

# “A Better Way” for the Murray Darling Basin!

Supplementary to the documentary *Muddied Waters - A Clear Solution*.  
2015 - with minor updates in 2022.

And:

- It won't cost the earth – certainly not A\$13 billion dollars.
- It won't damage floodplain farms and force farmers from their land.
- No need for water entitlement diversion reductions to service a government wish.
- Will use a portion only of the freshwater volumes to be used for the Lower Lakes etc. for an estuary with provisions for handing back the balance for productive upstream use.
- No need for costly over-bank flooding and subsequent property damage.
- No disruption for growers - improved growth in Australian foodstuff production and export.
- Growers and communities throughout the basin and the nation will benefit.
- Massive sulphuric acid mobilisation below Lock One will be checked.
- Murray River environments, aquatic life and biota will benefit.
- A working estuary will reward immeasurably with huge benefits because:
- The MDB Lower Lakes are within a highly variable system; the Lower Lakes will always be a reversible system – [fresh on rare occasions during natural flooding and estuarine at all other times](#).

**However: Early signs of Climate Change with sea level rise, is already upon us! This will make change inevitable, well before(circa) 2050. This will affect the 7.6km barrages and barrage embankments. There's time to raise barrage embankment heights so long as we plan and act now ! Improve our ailing food security upstream asap by saving our freshwater resource for the growers; not so much for the Lower Lakes, but for our food production, rather than waiting for the inevitable. Assist our growers by improving our nation's precious freshwater distribution today!**

Please make this “[Today's urgent priority for tomorrows Future!](#)  
Anything else may become a poor and costly alternative!

### **Very much in brief:**

To keep the Murray Mouth open nine out of ten years, a former Federal Water Minister in 2014-15 ordered large volumes of fresh water flushed down the 2,500km Murray River system. Much is lost along the way! Upwards of 60% evaporation loss alone is possible across the basin (fmr.MDBC ref data), and that's without the additional river floodplain constraints issues where additional evaporation and seepage from forcing shallow water over dry, fertile floodplain land will occur, with an extreme likelihood of extensive top soil loss and sediment damage in the water column.

Historically, minimal water flows have been maintained throughout the length of the Murray River since the 1936 completion of the Hume Dam. The Murray system since then is regulated through this storage to assist in avoiding over-bank flooding in narrow sections of the Murray system at all times, save for rare natural flooding occasions. Similarly with large volumes of water released from the Murrumbidgee River storages in recent years, although recent flooding already caused extensive damage, while heightening the concerns for growers.

Given the government proceeds with its "constraints" issues, there is no doubt whatsoever it will cause extensive damage to flood plain property and soils located in these extensive areas where narrower river sections occur, particularly in NSW and Victoria, where fencing, crops, stock, farm infrastructure and bridges etc. will suffer various levels of damage, some will be permanent. Councils throughout river regions including the **13 Ramroc Group Councils** are very concerned, while compensation and insurances alone will be difficult for all parties.

There are potential threats to upstream holiday homes in South Australia; notwithstanding a possibility of damage on reaching the lower Murray flats further downstream. There're increasing concerns from among ordinary Australians with little basin connection who are learning about the ways of the authority with its constraints issues. Many are venting their dis-belief that a government and its agency would pursue such a course of destruction and waste.

A waste that would increase with an extra 450 gigalitres proposed in Goolwa SA by the former Prime Minister Julia Gillard as additional to the 2750GL/yr designated up to 2019, to be increased to 3200GL and forced down the Murray and Murrumbidgee systems by about 2024. Reduced volumes have since been discussed during August 2015. Besides, there is no way of sending 450GL into South Australia without property damage.

The *Murray Darling Basin Authority (MDBA)* had proposed to increase the flows from the current maximum of between 25,000ML/day and 40,000 ML/day through several severely restricted river flood plain reaches, farms and other properties, including extensive public and private holdings found along these systems.

As an example, flows three years ago (2012) through the Millewa and Barmah Chokes were controlled at 10,500ML/day and about 8500ML/day respectively.

The original *MDBA* proposal was to fulfil a flow-rate of 2000GL/yr over the Lower Lakes barrages for 95 per cent of the time with a minimum 650GL at all times, in line with what the agency announced in its first ***Guide for the Basin Plan***. Simply though, the MDB system and subsequent rain runoff into the catchments doesn't provide enough for additional flows of river water over riverbanks and floodplain expanses, to service a political whim of over-bank flooding as the means to additionally cater for the Lower Lakes and the Murray Mouth at the very end of system! It's quite apparent, even today how this nonsense will be thwarted by a lack of freshwater.

**An important Quote:**

From a fact sheet (undated); the former *Murray Darling Basin Commission (MBDC)* advised its concerns with the *Barmah Choke* on the Upper Murray River system when it wrote, "*there're other environmental challenges in river management with the Barmah Choke. Operating the river for long periods at top-of-bank levels leads to notch erosion and bank instability.*" "*The Barmah Choke also limits the ability to target the delivery of environmental flows from upstream storages to downstream icon sites,*" the *MDBC* said.

**Seriously:**

None of the proposed, man-forced over-bank flooding impulses down the Murray, the Goulburn and Murrumbidgee systems need occur, notwithstanding the likelihood of extensive property damage and massive water loss. Certainly not when attempting to keep the Murray River mouth clear. Distance and evaporation alone will defeat such a destructive notion!

**There is a Solution:**

In brief for now, all it will take is one more river Lock; we'll call it ***Lock Zero*** given the current first lock, ***Lock One*** is located some 275km upstream of the Murray Mouth at Blanchetown in South Australia. The Goolwa Barrage will require adjustments while its imperative that civil works remove (or partly remove) an unwanted island that grew from post-barrage times to where its restricts the Mundoo Channel outlet opposite the Murray Mouth by as much as 70%.

**Importantly:**

History reveals much about the interaction of the Murray River with the Lower Lakes, the Coorong and the Great Southern Ocean.



Dredging the Murray Mouth with two dredges continues, while *Great Southern Ocean* water continues to push inwards against Murray River freshwater on the upside of the Murray Mouth. Pix by Ken Jury- May 2022.

In **pre-barrage times**, it was a variable Lower Lakes when low flows meant the remaining fresh water had to compete with regular Southern Ocean intrusions, as the latter pushed fresh water back into the upper end of the Lower Lakes and on occasions, into the river resulting in a mix of ocean and fresh water, becoming estuarine as naturally found upstream in most global estuaries.

Importantly, the estuarine lakes in pre-barrage times contained extensive water bodies that were extremely useful, with high value outcomes.

Records from these times reveal how estuarine fish populations flourished high up in Lake Alexandrina to where it supported major commercial fishing operations for 44 or so commercial fishers out of Milang and Goolwa, some of whom regularly fished towards the top of Lake Alexandrina area, where they harvested freshwater Murray Cod, Callop (Yellowbelly or Golden Perch), and Mulloway from tidal prism water, often in the same hour, in a nearby location on the same day.

Prior to the barrages (pre-barrage times), each of the fresh and estuarine species were almost plying the same water column save for the natural stratification of fresh water accompanied nearby by mixed estuarine water, at times the fresh still stratified but expected to gradually mix into estuarine water, at which stage the

Murray Cod would follow freshwater trails for survival while Mulloway remained in estuarine water. Often within close proximity; sometimes found in areas less than a few hundred meters apart. History reveals how Pioneer; Captain Charles Sturt discovered stratified lakes water during his arrival out of the River Murray at the top of Lake Alexandrina.

Commercial fishers primarily established their grounds by taste-testing for fresh water and saline water in the often stratified water columns. These details are provided from an interview by the author of this paper with one of the few remaining Lower Lakes Commercial Fisher identities, Mr Victor Woodrow (in his nineties today) who fished with his late father during pre-barrage times, during school holidays near the top of Lake Alexandrina, in the area described above until the completion of the Goolwa Barrage that signalled the end of estuarine this fishery in the Lower Lakes. (Mr Woodrow resides in Adelaide today).

**Records reveal how flourishing estuarine fish populations in the Lower Lakes came to an abrupt end when the barrages were completed.** Following the introduction of the barrages, estuarine fish, invertebrates and general biota once found in the Lower Lakes and sometimes as far upstream at Swan Reach during low flows in pre-barrage times, were shut out from what was previously a magnificent estuarine system. A system that supported a major South Australian fishery supplying SA state fish needs with surplus fish being railed into Victoria, for almost five decades.

Today, fish species including Mulloway and Black Bream continue to be guided into the Coorong part of the estuary due to their DNA, but the barrages thwart them even though these fish come right up to these concrete structures with a view to reaching the lakes and channels to breed.

It is known through recent fish tagging that Mulloway entering the Glenelg River in Victoria, where this river also meanders slightly into South Australia, that these fish do not breed in the Glenelg river. Science tells how they rest and feed in the Glenelg River and then make their way to the Coorong with the notion of entering and breeding inside the Lower Lakes.

Some suggest that the basin ends at the real mouth of the river just below Wellington at the head of Lake Alexandrina **and not 45km downstream** at 'the bottom of the lakes, on the south-west outer edge of the Coorong, at the Murray Mouth where the river spills into the Great Southern Ocean.

**Significantly:**

So long as the barrages are open to exhaust flooding freshwater, with regular high tides and even during neap tides, together with regular, strong prevailing westerly winds, it's inevitable that Southern Ocean intrusions on occasions will reverse out-flowing fresh water back through the river mouth, and through the open barrages, pushing fresh and by now, ocean and fresh (estuarine) flows

back upstream into Lake Alexandrina, towards the entry point of the Murray River into Lake Alexandrina.

The threat of sea level rise is real so that we can with some certainty expect increases in Ocean intrusion into the Lower Lakes! There're already noticeable signs along Australia's southern coastline during winter.

**NASA said in its extensive August 26<sup>th</sup>, 2015 “Global Climate Change” data, “Warming seas and melting ice sheets,”**

“For thousands of years, sea level has remained relatively stable and human communities have settled along the planet's coastlines. But now Earth's seas are rising. Globally, sea level has risen about eight inches (20 centimetres) since the beginning of the 20th century and more than two inches (5 centimetres) in the last 20 years alone.”

“Scientists estimate that about one-third of sea level rise is caused by expansion of warmer ocean water, one-third is due to ice loss from the massive Greenland and Antarctic ice sheets and the remaining third attributed to melting mountain glaciers. But the fate of the polar ice sheets could change that ratio and produce more rapid increases in the coming decade,” NASA said 10/09/2015. Footnote: NASA, BOM and the CSIRO share their data on climate change.

In the Lower Lakes, Murray Mouth region, evidence has been collected from officially located automatic, real-time beacon probes located across the Lower Lakes and Coorong, streaming out ‘real time’ probe data and plot readings.

This data is accrued in a central computer storage, where ECu (electrical conductivity unit levels), otherwise known as salinity levels taken from the in-water probes, provide plot readings accurately describing in ‘real time,’ ocean water ingress as its recorded across the Lower Lakes and Coorong system, as monitored and recorded by government electronic monitoring systems.

These computer findings are regularly monitored by others on hard copy in an exercise to report that water in the lakes is often estuarine. A series of plot data collected by the author and a colleague scientist also reveal ocean ingress occurrences when southern ocean water actually circumnavigated Hindmarsh Island.

**There's a huge waste of expensive freshwater entering the lakes with much of this becoming highly saline and wasted.** The Lower Lakes aren't lakes but leaky, shallow depressions of sand, silt and river debris culminating in the formation of extensive acidic soils (**500 million tonnes plus, throughout the Lower Lakes and lower river regions**) with high levels of seepage and evaporation. They were formed by receding ocean water about 7000 years ago, leaving remaining sand, silt and calcareous ridges that border the lakes and the SE natural drains today. The Lower Lakes combined hold 2018GL of water.



NE **Lake Albert**, the smaller of the two lakes at the peak of the Millennium Drought. The fine black dots are cattle seeking water from an ever-receding lake. They gave up and turned around!  
Pix by Ken Jury

The 4,500GL annual average of freshwater used in the Lower Lakes, the Goolwa Channel and Murray Mouth region, would have been valued at more than A\$10 Billion dollars, had the lakes been full during the peak of the Millennium drought.

The figure of \$2.4 million dollars per gigalitre was likely the absolute top tender buyback figure during the Millennium drought, when water was scarce! The average tender price for High Security water (for SA) **during 2012-13** stood at a massive \$1.675 million per gigalitre. Water markets today have affected growers badly. Many growers and dairy operators 's have packed up and left!

This figure puts a value on Lower Lakes stored and used water for an average year at around \$10 plus Billion dollars, while the previous Govt. said at the time, they'll continue to send river water towards the river mouth for 9 out of every 10 years.

From a personal written inquiry with the SA Dept. Environment & Water, concerning 2019-2020 usage of Lower Lakes water; there were 166 licensed irrigators across the region who combined, used a total of only 21GL for the year. We're informed that the average loss to evaporation from the lower lakes per

year can be as low as approx. 800 GL evaporation reaching well past 1000GL during the Millenium drought.

Basically, precious freshwater is being sent down to evaporate, to service a small amount into the Northern Lagoon of the Coorong to maintain its estuarine feature, to secure its valuable marine commercial fishery, with the balance being wasted in the ocean! This is ludicrous! One wonder's what the return would realise with our food security, when using the same volume of water for additional food grown in the basin over the same period?

**There's a much better way:**

To make better use of our basin and its limited fresh water, and with the help of free, highly oxygenated Southern Ocean water, another lock (Lock Zero), should be built upstream of Wellington towards Taillem Bend.

**A more practical foundation opportunity for another Lock is available today!**

As Scientist, Ian *Rowan* BSc Hon. points out, in today's world it's no longer a problem when not locating sound bedrock for river footings, when the use of friction piling has very much become the accepted alternative.

One recent example of friction pile engineering is the ***Hindmarsh Island Bridge*** where friction piling was successfully used to hold this massive structure in place.

As old as it is, the Goolwa barrage also sits on a footing using friction piling!

**There're benefits to be gained from preventing uncontrolled use and loss of River Murray water in Lake Alexandrina:**

An additional lock, Lock Zero should be built and used to regulate minimal freshwater flow into Lake Alexandrina to mix with ocean water, forming and maintaining an estuarine environment, and for the first time, to provide for the control of the pool height between Lock One at Blanchetown and Lock Zero, while providing the means to greatly assist in clearing the Murray Mouth.

This in itself would rid this section of the river of acid mobilisation during drought, so bad at times, that even the authorities openly admitted defeat with treatment of mobilised, acid-laden water, notwithstanding a possible threat to the intake pipes that feed water back to Adelaide hills storages.

**Return the Lakes to their former estuarine system and stop the freshwater waste!** In what would have been a natural occurrence in pre-barrage times, the use of clean, highly oxygenised water from the Southern Ocean, mixed with a percentage of stored fresh water gradually released from upstream through a



new Lock Zero; the Lower Lakes system would again become estuarine to inundate the lakes and deal with any drying lake or channel mud while limiting acid sulphide development and mobilisation throughout the estuarine environment. All without using massive volumes of expensive irrigation water, year after year, which should otherwise be better used to produce Australia's food .

By retaining the barrages, freshly mixed estuarine water could be held within the lakes system for extended periods, and released out of the lakes/channels, from selected barrages to provide strong scouring/cleaning flows and to regulate the removal of silt and sand from the areas between the barrages and certainly that found in the Murray Mouth outlet to the sea.



Liming highly acidic water and acidic soils exposed in Currency Creek that flows into the Goolwa Channel. Pix by Ken Jury.

By using Lower Lakes estuarine water, the 840 sq km system can be cleaned and flushed at will, while replenishment for the lakes with free ocean water will greatly supplement much smaller qualities of freshwater from behind Lock Zero!

By allowing lake levels to recede by 10 to 20cm only by selective use of barrage gates, estuarine water from the 840 sq km surface of the lakes will provide ample flushing and scouring water for the river mouth.

### **Scouring those channels and the mouth:**

Upgrading the barrages will enable restriction of the outgoing flows to elected channel(s), to bias the movement of sand and silt during outflows, and time regulated to suit falling tides.

To enable selective flushing, there should be an upgrading at the Goolwa Barrage where the lifting of multiple barrage compartment concrete logs stacked on top of each other is both cumbersome and time consuming as they're handled individually- one by one by a crane as commonly seen at this barrage today.



Currency Creek succumbs to drought; oxygen reaches cracked acidic soils leading to the mobilisation and formation of sulphuric acid to a dangerous pH1.5. Nearby Lake Alexandrina contains at least 500 million tonnes plus of acidic soils.

This is an extremely costly and time wasting exercise to continue with when it's necessary to reach the desired scouring out-flow swoosh effects from some of the barrages.

Lifting single concrete logs this way is far from practical and it's outdated.

There are alternatives for the barrages today, with tests underway using stainless steel devices to fit into the existing slots in a few of the bays in the Goolwa and possible the other Barrages. To either operate in one single lift and fall motion to enable necessary strength in water outflows to clear the mouth and keep it clear, while equally affording gate opportunities to direct outflows of estuarine water towards the mouth from the northern lagoon of the Coorong. We understand that the Department of Environment & Water is trialling these stainless steel gates.

The lakes themselves should gradually become estuarine again, to develop channels and flats, quickly becoming colonised with estuarine biota associated with the cycles of inundation and exposure to inter-tidal zones.

**The savings would be massive:**

During average river flow years, the use of ocean water mixed with a 40% portion of freshwater would free up a minimum 2700 gigalitres/yr of freshwater being part of what was previously used in the lakes and the channels, now to be re-directed back upstream as surplus freshwater for food production with some towards environmental flows for up-river environments. **There's more, but first:**

**Remove this sandy, highly vegetated knoll, shown on page eleven.**

Bird Island as its known, faces the river mouth, is located downstream of the Mundoo Barrage and it must be removed as it directly blocks about 70% of the flow from this barrage to the mouth.

This obstruction and a minor connected peninsula gradually formed and vegetated as a result of building the Mundoo barrage. It also impedes movement both ways of Coorong water and water released from the Mundoo Barrage and 3 other barrages within the area that would otherwise clear the mouth of sand and silt.

In consideration of a future for the Lower Lakes system, we should keep in mind how these lakes and nearby channel environs regularly require at least 4500gigalitres/yr of freshwater.

This amount includes top-ups to replace and maintain evaporation and seepage from the shallow lakes, to maintain the channels leading to the river mouth by providing for scouring these extensive systems before & beyond the barrages, and currently, to sacrificially supply regular scouring flushes in failed efforts to keep the mouth open.

Current scouring success rates today are minimal, extremely wasteful and expensive.

On occasions in recent months, larger vessels have not always been able to comfortably navigate across the Coorong adjacent to the inside of the Murray Mouth. Dredging the mouth continues at great expense! That expense in one single decade was alleged to have reached \$50 million dollars.

**A formula for success:**

Combined, the lower lakes hold approx. 2018GL of freshwater at capacity and often it can be highly saline water.

That's approximately 750GL below the original 2,750GL amount of fresh water being sought by the *MDBA* and a former Water Minister from upstream food growers, **as its environmental saviour.**



The Murray Mouth from the west.

**With change – we can do with much less:**

Simplistic perhaps, but logically there's a view to reduce fresh water maintenance volumes for the lower lakes to just 40%, (about 1800GL/yr) as a freshwater allowance required to mix with barrage entrapped, highly oxygenated Southern Ocean water for the return of a healthy estuarine system within the Lower Lakes.

In order to do so, and as mentioned previously, there will be the need for retaining the barrages (with some minor and in-expensive modification) so that fast manipulation of incoming ocean water and outgoing estuarine water during cleaning the lakes can occur un-impeded.

Albeit, after retaining 40% (1800GL of fresh) for an estuarine mix behind a new lock we've named "Zero", there remains a freshwater balance of 2,700GL as a left-over from an annual average of 4,500GL/yr previously used within the lakes and for sand, silt and river mouth clearance purposes etc.

This represents a meagre 50GL of the 2750GL MDBA water claw-back figure at the time, dumped upon farmers and irrigators etc., for the environment, and to keep the river mouth clear.

We should also bear in mind a likely additional freshwater saving, over and above from not allowing freshwater into the lakes on its own, to be lost to salinity and massive evaporation and seepage, and that used for clearing the mouth. There're positives here!

**A reversal of the system has many possibilities:**

There're often seasonal periods when the elected 40% or 1800GL/yr of freshwater required for mixing in the lakes may be further reduced due to seasonal Lofty Ranges rain run-off reaching the lakes. There's a handful of streams that reach the Lower Lakes including Currency Creek and the Finniss and Angus River's that yield significant winter freshwater flows that often reach Lake Alexandrina.

This Lofty Ranges run-off water will again help compensate growers or it could be held as future fresh water meant for the lakes (to mix with ocean water), being held upstream of Lock Zero for this purpose.

Moreover in an adaptive way of thinking, to suit the situation at the time when ensuring the continuity of the estuary or, if additional fresh flows persist through flood or minor flood, then ocean water and river flood water would be adjusted by way of the now rejuvenated barrages and through Lock Zero to suit the situation. In all circumstances the biota throughout will adjust both ways (fresh or estuarine), as it most certainly always does in an estuarine environment!

**Estuarine water:**

Importantly, estuarine water can be made up of varying volumes of fresh and ocean water, as is naturally the case in most estuarine deltas worldwide. Contrary to claims, estuarine water occurs at varying salinity levels in all estuaries worldwide. It depends on the volume of fresh water flows at the time! These are generally healthy eco-systems that provide immeasurable benefits including commercial and recreational. RAMSAR is generally keen to support the values of a healthy, workable Lower Lakes estuary, as they were previously.

Returning the Lower Lakes to estuarine would once again create a very useful and beneficial environment. Estuaries 'the world over' are known for their productiveness! Such the case with viable fisheries! It's a known fact that Mulloway (one of many examples of quality commercial fish known to the region) would gradually return to the Lower Lakes again to become part of a major fishing industry, a fish nursery and breeding ground, for the return of a much larger fishery. In turn, tourism would surge ahead and so would development.

**How little did the river hold during the Millennium drought?**

In our worst drought in history, during the year when about 1100 GL were lost to evaporation from the lakes, a qualified individual had set-about measuring as best he could, water volumes held in the river/anabranches and backwaters between Wellington at the head of Lake Alexandrina and the border with NSW during the same year. The results concluded that evaporation and seepage claimed a greater loss of water from the Lower Lakes than what the river contained at the same time within the South Australian section of the river. Annually, these water losses alone cost multiple billions of dollars while losses during the worst millennium drought years from the Lower Lakes would have likely reached higher levels in the region.

### **Flushing the river mouth:**

On returning the lakes to an estuary; during periods when flushing is desirable across the Lower Lakes system; carefully selected barrage gates would be opened to coincide with outgoing tidal periods with particular emphasis on directional flow towards the Murray Mouth.

In particular the operation of Mundoo Barrage with released flows moving through Mundoo channel towards its delta that faces the Murray Mouth.

Should the level in the lakes be allowed to fall only 10cm on a single outgoing tide as an example, then this would represent an approximate 75 GL of water that would flow out through selected barrage gates towards the mouth. We're aware through MDBA exercises how 75GL will never clear the river mouth.

However, a 20 cm lakes surface drop would realise somewhere in the order of 150GL that would be used in one single out going, tidal session of approximately 5 hours to successfully scour and clear the mouth.

Volumes of this dimension have only been available in previous flood times, similar to that of the 1956 Flood. Basically, the use of Southern Ocean water becomes the greater component for this estuary and its basically free, while its also provides the means for clearing the mouth region.

Replenishment of ocean water into the lakes can be done often and at will, in a few hours during incoming tidal periods as required.

Due to barrage control of water in and out, marinas should not be affected to where it would be detrimental, providing suitable but simple management strategies are agreed and exercised.

The concrete logs in the Goolwa Barrage represent gates (or logs) that either harness or release water. The Goolwa Barrage is one of five barrages spread



over 7.6km, separated by earthen embankments between the remaining four barrages.

An engineering solution is being trialled as an alternative regarding the current issue of lifting and manipulating the cumbersome concrete blocks in the Goolwa barrage.



Engineering improvements to the Goolwa Barrage would allow for the faster movement of larger volumes of water. Photo Ken Jury

**In the photograph above, removed logs are shown on the top of the barrage to the right, just beyond one of two rail lines that support a crane (out of shot) used as the mobile lifting or lowering device across the barrage. The other rail line is found slightly right of the pedestrian walk. Log slots are located centrally in the structure, as seen across the top, in every bay across the barrage where individual logs are lowered down between the protective steel lined slots found at either end of each bay, to accept individually inserted or removed logs.**

I believe that selective opening of the barrages in a single action will provide the necessary estuarine water outflows to clear the mouth and keep it clear while affording opportunity to direct outflows or inflows of clean ocean water or to expel outflows of ocean/freshwater towards the mouth and, to offer minimal assistance to the southern end of the northern lagoon of the Coorong.

Importantly, my colleagues and I share the belief that neither the former 2750GL/yr nor 3,200GL/yr would have made any useful difference to keeping the mouth of the river clear. There are many reasons including the fact that most of this water, when available would be sent downriver, will be lost.

Furthermore, and as an example in 2011; during the months of March to May in that year, a remnant minor flood came down the river whereby flows of up to 80GL/day passed the Goolwa wharf and through the opened barrage gates. Flows at this rate made no discernible difference to the sand bars and the depth of the channel through the Murray Mouth.

In fact at the time, prevailing wind and tides pushed much of this water back through the open barrages, as is the case on many occasions during autumn and winter. Wind Seiche in particular, (the gentle blowing of water across a saucer) plays a large part in mixing ocean and freshwater into estuarine, while it also alters the AHD 's (Australian Height Datum Levels) during windy days.

Up to two dredges currently operate 24/7 today, to keep the mouth clear.

**Note to assist readers: A single gigalitre is equal to one km x one km by one metre deep.**

The weight and power behind the volumes of freshwater sent downstream in recent times are hard pressed to match the weight and push of the mighty southern ocean and with water availability waning, one would seriously expect that the Lower Lakes should not be kept in a freshwater condition only.

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Please note: My documents are generally 'Work in Progress.' Feb.2017