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Submission to Regional Australia Committee
Inquiry into the impact of the Murray-Darling Basin Plan in Regional Australia

Firstly, I commend the committee on its interim findings, especially in respect of "more strategic buy backs" and "opportunities for engineering alternatives". My submission points to broadly similar conclusions.

Secondly, I apologise for not lodging a submission earlier. My reasons for this (which largely summarise my concuusions) are;

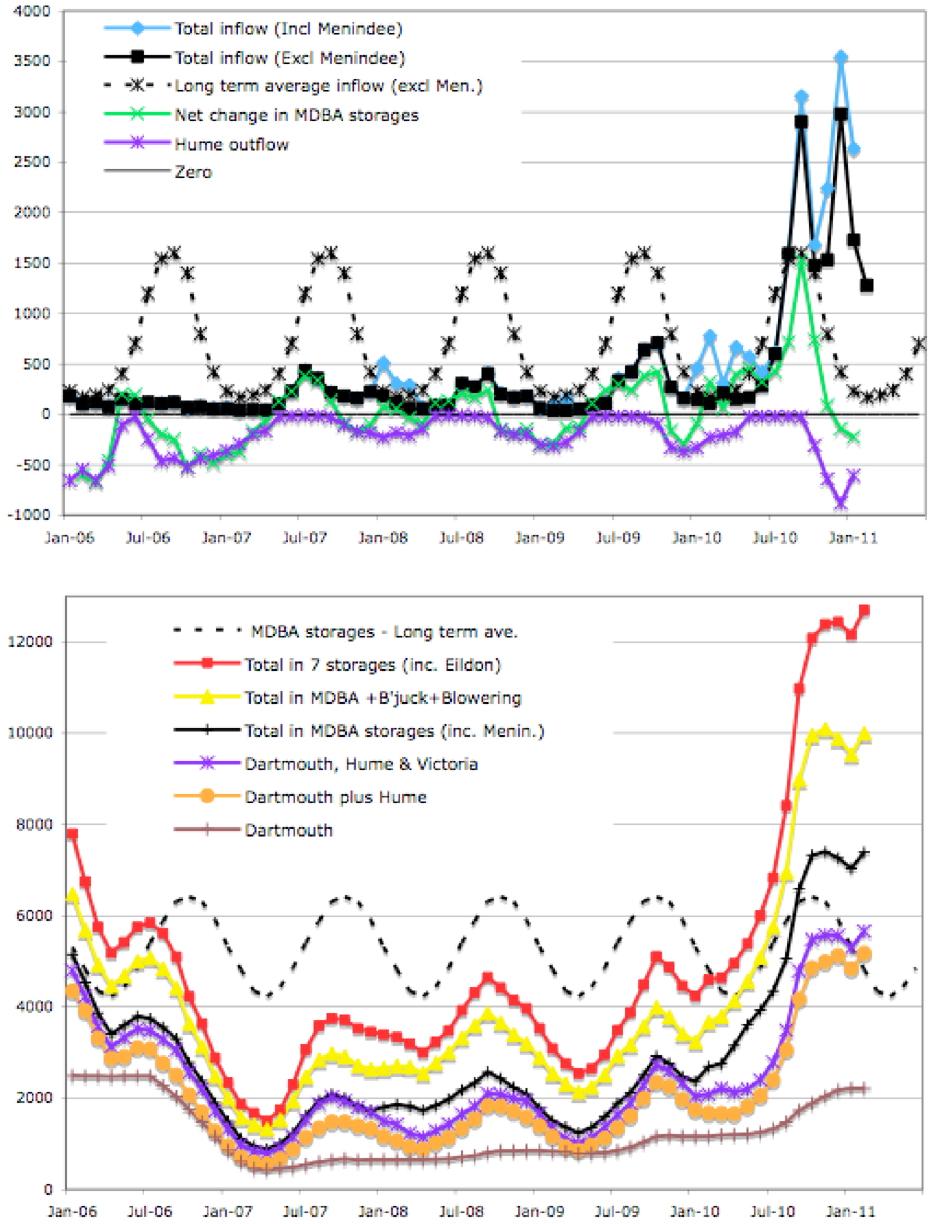
- I only recently discovered what seems to be a **flaw in some of the hydrologic modeling** used in the "Guide to the proposed basin plan" – specifically, modeling salt exports through the Murray mouth (figure 8.7 in the "guide").
- The **full impact of the recent rains/large inflows into the basin** (including extensive fish deaths from low dissolved oxygen in rivers after floods) **are still emerging** – and proper assessment of all aspects takes time.
- It seems increasingly clear (to me at least) that the recent rains have greatly **reduced the need for major changes in river management being fully decided and implemented quickly**. There was a case for urgent action when the river environment was still deteriorating in what was the 15 year period of lowest inflows in the systems history. However, that has changed and now most rivers and storages are full (or overflowing) and we have more time for careful consideration "to get it right".
- Now that I have had a chance to analyse the data (including the recent strong inflows) it is increasingly clear to me that one can demonstrate from historical data that diversions from some rivers have been excessive (for which the bottom panel of the last graph is an example). Demonstrations using "actual" data are more convincing to many because they can eliminate suspicions that many have (often justifiably) about "model results" – especially when details of models are not clearly understood.

As a career economist/statistician (with experience in economic modeling) I was appalled at the scarcity of detailed time series of historical data in the "guide" and its 1200 page technical appendix. I was also appalled by the "guides" reliance on modeled results – especially when details of those models were not clearly specified. **Anyone who understands modeling knows** how important the model's specifications, assumptions and coefficients, etc, are to results - and how to conjure "desired" results from plausible sounding parameters. I**t is critical for a model's credibility that its main parameters are published, well known and widely understood** – as for example, has largely been the case for models used by Treasury. **Users should be suspicious of "model results" if its inputs are not well known.**

It was obvious that the **economic model** (giving the odd result of a 30% cut in water reducing basin employment by only 0.1%) **had to be flawed**. No doubt this has already been pointed out to the committee, so I need not pursue it further.

Having now carefully analysed the available historical data on salinity (supplied to me by MDBA on 30 November 2010), I believe the **hydrologic modeling** underlying figure 8.7 in the "guide" is flawed. However that is probably best explained in conjunction with the actual data – as depicted in graphical form. The graphs begin with the most recent events and then put them into a historical perspective.

Graph I **Inflows and storage levels**



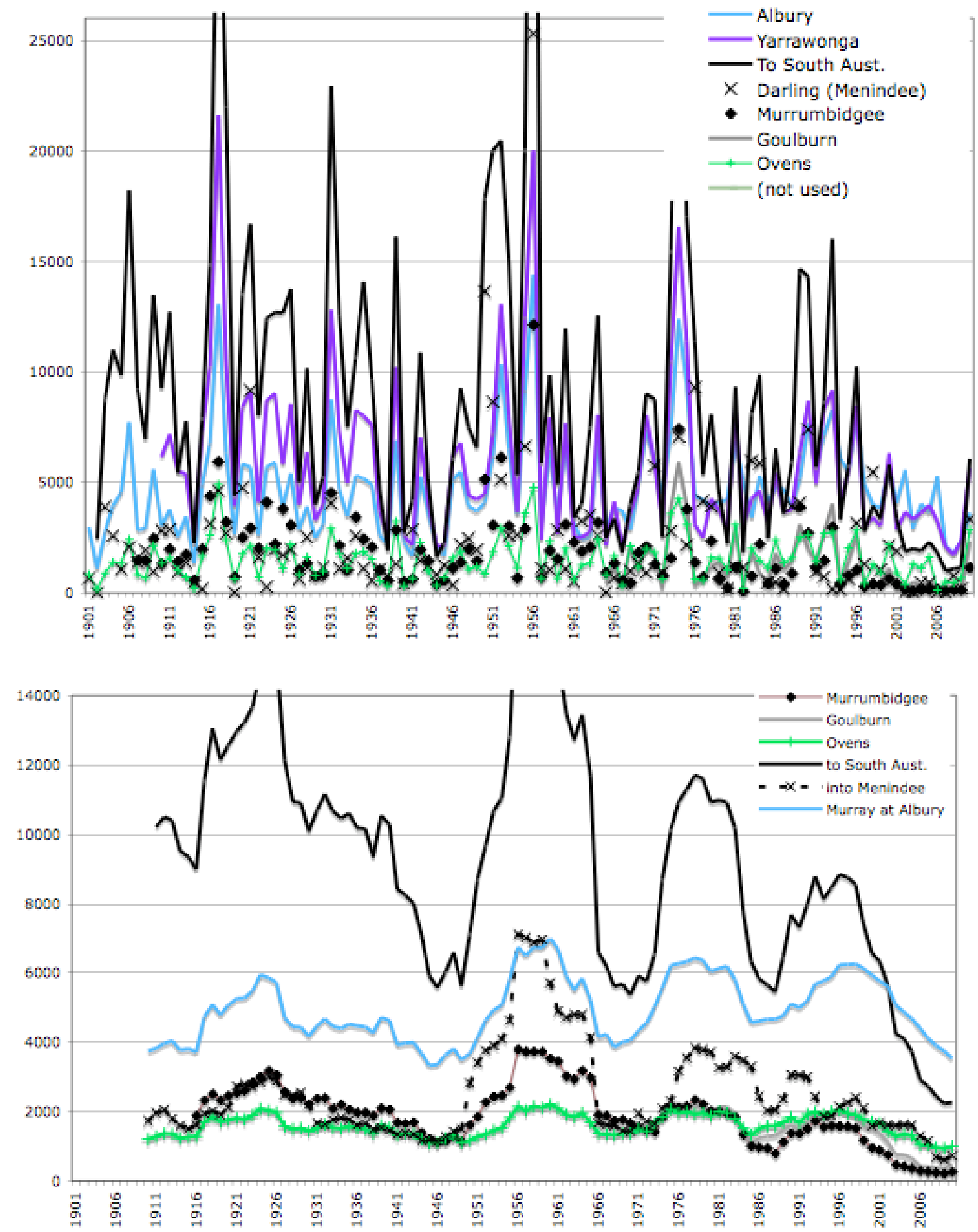
All data in gigalitres. Plotted monthly to Jan 2011. Data to Feb 16 for inflows, Eildon, Menindee & Victoria. Other dams to Feb 21

The top panel of **Graph I** compares MDBA published data for monthly **inflows into the Murray system** (excluding the Darling) with long term averages – and some other related aggregates. It is worth noting that average annual total inflows (excluding the Darling and Snowy releases) of about 9000 GL, are **much lower** than long term average inflows of about 15900GLpa for the Murray and its (non Darling) tributaries quoted in the “guide”. However for 3 months, the MDBA has effectively ignored my repeated requests for an explanation of this disparity.

The lower panel of **Graph I** shows end month levels in major storages on the Murray and its largest tributaries for the same time period. It also shows the long term average storage levels for MDBA storages (ie at Dartmouth, Hume, Lake Victoria and Menindee). One can see;

- how Dartmouth has been used as a base (reserve),
- Hume (and Victoria) are used to accommodate seasonal flows,

Graph II **River flows - Annual and 10 years ending in year shown**



Annual flows in Gigalitres (top panel, 10 year average in lower panel). Murrumbidgee, Goulburn and Ovens river data are closest measuring point to Murray (Balranald, McCoys & Wangaratta).

- the rapid rise in Menindee in 2010. The black line also shows the total for MDBA storages,
- **how quickly storages filled in the second half of 2010**; and are now well above long term average levels – and at record levels for the end of summer.

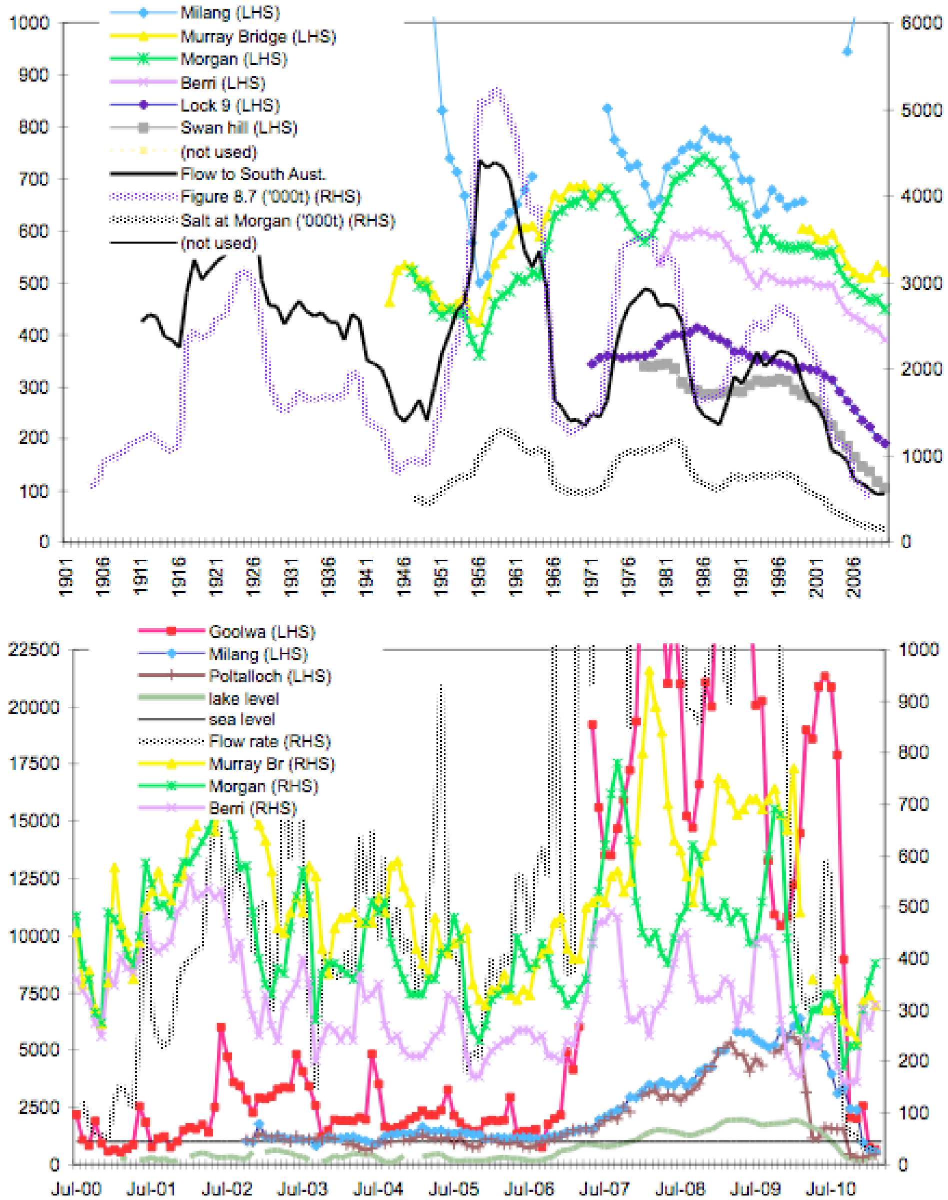
The top panel of **Graph II** shows annual flows in the Murray and its major tributaries over a long period. One can see that the period 2002 to 2009 is the longest period of continuous low flows to South Aust. in 110 years. The **great volatility** in flows suggests two things. **First, utilisation of storages is important,** and **second**, to make much sense of even annual data, one needs to look at **longer term averages.** The lower panel shows **ten year rolling averages of the data shown in the top panel**. It shows that (apart from increasing diversions for irrigation), **much of the reduction in "flow to South Aust" could be associated with longer term reductions in the net inflow from major tributaries** – except the Ovens river. Flows from the Ovens, which has no major dams, remained around their long term average throughout the 20^{th} century. There seem to be a clear long term downtrend in inflows from the Murrumbidgee (and to a lesser extent the Goulburn) since the 1950s - when major storage enlargements were completed on both rivers. Net inflows from the Darling also seem to have trended downwards from the 1950s. It is easy to see why "downstream" communities (especially in S.A. – with its high ratio of "critical human use" to irrigation) are so unhappy with the "guide". Having watched the water flowing to/by them decline as more and more is taken out upstream, they are now being asked for cuts in their allocations - to fix problems that they see as caused by those further "upstream".

Graph III shows salinity. Because even annual averages for salinity can be very volatile, I have used 10 year averages (ie average in the 10 years to the point shown) in the top panel. Before going further, I should explain some of the reasons for the volatility. Generally, **low river flows are associated with very high salinity** - especially in the lower reaches of South Australia and the lower lakes. However **high flows can also produce high salinity** (generally temporarily) – especially when heavy rain falls on saline plains and backwaters – so salt gets washed into the rivers (where in recent years some of it would be trapped by salt interception schemes). **Generally, salinity rises as water moves downstream** – and the lower Darling is usually saltier than the Murray. Thus the Murray downstream of Wentworth, is saltier when Darling inflows are high – as they have been recently.

The lowest line of salinity averages on graph III is for Swan Hill, it shows how successful salt interception scheme have been in recent decades. The lines above show how (long term average) salinity gets higher as the river flows downstream. "Lock 9" is just after Wentworth (where the Darling joins the Murray), Berri is after the South Australian border – on the way to Morgan – and then Murray Bridge – just above where the river enters Lake Alexandrina.

The high (negative) correlation between (average) salinity and (average) flow rates can be seen by comparing salinity readings with the solid black line showing a 10 year rolling average of "flow to South Australia" (the same line as in the lower panel of graph II – except it had to be adjusted to fit the different scale). Note how the long term **peaks in flows coincide with troughs in salinity and vice versa.** Furthermore;

Graph III **Salinity**



All lines with markers show salinity levels in microseimens/cm. Top panel is average in 10 years ending the year shown. Lower panel monthly - last plots are late Feb 2011. Flow rate in lower panel is days to fill L.Alexandrina. Lake level is mm from 1m above sea level on inverted scale.

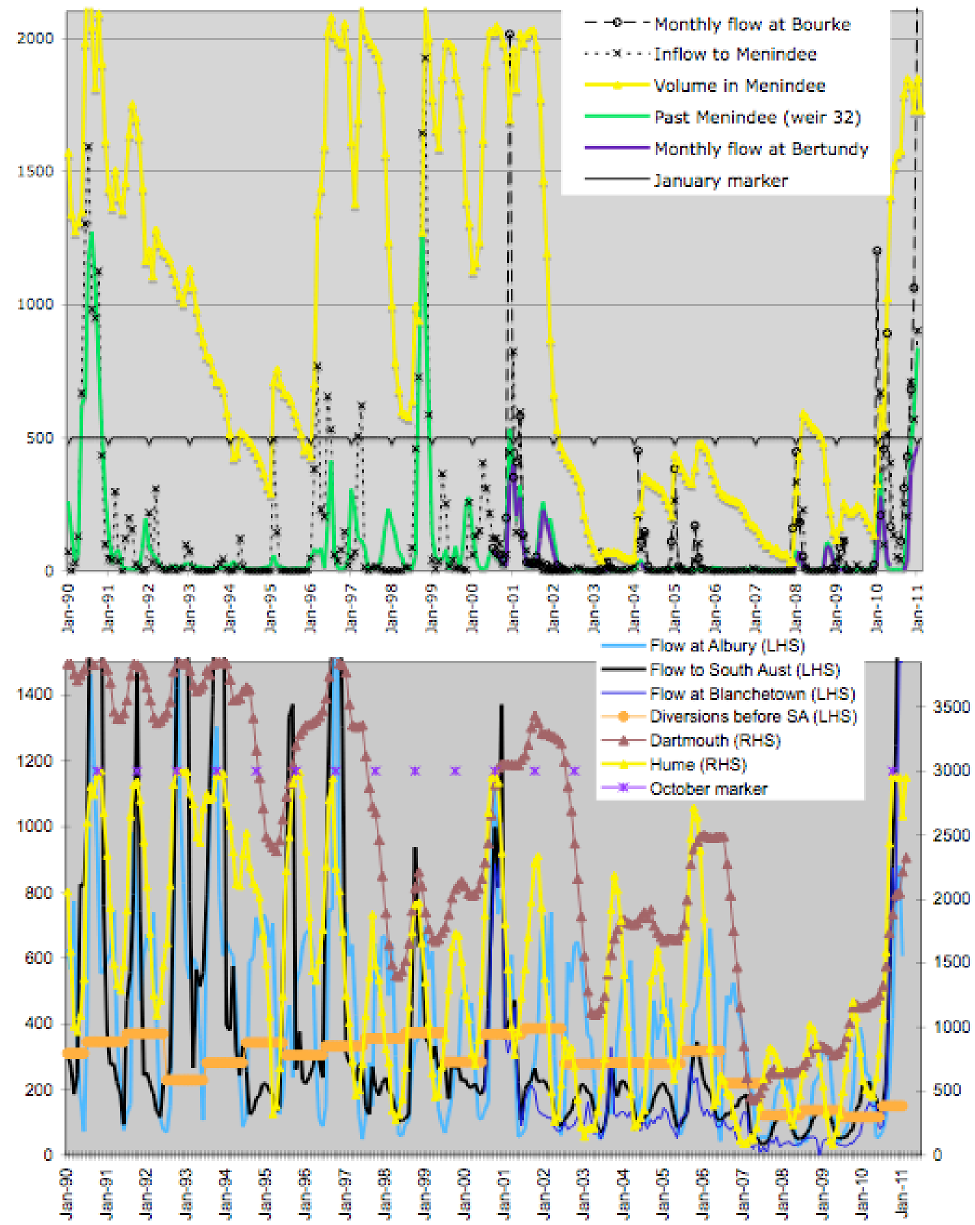
the **modeling underlying Figure 8.7 in the "guide"** (one of the few showing annual plots over a long period) **seems implausible**. It is shown by the speckled blue line on graph III, which shows more pronounced peaks and troughs than "flow to South Aust." – in other words, it implies that salinity rises in periods of high flows (and vice versa). Also the "2 million ton target for salt exports out the Murray mouth" seems to ignore the salt gathered by salt interception schemes in recent decades. The **hatched black line** at the bottom of graph III gives **an indication of the average "quantity of salt" approaching the Murray mouth** (passing Morgan) over the preceding 10 years. It was derived by multiplying "flows to SA" by "salinity at Morgan" (the nearest place with continuous data back to the 1930s) by the "conversion factor for microseimens/cm (us/cm) to mg/litre" etc. The **broad shape of the line seems more representative of the quantity of salt flowing TO the Murray mouth than that shown on figure 8.7**. How much flows **OUT** the mouth depends on what is in the lakes. Even when the lakes are full, this can vary from about 500,000 tons in Lake Alexandrina alone (1700GL at 500 us/cm) to over 10 million tons (1700GL at >9500 us/cm).

The lower panel of **Graph III** shows monthly **salinity levels** in the lower Murray & lakes and some causal factors. It also shows **the beneficial effect of the major inflows of recent months –** for the 3 different parts of Lake Alexandrina for which there are regular salinity readings (Milang, Poltallock & nearer the mouth at Goolwa). The lake level (thick grey line) is millimeters below 1 metre AHD on an inverted scale (thus the "normal full level" of about 750mm shows as 250 on the left scale – and the abnormally low levels of up to a meter below sea level in 2009 show up as 2000). For "inflow" into the lake, I used total capacity of Lake Alexandrina (approx 1700 GL) divided by the average flow rate at Blanchetown (the nearest easily available to me). – ie the number of days it would take that flow rate to fill Lake Alexandrina (or replace existing water). Thus, when inflow is very low one gets very high readings – that go with the high salinity –and vice versa. **The very high salinity, very low inflows and (record sustained) low lake levels of 2007- 09 stand out clearly**. This was followed by a rise in inflows in early 2010, that raised lake water levels ahead of the **rapid falls in salinity associated with the very high inflows into the lower Murray system in recent months**. Even at recent high rates of inflow, it takes about a month to replace all the water in Lake Alexandrina – even if the fresher water disperses evenly. It takes longer to diffuse through other parts of the lower lakes– some of which have narrow entrances and/or only recently been "reconnected" by removing embankments put in place to slow the deterioration of the lower lakes. The very low levels (and very **high salinity) in the lower lakes in the 5 years to 2009, seems a "one-off" from with the prolonged low inflows** over this period. While there have been many years of very low flows into the lower lakes over the last century, the **last decade was the first time that very low flows continued for a long run of successive years (see graph II)**.

Prior to the recent flooding rains, average salinity at Swan Hill, and most points downstream (especially in S.A.) was well below long run averages (see also lines 47-9 of the attached "Summary table"). Once the system settles down after recent rains (which washed a lot of long term salt buildup into the river – especially in northern Victoria), **salinity in the Murray system and lower lakes seems almost certain to be at or near the lowest levels on record**.

Salinity (and low stream flows) was once seen as the basin's major problem, yet graphs II & III show **there are ways of improving the river environment than diversion of water from irrigators**.

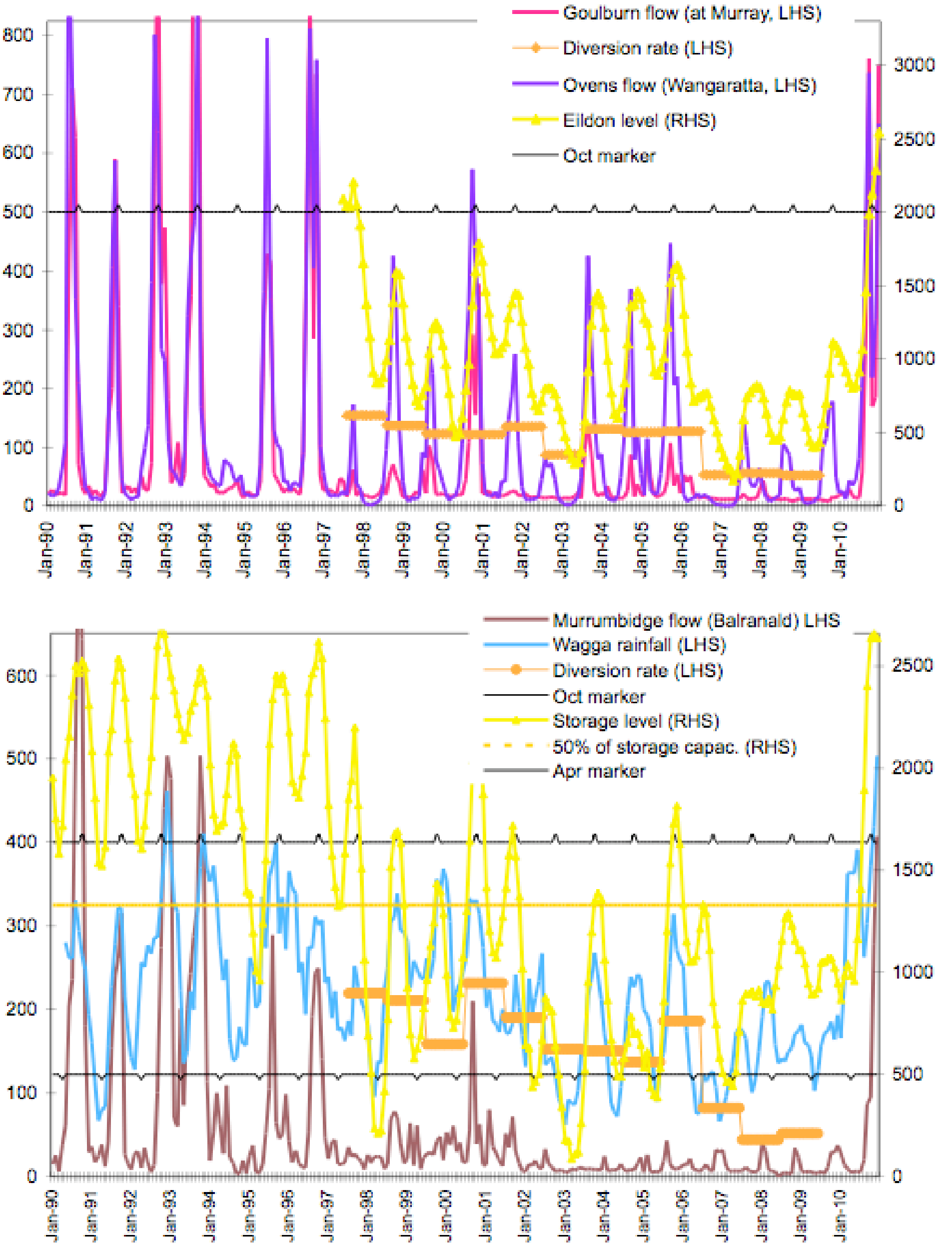
Graph IV Murray & Darling - Flows & Storage levels



Monthly flow and storage levels in gigalitres. Flows at Bourke and Bertundy (near Wentworth) from Jul 2000. Capacities of Dartmouth and Hume are 3850 and 3000 GL respectively. Diversions are annual data divided by 12 (2010/11 YTD by 7). Last plots for January 2011. Storage levels plotted to 21 Feb 2011.

The top panel of **graph IV** shows **monthly flows in the Darling** and movements in **storage levels at Menindee** since 1990. It shows how erratic flows can be - with several examples of **neglible flows to Menindee for periods of several years**. Significant flows to the Murray can be even less frequent. It also shows how when flows do occur they can be substantial – and fill Menindee lakes quite quickly.

Graph V **Goulburn and Murrumbidgee flows and storage**



Monthly flows and levels in gigaliters. Diversion rate are annual diversions divided by 12.
Wagga rainfall is mm in previous 5 months. Last plots for Dec 2010.

The lower panel of **graph IV** shows **monthly data for Murray flows -** and **levels in its major storages**. The main difference from the top panel is that it has to use split scales – to get "flows" data to a level where it can be seen on a graph. It also shows **diversions** (largely for irrigation). This was estimated simply by dividing MDBA figures for diversions in financial years by 12. The high seasonal variation in flows and storage levels stands out clearly. The ratio of "diversions" to "end system flows" (for which flow at Blanchetown is the nearest indicator) seems less than those shown in the following graphs.

The top panel of **Graph V** shows **monthly flows in, and average monthly diversions from, the Goulburn River** for the last 20 years. It also shows storage levels in Eildon and diversions for the years where data was available from the MDBA. The top of the right hand scale showing storage levels is set at Eildon's capacity (3330 GL). It also shows flows from the (not significantly dammed) Ovens. It shows the high seasonal element of flows in both rivers – which have adjoining catchments with very similar rainfall patterns. One can also see where the contribution to the Murray from the Ovens has often been much greater than the, much larger, Goulburn – especially from 2006 to 2009.

The lower panel shows similar data for the **Murrumbidgee** – the top of the right hand scale is set at the combined capacity of Burinjuck and Blowering. The brown line shows monthly flows at Balranald (about 20 Km from where it joins the Murray). It shows that, prior to the big flows in late 2010, the **Murumbidgee (with long term inflows of about 30 % of the Murray system excluding the Darling) made a negligible contribution to Murray flows in the decade till December 2010**. The blue line shows total mm of rain at Wagga in the previous 5 months (5 months because it suits the scale – it also about equals the average seasonal peak in the main Murray catchments). It is clear that over the last 20 years, the **Murrumbidgee has only made any significant contributions to flows in the Murray when the dams are full** (about October in 1990, 92, 93, 95 and 2010) and/or there is substantial **widespread rain downstream of the dams**. Indeed over the entire decade to June 2010, only about 200Gl a year (16 GL a month) reached Balranald – because an average of over 1600 Gl a year (133 GL a month) was diverted from the river (largely for irrigation) – see also lines 15 & 23 in the "summary table". This suggests the Murrumbidgee should be high on a list of targets for major buy-backs of water rights. The many kilometers of open earth irrigation channels in the region add to that case.

In respect of storages levels shown in graphs I, IV and V, it seems worth noting that;

- in 15 of the last 34 years (which include the driest 15 year period in history), Hume reached full capacity (about October),
- the major Murrumbidge dams, and even Dartmouth, reached full capacity half a dozen times in the 1990's (before the 15 year drought took hold),
- Lake Victoria is bouncing off its maximum capacity almost every year – except in extreme droughts,
- In 2010, the first time in a decade we get spring rains above our long term average, Hume, Menindee, Victoria, Burrinjuck and Blowewring were **all full well before the end of spring and the end of the year's rain**.

Some conclusions
The environment is getting its best watering for a long time. But for a temporary rise in salinity (and blackwater events/declines in dissolved oxygen) associated with several bursts of flooding rain across northern Victoria, **salinity in the Murray is well below pre drought levels** and **rapidly approaching longer term lows in the lower lakes**. Thus, **one of the major long term concerns facing the Murray Darling, salinity, seems largely under control – without the introduction of SDLs**. The degradation that occurred in the lower lakes during the prolonged low inflows in the 15 years to 2009/10 seems more due to the lakes not getting the 5000 GL a year average inflows associated with current diversion limits – than providing a clear case that average "end system" flows need to be raised substantially above 5000GL (to 7000Gl under "scenario 1" of a 3000GL reduction in SDL's). **Surely it makes more sense to carefully moniter the full environmental benefits of recent rains, and fully explore other options to improve the environment (including engineering solutions) – before "locking in" a major permanent reduction in diversion limits**.

Much of **the recent very heavy rains in south eastern Australia fell downstream of major storage facilities – and hence is flowing out to sea.** While, at least initially, desirable on this occasion, such **limited storage capacity inland of the great dividing range seems a major shortcoming.** This is even more important when even **many major dividing range dams reached capacity so quickly in 2010.** Closer examination[1] suggests that major storage capacity in the Murray and lower Darling have **a maximum capacity of only the equivalent of about one year's inflow.**[2] The data also show lakes Hume & Victoria regularly bouncing off maximum capacity in even average years – and Hume, Dartmouth and others quickly getting so low in drier years.

Much is easier in hindsight. But, were storages upstream of Barmah able to "absorb" more of recent large inflows (or were there storages close by to dilute "blackwater"), **water quality and the environment could have been better off**. Improvement in environmental flows does NOT reduce the need for optimum use of storages.

The scarcity of major storages inland of the great dividing range reflects geography (deep valleys make good storages, much less affected by evaporation loss than shallow storages on plains). However you don't find deep valleys on the low lying plains where the Murray and major tributaries flow for much of their length. Thus we have to "make do" with shallower storages than is desirable – for example Menindee and Lake Victoria. However, when one considers,

- the Murray system has a huge number of connected lakes and waterways, many of which flow back to the Murray,

[1] The only long-term data in the "guide" showing annual flows and their variability is figure 3.3 (modelled streamflow at Wentworth) – which shows several cases of streamflow being well below "average" over (sometimes several) successive years.
[2] As storages had been far below capacity for a long time, it may have seemed silly to discuss raising storage capacity in the guide. However that situation has clearly changed dramatically. Discussion of the adequacy of storages should be included in the next draft of the plan. "Re-engineering" Menindee lakes has been mooted for years and should be part of any basin plan. Ways should be found to improve the effectiveness of Lake Victoria (the next largest downstream storage), which has too many constraints for it to be as effective as is desirable.

- used in conjunction with deeper storages upstream, even shallow downstream storages, close to where water is needed, can be invaluable - to “the environment”, “critical human use” or irrigators[3]. They can be especially valuable if they are close enough to divert, dilute or restore “blackwater” - and reduce large scale fish deaths (which occurred on a large scale this summer),
- how easily modern earthmoving equipment can move or create mountains (or valleys) for major freeways or mines,

the case for a major effort to **raise the size and effectiveness of “downstream” storages seems compelling** – as part of an increase in total storage capacity in the Murray system. It could include dedicated “environmental storages” within important wetlands - and raising the capacity of Lake Hume (and others?) by excavating large shallow shorelines to increase average depth. I would also look at Lake Mulwalla, capable of holding only 5% of the Ovens river’s average annual flow, but the largest dam on the Ovens– which accounts for around 10% of Murray system inflows.

<u>Simpler and/or Interim targets</u>

<u>IF</u> one accepts that widespread major reductions in diversion limits are necessary[4], then in an ideal world (where irrigators pay a price for water sufficient to ensure its efficient use), the best way is <u>both</u> progressive increases in the “price of water” and progressive reductions in the “supply” for users. If the former is not achievable in the short term, there is merit in **an “interim target reduction in diversion limits”.** While an overall average **<u>of the order 3% per annum</u> (for a specified number of years) seems appropriate for the system as a whole, it is probably better expressed as a target range of 2 to 4% per annum** to take account of different environmental requirements in different parts of the basin. Such a target, could be **a useful start towards longer term SDLs** because,

- small targets are much less intimidating than numbers like 30%, - yet 3% p.a. cumulates to well above 30% over the 10 years envisaged to get proposed new SDLs into full operation,
- a simple overall target (combined with buying back entitlements from willing sellers) **avoids the need for very detailed prescriptive targets – except for areas identified as requiring more environmental water <u>in that river</u>**,
- even indicative interim targets could provide greater certainty, better planning by users and more efficient water use,
- it could reduce tensions in regional areas which have invested heavily in water efficiency (eg S.A Riverland) and feel they have already done the maximum possible – and shouldn’t be asked for further reductions,

[3] It takes about a month for water to flow from Hume to S.A. (or from Murrumbidgee dams to the Murray) and much longer to flow down the Darling. Downstream storages can deliver water to users (or dilute/re-oxygenate poor quality water) much faster.

[4] The more I look at the data, the less convinced I get about the “case” for substantial widespread cuts in water allocations (in the eastern states: the case for major cuts in S.A was always weak). There is clearly a strong case for cuts in the Murrumbidgee – and perhaps some Darling tributaries (for which I haven’t examined detailed data). However the **SDLs proposed in the guide <u>would not have prevented</u> the deterioration in the river environment in the 15 year period of low average inflows to 2009/10. In such periods water available in <u>storages and the mechanism to achieve immediate temporary cuts in allocations are the crucial factors</u> for the health of the river system.**

- it could avoid the risks from delays in approval/adoption of a "final"[5] plan and avoid distortions from major timing differences in state governments' water plans being approved/audited by the MDBA. Victoria is identified for large cuts in SDLs, yet Victorian plans will not be incorporated till 2020.
- it would give more time to fully assess the impact of the recent flushing and further develop objective indicators on the benefits to the environment to help assess the balance of environment with economic and social costs. Even a temporary return to "average inflows" allows a better assessment of how much of the recent environmental stress in the Murray Darling was due to drought, and how much due to "excess allocations" of water rights,

Table 5.2 of the "guide" shows that both **the largest totals for water diversions**, and, **largest proportionate share of river flows diverted**, are for the Murrumbidgee, Goulburn and (to a lesser extent) Murray river upstream of Wentworth. With almost 5000km of open unlined channels in the Murrumbidgee and mid Murray, buybacks in these areas could make a major contribution towards a total target for some years.

<u>Efficiency & transparency in Government authorities</u>
It greatly concerned me that I learned more about the basin in a few hours on the MDBA website – than in wading through the 260 page "guide" - and its huge "technical background". This led me to compare the "guide", and MDBA, with the government bodies I am familiar with, the Reserve Bank, (and to a lesser extent, the Bureau of Meteorology). Both, like the MDBA, have responsibilities with wide ranging ramifications. One can log on to the Bureau of Meteorology website and easily find and download rainfall (or other climate) data – some going back over 100 years. In recent decades, the RBA has developed a reputation for efficiency and transparency which the MDBA could do well to follow. All RBA decisions are readily accessible through the RBA web site, as are the analysis (or models) and data on which their decisions are based. Research papers and conferences on matters relevant to their responsibilities are properly indexed – as are sets of charts and historical series of statistics (with relevant definitions and/or description).

Although the MDBA has some publications of commendable quality (eg "Drought Updates" through 2008 & 2009) the contrast with the "guide" could hardly be more marked. Not only is the "guide" so lacking in actual historical data – tracking down MDBA historical data in easily usable time series format is a time consuming and frustrating exercise. Some emails/requests I made to the MDBA in November are still unanswered – including those asking why the MDBA's published figures for long term average "Total inflows (excluding Menindee and Snowy releases)" of around 9000 GL a year, are so different to the average inflows of 15900 a year quoted throughout the "Guide" (for the Murray and non-Darling tributaries).

The RBA would never allow the waste involved in a 1200 page "Technical Backgound" in expensive glossy printing - especially one containing so much repetition, countless half page graphs of responses to telephone surveys containing

[5] I have difficulty with the guide's concept of a single final plan. We are dealing with evolving conditions – so a succession of short to medium term plans seems a much more sensible approach. **Ongoing improvements in water efficiency, by both irrigators and the environment, should be a major factor in this process**.

subjective questions (some covering small numbers of respondents). Such waste is grossly inconsistent with the environmental themes running through the guide.

In respect of **environmental issues** - I want to see a healthy river system (and believe this can be consistent with prosperous regional communities within it). I can go along with preserving the river environment as far into the associated wetlands as the rest of the community/the government is prepared to pay for. My main concern is about ensuring the judgement on how far the government goes is based on a transparent and balanced assessment of the facts – and the true "costs" (which may involve some hard decisions on some wetlands it may be too costly to preserve). I hope the Commonwealth's role as environmental water holder will enable sound judgements.

Finally, I should note that, for a private citizen to devote so much time to personal submissions (knowing the MDBA and this committee may get thousands) should be seen as an **indication of how much work needs to be done to turn the "guide" into a sensible plan**. I have tried to be as accurate and objective as possible, and apologise for any errors (especially from my graphics software and printer(s) which seem to have minds of their own).

Naturally, I would be happy to assist the committee in whatever manner I reasonably can. This could include updating the graphs (and "Summary Table") in this submission as later data becomes available – or supplying other graphs (for example demonstrating the connections between salinity, streamflows and major rainfall events).

Rob Foster
25 February 2011 ("Summary table" and graphs to dates noted on graphs/footnotes)

Attachment (one page) "Summary Table"

Tailpiece – Author's credentials
I grew up in Mildura, and spent many vacations traveling the Murray valley (and Darling and Wimmera) or on family friends properties, ranging from (then open earth channels, now largely piped drip feeders) irrigators, to riverfront properties and dryland farms. Over the years, I have visited and become familiar with most parts of the basin between Charleville, Khancoban and Goolwa. I have an honours degree in economics and was involved in economic modeling from almost its beginnings in Australia. This included the initial "national income forecasting model" developed jointly with the ABS and Treasury – to the development of "Retirement income forecasting models" in the 1990s (which included sole & joint authorship of published papers). In later years, I was heavily involved in ensuring the integrity of the data in the Reserve Bank's then "Statistical Bulletin", and the banks other statistical publications. I was editor of the last 2 versions of the banks widely respected "Australian Economic Statistics 1949/50 -1994/95".

I have tried to be as accurate and objective as possible, and avoid emotional involvement - that I feel for both the health of the river and irrigators (or others) whose livelihoods are threatened (some unnecessarily). My emotional involvement can be summarized as;

We love our sunburnt country, our land of sweeping plains,
But we need to treat it better, and use our bloody brains,
To use our water wisely, and cut our greenhouse gases,
Or else we'll have disaster, for our ever growing masses.

Our Murray river's dying, it makes me want to cry,
To see it and the Darling, so bloody close to dry,
It's hard enough to save them, but somehow we must,
Too much of our wide brown land is already salt or dust.

We must be really skilful, to save our precious land,
And overcome the doubters, and help them understand,
That the need is urgent, to get the balance right,
Through careful thought and reason – and not a bloody fight.

SUMMARY TABLE

	A	B	C	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	As per Model used				Last	Last														As proposed for red-	
2	in guide to Plan				100+ yrs	40 yrs	.00/01	.01/02	.02/03	.03/04	.04/05	.05/06	.06/07	.07/08	.08/09	.09/10	.10/11		average	uctions in Diversions	
3	annual	Diversn	flow														YTD/latest		.2000/10	of 3000gl	of 4000gl
4	inflow	limit	at end	**Inflows**																	
5	15959			Inflows EXcl. Menindee & Snowy.		8930	9898	4423	2085	5563	4878	6173	1067	2170	1928	3586	(11080)		4177		
6				Snowy releases from Murray 1		1234	1210	855	1309	939	1169	1215	1027	711	888	1114	(1100)		1044		
7				Inflows into Menindee		2277	2686	93	52	482	291	171	21	762	181	2180	(1757)		692		
8				Darling flow at Bertundy			1631	1048	23	56	36	16	17	142	267	546	(850)		378		
9																					
10				**Diversions in year to June**																	
11		1721		NSW Murray			2342	2164	1739	1289	1276	1726	685	236	368	470	(583)		1171	1247	1086
12		1656		Vic Murray			1645	1833	942	1387	1497	1622	1575	679	696	900	(389)		1197	1214	1064
13		665		SA Murray			662	627	657	696	560	462	357	535	574				570	492	433
14		4042		**Total Murray (includes SA)**			4420	4624	3338	3372	3333	3810	2617	1450	1638				3178	2943	2583
15		2060		Murrumbidgee			2781	2384	1833	1803	1645	2232	985	530	621				1646	1396	1190
16		1593		Goulburn			1468	1618	1043	1564	1504	1524	642	675	624				1185	1151	992
17		7695		Total diversions (sum of above)			8669	8626	6214	6739	6482	7566	4244	2655	2883				6009	5490	4765
18																					
19				**River flows**																	
20				Outflow from Hume		4423	4888	3585	4392	3092	2979	3775	3580	1311	1737	1844			3118		
21	1804		1708	from Ovens (Wangaratta)	1549	1591	2103	877	362	1379	1254	1465	132	521	424	864	(2500)		938	1716	1717
22	3559		1600	from Goulburn (near Murray)		1374	1109	220	171	494	411	470	146	205	131	184	(2200)		354	1785	1937
23	4791		1593	from Murrumbidgee (Bal-	1811	1146	589	284	130	123	125	179	172	138	105	187	(900)		203	2109	2325
24				ranald)																	
25				Murray at Euston	8139	6466	5514	1934	2479	2763	2731	3211	2096	1574	1479	1948	(4400)		2573		
26				Murray flow to S.A.	9029	6808	6543	2294	1799	2082	1850	2397	1405	960	1175	1693	(4925)		2220		
27																					
28				Murray flow at Blanchetown			5802	1659	1135	1603	1306	1965	956	430	566	1023	3900		1645		
29																					
30			5105	Ouflow thru Murray mouth																7060	7745
31																		Capac-			
32				**Water in Storages (end Jun)**													Dec-10	ity	end Jun		
33				Dartmouth		2122	3092	3214	1148	1858	1717	2487	486	664	804	1252	(2180)	(3906)	1672		
34				Hume		1107	1229	551	519	294	896	622	385	467	316	796	(2980)	(3038)	607		
35				Victoria		455	360	392	287	256	345	415	284	303	241	354	(440)	(677)	324		
36				Menindee		1173	2030	400	70	332	330	269	79	541	228	1522	(1700)	(1731)	580		
37				MDBA dams INCl Menindee		4857	6711	4557	2023	2741	3288	3793	1234	1974	1589	3924	(7300)	(9352)	3183		
38				% of capacity		52%	72%	49%	22%	30%	35%	41%	13%	21%	17%	42%	79%		34%		
39				Burrinjuck		553	412	258	72	404	249	345	319	426	382	421	(1000)	(1026)	329		
40				Blowering		789	860	412	192	88	286	870	395	609	542	744	(1620)	(1631)	500		
41				Eildon		n.a.	1081	711	377	673	940	748	354	474	433	916	(2540)	(3334)	1048		
42				Major 7 dams (listed above)			7034	5538	2595	3573	4433	5489	2223	2941	2718	4484	(12460)	(15343)	4862		
43				% capacity		n.a.	46%	36%	17%	23%	29%	36%	14%	19%	18%	29%	81%		52%		
44				change (major 7)				1496	2943	-978	-859	-1056	3266	-718	223	-1766					
45																					
46				**One indicator of system health - Salinity (Calendar years)**																	
47				at Swan Hill		252	230	131	104	97	115	79	81	71	54	102	225		106		
48				at Morgan		574	513	631	423	417	360	369	510	472	506	282	360		448		
49				at Milang (Lake Alexandrina)		1142	n.a.	1049	1159	1327	1348	1168	2003	3956	5448	4194	620		2406		
50																					

51 **Notes:** Unless otherwise noted, all flows and levels data are in gigalitres for the year ending June. Salinity is average daily microseimens per cm for calendar year.
52 Data for 2010/11 is "Year to Date" or latest, storage levels are end December; flows 6 months to Dec. Diversions are 7 months to 2 Feb. Salinity is average for 2011 to date (to early Feb).
53 Murray diversion data (lines 25-27, cols I to R) taken from MDBC/MDBA annual reports and "River Murray Weekly Reports". Some inconsistencies between total and components.
54 Diversion data for other rivers from Table 2.8 on page 38 of "Volume 2 - Technical Background".
55 Long term data taken from an excel "workbook" supplied by MDBA on 30 November - in response to a written request. This has been supplemented where necessary
56 by data in MDBCA/MDBA "Murray River weekly reports". "100year+" (and some "last 40 years") averages are calendar years.
57 Updated to 11 Feb 11