planting (Not With Standings) purposes.	
19/05/2003 When flow event is over (ie flows < CTP thresholds), the embargo is lifted.	51.9
During 5 month intervening period negligible pumping opportunities , localised rainfall and inflows D/S Louth lead to small inflows in the Lakes. During this interval some 0.9 GL were diverted by major irrigators, another 1.3 GL by other users.	
10/10/2003 Small Border R's flow event triggered this Restriction .	58.2
During this embargo about 7 irrigators located between Mungindi to Macquarie R Junction were permitted restricted rate pumping access for about 4 days each and diverted about 3.5 GL . In addition , irrigators were permitted to divert about another 1 GL for Stock & Domestic and permanent planting purposes	
18/01/2004 When a second flow event was over (ie flows < CTP thresholds), the restriction was lifted despite the presence of significant flows occurring in the tributaries U/S of the B-D which will trigger pumping access on B-D.	38.2
This very significant event was occurring in the tributaries due to rainfall/flows all over the North-west just prior to embargo lifting. Based on this information NO restrictions were implanted (ie the embargo was actually lifted) despite critical levels in Menindee Lakes. After 14 days some 190 GL had passed Walgett while 21 days some 440 GL had passed Walgett. About 163 GL were diverted during the interval.	
24/02/2004 During this "restriction" flows exceeded CTP thresholds for some 30 -50 days throughout B-D. When event finally passed Bourke on 23/04/04, some 270 GL had passed Bourke and Menindee Lakes volume was 355 GL. During this "restriction" most irrigators continued to pump and diverted about 100 GL, about another 1 GL was diverted for other users.	163
19/05/2004 When flow event had been over for some time this "restriction" was lifted.	342
During intervening period negligible pumping opportunities , some 0.2 GL were diverted by major irrigators, another 0.6 GL by other users.	

19/09/2004 Small Border R's flow event triggered this restriction.	311
During this restriction a few non-major irrigators pumped about 1 GL for Stock & Domestic and permanent planting purposes. Major irrigators including one whose meter is on OFS to Crop lift pump (ie not affected by CTP thresholds or restrictions) pumped about another 2 GL .	
29/10/2004 Flow event barely reached Walgett and again after it had been over for some time before the restriction was lifted.	280
Another very significant event occurs all over the North-west but NO restriction is implanted even though Menindee Lakes volume is 233 GL. After 21 days some 500 GL had passed Walgett. On 5/02/2005 Lakes volume peaked at 430 GL. About 150 GL were diverted during the interval.	
01/07/2005 A moderate flow event from Namoi triggered this restriction, which on the information provided was to provide security in excess of normal requirements . The restriction was unusual in that it allowed pumping for about 50 % of time (ie 16 days 'B' Class pumping permitted even though CTP thresholds were exceeded for upwards of 35 days; 9 days 'C' Class pumping permitted). All active irrigators pumped for about max days permissible and diverted about 112 GL , about another 1 GL was diverted for other users.	329
16/08/2005 Flow event was all over when the restriction was lifted (ie Louth flows < CTP threshold). On 30/08/2005 Lakes volume peaked at 477 GL.	469
During intervening period the 3 small Border R's flows triggered pumping opportunities for the Barwon R (ie above Beemery) - During December, 2005 when Menindee Lakes 407 GL - During January, 2006 when Menindee Lakes 350 GL - During March, 2006 when Menindee Lakes 305 GL Some 35 GL were diverted by major irrigators, another 6 GL by other users..	
15/12/2006 Small Border R's flow event triggered this restriction. However Major irrigators diverted 4 GL mainly for purposes other than irrigation. Other users were permitted to divert about 1 GL for Stock & Domestic and permanent planting purposes.	175
23/12/2007 Restriction was lifted due to very significant flow events in Condamine-Balone, Castlereagh-Macquarie	27
After some 30 days (22/01/2008) some 500 GL had passed Bourke. By 31/01/2008 Lakes volume had reached 302 GL.	

Notes: * Lakes W+P are Lakes Wetherell + Pamamaroo