Failures to Deliver on the Key Objectives of the *Water Act 2007*

1. Overview. Our submission responds to several items with respect to the Royal Commission's Terms of Reference. Wherever possible, we have referred to and cite peer-reviewed academic research, including our own work, in support of this submission. Our joint submission calls on the Royal Commission to thoroughly investigate: (1) the effects of water recovery (the expenditures associated with ensuring sustainable levels of extractions either directly through purchases of water entitlements from willing sellers or indirectly through subsidies for on- and off-farm irrigation water infrastructure upgrades); and (2) the implementation of the current Basin Plan, including the scientific justification for proposals, such as the Sustainable Diversion Limit (SDL) Adjustment Mechanism and the Northern Basin Review, to reduce the planned environmental water recovery in the 2012 Basin Plan.

2. *Water Act 2007*. A key object of the *Water Act 2007*, as outlined in the Royal Commission's Issues Paper, is the goal to "return to an environmentally sustainable level of extraction" within the Basin. Specifically, 3d(i) of the Act requires "…the return to environmentally sustainable levels of extraction for water resources that are overallocated or overused"; and 3d(ii) cites the need "to protect, restore and provide for the ecological values and ecosystem services of the Murray-Darling Basin." As long as the *Water Act 2007* remains the law of the land, these goals are not negotiable and cannot be ignored nor reinterpreted by Ministers of the Crown. These key objects are important deliverables for the Basin Plan and a benchmark to judge its actual performance.

3. Key Findings. Item 24 of the Issues Paper highlights a key question, namely, whether the Basin Plan in its current, or any amended form, is likely to achieve the objects, purposes and desired outcomes of the *Water Act 2007*, and the Basin Plan? Our summary response is a definitive NO in relation to the current Basin Plan. In our view, and this is worth highlighting, we do *not* see the scientific evidence to show that the current plan — even if delivered "on time and in full" — will achieve the requirements of the *Water Act 2007*. The problems lie with the current Basin Plan and, in particular, with how the water recovery has been implemented to date. These are fundamental problems, which we document in this submission, and are independent of the speed with which the Basin Plan is being implemented.

(a) To be clear, we are *not* stating that the current Basin Plan has been overall negative for the environment (we believe it has been overall net positive), but that it falls a great deal short of: what is required by the *Water Act 2007*, what is necessary to ensure a sustainable future for the Basin and its communities, and what could be achieved in terms of public benefits given the huge expenditures of public funds.

(b) There were sufficient funds in 2010 to have delivered, by 2018, the necessary reductions in surface water diversions (well in excess of 3,200 GL/year) and also provided substantial support for Basin communities (Wentworth Group 2010). As we detail in point 9 of this submission, some $3.5 billion of these funds were used to subsidise increases in irrigation efficiency (the ratio of water used in beneficial crop production to the water applied to an irrigator's field). This expenditure has, in our view, at best contributed to no benefit and, at worst, reduced net water availability in the Basin.

4. Process used to determine the "Environmentally Sustainable Level of Take". We contend, based on the evidence available to us (and documented below), the process to determine the 2,750 GL/year surface water diversions in the Basin lacks a rigorous scientific basis, has not had a transparent scientific peer review, and will fail to deliver on the key objects of the *Water Act 2007*. The *Guide to the Proposed Basin Plan* (MDBA 2010), and which was subject to international scientific peer review, indicated that 3,856 GL/year was the minimum mean increase (adjusted downwards by a 20% confidence limit to 3,000 GL/year as the lowest recommended reduction in surface water Basin-

wide diversions) in the volume of water for environmental purposes that was needed to deliver on the *Water Act 2007*. This volume, according to the Murray-Darling Basin Authority (MDBA) (2010b, p. 114), only had a *low* likelihood (or high uncertainty) of success in delivering healthy rivers across the Basin. To deliver a *high* likelihood (or low uncertainty) of success, the *Guide to the Proposed Basin Plan* recommended a mean reduction of 6,983 GL/year (adjusted upwards to 7,600 GL/year by a 20% confidence limit as the highest recommended reduction in surface-water diversions) in surface water diversions. We are not aware of a scientifically credible justification to move from between the mean high uncertainty volume of 3,856 GL/year and the low uncertainty volume of 6,983 GL/year reduction in Basin-wide surface water diversions in the Guide, to the 2,750 GL/year reduction in surface water diversions adopted in the 2012 Basin Plan.

(a) The Baseline Diversion Limit (BDL) in the Basin Plan was calculated by the MDBA (2011a, pp. 85–86), based on the state of affairs as of 30 June 2009, and is the sum of measured long-term average annual water diversions (10,636 GL/year), estimated diversions from non-regulated streams (267 GL/year), estimated interceptions from farm dams (2,384 GL/year), and estimated interceptions from plantations (336 GL/year). As a result of this method of calculation, the Basin BDL for surface water was established at 13,623 GL/year (MDBA 2012) — a volume that greatly exceeds the measured annual total volume of surface water diverted in the Basin in any year from 2000–2001 to 2014–2015, or in any year prior to setting of the Cap in 1995. This target is problematic for at least two reasons.

(b) The first concern is the adequacy of the SDL goal. Namely, under the current Basin Plan, the Basin-wide SDL of 10,873 GL/year is very similar to the average long-term historical water-course diversions in the Basin (and importantly *not* including interceptions estimated at 2,735 GL/year) of 10,942 GL/year (MDBA 2010a, p. 51). Yet in the *Guide to the Proposed Basin Plan* (MDBA 2010a, p.132), when evaluating the effects of a 3,000 GL/year reduction in surface water diversions, the expected water-course diversions, according to the MDBA itself, would have been 7,945 GL/year. Importantly, it is the high level of water-course diversions that are the key contributor to environmental degradation in the Basin (Davies et al. 2010, 2012; Grafton et al. 2013; Williams 2017), and why the *Water Act 2007* was legislated.

(c) The second concern is how the SDLs are being implemented. Delivery of the SDLs by 1 July 2019 requires water recovery, whereby the Australian Government acquires water for the environment, through either subsidies for irrigation efficiency infrastructure or direct purchase of water entitlements from irrigators. The long-term average yield of the acquired water entitlements through water recovery is counted as 100% towards achievement of the adjustment to the SDL in the current Basin Plan. Yet water entitlements are, on average, not fully utilised. That is to say, between 2006–2007 and 2010–2011 irrigators in the Southern Murray-Darling Basin (MDB) used on average 72% of their water received (Wheeler et al. 2014). Thus, the actual net increase in stream flows is substantially less than what is reported by the Australian Government.

(d) The *Guide to the Proposed Basin Plan* by the Murray-Darling Basin Authority (MDBA), released to a 'storm' of protest by irrigators (Miller 2011) in October 2010. These protests, in our view, resulted in the 2012 Basin Plan having a lower volumetric reduction in surface water diversions and an increase in permitted groundwater diversions than was recommended in the Guide. In other words, the 2,750 GL/year reduction in surface water diversions (along with proposals to reduce this volume in both the Northern and Southern Basin) represents a political compromise to ensure passage of the Basin Plan (Grafton 2017), rather than a volume that would meet the key goals of the *Water Act 2007*. We accept that democratically elected governments frequently need to make political compromises, but their decisions must still be consistent with the law of the land (namely, the Water Act 2007) and the justification for such political decisions should not be represented as a scientific justification when this is not the case.

(e) While the calculations to obtain the SDLs in the current Basin Plan are baffling, the groundwater SDLs appear to defy scientific logic. Namely, the BDL for groundwater is defined at 2,386 GL/year in the current Basin Plan (500 GL/year more than the BDL in the *Guide to the Proposed Basin Plan* of 2010 of 1,786 GL/year), yet the SDL for the Basin is 3,334 GL/year (1,733 GL/year *more* than the SDL recommended in the *Guide to the Proposed Basin Plan* of 2010 of 1,601 GL/year). This represents an increase in 40% at a Basin scale over the BDL and a more than 100% increase than the recommended SDL in the *Guide to the Proposed Basin Plan* of 2010. Importantly, CSIRO (2008) provided a case as to why groundwater extractions across the Basin should be reduced given the importance of groundwater – surface water interactions. The key point is that increases in permitted groundwater extractions (as per the SDLs) that results in higher groundwater extractions will, eventually, have a negative impact on the ecosystem services of the MDB. Consequently, in our view, the substantial increase in groundwater SDLs, in excess of current levels of groundwater extractions in the Basin Plan, puts at risk the achievement of the key objects of the *Water Act 2007*.

(f) Another issue of concern is the failure to include climate change in the determination of the SDLs in the current Basin Plan. This is because SDLs are based on the historical climate; contrary to what was planned for in the 2010 MDBA *Guide to the Proposed Basin Plan* (Pittock et al. 2015).

(g) The MDBA's (2011b) justification for the 2,750 GL/year reduction in surface water diversions is based on implicit (but not specified) assumptions and unproven projections about the management of environmental flows within the Basin. In particular, such modelling and projections of associated environmental impacts of streams flows are based on expectations about state water policies and practices that, in 2017, were shown to be grossly inadequate (Ombudsman NSW 2017). These policy assumptions cannot be falsified ex-ante and only calibrated and tested in practice. In other words, they can only be refuted ex-post if the reductions in surface water diversions fail to deliver the expected environmental benefits required by the *Water Act 2007*.

(h) The opaqueness of how the final determination of the SDLs were arrived at in the 2012 Basin Plan, led the Australian Senate inquiry into the 'Management of the Murray–Darling Basin' in March 2013 to recommend to the MDBA to provide a "concise and non-technical explanation of the hydrological modelling and assumptions used to develop the 2750 GL/y return of surface water to the environment, to be made publicly available." (Senate Rural and Regional Affairs and Transport References Committee 2013).

(i) The fundamental point we are making is that the scientific justification, and the basis for the 2,750 GL/year reductions in surface water diversions in the Basin Plan, is based on a 'black box' and on trust that the MDBA (and the states) have the capacity to overcome 'environmental constraints' and deliver water to achieve particular environmental objectives. This was a very big ask in November 2012 when the current Basin Plan was enacted, but in April 2018 it lacks scientific credibility when there is already substantial evidence that the projections from the 'black box' are not delivering what was promised and, thus, are currently failing to achieve the key objects of the *Water Act 2007* (see point 8).

(j) By contrast to the 2,750 GL/year calculation in the current Basin Plan, the MDBA's October 2010 *Guideline to the Proposed Basin Plan* can be assessed because its calculations are based on end-of-system flows that can be readily evaluated using existing hydrological models and data. Further, this work was subjected to scientific scrutiny and review by an international panel of experts.

5. Northern Basin Review. The MDBA's modelling of the SDLs, among other evidence, has been used to justify a 70 GL/year reduction in environmental water recovery in the Northern Basin as part of the Northern Basin Review.

(a) Our view is that this recommendation by the MDBA lacks scientific credibility when, according to the MDBA's own report in November 2017, between 49% and 75% of surface water diversions in the Northern Basin (MDBA 2017, p. 17) are not even metered. Equally disturbing is the statement by the Independent Review Panel convened by the MDBA that "…there remains only one water resource plan in place, and inadequate protection of in-stream environmental water." (MDBA 2017, p. 117).

(b) Evidence of the inability of the MDBA to adequately model flows in the Northern Basin is provided in a report released in March 2018 by the MDBA, notably after the 70 GL/year motion was disallowed in the Australian Senate. In this report, it is observed that "When flows fall below about 400-500 ML/d at Bourke, there is a divergence between the observed and Baseline model flow exceedance curves, indicating the model has difficulty predicting these flows." (MDBA 2018, p. 4). Importantly for delivery of the key objects of the *Water Act 2007*, this same MDBA report also observes, with respect to the Barwon-Darling, that: "The maximum dry spell between flow low [low flow] events is approximately doubled in length for many of the flow requirements described when comparing observed flows to the without development flow regime. In extreme cases, the maximum dry spell is greater than 10 times longer which is likely to place ecosystems under severe stress. Periods of low or no flow have increased for gauges downstream of Bourke post 2000 as compared to pre-2000." (MDBA 2018, p. 5).

(c) The magnitude and extent of floodplain harvesting and its impacts on declines in river flows is another of several large uncertainties in water accounting in the Murray-Darling Basin. There are very few measurements of floodplain harvesting in the Basin. We believe that the volume of water harvested has been grossly underestimated for many years. Without measurements, including evaporative losses from storages of harvested water, not only do the water balances of the Murray-Darling remain incomplete, but any policy of water allocation and recovery cannot be fully assessed in terms of its costs and benefits.

(d) Given the very large uncertainty in the water accounts arising from a failure to describe and quantify the magnitude of floodplain capture, we contend it is highly risky to adopt any reduction in environmental water recovery in the Northern Basin. Collectively, the evidence we have available to us leads us to a clear and definitive conclusion: there is no scientifically credible evidence to justify an increase in surface water diversions of 70 GL/year in the Northern Basin, as was recommended by the MDBA in the Northern Basin Review.

6. <u>The 36 Supply Measure Projects</u>. The supply measure projects are intended to substitute for 605 GL/year reductions in environmental water recovery that was included in the Basin Plan's 2,750 GL/year reductions in surface water diversions.

(a) As discussed in detail in point 9, critical to increasing net water availability and delivering on the key objects of the *Water Act 2007*, is an absolute need to have full and transparent water accounting in the Basin. Without such understanding it is simply not possible to know how supply projects will deliver, or not deliver, on the flows necessary to ensure the key objects of the *Water Act 2007*.

(b) Our view of the critical importance of full water accounting is supported by the MDBA's own Independent Review Panel which stated in November 2017: "Implementing SDLs requires effective water accounting. Achieving compliance with SDLs, protecting environmental flows and control of illegal take all require comprehensive water accounting supported by measurements, calculations, estimates and system modelling" MDBA (2017, p. 127). Such water accounting still does not exist despite the expenditure of many billions on water recovery and it has been more than five years since the enactment of the Basin Plan. The point we are making is simply: How can the MDBA recommend increases in surface water extractions (of 605 GL/year) in the absence of comprehensive water accounts and with black-box modelling that, to date, has

failed to deliver Basin-wide improvements in the riparian environment? This fails the basic minimum standards of scientific credibility.

(c) The onus should be on the MDBA and the Australian Government to scientifically prove that reducing an already inadequate reduction in surface water diversions of 2,750 GL/year (see points 4(a) to (f) above) by 22% will deliver on the key objects of the *Water Act 2007*. The evidence from the Northern Basin Review (see the MDBA's 2018 report and point 5 above) and the lack of evidence for environmental Basin-wide improvements (see point 8) shows that allowing these supply projects to substitute for environmental water recovery is a very high risk strategy. Indeed, we contend that the current evidence in April 2018 is such that these supply measure projects are more likely than not to move environmental outcomes in the Basin further away from environmentally sustainable levels of extraction, compared to decreasing surface water diversions by the same volume.

7. Recovery of 450 GL for Enhanced Environmental Outcomes. The 450 GL/year of enhanced environmental outcomes was a political compromise to ensure South Australia agreed to the Basin Plan.

(a) The stated purpose of these projects is to provide additional environmental benefits over and above those provided with the 2,750 GL/year reduction in surface water diversions. To the extent these projects do 'no harm' and leave unaffected planned reductions of 2,750 GL/year in surface water diversions, and do not contribute to increased water consumption, then they should be, at worst, neutral in delivery of the key objects of the *Water Act 2007*. This is in direct contrast to the 70 GL/year reduction in environmental water recovery in the Northern Basin Review and the 605 GL/year reduction in the proposed SDL Adjustment Mechanism. Both of these proposed reductions (70 GL/year and 605 GL/year), that have been recommended by the MDBA, we believe would have an overall negative impact on the delivery of the key objects of the *Water Act 2007*, compared to the reduction in surface water diversions of equivalent volumes.

(b) It should go without saying that any initiative or action as part of the current Basin Plan should do 'no harm' and also should, at the very least, improve ecological outcomes. Equally as important, could more be achieved for the $1.77 billion budget? The answer is an unequivocal YES. This means that the planned expenditure of funds for enhanced environmental outcomes is not cost effective, nor does it represent value for money. Details as to why this is the case are provided in point 9. The short explanation is that even under the very best case scenario (which requires the bold assumption that the enhanced environmental outcomes are equivalent to an extra 450 GL/year in environmental water recovery) the cost of enhanced environmental outcomes is some $3,933/ML. By comparison, the cost to directly acquire some 1,230 GL of water entitlements for the environment from willing sellers was $2,026/ML (Grafton and Wheeler 2018, Table 2).

(c) Our calculations show that, if instead of employing these measures, it would be possible to acquire an additional 320 GL/year or increase the environmental 'pay off' by some 80% via direct purchases of water entitlements. In sum, Australian taxpayers would be much better served in terms of environmental outcomes for the same costs, or could achieve the same projected environmental outcomes equivalent to 450 GL/year at a much lower cost, if the direct purchase of water entitlements from willing sellers was the method employed.

8. Environmental and Ecological Health of the Basin. There is substantial evidence that the current Basin Plan is failing to deliver on the key objects of the *Water Act 2007*.

(a) Evidence of lack of progress, to date, in terms of environmental benefits in the Basin is provided by the Australian State of the Environment (SOE) Report that was published in March 2017 (Argent 2017), and which includes a specific report on Inland Water. Its findings on the MDB are for the period since 2011 and provide an assessment grade of *very poor and deteriorating* for the

'state and trends of inland water ecological processes and key species populations'. The SOE Report further observes that there is "widespread loss of ecosystem function" in the Basin. The SOE Report also notes that, in terms of the 'state and trends of inland water flows and levels' in the MDB there has been no Basin-wide improvement since 2011 and that "Longer-term downwards trends in flows seen in nearly 50% of stations, with no change in trends evident since 2011 (Argent 2017, p. 36)."

(b) The most recent dredging to keep the Murray Mouth open recommenced in January 2017 due to low flows. Yet one of the goals of the 2012 Basin Plan was to ensure there would be no dredging in 95% of years. Importantly, the simple correlation between South Australian environmental flow releases and barrage flows is only r = 0.06 (Grafton and Wheeler 2018). This finding should be of major concern to those who care about the state of the environment in the Basin because it suggests that the current Basin Plan will fail to deliver adequate flows at the Murray Mouth in periods of drought.

(c) While we accept that the full set of environmental benefits cannot be delivered by 2018, it is also true that substantial water recovery began a decade ago and delivery on the 2,750 GL/year SDL target is just over one year away.

(d) In November 2017, the Wentworth Group provided similar conclusions to the State of the Environment Report (Wentworth Group 2017). It observed that there is no evidence to date to demonstrate Basin-wide improvements or that long-term deterioration in key river conditions has stopped.

(e) CSIRO (2011) concluded that an increase in environmental flows of 3,000 GL would be *insufficient* to meet the South Australian environmental water requirements or to meet the salt export requirements specified by the MDBA.

(f) A Goyder Institute Report in 2012 also noted that "While the Draft Basin Plan would bring some benefits to the South Australian environmental assets of the River Murray, few of the EWRs [environmental water requirements] required to maintain the ecological character of the region are met" (Lamontagne et al. 2012, p. 27).

(g) Further details as to what volumes, on average, are required to deliver on the *Water Act 2007* are provided in a report we co-authored, with others, in 2010 (Wentworth Group 2010). This report states: "To achieve a level of two-thirds natural flow in all the catchments of the Basin the environment's share of the existing Cap on diversions would need to be increased by approximately 4,400GL". Importantly, this same report (Wentworth Group 2010) details how this volume of water could have been recovered with full compensation to irrigators and with billions to spare to assist Basin communities with their development given the money that was available at the time under *A National Plan for Water Security*. This report was also followed up with an explicit statement by the Wentworth Group in October 2012 about the volumes required to deliver on the key objects of the *Water Act 2007*. Namely, "…that the 3,200 Gl …still falls well short of satisfying the requirements of the Commonwealth *Water Act 2007* to deliver a healthy working Murray-Darling Basin." (Wentworth Group 2012, p. 4).

(h) We further observe that, based on recent measures, the state of the Coorong, Lower Lakes and Murray Mouth is currently deteriorating, not improving. This should be of major concern because it is said that a river 'dies from its mouth'. For instance, in 2017, of the 40 species of waterbirds used to provide a Whole of Icon Site Score (WOISS) in the Coorong, 23 species were below their long-term (2000–2015) median abundances (Paton et al. 2017). While a single year's abundance is not indicative of a trend, nor do we claim such a trend, it is nevertheless alarming that the expected water recovery following the end of the Millennium Drought in 2010, and from water recovery has, so far, failed to deliver on the key targets in the Condition Monitoring Plan for this icon site. More generally, Kingsford et al. (2017) identify, based on large temporal and spatial scale analyses, that there is "…severe long-term ecological impact of water resource development on prominent freshwater animals, …" within the MDB.

(i) Additional published evidence about the state of the environment in the Basin, and that is linked to the SDL target, is provided by Thompson et al. (2017). They highlight legacy impacts that are likely to have a deleterious effect on the Basin environment, and that negatively affect ecological responses. The key finding we take from this research is that, in response to legacy effects, there is an even greater requirement for environmental flows at a Basin scale so as to allow ecosystems to recover to an acceptable (as per the *Water Act 2007*) condition.

9. Water Recovery to Date. Water recovery refers to the acquisition of water entitlements for environmental purposes, be it by direct buybacks of water entitlements from willing sellers or expenditures to upgrade on- or off-farm irrigation infrastructure. Water recovery is not directly part of the Basin Plan, but provides the financial resources and complementary actions to reduce diversions by irrigators to ensure the SDL target is reached by 1 July 2019.
   (a) To date, the direct purchase of water entitlements from willing sellers has allowed the Commonwealth Environmental Water Holder to accumulate some 1,230 GL of water for environmental purposes. This has been at a total cost of some $2.5 billion and at a cost per ML of a little over $2,000. By comparison, subsidies to increase on-farm and off-farm irrigation efficiency have, to date, cost some $3.5 billion and resulted in the acquisition of some 700 GL of water entitlements for the environment at a cost per ML of some $5,000 (Grafton and Wheeler 2018). This more-than-twice cost differential per ML between subsidies for irrigation infrastructure and direct purchases of water entitlements was publicly identified as early as April 2007, shortly after *A National Plan for Water Security* was announced by Prime Minister Howard. It has also been consistently highlighted in the peer reviewed literature (see Grafton 2010; Grafton and Wheeler 2018) ever since and three federal Water Ministers were briefed, face-to-face, about this large cost differential.
   (b) The key point is that by choosing to spend almost twice the money in total on subsidies (and 2.5 times more per ML of water acquired) for on- and off-farm irrigation water infrastructure upgrades, the Australian Government has increased the budgeted costs to deliver on the Basin Plan by several billion dollars. Indeed, on the basis of the MDBA's own assumptions, the 2,750 GL/year reduction in surface water diversions could already have been achieved for approximately $500 million less than what has already been spent on water recovery, and for some $3 billion less than what is included in projected expenditures.
   (c) A justification provided for directing more money to subsidies for on- and off-farm irrigation infrastructure upgrades is that direct purchases of water entitlements will result in unused or stranded irrigation assets. In fact, Wheeler and Cheesman (2013) found that 94% are partial entitlement sellers (in an irrigation district) and 83% of those who sold all their water entitlements kept their delivery rights. Further, Kirby et al. (2014, Table 1, p. 157) compared actual farm outcomes in the MDB from 2000–2001 to 2007–2008 and found that the real adjusted gross value of irrigated production fell by just 10%, despite a 70% decline in irrigated surface-water use. This, and many other reviews in the academic published literature, show that there is no direct linear relationship between selling irrigation water and decreased agricultural production and/or value. Indeed, the direct purchase of water entitlements to the government by willing sellers has been shown to *increase*, rather than decrease, the gross domestic product in the Basin (Wittwer and Dixon 2013).
   (d) The cost calculations provided in 9(a) and (b) are the best case scenario as they are premised on the Australian Government assumption that all the water entitlements acquired by direct purchase or through subsidies increase environmental flows by their long-term average annual yield (LTAAY). This assumption is incorrect. As already mentioned in point 4(b), on average, irrigators in the Southern MDB used just 72% of the water they receive (Wheeler et al. 2014). Thus, using the LTAAY for water entitlements held by the Commonwealth Environmental Water Holder overstates the net environmental benefit because, on average, some 28% of the water

allocated to these entitlements remained undiverted and potentially available for environmental flows. In other words, the actual increase in environmental flows associated with water recovery is, on average, 28% less than what is claimed by the Australian Government.

(e) The other critical issue in relation to water recovery and the volumes of water available for the environment relates to 'recoverable return flows' (Perry et al. 2009). These are surface flows to streams and rivers and to aquifers that irrigators view as water 'losses' in that they do not contribute to the growing of crops on their fields. But such 'losses' are volumes of water that are reused downstream and/or provide increased stream flows or recharge aquifers, have value and should be accounted for in what happens to stream flows as a result of water recovery. These return flows can be large. Jägermehr et al. (2015) estimate that return flows on a worldwide basis comprise about half of all irrigation diversions and that, if water diversions were to remain unchanged: a shift from surface to sprinkler irrigation would reduce return flows by 30%, a shift from sprinkler to drip irrigation would reduce return flows by 60%, and a shift from surface to drip irrigation would reduce return flows by about 75%. The relevance of return flows to water recovery is that, at the very least, wherever return flows represent a substantial proportion of water losses, subsidies for irrigation upgrades may, in fact, *reduce* stream flows (Qureshi et al. 2010).

(f) As of April 2018, there are no comprehensive estimates of the effects on return flows from the direct purchase of water entitlements or subsidies for on- and off-farm irrigation water infrastructure upgrades. The only measures of which we are aware that are available from the MDBA are in a consultant's report for 1993–94 and 2008–09, but these are available only for some irrigation systems and provide for just the end-of-system or channel drains. These estimates do not include groundwater recharge or diffuse return flows.

(g) Importantly, as far as we are aware, there has been no publicly released cost–benefit analysis to justify the expenditures of billions for irrigation infrastructure.

(h) In the absence of Australian Government data on return flows, we have resorted to our own estimates of the possible effects on environmental flows. To do so we specified: (i) the proportion of water entitlements provided by irrigators to the Australian Government for the subsidies received; and (ii) the ratio of non-beneficial water consumption (such as evaporation) and also flows to sinks that, when combined, we identify as water savings, to the total water losses that we define as the sum of water savings and recoverable return flows (that would have returned to the environment and be available for reuse).

(i) Using published water balances for irrigation in Australia (Roth et al. 2013), and assuming irrigators provide 50% of the water losses in the form of water entitlements (this is what is the norm in the current on-farm efficiency subsidy programs), we estimate that the net change in the water available to the environment for $3.5 billion expenditures on irrigation infrastructure (on- and off-farm) is between negative 140 GL/year and zero. If our estimates are correct, this means that, even in our best case, the reported increases in environmental water due to subsidies are not 700 GL/year, but zero. That is to say, we estimate that $3.5 billion have been spent irrigation water infrastructure upgrades for water recovery that have generated for no apparent public good and have failed to help achieve the key objects of the *Water Act 2007*.

(j) Combining our estimate of the net effect of subsidies for irrigation infrastructure with the fact that environmental water recovery has been overestimated by, on average, 28%, we calculate that the *net* actual increases in Basin-wide environmental flows vary between 649 GL/year and 789 GL/year. This is in sharp contrast to the 2,108 GL/year estimated by the Australian Government. Our estimate does not include likely reductions in surface flows that will eventually arise with increases in groundwater diversions as a result of a Basin-wide groundwater SDL that exceeds current groundwater extractions. Until and unless there is a comprehensive and independent audit to provide a full before-and-after water accounting of the effects of water

recovery, it is not possible to have a more precise estimate of the net effect on stream flows in the Basin as a result of water recovery.

(k) A likely explanation as to why the Australian Government is prepared to spend billions of dollars on water infrastructure upgrades, both on and off farm, for no apparent public benefit is a network of informal alliances between politicians, bureaucracies and irrigator-sector organisations. These drivers are not unique to Australia (Huppert 2013). Such alliances for mutual benefit are contrary to the public good and the process of good decision making. It would seem that irrigator-sector organisations collaborate to prevent reform that is perceived to be contrary to the interests of irrigators, and to maximise irrigation-sector benefits (Marshall and Alexandra 2016).

10. Views of Indigenous People. We believe the First Peoples of Australia need to respond directly to the request by the Royal Commission about the water reform process in the MDB. Nevertheless, we wish to highlight the observation made by the National Water Commission, in a 2014 report (see National Water Commission 2014, p. 114), that there has been no material increase in water allocation for First Peoples over the decade 2004–2014. This is still true in April 2018. In our view, water resource plans that truly have regard to the views of First Peoples must have some allocation process that meaningfully engages with First Peoples. We find it hard to imagine how real engagement could not result in a change in the volumes of water that First Peoples either control or can direct towards the achievement of their cultural benefits, and according to their values, within water resource plans.

11. Illegal Take. The various police investigations and the ICAC Inquiry should identify criminal wrongdoing.
    (a) We believe what should be a focus for the Royal Commission is the 'culture' within the Australian and state public services that contributes to 'sins of omission', that is, the ignoring or failing to follow up on inconvenient truths. Dr James Horne PSM, the former Deputy Secretary of the Australian Department of Sustainability, Environment, Water, Population and Communities between 2007 and 2011, and who was responsible for the department's portfolio of water responsibility, is insightful on this issue. In an opinion piece published on 15 December 2017 (Horne 2017), and with which we concur, he states: "For more than a decade, federal and state governments have expressed their commitment to good compliance, the enforcement of water plans, and the importance of strongly supporting fairness to all water users, including the environment. Yet this seems to have been accompanied by a persistent lack of political commitment, and a culture where water theft and compliance with licence conditions have been optional." He goes on to state, and again we concur: "If a water licence holder wants to use water, they should be required to operate a tamper-proof meter of a specified standard. The policy should be 'no working meter, no water'".
    (b) While Dr Horne focuses on the political commitment, or rather lack of it in terms of water metering and compliance, we ask the Royal Commission to pose questions about the actions of senior public servants (that is those in the Senior Executive Service in the Australian Public Service and the equivalent in the public service in the relevant states). Namely: What did senior public servants know about accusations or other evidence (such as satellite imagery or hydrological modelling) of illegal take? And when were such accusations or evidence made known to them? And what did they do in response (prior and after the *Four Corners* program) to these accusations? To be clear, we are not accusing public servants of criminal activity, but that there is an appearance of a culture of 'looking the other way' in relation to illegal take, and possibly other activities contrary to the public interest, that requires a thorough investigation.
    (c) The culture we refer to in 11(b) is described, in relation to water compliance in New South Wales, by Ken Matthews AO, (founding Chair and Chief Executive of the National Water

Commission and previously the Secretary of two Australian Government departments), as follows: "My interviews with members of staff involved in water management suggested a culture of tolerance for expedient work practices in the interests of "outcomes", but at the expense of due and proper process. I saw examples of possible failures to confront unethical behaviour. I heard public servants clearly deficient in their understanding of the Westminster conventions. I observed a group culture diverging from the best traditions of Australian public administration." (Matthews 2017, p. 6). Such a public service culture, be it at the state or federal level, is contrary to the national interest and hinders the achievement of the key objects of the *Water Act 2007*. In our view, the culture at a federal level, in the context of water governance in the Basin, warrants investigation be it for no other reason than to restore public trust in these institutions as more and more is revealed that the current Basin Plan is not delivering on what has been claimed for it by senior public servants. Importantly, should it be found that senior public servants have not acted according to Westminster conventions, then they should be held accountable.

(d) More broadly than the question of illegal take is that senior public servants appear to be 'missing in action' with respect to a whole series of issues which has prompted the Royal Commission. This leads to a series of questions such as: Was there ever a cost–benefit analysis undertaken in relation to the billions of dollars in planned expenditures on subsidies for irrigation infrastructure? If it exists, why was it never made public? If it does not exist, how is it possible to spend billions of taxpayer dollars without a Basin economic evaluation as to its estimated costs and benefits? Further, how is it possible for the Prime Minister of Australia to make a commitment of some half a billion dollars to water metering and monitoring ($125 million to upgrade bulk offtakes; $225 million to upgrade farm offtakes to meet national metering standards; $200 million in telemetry and data systems to allow remote reading of meters and real-time data for better monitoring of flow-based water extractions; and $50 million to cover half the cost of introducing metering for stock and domestic users) yet more than 11 years later, with billions spent on water reform and water recovery, up to 75% of surface extractions in 2018 in the Northern Basin are unmetered?

(e) Funds were made available and provided to deal with a water crisis in the Basin in 2007, yet there has been an obvious failure in delivery over the past 11 years. Water Ministers and senior public servants must be held accountable for these failures. To be clear, this is a failure to ensure delivery of agreed-to actions publicly announced by an Australian Prime Minister. In January 2007 there was political leadership and a willingness to act such that in *A National Plan for Water Security*, released by Prime Minister Howard on 25 January 2007, it is stated (and with which we concur): "As water becomes more scarce and subject to greater demands, it is imperative that we can accurately measure and monitor the resource and its use. This applies equally at the national and basin scales, as well as for individual farms." (Howard 2007). Importantly, *A National Plan for Water Security* also specified: "To participate in the delivery system efficiency upgrade programme, irrigation water providers will be required to develop a system modernisation plan for their scheme and to monitor and evaluate implementation activities to ensure actual water savings are achieved".

(f) Despite the leadership demonstrated by Prime Minister Howard in 2007 in relation to the Basin, the ABC *Four Corners* program (aired in July 2017) featured accusations by irrigators that along the Barwon River on-farm levees have been constructed to trap stream flows so as to illegally increase the offtake of those who constructed the levees. The accusation is that, at least in part, the levees were constructed with funds that came from the Australian Government (either directly or indirectly via the relevant state) with the intent to increase irrigation efficiency. Again, questions must be asked of senior public servants. How did the half a billion dollars allocated in *A National Plan for Water Security* for water metering and monitoring actually get spent? What are the measured return flows for subsidising on- and off-farm irrigation upgrades? And what

metering was put in place, and also checks and controls, for those irrigators who received Australian Government payments (directly or indirectly) for on-farm irrigation water infrastructure upgrades, noting that such metering and controls were an explicit requirement in *A National Plan for Water Security*? See point 11(e).

12. Irrigated Crops. Much attention has been directed to crops that consume, on average, more water per hectare (such as rice which has a water application rate, on average, in Australia of about 12.1 ML/hectare) than other crops (such as grapevines which have a water application rate, on average, in Australia of about 4.1 ML/hectare). The more pertinent question is, how much water is applied to each crop during periods of high inflows and during periods of drought? And, what is the net diversion (water application less return flows) for each crop? And where does this occur? Thus, while rice production may have the highest water application rate in terms of gross diversions, it is likely to also have one of the highest return flows back to groundwater and streams. Consideration of these return flows, along with water applications, is critical in making an assessment as to whether one crop, or another, is relatively more or less beneficial on the environment than another.
    (a) In the western US, irrigators' water rights are in the form of net diversions while in the MDB they are in the form of gross diversions. Thus, Australian (but not American) irrigators do not have a private incentive to manage or care about return flows yet it is crucial to determining downstream effects of irrigation.
    (b) Some irrigated crops (such as cotton and rice) are seasonal and are only planted when the expected cost of water applications ensure a positive expected net return. Thus, in severe droughts when water prices are very high, there is very little rice or cotton grown in the Basin. This has a stabilising effect on water prices and water availability as water that might have been used for these crops becomes available for perennials, such as almond or fruit trees, that not only need water to produce a crop, but often require water to ensure the trees do not die during a drought. Further, this minimum watering requirement of such perennials reduces the resilience of these farming systems to cope with severe droughts.
    (c) The $3.5 billion subsidies to upgrade on- and off-farm irrigation water infrastructure provided by the Australian Government means that for every dollar spent on water application more water can be consumed by the irrigated crop. The adoption of and the precision and control of drip irrigation supported by these subsidies makes the irrigation of high valued crops per dollar of water applied (such as almonds) relatively more attractive to plant and grow. In turn, this has supported the rapid growth in almond plantings in recent years. The issue is that as more of the water available for irrigation is diverted for perennials, the greater will be the demand for water in a drought which will mean higher water prices.
    (d) There is also a possible market failure that should be investigated. Namely, how does a switch to greater plantings of perennials, such as almonds, in the Basin change the return flows from farmers' fields? This study should be part of much broader accounting of the water balances in the Basin, and that would include water applications, water consumption (transpiration and evaporation) and return flows (point and diffuse surface flows and groundwater recharge) by catchment, crop and method of irrigation. Without such water accounting, water managers are 'flying blind' and will not know what are the impacts of water recovery or, indeed, any other changes that affect how water is diverted and consumed in the Basin.

13. Murray-Darling Declaration. Given the billions of taxpayer dollars spent to date, and to no apparent public good, the approximate $2 billion yet to be spent upgrading on- and off-farm irrigation infrastructure cannot be justified on either environmental or economic grounds. It is for this reason that we, along with 10 other economists and scientists, came together to release the Murray-Darling Declaration (see https://murraydeclaration.org/).

(a) We have called for the halt to all further expenditures directed towards on- or off-farm irrigation infrastructure until there has been an independent and comprehensive audit of the effects of water recovery in terms of the delivery of the key objects of the *Water Act 2007*.
(b) We highlight that the Murray-Darling Declaration is consistent with the Inquiry of the Australian House of Representatives Standing Committee on Agriculture and Water Resources that reported its findings in December 2017. The Standing Committee has, as part of its **Recommendation One**, the need to undertake "…baseline measuring of regional ground or surface water systems at the commencement of each program, and then ongoing measuring to determine impacts of changed water practices resulting from WUE [water-use efficiency] funded projects," and in **Recommendation Two**: "…that the Auditor-General consider conducting a performance audit of Australian Government funded water use efficiency programs to assess the design process, evaluation arrangements, and effective and efficient administration of these programs. The Committee recommends that the audit take place in 2018."

14. Summary. Our key findings and submission to the Royal Commission are as follows:
(a) Under the current Basin Plan, the Basin-wide SDL of 10,873 GL/year is virtually the same as the average long-term watercourse diversions by irrigators of 10,942 GL/year. Yet it is the high level of extractions by irrigators that are the key contributor to environmental degradation in the Basin (Davies et al. 2010, 2012; Grafton et al. 2013; Williams 2017), and why the *Water Act 2007* was legislated.
(b) We contend that the target reduction of 2,750 GL/year in surface water extractions is well below the reduction in diversions needed to meet the key objects of the *Water Act 2007*. Further, this reduction is much less than the minimum mean reduction in Basin surface water diversions of 3,856 million GL/year estimated by the MDBA in 2010, and that would have a high uncertainty of delivering on the required environmental outcomes.
(c) The basis for the 2,750 GL/year reduction in surface water diversions in the Basin Plan has not been scientifically justified. Neither has the recommendation of 70 GL/year increase in surface water diversions in the Northern Basin as part of the Northern Basin Review, nor the 605 GL/year increase in surface water diversions with the proposed SDL Adjustment Mechanism. Such increases in diversions can only be scientifically justified if there is in place comprehensive water accounting that measures changes in the water balance, including return flows. These two amendments to the Basin Plan seriously diminish the likelihood that the key objects of the *Water Act 2007* will be achieved.
(d) On our best estimates, and in the best case, the public good of spending $3.5 billion to subsidise on- and off-farm water irrigation upgrades is zero, after accounting for the reduction in recoverable return flows. We are disturbed that such expenditures could be made in the absence of a publicly available cost–benefit analysis or even a system of measuring or properly estimating the effects on diffuse return flows associated with irrigation infrastructure upgrades.
(e) Given that billions of dollars were made available in 2007 in *A National Plan for Water Security*, including half a billion dollars for water metering and monitoring, we cannot understand why so little has been achieved in terms of Basin-scale environmental improvements and water accounting. This requires thorough investigation and questions need to be asked of senior public servants as to how this has come about.
(f) As a result of 'double-counting' of the environmental water recovered from water entitlements held by the Commonwealth Environmental Water Holder, and the reduction in recoverable return flows associated with subsidies for irrigation infrastructure, we estimate the actual increase in environmental flows as a result of water recovery to date could be 1,460 GL/year to 1,319 GL/year, LESS than the 2,108 GL/year claimed by the Australian Government. In other words, on our best estimates, the actual water recovered for the environment could be as little as 31% of what is claimed by the Australian Government. Should groundwater diversions increase

to the maximum possible SDL under the current Basin Plan, there would be an even smaller volume of water available for environmental purposes. In our view, until robust water accounting and quantitative hydrological analysis is put in place, there is a very high level of uncertainty as to how much water (net of effects on return flows, unmeasured water extractions, groundwater–surface water interactions, etc.) has, in fact, been made available to improve the environmental health of the Basin.

(g) Based on the scientific evidence we have provided in this submission (please see cited references), we contend that the current Basin Plan, even if it were to be delivered "on time and in full", will *not* achieve the key objects of the *Water Act 2007*. Thus, the current Basin Plan will fail in its primary purpose.

(h) If something is not working then it needs to change. Ignoring the problems, or claiming problems do not exist (as have some politicians and senior public servants) when there is easily accessible evidence to show otherwise (and which has been directly provided to them), is not acting in the public interest. Nor will it deliver on the key objects of the *Water Act 2007*.

(i) A first key step for the Basin and its communities is to *not* spend further billions subsidising on- and off-farm water infrastructure upgrades that appear to provide no public good.

(j) A second key step is to complete an independent and comprehensive audit as to what the Basin Plan, and water recovery, have accomplished. Based on this independent and comprehensive audit that must include a proper accounting of expenditures, outcomes and the water balance, Australia can then plot a path forward that truly delivers on the key objects of the *Water Act 2007*.

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