FINAL REVIEW REPORT FOR THE MURRAY-DARLING BASIN AUTHORITY (MDBA)

AN INDEPENDENT REVIEW OF THE SOUTHERN BASIN COMMUNITY MODELLING APPROACH



Contract: MD003930, Variations 1 & 2

11 July 2018

Prepared by Dr Boyd Blackwell, Dr Jim McFarlane & Dr Nam Hoang





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Figure front page: Red cliffs at Murtho on the River Murray, South Australia (Source: MDBA, 2017, Lower Murray. MDBA, Canberra. Accessed 18 June 2017 from http://www.mdba.gov.au/discoverbasin/catchments/lower-murray, Photo by Nolani McColl, 2013)

A suitable reference for this report is:

Blackwell, B., McFarlane, J. & Hoang, N. (2018). Final Review Report For the Murray-Darling Basin Authority (MDBA): An Independent Review of the Southern Basin Community Modelling Approach MD003930 Variation 1 & 2, 11 July 2018. Armidale: University of New England.



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1. Executive Summary

Introduction and Overview

This report provides an review of the social and economic modelling to be undertaken by the MDBA of the impacts of water recovery on the communities of the Southern Murray-Darling Basin (see Figure 1 in Introduction).

Strategically, the MDBA have engaged our services to not only review their modelling but also to help improve it in a critically yet constructive way. We have therefore been engaged early by being part of three workshops to witness, and contribute where necessary to the discussions on the design of the modelling approach being prepared for the Southern Basin. Our suggestions have been willingly embraced by the MDBA, particularly those from the Northern Basin that could not be practically and immediately implemented for the Northern Basin Communities but will no doubt be implemented over time. This report on the Southern Basin community modelling therefore builds on our previous review work for the MDBA on the impacts of water recovery for communities of the Northern Basin.¹

In this report in section 2 we provide an introduction to our review, briefly update the literature review undertaken in our Northern Basin review in section 3, and present the findings from some preliminary analysis of the census employment data for worker mobility in a few selected Southern Basin Communities in section 4. This was one of our recommendations flowing from our review of the Northern Basin modelling.

Literature Review Update

The recommendations from our previous report were addressed by the MDBA and continue to be relevant for this review. New findings include the following, more details of which can be found in the body of this report:

Updated Literature Review Implication 1 (ULRI1): Recent Australian research suggests that the MDBA should consider how it is addressing epistemic and stochastic uncertainty in its modelling and in particular, the attention given to quantifying, reducing and communicating uncertainties inherent in the modelling of water resources.

ULRI2: Recent international research on modelling the impacts from water recovery in the Murrumbidgee catchment has shown that worker mobility is critical for local economies and communities to successfully adapt to water recovery. This research found paradoxically that while agricultural output and employment may decline from water recovery, unemployment in total declined and mean household incomes rose because of outmigration of people from the basin to be employed in expanding non-agricultural sectors of a diversified economy. This finding reinforces the need to consider (i) worker mobility and (ii) the absorption capacity of the non-agricultural sectors so as to accurately model the impacts for basin communities.

ULRI3: Recent Australian research found that irrigators tended to exit during non-drought (less depressed property prices rather than drought periods because of lagged water scarcity, while poorer performing farms (lower returns and higher debt) had exit intentions during drought rather than non-drought times. Age was the strongest predictor of farm exit intentions, particularly during drought times. These irrigator exit findings may be important in interpreting the out-migration result from ULRI2 and reinforce the need to take account of farm (returns and debt levels where it is possible to do so) and community adaptability (including worker mobility) to dissipate the impacts of water recovery.

ULRI4: While there is naturally a strong focus in the current modelling to account for worker mobility to better account for the impacts from water recovery, accounting for internal migration (movement of people within Australia) may also be important to the MDBA's modelling and should be given some consideration.

¹ Blackwell, Boyd, McFarlane, Jim, & Stayner, Richard. (2016). An Independent Review of the Social and Economic Inputs to the Northern Basin Review: Final Report. Armidale: University of New England. Retrieved from

https://www.mdba.gov.au/sites/default/files/pubs/NB-social-economic-modelling-review%28UNE%29.pdf; Blackwell, Boyd, McFarlane, Jim, & Stayner, Richard. (2016). Independent Review of MDBA Dirranbandi (& Hebel) and St George Socio-Economic Modelling for the Northern Basin: Final Report 23 June 2016. Armidale: University of New England.

URLI5:2 Are the private benefits captured from water recovery (e.g. through irrigation efficiency)³ likely to translate into positive community employment impacts and if so, to what extent?

URLI6: If less water is being returned to stream flows (as identified by Quentin and Wheeler (2018)), then the modelling impacts of water recovery may be more adverse for some locations than current modelling indicates – if so, to what extent are impacts underestimated?

URLI7: To what extent do URL15 and URL16 offset each other and with what net effect?

ULRI8: MDBA should address the issue raised by Wheeler et al. (2018) ⁴ about investment in health and education providing 2-3 more permanent jobs (Whitwer and Dixon 2013) than spending on irrigation infrastructure.⁵

ULRI9: For completeness MDBA and KPMG should specifically address the issue raised by Wheeler et al. (2018) as to why they did not employ CGE modelling in their Northern and Southern Basin reviews.

ULRI10: The modelling being conducted for the Southern Basin should address the need raised by Wheeler et al. (2018) to model production revenue rather than output and how production revenue does not change proportionately with a change in water availability.

ULRI11: The long-term influences on irrigated farm production (increasing urbanization, temperatures, changing commodity prices, terms of trade and technology) should be considered in the Southern Basin modelling given the claim by Wheeler et al. (2018) that these were not included in the Northern Basin review.

ULRI12: MDBA, KPMG should address in their modelling the issue raised by Wheeler et al. (2018) of the paradox of irrigation efficiency and the rebound effect? (Relates to ULR5&7).

ULRI13: MDBA & KPMG should address the issue of sample selection bias in their modelling of Southern Basin communities, as raised by Wheeler et al. (2018) for the Northern Basin modelling. Related is the inclusion of impacts on nearby areas through spatial modelling to increase number of areas modelled and accounting for areas downstream that would potentially benefit from increased environmental diversions.

ULRI14: Given Wheeler et al. (2018) criticisms of the reports for the Northern Basin modelling, MDBA and KPMG should ensure that they undertake appropriate tests for: endogeneity, collinearity, heteroskedascity and serial correlation or other relevant statistical tests appropriate to the Southern Basin modelling. It is also suggested to make explicit comment on the small size of the samples used and how these could be increased to increase statistical power (e.g. through use of all SLAs in Southern Basin instead of selected condensed groupings which reduces the sample size).

ULRI15: MDBA and KPMG should ensure that the referencing in their reports is excellent to ensure that data sources and the documents themselves can be reviewed. This is required because Wheeler et al. (2018) argue that inadequate documentation would appear to result in an upward bias in the estimates of economic losses associated with water recovery for the Northern Basin review.⁶

ULRI16: MDBA and KPMG should note that the statement made by Wheeler et al. (2018) as to Blackwell et al. (2016) not highlighting the 'reflows issue' is inaccurate because we did identify the reflows issue under LI#15&16 in Table 1.

Analysis of Worker Mobility in Selected Localities

The key recommendations and findings from the analysis of worker mobility were:

https://mdbrcsa.govcms.gov.au/sites/g/files/net3846/f/mdbrc-submission-professor-sarah-wheeler-sa.pdf?v=1527826747 ⁵ Wittwer, G., Dixon, J., 2013. Effective use of public funding in the Murray-Darling Basin: a comparison of buybacks and infrastructure upgrades. Australian Journal of Agricultural and Resource Economics 57, 399-421. doi:10.1111/1467-8489.12001.



² New literature review items sine the initial draft report from this item onwards.

 ³ As identified by Grafton, Q., Wheeler, S.A., (2018). Economics of Water Recovery in the Murray-Darling Basin, Australia. Annual Review of Resource Economics 10, 3.1-3.24. <u>https://www.annualreviews.org/doi/pdf/10.1146/annurev-resource-100517-023039</u>
 ⁴ Wheeler, S., Connor, J., Grafton, Q., Crase, L., Quiggin, J., 2018. Submission to the Murray-Darling Basin's Royal Commission, in: Murray-Darling Basin Royal Commission (Ed.), Adelaide. 23 June 2018

Worker Mobility Recommendation 1 (WMR1): To overcome the inherent limitations in the ABS data such as mismatch of UCLs with LGAs, discussions directly with relevant ABS offices may mean that data based on adaptable polygons may need to be derived.⁷ To address the problem of unstated place of work or undefined place of work, the data will need to be 'Razzed' in accord with standard input-output economic modelling approaches. Alternatively, interpolating from the LGA data can be used to make adjustment.

WMR2: Given the worker mobility analysis in this report using ABS data, we recommend that worker mobility be taken into account to not skew the results of impacts for employment. Taking account of income coming in from surrounding areas (i.e. outgoing workers), that helps build resilience in the local economy, and income leaking from the local economy to the surrounding areas (i.e. incoming workers), that while initially seen as a vulnerability for the local economy, will in fact reduce the loss of local jobs to the local community, are both important to accurately assessing the impacts on communities.

WMR3: We recommend that UCL employment not be used as representative of either the magnitude or industrial composition of employment in the associated or encompassing LGAs – an alternative approach should be developed. Splitting local economies between their UCL and remaining LGA components to better capture the 'rural economy' of these LGAs is immediately problematic, because such an approach, using TableBuilder, can only capture outgoing employment, not incoming employment and refer to our recommendations in WMR1.

Worker Mobility Finding 1 (WMF1): Overall, in the selected locations between 2006 and 2011, there is a general shift from people working locally to people working outside a given LGA, though these findings are case specific (e.g. Griffith).

WMF2: Overall, in most of the selected LGAs, incoming workers were in decline between 2006 and 2011, but this finding is case specific.

WMR4: Outgoing and incoming worker mobility when considered together and across time periods can provide an indication of the health of employment conditions by measuring and distinguishing between local employment and incoming and outgoing employment for the rest of NSW and Australia.

WMR5: On the issue of supposed 'small numbers' for mobility between LGAs – it is the relative value and not the absolute value of these numbers that is important because this will determine the impact for any given community. This is why we have presented these employment mobility data in the body of our report as a percentage of local employment. We recommend a similar approach for the MDBA.

WMR6: ⁸ KPMG and MDBA should detail the steps they took and their findings from their worker mobility research to provide evidence for their decision not to incorporate it in their modelling.

More detail on these findings and recommendations, including the evidence for our reasoning, are provided in the main body of this report.

Final Review

The final review included two components:

- Review of KPMG's draft report and
- Review of MDBA's dairy production model for the Goulburn Murray Irrigation District

Firstly, the most substantive points we make for KPMG's modelling of Northern Basin communities are:

- 1. related to those raised by Wheeler et al. as noted above in the updated literature review findings
- 2. the need to consider the impact of foreign worker programs like the Seasonal Worker

⁷ See for example, Robertson, Stuart, & Blackwell, Boyd. (2015). Remote mining towns on the rangelands: determining dependency within the hinterland. *The Rangeland Journal, 37*(6), 583-596. Retrieved from http://www.publish.csiro.au/paper/RJ15046 8 New worker mobility review items since the initial draft report from this item onwards.

Programme (SWP, 403 visas). However, this issue has been comprehensively addressed in the modelling by MDBA undertaking a survey of farms to determine their demand for seasonal workers regardless of the source of these seasonal workers, i.e. whether from domestic or foreign sources.

- 3. the incorporation of the 100 percent graphs of crop types by region in the MDBA
- 4. including the graphs of model performance combined with explicit regression results (see main body of report for more details)
- 5. to ensure that KPMG have used the appropriate tests and methods for modelling their data (see main body of report for more details) and
- 6. adding additional variables where KPMG use a single independent variable will improve these model results because the communities are interrelated.

The main text provides a series of other comments.

Secondly, there were a number of key recommendations for the MDBA's GMID Dairy Production Modelling. Specifically:

Recommendation GMID Modelling 1 (RGMIDM1): A thorough proof read will eliminate any typographical and grammatical errors and improve the readability of the report.

RGMIDM2: The MDBA should explicitly address the Jeavons Paradox in regards to water-use efficiency in the MDBA and its impact on water use in the face of water recovery.

RGMIDM3: RGMIDM3: Because Ordinary Least Squares is incredibly robust even in the face of breaches of some of its assumptions, the multifactor modelling undertaken by the MDBA provides a initial indication of results, particularly where these are supported through suitable tests. However, it is recommended that future work of the MDBA should use panel data techniques (that encapsulate a mix of modelling cross-sectional and time series data together) in addition to the multifactor linear modelling for the relationship between the basin plan and milk production changes for the GMID and its six communities. These panel data results could then be presented alongside the linear results to demonstrate any improvement or the robustness of the linear results. Indeed, the conclusion of the report identifies this as a current limitation.

RGMIDM4: Given the inclusion of milk production in a previous year to model the current year's milk production, time series modelling techniques (which form part of panel data modelling approaches) would be imperative to correct for serial correlation or autocorrelation. Therefore, full regression results and relevant test statistics for various tests for violation and correction of violations for the Ordinary Least Squares assumptions should be provided for the models (relevant for Appendices too).

RGMIDM5: The statement that the modelling is capable of explaining most of the changes in milk production should be substantiated with a phrase or two such as because of the significance and high explanatory power of the models.

RGMIDM6: The provision of a table summarizing community consultation efforts of the MDBA social and economic modelling team needs to be prepared to emphasise the investment made here. The table should have dates, communities and number of people visited etc.

RGMIDM7: Because milk production is more likely to be affected by demand rather than supply, milk prices will be important in determining milk production. Therefore, the MDBA models for milk production should include the milk price. Because milk price data were limited, efforts should be made to obtain additional milk price data so it can be included in the modelling.

The main text provides a series of other comments.

Conclusion

Overall, the MDBA modelling of the impacts of water recovery for the communities of the Southern Murray-Darling Basin, including the work of KPMG and University of Canberra, has been undertaken



carefully, iteratively and in a comprehensive fashion, contextualized by contextual information, both quantitative and qualitative, obtained from various relevant data sources including extensive in situ visits to local towns and regions in the southern basin. There are a number of areas, like in any piece of work, where the MDBA can improve its future modelling and these are outlined in the executive summary of the report and more detail is provided in the body of this report.

2. Introduction

Background and Context

The MDBA asked us to review both their (i) proposed and (ii) actual socio-economic modelling of the impact of water recovery from the communities of the Southern Basin (Figure 1), building on the work already done for the Northern Basin⁹. This document provides (i) an initial review of some preliminary and foundation modelling elements important to the MDBA's approach; as well as (ii) a final review of the final modelling reports.





Source: http://www.mdba.gov.au/discover-basin/landscape/geography

⁹ MDBA. (2016). *Northern Basin Review: Technical Overview of Socio-Economic Analysis - Interim Report October 2016*. Retrieved from Canberra: <u>http://www.mdba.gov.au/sites/default/files/pubs/NBR-socio-economic-tech-</u>

overview.pdf

Relevant background documents for this review include those from the Northern Basin (NB) review such as:

- MDBA overview report (2016)¹⁰
- KPMG reports (2016)¹¹
- University of Canberra report (2016)¹²
- UNE report (2016)¹³

Proposed Modelling and Initial Review Preparation

On 25 October 2016, Dr Blackwell, as review leader, met with the MDBA, KPMG and University of Canberra to work shop the approach and necessary inputs, data and assumptions for undertaking the socio-economic modelling for the Southern Basin (SB) communities – see Figure 2 for results from workshop; factors to be considered in the SB review. The SB review was planned to be similar to what was done previously for the Northern Basin (NB) but was planned to take account of the greater availability of data and potential complexities of a higher number of community contexts (30 + in the case of the SB; with 40 communities used in the final modelling).



Figure 2: Factors identified to be considered in SB modelling

Source: Blackwell, B., personal collection, 2016

On 2 May 2017, Dr Blackwell again met with the MDBA, KPMG and University of Canberra to cover the progress of work to date. In this workshop there was a discussion of the overall approach, data inputs, and an in-depth discussion of the agricultural production of each of the communities and their surrounding areas in order to test that the MDBA had included the correct towns in the community boundaries. In addition, the MDBA reviewed the 720 subsector industrial categories of the economy from the ABS to refine the MDBA's subsector industrial breakdown that assesses the impacts of water recovery for each community. The subsector review exercise was particularly useful because it helped add a number of important sectors that are immediately and subsequently affected by water recovery, in turn enhancing the likely accuracy of modelling impacts of water recovery for each of the communities.

¹⁰ MDBA. (2016). Northern Basin Review: Technical Overview of Socio-Economic Analysis - Interim Report October 2016. Retrieved from Canberra: <u>http://www.mdba.gov.au/sites/default/files/pubs/NBR-socio-economic-tech-overview.pdf</u>

¹¹ KPMG. (2016). Northern Basin Community Modelling: Economic Assessment of Water Recovery Scenarios, Draft Report. KPMG, Sydney.

¹² Tanton, R., & Vidyattama, Y. (2016). *MDBA Community Profiles Data Extraction*. NATSEM, University of Canberra, Canberra.

¹³ Blackwell, Boyd, McFarlane, Jim, & Stayner, Richard. (2016). *An Independent Review of the Social and Economic Inputs to the Northern Basin Review: Final Report*. Armidale: University of New England. Retrieved from https://www.mdba.gov.au/sites/default/files/pubs/NB-social-economic-modelling-review%28UNE%29.pdf

On 20 June 2017, Dr Blackwell met again with MDBA, KPMG and University of Canberra along with Mr McFarlane (now Dr McFarlane) to discuss this and the other draft reports at a third workshop in Canberra. A number of considerations were addressed as presented in Figure 3 at the workshop, including an initial detailed analysis on worker mobility. From that workshop it was requested that further refinements occur as presented in the Tables 11 and 12 of the final section of this report.

Figure 3: Further factors identified to be considered in SB modelling



Source: Blackwell, B., personal collection, 2017

Following these workshops a series of multiple and regular tele-video-conference workshops were conducted to undertake ongoing review of progress of the modelling work. The workshop dates are as follows and generally occurred during the lunchtime period:

- 27 July 2017
- 20 October 2017
- 3 November 2017
- 17 November 2017
- 1 December 2017
- 15 December 2017
- 9 March 2018
- 14 March 2018 (Dr Blackwell was attending his Father's funeral; he caught-up on matters at the following meeting)
- 23 March 2018
- 4 April 2018
- 16 April 2018
- 7 May 2018

These culminated in an independent letter from Dr Blackwell advising on the progress of the modelling work as provided in Figure 4.



Figure 4: Review Letter of Modelling Progress

30 April 2018 Mr Phillip Glyde Chief Executive Officer Murray-Darling Basin Authority

Dear Mr Glyde,

RE: INDEPENDENT REVIEW OF SOUTHERN BASIN COMMUNITY MODELLING APPROACH - UPDATE ON PROGRESS TO DATE

On behalf of my colleagues Drs Nam Hoang and Jim McFarlane and I, I write to advise of the progress of MDBA and KPMG in undertaking the economic modelling work for water recovery as part of the Basin Plan for the Southern Basin communities. We are grateful to the MDBA in choosing us to undertake this review of what will be another milestone in Australia's water reform and local rural community history following the modelling work undertaken for the Northern Basin.

Consistent with our previous review work, we found Dr Phil Townsend and his team at the MDBA along the KPMG team more than willing to consider our views on how to improve the modelling work. There have been regular meetings throughout the previous months of work, where I have been invited to view and observe, in person and through video link, telephone and email, the work of the MDBA and KPMG. I have asked many questions and provided many suggestions for improvement. These questions and suggestions for improvement have been met seriously and many times the MDBA and KPMG have considered and investigated suggestions to see if they improve the modelling (e.g. worker mobility implications for local community impacts). As a result of this genuinely iterative process, as deliberately led by Dr Townsend, I believe the MDBA have been very thorough and have shown due care and diligence in undertaking their modelling work which is thus far fit-for-purpose - rigorously attempting to capture local economic conditions and muance in the face of and as a result of water recovery. I therefore have every reason to believe that this diligence and fitness-for-purpose will continue.

Indeed the modelling work and the important supporting information that has been prepared to date is much needed to help local communities manage, plan and prepare for changes in water supply and reliability along with the full range of changes before them.

Again, thank you for including us as reviewers of this milestone piece of work and we look forward to seeing the continuing modelling results progress along with the draft report of the MDBA.

Yours sincerely,

Dr Boyd D Blackwell BCom, BEcon, PGBEcon(Hons-1st), PhD (UQ)

Copies of the specification in preparing this report are provided in Figure 5.

Figure 5: Specification (Source: MDBA Executed Contract MD003930, pp.4-5)



The Supplier will provide the Customer with a report which:
 Reviews the proposed modelling approach and design for examining the effects of recovering water for the environment on the social and economic conditions of 30 communities from within the southern Murray Darling Basin; and
An initial scoping study of worker mobility which takes into account the locations where people live and where people work within the Murrumbidgee catchment. The initial scoping study should describe how worker mobility has changed across time.
In preparing the report, the Supplier will participate in a workshop to plan the community-level modelling design. The workshop will include a consideration of the data requirements, complexities and assumptions to be employed when designing the community-level modelling approach. The report will include a short literature review that defines matters for consideration when developing the modelling capability for examining the effects of recovering water for the environment on individual communities.
To describe worker mobility and changes in worker mobility within part of the Murrumbidgee catchment, the Supplier will examine the locations of where people work and live at the local government area and urban centre locality levels using data from the 2001, 2006 and 2011 census. The local government areas will include the shires of Griffith, Leeton, Carrathool, Hay, Murrumbidgee, Jerilderie and Narrandera. The urban centre localities will include the towns of Griffith, Leeton, Hay, Darlington Point, Coleambally, Narrandera and Goolgowi.
The Customer will provide the supplier with a draft modelling design and approach for estimating the community-level effects of water recovery by 16 June 2017 for review. The review of the proposed modelling approach will consider the:
 Appropriateness of the proposed modelling approach;
2. Baseline data availability and suitability;
3. Assessment methodology; and
4. Limitations of the proposed modelling approach.
The report should describe opportunities for further improving the proposed modelling approach.
The Customer will provide the Supplier with a report on the final modelling design and approach used to estimate the community-level effects of recovering water for the environment in order for the Supplier to provide a final report to the Customer which considers the:
 Appropriate ress of the final modelling approach used, Suitability of the baseline data used to model the effects:
2. Guidability of the baseline data used to model the enects,
CD14-0194 4
Murray-Darling Basin Authority: Deed of Variation MD003930: Independent review of southern Basin community modelling Approach
3. Limitations of the proposed modelling approach; and
4. Options for improving the modelling approach.
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Materials Provided for Initial Review

We have been presented with initial drafts and descriptions respectively of:

- 1. KPMG's early thinking on their preferred approach to the modelling¹⁴
- Land use data as a proportion of total agricultural landuse from the MDBA provided in the 9 June 2017 along with population for each of the communities for 2001, 2006 and 2011 dated 7 June 2017
- Detailed industry CDP employment data 8 June 2017, LGA employment data second cut 8 June 2017, CDP employment data 4th cut 8 June 2017, aggregated to the following 13 broad industry classifications from NATSEM, University of Canberra:
 - i. Irrigated agriculture
 - ii. Agricultural services, wholesale
 - iii. Ginning
 - iv. Dairy/milk processing
 - v. Mining
 - vi. Fruit and vegetable processing including wine

¹⁴ KPMG. (2017). KPMG Southern Basin Modelling Approach 25 June 2017. Unpublished document.

- vii. Agricultural manufacturing
- viii. Manufacturing
- ix. Non-agricultural private
- x. Health, government services
- xi. Non-irrigated agriculture
- xii. Transport
- xiii. Water industry (later, it was decided not to separate out this final category)

A further category is provided which is 'not stated or inadequately described'.

Final Review

In addition to completing the initial review of proposed and ongoing work of the MDBA including the labour mobility question, Dr Blackwell undertook a final review of the modelling work drawing on the following documents to address those remaining issues as noted in the final paragraph of Figure 5:

- 1. KPMG Southern Basin Community Modelling: Model Documentation¹⁵
- 2. KPMG Simulation Results All Sectors (Results 1 June 2018) 12June2018.xlsx¹⁶
- 3. MDBA GMID Dairy Modelling report¹⁷
- 4. MDBA Farm employment results 7may18.docx
- 5. MDBA Farm FTE CDP BP 4may18.xls
- 6. University of Canberra Community Profiles Data and Seasonal Workers Estimation Report¹⁸
- 7. MDBA seasonal workers survey draft report¹⁹

Item 4 represents summary written findings from item 3. Item 7 was the survey work that evolved as a result of the findings in item 6, though item 6 also provides the data for the community profiles.

This report therefore includes the initial and final reviews of the MDBA's modelling work for Southern Basin communities and can be read as a single document rather than having to refer to the initial review only.²⁰

General Approach and Processes of MDBA

The marrying of qualitative and other quantitative contextual information to the modelling means that the MDBA is not relying on the modelling solely, though this has the potential to add to evidence in supporting their evaluation. The MDBA is using a Triple Bottom Line for its evaluation approach.

The community consultation that has been undertaken is critical to help address community concerns over the effects of water recovery. Water recovery would rarely be acceptable to regional, rural and remote communities given that water has been critical to their initial development through agriculture. However, a great deal of angst and stress can be reduced if a fair approach is used to determine the distribution of water recovery amongst communities (though this is complicated by the hydrological and physical constraints within the basin as well as environmental flow requirements) – that is if procedural

²⁰ Blackwell, Boyd, & McFarlane, Jim (2017). Initial Review Report For the Murray-Darling Basin Authority (MDBA): An Independent Review of the Southern Basin Community Modelling Approach, MD003930, Variation 1, 29 June 2017. Armidale: University of New England.



¹⁵ KPMG (2018). Southern Basin Community Modelling: Model Documentation – Draft, 7 June 18. Canberra: KPMG Economics.

¹⁶ Provided by Thomas Massey, Consultant KPMG, Brisbane, 13 Jun 2018

¹⁷ MDBA, 2018. Economic Modelling of Dairy Production in the Goulburn-Murray Irrigation District: Third Draft, June 2018. MDBA, Canberra.

¹⁸ University of Canberra, 2018. Data for the MDBA Community Profiles and Report on Seasonal Workers Estimation. University of Canberra, Canberra.

¹⁹ We have been informed that this short report will form an appendix to the main MDBA report: MDBA, 2018. A short report on collection of employment data of seasonal workers in Southern Connected Basin. MDBA, Canberra.

justice²¹ is followed – distributional justice is what communities maybe most concerned about but we have not been commissioned to comment on this directly – rather we have been asked to comment on the social and economic modelling approach, how it can be improved and whether the MDBA approach is reasonable.

The MDBA technical summary report is a key to communicating to the people of the <mark>30 plus communities</mark> (see Figure 6) the modelling approach used by MDBA and synthesising the findings from the various reports and elements to their modelling approach for the Southern Basin.



Figure 6: Communities and boundaries included in the Southern Basin modelling (Source: MDBA 2018)

General Approach to Undertaking Modelling Review

Our general approach to assessing the modelling is presented in Figure 7 and entails assessing the reliability and validity of the key links or drivers between water availability, water recovery for the environment and production, and how these water inputs are then used in estimating production (such as through the land use models for communities), and the resulting effects on employment and social benefits or costs. Employment offers an ideal measure of the social and economic consequences of water allocations and this is the key indicator of socio-economic impact that the MDBA has focused on in its modelling.

Figure 7: Building Block Approach to Assessing Modelling (Source: Blackwell 2016)

²¹ Lukasiewicz, Anna, & Baldwin, Claudia. (2014). Voice, power, and history: ensuring social justice for all stakeholders in water decision-making. *Local Environment*, 1-22. Retrieved from http://dx.doi.org/10.1080/13549839.2014.942261



In this report we focus on the particular issues of modelling local economies as precisely as possible, particularly by taking account of a significant rise in worker mobility in recent decades.²² In our future report we will focus on:

- whether the approach and the results obtained can be used by the MDBA to help reach a decision about the effects of changes in water availability by interpreting the model outputs (i.e. hectares used in production and employment impacts)
- 2. limitations in this regard and
- 3. considerations for future work.

Outline of Report

As an outline of the remainder of the report, **Section 3** provides a rapid review of the relevant literature to help identify what modeling has been done previously and lessons learned for improvements. **Section 4** provides our review of data relevant to worker mobility for selected communities to inform how the MDBA will model this potentially important consideration as suggested from our NB review.²³ **Section 5** provides a review of the final modelling documents of KPMG.

²² Blackwell, Boyd, Fischer, Andy, McFarlane, Jim, & Dollery, Brian. (2015). Mining and other industry contributions to employment leakage in Australia's Northern Territory. *The Journal of Developing Areas, 49*(6), 263-278.
 ²³ Blackwell, Boyd, McFarlane, Jim, & Stayner, Richard. (2016). *An Independent Review of the Social and Economic Inputs to the Northern Basin Review: Final Report*. Armidale: University of New England. Retrieved from https://www.mdba.gov.au/sites/default/files/pubs/NB-social-economic-modelling-review%28UNE%29.pdf

3. Brief Literature Review

Introduction

We refer readers to the relatively extensive literature review we undertook for the MDBA as part of the Northern Basin Community review, ²⁴ because this includes a review of relevant international and domestic literature for the basin as a whole. Here we simply provide a summary of that review, combined with a brief update of literature that has emerged since this report in October 2016. Literature will continue to emerge and require further reviews over time.

Summary of Previous Review from Blackwell et al. 2016

The MDBA has already undertaken an extensive range of social and economic modelling in informing the development and implementation of the Plan. We have identified 24 insights from the domestic and international literature which required consideration in undertaking the social and economic modelling of impacts for recovery in the Northern Basin – these remain important to the Southern Basin both in terms of relevance and equity. A summary of these is provided in Table 1 which shows that most of these are already incorporated in the modelling of the Northern Basin communities or provide impetus to the current modelling, noting that most of our comments have been addressed, at least through explanation, in the latest draft reports for the Northern Basin as noted in the Table final column in red. As part of the Northern Basin review only one insight was not addressed and could be done as part of the MDBAs ongoing work program rather than immediately. To gain further details for each insight, particularly the references, simply go to the coding (LI#) and yellow highlight in text of the Blackwell et al. 2016 report.²⁵ Overall, these 24 insights reinforced our recommendations in regards to the modelling of Northern Basin communities but are equally relevant to the Southern Communities, despite these communities being different, the data availability for these being greater and possibly more complex.

LI#	Insight	Relevance to MDBA modelling	Whether incorporated ([] OR []) by MDBA modelling/processes (suggested inclusion timeframe) Subsequent incorporation by MDBA ([] OR []) Incorporation by MDBA into SB modelling ([] OR [])
1	Remote sensing can be combined with basin-scale hydrological modelling to better understand water cycling and local processes	Not directly relevant but reinforces current locally nuanced approach taken	ΝΑ
2	Water productivity should be measured through impact on goods and services rather than focused on amount of water used	Assessing impacts on jobs goes some way to doing this.	Previous modelling incorporates impacts for local communities on jobs, value added and regional output (Arche and Gillespie). But, more nuanced impacts could be assessed for communities by building smaller local economy models
3	Site or locale specific studies necessary for establishing relationship between water use, hectares irrigated and the social and economic consequences	Reinforces MDBA current approach	0
4	Significant body of work already undertaken by MDBA in its social and	Large body of background work that has guided the MDBA and reinforces need and approach for	KPMG reports on modelling and analysis inform the basin plan

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Table 1: Summary	v of literature insights	(11), relevance.	and incorporation	Source: see 1 # in texti
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²⁴ Blackwell, Boyd, McFarlane, Jim, & Stayner, Richard. (2016). An Independent Review of the Social and Economic Inputs to the Northern Basin Review: Final Report. Armidale: University of New England. Retrieved from <u>https://www.mdba.gov.au/sites/default/files/pubs/NB-social-economic-modelling-review%28UNE%29.pdf</u> 24 Initial



LI#	Insight	Relevance to MDBA modelling	Whether incorporated ([] OR []) by MDBA modelling/processes (suggested inclusion timeframe) Subsequent incorporation by MDBA ([] OR []) Incorporation by MDBA into SB modelling ([] OR [])
	economic analysis of the Plan	current modelling work	
5	Cotton water application rate of 4.5-7ML/ha	Consistent with current modelling	0
6	KPMG found Arche Gillespie I-O approach reasonable but temporal and transitional processes need to be incorporated	Reason for current modelling	NA
7	Community vulnerability and adaptability indices provide an important baseline for ongoing monitoring and evaluation framework of social and economic consequences of Plan	MDBA has such a framework	0
8	CGE TERM H2O modelling shows employment impacts across entire basin relatively small due to tradability of water	While the case at macro-level, is not the case at local level and hence need for current work	
9	Water price more sensitive to drought and producer costs than water availability	This result may be more a function of the CGE modelling approach than reflecting local conditions, reinforcing need for such local modelling	Such modelling at the micro-scale could be undertaken to assess such sensitivity but would be constrained by data availability
10	St George and Dirranbandi (Hebel) identified as high risk areas (proportion of irrigated ag, socio-economic condition) in implementation of the Plan	Reinforces need for current work nuanced to meet local conditions	
11	Income measures could be incorporated and provide comparison with employment number analysis	We are informed that MDBA used income measures to convert part- time employees to full time equivalent.	 Measuring localized employment income impacts could be part of the MDBA's ongoing social and economic monitoring and evaluation framework (medium to long-term) I noted in chapter 5 of KPMG community model report ²⁶
12	Commuting and work migration will be important to modelling the spatial (i.e. local) consequences for job losses	We believe this is highly relevant given recently emerging literature of its significance not just for mining but for all sectors	 (medium to long-term) [] noted as limitation in KPMG community model report ²⁷ Has been investigated but not incorporated into KPMG 2018 Southern Community report because the migrating labour was viewed as only a small proportion of total labour and because this labour was mainly commuting to nearby LGAs which were captured by the community boundary approach adopted.
13	Resilience, migration and commuting, globalisation and technological advancements and	All these have been incorporated except for commuting and work migration	See literature insight 12 for more detail.

²⁶ KPMG. (2016). Northern Basin Community Modelling: Economic Assessment of Water Recovery Scenarios, 16 August 2016 Draft

Report. Sydney: KPMG, p. 33. ²⁷ KPMG. (2016). Northern Basin Community Modelling: Economic Assessment of Water Recovery Scenarios, 16 August 2016 Draft *Report,* p. 16.



LI#	Insight	Relevance to MDBA modelling	Whether incorporated ([] OR []) by MDBA modelling/processes (suggested inclusion timeframe) Subsequent incorporation by MDBA ([] OR []) Incorporation by MDBA into SB modelling ([] OR [])
	associated falls in labour demand need to be incorporated into any modelling		
14	TERM H2O CGE predicted water buybacks increased water asset values and had little effect on aggregate farm output in the SB	This prediction could be tested with time for both the southern and northern basins, though it was done at a macro-scale and not local/micro scale.	(medium to long-term) [] MDBA are incorporating this with milk and area of other crops types in SB modelling
15&16	Investment in infrastructure upgrades in SB increased regional output and jobs but could have little effect on water savings	Used TERM H2O CGE and reinforces need for localized understanding of effects of infrastructure investment	 Infrastructure jobs stimulus was incorporated into work of Arche and Gillespie as offsetting gains in jobs though noted as underestimated by KPMG Return flows negating water savings (short term) I discussed Collarenebri, Dirranbandi flow on for Moree, St George ²⁸ and some infrastructure water savings retained for productive uses, netted for current water recovery in relevant communities, ²⁹ and accounted as 30% return of water savings in Wee Waa. ³⁰ MDBA has this for all relevant localities but with different % retained by irrigators
17 & 18	Commonwealth water buybacks in SB (2008-2012) had little impact on farm net income	Proceeds from sale were used to pay-off debt/interest or invest on- farm and resulted in greater use of existing entitlements (and this latter response not sustainable). Community impacts not assessed and could be positive and negative	 Substitution between factors of production needs to be incorporated into jobs impact work (temporal inclusion not yet known) discussed in KPMG report.³¹
19	Impact on jobs considered an important measure of social and economic consequence	Foundation for current work. (Infrastructure investment has employment multipliers 1/3 to ¼ of those for public health and education)	0
20	Importance of incorporating 'people and place' thinking into social and economic monitoring and evaluation framework	MDBA conscious of these concerns and have undertaken an identification of cultural Aboriginal and Torres Strait Islander values and has an ongoing program of monitoring community wellbeing	Where communities believe this is not the case, this could become part of the MDBA's ongoing work program (i.e. medium to long-term)
21-24	Negligible effects of drought on Chinese macro economy though urban and rural households experienced severe losses in food and welfare due to water recovery, especially in northern and southern basins	Farmers substituted capital and labour (moved from non-ag to ag) for water. Distinction between negligible macro and significant regional and community impacts reinforces need for current modelling work. Ability to substitute labour for water hindered by higher wages in Australia, and already	See insight 17 and 18 above.

²⁸ MDBA. (2016). Northern Basin Review: Technical Overview of Socioeconomic Analysis, Draft Report, p 1.

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²⁹ MDBA (2016). Northern Basin Review: Technical Overview of Socioeconomic Analysis, Draft Report, 2 Sep 2016. Canberra: MDBA, p 26.

³⁰ MDBA. (2016). Northern Basin Review: Technical Overview of Socioeconomic Analysis, Draft Report, 2 Sep 2016. Canberra: MDBA, p 33.

p 33. ³¹ KPMG. (2016). Northern Basin Community Modelling: Economic Assessment of Water Recovery Scenarios, 16 August 2016 Draft Report. Sydney: KPMG, pp. 18-19.

LI#	Insight	Relevance to MDBA modelling	Whether incorporated ([] OR []) by MDBA modelling/processes (suggested inclusion timeframe) Subsequent incorporation by MDBA ([] OR []) Incorporation by MDBA into SB modelling ([] OR [])
		increased capitalization from drought.	



Updates for Initial Review

Literature Directly Relevant to Social and Economic Modelling in the MDB

The journal *Water Economics and Policy* prepared a special issue focused on water reform and planning in the Murray-Darling Basin in 2016 which was published online in 2017. Within this issue and of particular note, Settre et al. (2017) specifically criticise the hydrological economic modelling to date for the MDB on the grounds that uncertainty (i.e. unknown risk) is not sufficiently or appropriately addressed through current approaches:

While consideration of uncertainty is increasing in prominence, our review indicates the robust treatment of epistemic and stochastic uncertainty have not been fully integrated in the hydro-economic modeling literature. When hydro-economic modeling results are used to inform policy, treatment of uncertainty has both technical and political implications. We conclude that the methodological rigor of MDB hydro-economic modeling uncertainties inherent in the modeling of water resources.³²

Updated Literature Review Implication 1 (ULRI1): The MDBA should consider how it is addressing uncertainty in its modelling and in particular, the attention given to quantifying, reducing and communicating uncertainties inherent in the modelling of water resources. (The MDBA has instructed that it will use entitlements and allocations against those entitlements to address uncertainty).

Roobavannan et al. (2016), using a simulation model and empirical data, found that in the Murrumbidgee River Basin (which includes Canberra and Wagga Wagga – see Figure 8), sectorial transformation and outmigration of employment facilitated the catchment community's adaptation and the impact of reallocation of water to agriculture was reduced in a diversified economy.³³ This out-migration paradoxically resulted in a decline in unemployment and an increase in median household income in the River Basin. These findings while established through a simulation model and with the use of empirical data have very important implications for the proposed approach to taking account of worker mobility in modelling the impacts for the Southern Basin communities.



Figure 8: Murrumbidgee River Basin

Source: Roobavannan et al. (2017, p. 180)

³² Settre, Claire, Connor, Jeff, & Wheeler, Sarah Ann. (2016). Reviewing the Treatment of Uncertainty in Hydro-economic Modeling of the Murray–Darling Basin, Australia. *Water Economics and Policy*, *3*(3), 1650042, p. 1. Retrieved from http://www.worldscientific.com/doi/abs/10.1142/S2382624X16500429

³³ Roobavannan, M., Kandasamy, J., Pande, S., Vigneswaran, S., & Sivapalan, M. (2017). Allocating Environmental Water and Impact on Basin Unemployment: Role of A Diversified Economy. *Ecological Economics, 136*, 178-188. Retrieved from http://www.sciencedirect.com/science/article/pii/S0921800916310102

http://www.sciencedirect.com/science/article/pii/s092180091

This research on modelling the impacts from water recovery in the Murrumbidgee River Basin has shown that worker mobility is critical for local economies and communities to successfully adapt to water recovery. Paradoxically, the research found that while agricultural output and employment may decline from water recovery, in total unemployment fell and mean household incomes rose because of outmigration of people from the basin and absorption of the labour force in expanding non-agricultural sectors of a diversified economy. **ULRI2**: This finding reinforces the need to consider (i) worker mobility and (ii) the absorption capacity of the non-agricultural sectors so as to accurately model the impacts for basin communities.

Wheeler and Zuo (2017) analysed in the SB, irrigator intention to exit as a result of drought and water scarcity using ABARES farm survey data from 2006 to 2013.³⁴ Weak evidence exhibited for irrigators to exit during times of drought, while lagged water scarcity presented stronger evidence during periods of non-drought (or when property prices are less depressed). There was also strong evidence that poorly performing farms (lower returns and higher debt) were more likely to exit during times of drought, but not so in non-drought periods. Age appears to be a key motivation for farm exit across all industries and was most significant during drought. **ULRI3**: These irrigator exit findings may be important in interpreting the out-migration result from ULRI2 and reinforce the need to take account of farm (returns and debt levels) and community adaptability to dissipate the impacts of water recovery.

Vidyattama et al. (2016) found that migration levels in the MDB were not that different to internal migration levels in other regional areas in Australia.³⁵ While this is the case, internal migration may provide an opportunity for better assessing the impacts of water recovery in the basin. Internal migration means the relocation of people's residence as apposed to their place of work. **ULRI4**: While there is naturally a strong focus in the current modelling to account for worker mobility to better account for impacts from water recovery, accounting for internal migration may also be important to the MDBA's modelling and should be given some consideration. If people can move to a new location and new job, then any loss in jobs to the home region becomes job fills in the new region, and a substitution between regions. People may also internally migrate to move to a preferred living location and commute to their old location, so internal migration may not necessary immediately marry with changes in jobs but one would expect this to be the case for most internal migration.

General literature

Hart and Doolan published in 2017 a book on decision making in water resources policy and management in Australia, noting that '(t)he Australian experience over the past three decades has led to major improvements in the decision-making processes in water resources policy and management, particularly in response to drought and climate change, providing an ideal model on which other nations can use and adapt'.³⁶ This would suggest that the social and economic modelling work being done for the basin could be used in guiding similar approaches overseas. Furthermore, Hart and Doolan identify the Northern Basin review in Chapter 13 as part of case study 1, *The Murray Darling Basin Plan.*³⁷ In Chapter 10, there are also some comments about social assessments informing the selection of policy instruments, and robust public consultation being essential to both social acceptability and effective social assessment, and social impact assessment being critical to social acceptability.³⁸ Our scope of review is contained to the social and economic modelling work rather than any consultation undertaken as part of this work, though we note

³⁴ Wheeler, Sarah Ann, & Zuo, Alec. (2017). The impact of drought and water scarcity on irrigator farm exit intentions in the Murray– Darling Basin. *Australian Journal of Agricultural and Resource Economics*, 10.1111/1467-8489.12218. Retrieved from <u>http://dx.doi.org/10.1111/1467-8489.12218</u>

³⁵ Vidyattama, Yogi, Cassells, Rebecca, Li, Jinjing, & Abello, Annie. (2016). Assessing the significance of internal migration in drought affected areas: A case study of the Murray-Darling Basin. *Australasian Journal of Regional Studies, 22*(2), 307-328. Retrieved from http://search.informit.com.au.ezproxy.une.edu.au/documentSummary;dn=328534993450179;res=IELAPA

 ³⁶ Provided in the overview online from Hart, B., & Doolan, J. (2017). *Decision Making in Water Resources Policy and Management:* An Australian Perspective: London: Elsevier Science. Retrieved from <u>https://books.google.com.au/books?id=BgCqDQAAQBAJ</u>
 ³⁷ Ibid, pp. 235-6.

the extensive personal first hand knowledge the modelling staff have gained from visiting most if not all the communities being studied.

While the focus of the modelling for this report is on the impacts of water recovery on the social and economic wellbeing of communities, Qureshi et al. considered the impact of water variability including drought on the residual value of water across the MDBA.³⁹ These authors found that residual values naturally vary across regions in response to water availability. Fruits, nuts and grapes and cotton were found to represent the highest value water uses and trading from low value to high value products resulted in economic losses which were lower than those associated with the proportional decline in water availability during drought periods.

A status report on water market conditions for the Southern Basin

Water asset prices in the Southern Basin are at an all-time high having doubled since 2013. ⁴⁰ The high prices reflect a number of factors including the high demand for food, low rainfall and differences in the traditional focus of farming production. The Northern Basin has traditionally focused on fibre production while in contrast, the Southern Basin traditionally focused on food production. ⁴¹ However, in recent years as a result of improved technologies, the Plan and other conditions, the traditional foci of both sections of the basin are changing as noted in the October 2016 MDBA modelling workshop.

Nonetheless, forecasts for water prices are highly variable and range from \$40 to \$70 a megalitre for the 2016-17 season following average rainfall and inflows across the Southern Basin, the cost of carrying water over into the new season, and a risk premium to account for uncertainty over general security allocations next season.⁴²

ABARE reports also indicate a larger food proportion in the Southern Basin⁴³. Whether this continues will depend on the demand for these products versus the demand for the Northern Basin's high water demand for fibre production as this moves further south into the Riverina and beyond.⁴⁴ General opportunities to improve the water market exist according to ABARE such as carryover rules, trading rules and environmental water transfers.⁴⁵

Updates for Final SMDB Modelling Review

Grafton and Wheeler (2018) reviewed recent water reforms and the effects of water recovery intended to increase stream flows in the MDB. They found that:

- a. the actual increase in volumes of water measured through stream flows is much less than that claimed by the Australian Government.
- b. irrigation efficiency subsidies have reduced groundwater and stream return flows
- c. buy-backs are more cost effective than subsidies
- d. much of the gains from water recovery have been captured as private benefits to irrigators and

³⁹ Qureshi, M. E., Ahmad, M. D., Whitten, S. M., Reeson, A., & Kirby, M. (2015). Impact of Climate Variability Including Drought on the Residual Value of Irrigation Water Across the Murray–Darling Basin, Australia. *Water Economics and Policy, 0*(0), 1550020. Retrieved from <u>http://www.worldscientific.com/doi/abs/10.1142/S2382624X15500204</u>

⁴⁰ Strathearn, Peri (2017). Water price index gives snapshot of entitlements' value in southern Murray-Darling Basin. The Murray Valley Standard. 24/5/2017

⁴¹ ABARES (2016). Horticulture farms in the Murray–Darling Basin. Australian Government, Canberra.

⁴² Hunt, Peter (2017). Dairy season 2017: Wade in with caution. The Weekly Times. 7/6/2017. Since this time, in August 2017 water was trading at \$100/ML (Townsend, P. 2017, pers. Comms, Sept).

⁴³ ABARES (2016). Rice farms in the Murray–Darling Basin. Australian Government, Canberra.

ABARES (2015). Dairy farms in the Murray–Darling Basin. Australian Government, Canberra.

ABARES (2015). Wine grape farms in the Murray Darling Basin. Australian Government, Canberra.

⁴⁴ Hunt, Peter (2017). Dairy season 2017: Wade in with caution. The Weekly Times.7/6/2017

⁴⁵ ABARES (2016). Lessons from the water market - The southern Murray–Darling Basin water allocation market 2000–01 to 2015– 16. Australian Government, Canberra.

e. more than a decade after water recovery began in the basin, there is no observable basin-wide relationship between water volumes recovered and flows at the mouth of the River Murray.

Assuming for a moment that Grafton and Wheeler's (2018) findings hold, item a means that there is less water in system than is currently modeled – therefore further water reductions may result in greater adverse impacts on employment that are currently modeled? Item d indicates that there could be employment gains from water recovery, assuming that these private benefits are translated into investment in employment (along with capital and land). Item e is a bit of a furphy because water recovery may ultimately have limited effect on flows at the end of the system at the mouth of the Murray – climatic and coastal conditions can ultimately determine this. Thus, the MDBA should address the implications of items a-d to their modelling: **ULRI5**: Are the private benefits captured from water recovery (e.g. through irrigation efficiency) likely to translate into positive community employment impacts and if so, to what extent? **ULRI6**: If less water is being returned to stream flows, then the modelling impacts of water recovery for some locations may be more adverse than current modelling indicates – if so, to what extent are impacts underestimated? **ULRI7**: To what extent do URL15 and URL17 offset each other and with what net effect?

Murray-Darling Basin Royal Commission

Most importantly, His Excellency the Honourable Hieu Van Le AC, Governor of South Australia established the Murray-Darling Basin Royal Commission ⁴⁶ on 23 January 2018 to investigate the operations and effectiveness of the Murray-Darling Basin. At the time of writing the Royal Commission was still undertaking hearings (began on 13 June 2018) but its submissions had closed.

One submission by Wheeler et al. (2018) ⁴⁷ heavily critiqued the Basin Plan, specifically questioning:

- whether the basin plan will achieve its objectives including enhanced environmental outcomes and additional 450 GL
- whether assumptions in original plan have been sufficiently adjusted to account for the impact of improved technologies
- whether the basin plan will meet is objectives of enhanced environmental outcomes and the additional 450GL taking account of likely future climate change

Wheeler et al. (2018) specifically argue strongly that subsidies for irrigation infrastructure and supply projects are inferior as a way to support local rural communities, rather health, education and effective structural adjustment projects are preferred. **ULRI8**: MDBA should address the issue raised by Wheeler et al. (2018) about investment in health and education providing 2-3 more permanent jobs (Whitwer and Dixon 2013) than spending on irrigation infrastructure.⁴⁸

They also make criticism of the Northern Basin Communities modelling work of MDBA and KPMG by arguing that CGE should have been used.⁴⁹ KPMG have CGE capability and if needed could have employed this. As noted by Blackwell et al. (2015) ⁵⁰in their review of the modelling, CGE is not appropriate given its tendency to model marco-level impacts rather than local. Instead input-output modelling is preferred to capture local economic structure and to assess change. All methods suffer limitations – see for example The Australia

⁴⁶ Murray-Darling Basin Royal Commission, 2018. Murray-Darling Basin Royal Commission, MDBRC, Adelaide. 23 June 2018, https://www.mdbrc.sa.gov.au.

⁴⁷ Wheeler, S., Connor, J., Grafton, Q., Crase, L., Quiggin, J., 2018. Submission to the Murray-Darling Basin's Royal Commission, in: Murray-Darling Basin Royal Commission, Adelaide. 23 June 2018 <u>https://mdbrcsa.govcms.gov.au/sites/g/files/net3846/f/mdbrc-submission-professor-sarah-wheeler-sa.pdf?v=1527826747</u>

⁴⁸ Wittwer, G., Dixon, J., 2013. Effective use of public funding in the Murray-Darling Basin: a comparison of buybacks and infrastructure upgrades. Australian Journal of Agricultural and Resource Economics 57, 399-421. doi:10.1111/1467-8489.12001.

⁴⁹ Wheeler et al. 2018, op. cit. p. 6.

Institute's identification of limitations for both input-output and CGE modelling.⁵¹ CGE is not particularly adept to capturing local nuance and change, rather it will tend to capture changes over the long term when markets equalize and impacts dissipate. **ULRI9**: For completeness MDBA and KPMG should specifically address the issue raised by Wheeler et al. (2018) as to why they did not employ CGE modelling in their Northern and Southern Basin reviews.

Wheeler et al. (2018) also argue that farm irrigated hectare production does not vary proportionately with farm water use because farms undergo adaptation, surplus water use, water substitution, water trade and farm restructuring following buyback. They argue that farm revenue, which is far less proportional to water reductions, should be the key impact to assess, rather than farm production. Factor inputs into production (land, labour and capital) and output mix changes as a result of changes in water; to ignore this may overestimate the impacts of water reductions on labour. **ULRI10**: The modelling being conducted for the Southern Basin should take account of the need to model production revenue rather than output and how production revenue does not change proportionately with a change in water availability.

Wheeler et al. (2018) go on to argue that the KPMG and MDBA modelling ignores all long-term influences such as increasing urbanization (which is not necessarily true in many rural locations – many rural town populations are dwindling), increasing temperatures, changing commodity prices, terms of trade and technology change on irrigated farm production. 'Assuming that water use is the only long-term driver provides misleading policy advice that will only be detrimental to rural communities in the long-term. **ULRI11**: The long-term influences on irrigated farm production (increasing urbanization, temperatures, changing commodity prices, terms of trade and technology) should be considered in the Southern Basin Modelling because, according to Wheeler et al. (2018), these were ignored in the Northern Basin Modelling. Wheeler et al. (2018) predict that the error of not including these impacts in the water buyback impacts resulted in an overstatement of the impacts of more than double.

Furthermore, Wheeler et al. (2018) refer to the paradox of irrigation efficiency and the rebound effect (the increase in farm water use that can arise from increased irrigated land and changing crop mix) and they argue that Ernst and Young's (2018) analysis of efficiency measures by 2024 in the MDB to achieve the goal of additional environmental water recovery of 450GL with neutral or positive economic effects as evidence of this effect.⁵² **ULR112**: The MDBA & KPMG should address in their modelling the issue raised by Wheeler et al. (2018) of the paradox of irrigation efficiency and the rebound effect?

Wheeler et al. (2018) refer to sample selection biases where only 15 ill-affected communities were selected for modelling in the Northern Basin by KPMG/MDBA to assume representative of a wider population that includes 67 communities to draw recommendations for water reductions. **ULRI13**: MDBA should address the issue of sample selection bias in their modelling of Southern Basin communities, as first raised by Wheeler et al. (2018) for the Northern Basin modelling. Related is the inclusion of impacts on nearby areas through spatial modelling to increase number of areas modeled (e.g. through SLAs) and accounting for areas downstream that would potentially benefit from increased environmental diversions.

Statistical modelling issues were also raised by Wheeler et al. (2018) of the KPMG and MDBA reports for the Northern Basin including 'less than rigorous statistical approaches that confound misspecified

⁵¹ Denniss, R., 2012. The use and abuse of economic modelling: Users' guide to tricks of the trade. Institute, T.A., Canberra. 23 June 2018,

http://www.tai.org.au/sites/defualt/files/TB%2012%20The%20use%20and%20abuse%20of%20economic%20modelling%20in%20Au stralia_4.pdf.

⁵² Ernst and Young, 2018. Analysis of efficiency measures in the Murray-Darling Basin: Independent Report to the Murray-Darling Basin Ministerial Council. EY, Canberra. 23 June 2018, <u>https://www.mdba.gov.au/sites/default/files/Analysis-of-Efficiency-Measures-</u>

assumptions about hydrological, agricultural and or economic relationships'.⁵³ Wheeler et al. (2018) state that there is no noted checking, '(or where tests were done, substantial concerns surround the tests concluded) bringing into question the validity of the modelling results. Sample sizes were also very small' ⁵⁴of:

- endogeneity
- collinearity
- heteroskedascity or
- serial correlation⁵⁵

ULRI14: Given Wheeler et al. (2018) criticisms of the reports for the Northern Basin modelling, MDBA and KPMG should ensure that they undertake appropriate tests for: endogeneity, collinearity, heteroskedascity and serial correlation or other relevant statistical tests appropriate to the Southern Basin modelling. It is also suggested to make explicit comment on the small size of the samples used and how these could be increased to increase statistical power (e.g. through use of all SLAs in Southern Basin instead of selected condensed groupings which reduces the sample size).

ULRI15: MDBA and KPMG should take care to ensure that the referencing in their reports is excellent to ensure that data sources and the documents themselves can be reviewed. This is required because Wheeler et al. (2018) argue that inadequate documentation would appear to result in an upward bias in the estimates of economic losses associated with water recovery.⁵⁶

ULRI16: MDBA and KPMG should note that the statement made by Wheeler et al. (2018) as to Blackwell et al. (2016) not highlighting the 'reflows issue' is inaccurate because we did identify the reflows issue under LI#15&16 in Table 1.

Naturally as time passes from when this review was prepared new literature will emerge and readers should familiarize themselves with this literature and its implications for our review of the modelling work of the MDBA

⁵⁶ Wheeler et al. 2018, p. 6.



⁵³ Wheeler, S., Connor, J., Grafton, Q., Crase, L., Quiggin, J., 2018. Submission to the Murray-Darling Basin's Royal Commission, Adelaide. P. 6. 23 June 2018, <u>https://mdbrcsa.govcms.gov.au/sites/g/files/net3846/f/mdbrc-submission-professor-sarah-wheeler-sa.pdf?v=1527826747</u>.

⁵⁴ Ibid, p. 6.

⁵⁵ See Bhargava, A., Franzini, L., Narendranathan, W., 1982. Serial Correlation and the Fixed Effects Model. Review of Economic Studies 44, 533-549.

4. Worker Mobility

Introduction

In this section of the report we provide some initial and indicative results on the likely scope for worker mobility between their place of usual residence (PoUR) and their place of work (PoW). As noted in our report for the Northern Basin communities, there may be considerable adjustment required when the mobility of workers is considered. For example, if a worker lives outside a Local Government Area (LGA) and commutes to work to a second LGA, then it can be assumed that that worker spends their income in their home LGA and not in their working LGA. The impacts of water recovery are therefore likely to be more geographically dispersed and the resilience of LGAs or towns to withstand water recovery will in part depend on the extent of this dispersion.

Theory of Dispersion of Impacts

There are two types of flows of workers for a given area: outgoing workers and incoming workers.

Outgoing workers, workers whom reside in a given locality and commute to an outside locality – will bring outside income to their home locality. *Ceteris parabis*, if the water recovery occurs in the home locality but not the work locality, the resilience of the home community is higher with this outside sourced income.

Incoming workers, workers whom reside in an outside locality and commute into a given locality will take income home to the outside locality. *Ceteris Paribus*, with water recovery in a given locality, this will also impact the outside locality because of incoming workers.

Taking account of the impacts of both outgoing and incoming workers where these make a substantive proportion of 'local' workers (workers whose PoUR and PoW are the same) will therefore be important to assessing the social and economic consequences from water recovery for any given locality and indeed outside localities.

Localities

The MDBA has asked us to consider the extent of worker mobility both for LGAs and urban centres and localities (UCLs). The LGAs are:

- Carrathool
- Griffith
- Hay
- Jerilderie
- Leeton
- Murrumbidgee
- Narrandera

The UCLs (with those directly matching an LGA are marked with a *) are:

- Coleambally
- Darlington Point
- Goolgowi
- Griffith*
- Hay*
- Leeton*
- Narrandera*

Methodological Considerations



There are four data limitations that limit our initial analysis which need to be outlined. Firstly, we have used TableBuilder Pro to access the data from the Australian Bureau of Statistics (ABS) and this interface provides statistics immediately only for 2006 and 2011 years, not 2001. 2001 census data have therefore not been analysed, but comparison between 2006 and 2011 provides an initial indication of changes. Once 2016 data becomes available, these should provide a further year for comparison.

Secondly, PoW data is only available by LGA, statistical area (SA) or postcodes (DZN), not UCLs. Therefore we can only roughly estimate local workers - henceforth referred to as Local2 with a PoUR in a given UCL whom work in the associated LGA - that is 'outgoing workers' and not incoming workers. This was a key verbal request of the MDBA – to establish the extent to which UCLs represented workers relative to a whole LGA. In this case we can only roughly estimate this for outgoing workers and cannot estimate it at all for incoming workers.

Thirdly, a related limitation to the second point, is that not all UCL have a same named LGA, and therefore the comparison and nexus for assessing local employment becomes tenuous, such as in the cases of:

- Coleambally
- **Darlington Point**
- Goolgowi •

Having said this, it is still worth making the comparison to observe the outcomes to gain a sense of the imprecision in these relationships.

Fourthly, there are a considerable number of people whom do not state their PoW from the census which is not discernable as to whether it is at the local level (PoW-PoUR), rest of New South Wales (NSW) or rest of Australia. For the UCLs (PoUR) and LGAs (PoW) considered here this error relative to Local2 employment adds a range of error from two percent for Leeton to 11 percent for Darlington Point. So as to not skew the results by combining unstated PoW with Local, rest of NSW or rest of Australia we have not included them in the calculations contained in this report. However, this error is inherent in the ABS data and standard input-output modelling approaches, such as 'razzing' the data, can be used to correct for this error. 57

Worker Mobility Recommendation 1 (WMR1): To overcome the inherent limitations in the ABS data such as mismatch of UCLs with LGAs, discussions directly with relevant ABS offices may mean that data based on adaptable polygons may need to be derived.⁵⁸ To address the problem of unstated place of work or undefined place of work, the data will need to be 'razzed' in accord with standard input-output economic modelling approaches.

Initial Findings - LGAs

As Tables 2 and 3 identify, worker mobility out of and into LGAs is substantial.⁵⁹ Table 1 shows that the percentage of outgoing workers (bring income into the local LGA) as a percentage of local employment ranges from 12 percent in Griffith to 52 percent in Murrumbidgee. Similarly, incoming workers (take income out of the local LGA) as a percentage of local workers ranges from almost eight percent in Hay to almost 25 percent in Jerilderie. In both cases most of these mobile workers, whether outgoing or

⁵⁹ The differences between the Local employment in Tables 1 & 2 maybe explained as a rounding error and the inherent caveat by the ABS within TableBuilder that '(c)ells in this table have been randomly adjusted to avoid the release of confidential data. No reliance should be placed on small cells'. However, this rounding error is less than the error relating to not accounting for mobility, that is, from both outgoing and incoming workers.



⁵⁷ See for example, McFarlane, Jim, Grant, Bligh, Blackwell, Boyd, & Mounter, Stuart. (2016). Combining amenity with experience: exploring the hidden capital of the winescape experience. Tourism Economics, early view online. Retrieved from http://journals.sagepub.com/doi/abs/10.1177/1354816616665754

⁵⁸ See for example, Robertson, Stuart, & Blackwell, Boyd. (2015). Remote mining towns on the rangelands: determining dependency within the hinterland. The Rangeland Journal, 37(6), 583-596. Retrieved from http://www.publish.csiro.au/paper/RJ15046

incoming are derived from NSW, but the percentages relative to the rest of Australia are not insignificant. **(WMR2)** We therefore recommend that worker mobility be taken into account to not skew the results of impacts for employment by taking account of income coming in from surrounding areas (i.e. outgoing workers), that helps build local economy resilience, and income leaking from the local economy to the surrounding areas (i.e. incoming workers), that while may be seen as a vulnerability for the local economy, will in fact reduce the loss of local jobs to the local community. Rather, the loss will be born by outside communities. This is the reason why Blackwell et al. have described supposed 'employment leakage' as providing an overall benefit to the local and broader economies by providing flexibility in labour markets and building a degree of resilience in the local and the broader economies when shocks are felt or adaptation needs to occur.⁶⁰ Blackwell et al. also point out an additional benefit from increased labour mobility is that people are free to choose where they prefer to live.⁶¹ Furthermore, attempting to reduce employment leakage may mean reducing the extent to which the local economy enjoys income from its workers going out to work in other LGAs. However, readers should note that it is not possible to draw conclusions from Table 2 and 3 because it is essential to look at jobs in nearby LGA first (which forms part of rest of NSW).

	PoW by LGA	(B)	(B/A%)	(C)	(C/A%)	(D=B+C)	(C/A%)
PoUR by LGA	Local ^a (A)	Rest of	% of	Rest of	% of	Total Rest of NSW +	% of
		INDAN	LUCAI	Australia	LUCAI	Ausi.	LUCAI
Carrathool (A)	975	279	28.6%	14	1.4%	293	30.1%
Griffith (C)	9724	1105	11.4%	57	0.6%	1162	11.9%
Hay (A)	1107	139	12.6%	20	1.8%	159	14.4%
Jerilderie (A)	513	160	31.2%	11	2.1%	171	33.3%
Leeton (A)	3652	880	24.1%	22	0.6%	902	24.7%
Murrumbidgee (A)	678	343	50.6%	9	1.3%	352	51.9%
Narrandera (A)	1698	646	38.0%	11	0.6%	657	38.7%

Table 2. Outgoing Worker mobility by LGA, 2011

Notes and Source: Manipulation of ABS 2017⁶². **a**. 'Local' is where LGA PoUR = LGA PoW. **b**. Rest of NSW = Total NSW-Local. **c**. Rest of Australia = All Australian States Total – Total NSW.

PoUR by LGA	(B)	(B/A%)	(C)	(C/A%)	(D=B+C)	(C/A%)
Local ^a (A)	Rest of NSW ^b	% of Local	Rest of Australia °	% of Local	Total Rest of NSW + Aust.	% of Local
937	142	15.2%	18	0.4%	160	17.1%
9698	837	8.6%	69	0.3%	906	9.3%
1096	59	5.4%	23	1.6%	82	7.5%
514	105	20.4%	18	3.5%	123	23.9%
3663	463	12.6%	19	0.4%	482	13.2%
685	139	20.3%	3	0.4%	142	20.7%
1713	288	16.8%	14	0.6%	302	17.6%
	PoUR by LGA Local ^a (A) 937 9698 1096 514 3663 685 1713	PoUR by LGA (B) Local ^a (A) Rest of NSW ^b 937 142 9698 837 1096 59 514 105 3663 463 685 139 1713 288	PoUR by LGA (B) (B/A%) Local ^a (A) Rest of NSW ^b % of Local 937 142 15.2% 9698 837 8.6% 1096 59 5.4% 514 105 20.4% 3663 463 12.6% 685 139 20.3% 1713 288 16.8%	PoUR by LGA (B) (B/A%) (C) Local * (A) Rest of NSW * % of Local Rest of Australia * 937 142 15.2% 18 9698 837 8.6% 69 1096 59 5.4% 23 514 105 20.4% 18 3663 463 12.6% 19 685 139 20.3% 3 1713 288 16.8% 14	PoUR by LGA (B) (B/A%) (C) (C/A%) Local * (A) Rest of NSW * % of Local Rest of Australia * % of Local 937 142 15.2% 18 0.4% 9698 837 8.6% 69 0.3% 1096 59 5.4% 23 1.6% 514 105 20.4% 18 3.5% 3663 463 12.6% 19 0.4% 685 139 20.3% 3 0.4% 1713 288 16.8% 14 0.6%	PoUR by LGA (B) (B/A%) (C) (C/A%) (D=B+C) Local * (A) Rest of NSW * % of Local Rest of Australia * % of Local Total Rest of NSW + Australia * 937 142 15.2% 18 0.4% 160 9698 837 8.6% 69 0.3% 906 1096 59 5.4% 23 1.6% 82 514 105 20.4% 18 3.5% 123 3663 463 12.6% 19 0.4% 482 685 139 20.3% 3 0.4% 142 1713 288 16.8% 14 0.6% 302

Table 3. Incoming Worker mobility by LGA, 2011

Notes and Source: Manipulation of ABS 2017⁶³. **a**. 'Local' is where LGA PoUR = LGA PoW. **b**. Rest of NSW = Total NSW-Local. **c**. Rest of Australia = All Australian States Total – Total NSW.

⁶³ Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS <u>http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240</u>



⁶⁰ Blackwell, Boyd, Fischer, Andy, McFarlane, Jim, & Dollery, Brian. (2015). Mining and other industry contributions to employment leakage in Australia's Northern Territory. *The Journal of Developing Areas, 49*(6), 263-278.

⁶¹ Ibid.

⁶² Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS <u>http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240</u>

Initial Findings - UCLs

Table 4 shows that the selected UCLs also exhibit a high degree of worker mobility, despite the inherent limitations of the ABS TableBuilder data availability. Again the vast majority of outgoing workers (this is all that can be ascertained in this case because of the limitation on UCLs being only available in TableBuilder by PoUR, not PoW) come from the rest of NSW – that is, outside the UCL and associated LGA – ranging from 12% of Local2 employment in Griffith and Hay UCLs to 109% in Darlington Point.⁶⁴ There is some mobility from the rest of Australia, though this is relatively small, for example, at most 3.2 percent of Local2 employment for Darlington Point.

Table 4. Outgoing	worker mob	llity by UCL i	YOUR and LO	calz, Rest of NS	w, Rest of A	lustralia LGA Pow, 20	11
	PoW by LGA	(B)	(B/A%)	(C)	(C/A%)	(D=B+C)	(C/A%)
PoUR by UCL	Local2 ^a	Rest of	% of	Rest of	% of	Total Rest of NSW +	% of
	(A)	NSW ^s	LocalZ	Australia °	LocalZ	Aust.	LocalZ
Griffith	6707	784	12%	55	0.8%	839	12.5%
Leeton	2237	470	21%	11	0.5%	481	21.5%
Narrandera	1026	357	35%	7	0.7%	364	35.5%
Coleambally (L)	239	43	18%	3	1.3%	46	19.2%
Darlington Point (L)	186	202	109%	6	3.2%	208	111.8%
Goolgowi (L)	88	43	49%	0	0.0%	43	48.9%
Hay	810	99	12%	9	1.1%	108	13.3%

Notes and Source: Manipulation of ABS 2017⁶⁵. **a**. 'Local2' is where UCL PoUR is matched with encompassing LGA PoW – see 'Methodological Considerations' for more detail in this section of the report. **b**. Rest of NSW = Total NSW-Local2. **c**. Rest of Australia = All Australian States Total – Total NSW.

 Table 5
 shows that in addition to Local2 employment, there is considerable relative outgoing employment

 across the range of selected NSW LGAs. This confirms the results obtained from Table 4
 but provides a

 little more details on the magnitude of employment flows.

PoUR by UCL	PoW by LGA Carrathool (A)	Griffith (C)	Hay (A)	Leeton (A)	Murrumbidgee (A)	Narrandera (A)	Jerilderie (A)	Total (PoW)
Griffith	28	6707	3	56	48	5	0	6847
Leeton	0	143	3	2237	7	74	0	2464
Narrandera	0	7	0	194	3	1026	0	1230
Coleambally (L)	0	11	0	0	239	0	12	262
Darlington								
Point (L)	0	116	5	11	186	3	0	321
Goolgowi (L)	88	27	0	0	0	0	0	115
Нау	3	3	810	0	4	0	0	820
Total	119	7014	821	2498	487	1108	12	12059

Table 5. Local 2 ^a (Bold) and outgoing employment with UCL PoUR by Selected NSW LGA PoW, 2011

Notes and Source: Manipulation of ABS 2017⁶⁶. **a**. 'Local2' is where UCL PoUR is matched with encompassing LGA PoW – see 'Methodological Considerations' for more detail in this section of the report.

Is UCL employment representative of LGA employment?

⁶⁵ Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS

⁶⁶ Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240



⁶⁴ A percentage over 100% is possible because this simply means there are more people working outside the given area than there are those working within a given area (local employment or its proxy).

http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240

This question can be answered in terms of magnitude and structure. Firstly, in magnitude, the simple answer to this question is 'No'. Table 6 demonstrates that the percentage of unaccounted for employment between Local2 (UCL PoUR matched with associated LGA PoW) and Local employment (where PoUR=PoW by LGA) ranges from 26 percent in Hay to 91 percent in Goolgowi. It is therefore highly variable. However, there is less unaccounted for employment (though still substantial) where the UCL name matches the LGA name – ranging from 26 percent in Hay to 40 percent in Narrandera. In contrast, where the UCL does not match the LGA name, Local2 as a percentage of Local employment ranges from 65 percent to 91 percent and therefore even more unaccounted for.

	PoW by LGA	(B)		(1-A/B)%
PoUR by UCL	Local2 ^a (A)	Local ^b	Encompassing LGA	Unaccounted for Employment (%)
Griffith	6707	9698	Griffith	31%
Leeton	2237	3663	Leeton	39%
Narrandera	1026	1713	Narrandera	40%
Coleambally (L)	239	685	Murrumbidgee	65%
Darlington Point (L)	186	685	Murrumbidgee	73%
Goolgowi (L)	88	937	Carrathool	91%
Нау	810	1097	Нау	26%

Table 6. Outgoing employment by UCL PoUR by associated LGA Pc	oW (i.e. Local2) 8	& Local comparison, 2011
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Notes and Source: Manipulation of ABS 2017⁶⁷. **a**. 'Local2' is where UCL PoUR is matched with encompassing LGA PoW – see 'Methodological Considerations' for more detail in this section of the report. **b**. 'Local' is where LGA PoUR = LGA PoW.

The second question is whether the structure of employment between UCL and LGA differs. The short answer is yes. Table 7 demonstrates that UCLs with the same LGA name have agriculture as a percentage of total industrial sector Local2 employment of between four and 10 percent. This means that agriculture employment can more than double between these locations. Where UCL and LGA names do not match, Local2 employment accounts for between 13 and 25 percent of the selection locations' total subsector employment.

PoUR by UCL	PoW by LGA Carrathool (A)	Griffith (C)	Hay (A)	Leeton (A)	Murrumbidgee (A)	Narrandera (A)	Jerilderie (A)
Griffith	32%	6%	0%	21%	50%	0%	-
Leeton	-	2%	0%	4%	100%	8%	-
Narrandera	-	0%	-	10%	-	4%	-
Coleambally (L)	-	0%	-	-	13%	-	100%
Darlington Point							
(L)	-	4%	-	0%	25%	-	-
Goolgowi (L)	23%	0%	-	-	-	-	-
Hav	-	0%	10%	-	-	-	-

Table 7: Local2 a (Bold) – agriculture b as percentage of total c employment for selected UCLs and LGAs, 2011

Source and notes: Manipulation of ABS 2017⁶⁸. **a**. 'Local2' is where UCL PoUR is matched with encompassing LGA PoW – see 'Methodological Considerations' for more detail in this section of the report. **b**. agriculture = agriculture, fisheries and forestry. **c**. Total employment is the addition of all sectors at INDP level 1 and does not include 'inadequately described', 'not stated', and 'not applicable'.

 Table 8
 compares Local2 employment with Local employment for agriculture and the amount of

 unaccounted for employment. Again, Local2 employment in agriculture as a percentage of total

 employment across all industrial subsectors, accounts for between four and 25 percent. Where UCL and

⁶⁷ Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS <u>http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240</u>

⁶⁸ Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS <u>http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240</u>



LGAs are of the same name, this ranges between four and 10 percent. Where UCL is not the same as LGA name, the percentage is greater at between 13 and 25 percent – in both cases highly variable. When the Local2 percentage of total is compared to Local percentage of total they range between ten and 19 percent and 21 and 50 percent – similar results. Finally, unaccounted for employment resulting from using UCLs to proxy LGA employment is large as noted in the final column of **Table 8**, similar to the results from **Table 6**. (WMR3) Given these combined results, we therefore recommend that UCL employment not be used as representative of either the magnitude or industrial composition of employment in the associated or encompassing LGAs – an alternative approach should be developed. Splitting local economies between their UCL and remaining LGA components to better capture the 'rural economy' of these LGAs is immediately problematic, because such an approach, using TableBuilder, can only capture outgoing employment, not incoming employment and refer to our recommendations in WMR1.

0						
	PoW by LGA			(B)		(1-A/B)%
PoUR by UCL	Local2 ^b (A)	% total Local2 °	Encompassing LGA	Local	% total Local º	Unaccounted for Employment (%)
Griffith	366	6%	Griffith	1022	11%	64%
Leeton	79	4%	Leeton	377	10%	79%
Narrandera	37	4%	Narrandera	352	21%	89%
Coleambally (L)	31	13%	Murrumbidgee	250	37%	88%
Darlington Point (L)	46	25%	Murrumbidgee	250	37%	82%
Goolgowi (L)	20	23%	Carrathool	486	50%	96%
Нау	77	10%	Hay	210	19%	63%

 Table 8: Agricultural a Local2, Local and unaccounted for employment, 2011

Source and notes: Manipulation of ABS 2017⁶⁹. **a**. Agricultural = agriculture, fisheries and forestry. **b**. 'Local2' is where UCL PoUR is matched with encompassing LGA PoW – see 'Methodological Considerations' for more detail in this section of the report. **c**. Total employment is the addition of all sectors at INDP level 1 and does not include 'inadequately described', 'not stated', and 'not applicable'. d. .

Temporal Changes in Worker Mobility

As noted above, TableBuilder Pro currently only provides data for 2006 and 2011 in anticipation of the release of 2016 data by October 2017. Despite this limitation on data availability, Tables 9 & 10 provide comparisons of the change in outgoing and incoming employment from 2006 to 2011 and can be compared to the results from Tables 2 & 3 respectively.

	PoW by LGA	(B=A/Local06%)					(D)		(E=A+D)	(E/A%)
PoUR by LGA	Local ª (A)	% of Local 2006*	Rest of NSW b	% of Local	Rest of Australia c	% of Local	Total Rest of NSW + Aust.	% of Local	Net Employment	% of Local 2006*
Carrathool (A)	-14	-1%	19	2%	14	1.4%	33	4%	19	2%
Griffith (C)	55	1%	345	4%	14	0.1%	359	4%	414	4%
Hay (A)	-114	-9%	-16	0%	9	0.9%	-7	1%	-121	-10%
Jerilderie (A)						-				
	96	23%	-161	-46%	0	0.5%	-161	-46%	-65	-16%
Leeton (A)	-201	-5%	245	8%	-3	0.0%	242	8%	41	1%
Murrumbidgee										
(A)	-128	-16%	33	12%	6	1.0%	39	13%	-89	-11%

Table 9. Change in Outgoing Worker mobility by LGA, 2006-2011

⁶⁹ Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240



Narrandera (A)						-				
	-53	-3%	20	2%	-6	0.3%	14	2%	-39	-2%
Total	-359	-2%	485	3%	34	0.2%	519	3%	160	1%

Notes and Source: Manipulation of ABS 2017⁷⁰. **a**. 'Local' is where LGA PoUR = LGA PoW. **b**. Rest of NSW = Total NSW-Local. **c**. Rest of Australia = All Australian States Total – Total NSW. * This is calculated from the previous column. All other columns are calculated from changes in either levels or percentages between 2006 and 2011, that is they are not calculated from the previous column.

Table 9 shows that the change in work mobility is highly case specific. The percentage change in local employment on 2006 levels ranges from -16 percent in Murrumbidgee to +23 percent in Jerilderie but most locations lose local jobs with a two percent decline of 359 local jobs. In contrast, outside the local area the majority of locations gain jobs: for the rest of NSW there has been an increase of three percent or +485 jobs, while the rest of Australia has experienced a 0.2% increase or +34 jobs. Net change in jobs is mixed with most locations having a decrease in jobs but overall there are 160 jobs or a one percent increase relative to 2006 local employment levels. Worker Mobility Finding 1 (WMF1): Overall, while results are case specific, in the selected locations there is a general shift from people working locally to people working outside a given LGA.

Table rol enang					DOG LOIT					
	PoUR by LGA	(B=A/Local06%)					(D)		(E=A+D)	(E/A%)
PoW by LGA	Local ª (A)	% of Local 2006*	Rest of NSW b	% of Local	Rest of Australia °	% of Local	Total Rest of NSW + Aust.	% of Local	Net Employment	% of Local 2006*
Carrathool (A)	39	4%	-131	-15%	-4	-1%	-135	-13%	-96	-11%
Griffith (C)	29	0%	35	0%	13	0%	48	1%	77	1%
Hay (A)	-125	-10%	-17	-1%	10	1%	-7	1%	-132	-11%
Jerilderie (A)	97	23%	39	5%	12	2%	51	8%	148	35%
Leeton (A)	-190	-5%	-154	-3%	-5	0%	-159	-3%	-349	-9%
Murrumbidgee										
(A)	-121	-15%	-111	-11%	-10	-1%	-121	-10%	-242	-30%
Narrandera (A)	-38	-2%	-9	0%	11	1%	2	1%	-36	-2%
Total	-309	-2%	-348	-2%	24	0%	-324	-1%	-633	-3%

Table 10. Change in Incoming Worker mobility by LGA, 2006-2011

Notes and Source: Manipulation of ABS 2017⁷¹. **a**. 'Local' is where LGA PoUR = LGA PoW. **b**. Rest of NSW = Total NSW-Local. **c**. Rest of Australia = All Australian States Total – Total NSW. * This is calculated from the previous column. All other columns are calculated from changes in either levels or percentages between 2006 and 2011, that is they are not calculated from the previous column.

Table 10 shows that the changes in incoming workers are case specific. Most LGAs experience a decline of workers from the rest of NSW which more than offsets for most LGAs any increase in incoming workers from the rest of Australia. Overall there is little change on average to incoming workers but again this varies by location. Similarly changes in net employment vary by location and have a range of -30% in Murrumbidgee to +35% in Jerilderie. WMF2: Overall, while results are case specific, in most LGAs incoming workers were in decline between 2006 and 2011.

⁷¹ Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS <u>http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240</u>



⁷⁰ Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS <u>http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240</u>

By comparing the results in Table 9 with those in Table 10 for each location, a sense of the general nature of employment conditions and changes can be ascertained for a given locality. For example, interestingly for Jerilderie, local employment has increased as has incoming employment but outgoing employment has declined. This shows an overall improvement in job opportunities resulting in a decline in workers having to work outside the local area, combined with an increase in local jobs and an increase in incoming workers to fill further vacancies. These conditions suggest a positive jobs environment.

In contrast, employment conditions in Murrumbidgee appear to have worsened. There are fewer local jobs and an increase in outside employment (Table 9) while fewer people are coming in to work in Murrumbidgee from the rest of NSW and the rest of Australia.

WMR4: Outgoing and incoming worker mobility when considered together temporally can provide an indication of the health of employment conditions by measuring and distinguishing between local employment and incoming employment from, and outgoing employment to, the rest of NSW and Australia.

Final Tables for Worker Mobility

The MDBA asked us to prepare the final tables of worker mobility to provide a picture of the inter-LGA mobility (ingoing and outgoing workers in single tables) for the region under consideration. We have done this for 2006 and 2011 as depicted in Tables 11 and 12. In addition, we provide in these tables the next three highest NSW LGAs for mobility and we also provide the rest of NSW and rest of Australia mobility numbers to provide context. These tables further reinforce our recommendations above.

The Issue of 'Small Numbers'

WMR5: On the issue of supposed 'small numbers' for mobility between LGAs – it is the relative and not absolute value of these numbers that is important because this will determine the impact for any given community. This is why we have presented these mobility data as a percentage of local employment above. We recommend a similar approach for the MDBA.

Absolute values only provide impact at the whole of basin or macro economy scale but what's of interest to the MDBA's modelling are the relative impacts; what can be born by a given local community or economy - hence, the percentages provided in the tables above.

Decision by MDBA and KPMG on incorporation of worker mobility impacts on basin effects from water recovery

While the MDBA and KPMG took considerable time and effort to assess the significance of worker mobility on community employment impacts from water recovery, they decided to not incorporate worker mobility into their modelling because they viewed the impacts from doing so to be marginal and most worker commuting was with adjacent LGAs which were captured through the community boundaries of their approach. **WMR6**: KPMG and MDBA should details the steps they took and their findings from their worker mobility research to provide evidence for their decision not to incorporate it in their modelling.



	POW by LGA										
PoUR by LGA	Carrathool (A)	Griffith (C)	Hay (A)	Jerilderie (A)	Leeton (A)	Murrumbidgee (A)	Narrandera (A)	Total	Rest of NSW ^b	Next 3 largest	Rest of Australia ^c
Carrathool (A)	976	128	7	0	3	3	3	1120	279	Lachlan 10 Bland 8 Central Darling 5	14
Griffith (C)	51	9687	3	0	76	62	13	9892	1105	Wagga Wagga 19 Albury 12 Bland 9	57
Hay (A)	3	3	1088	0	0	4	0	1098	139	Wakool 7 Canargo, Cenral Darling each 5 Balranald, Berrigan each 3	20
Jerilderie (A)	0	4	0	511	0	34	0	549	160	Berrigan 58 Urana 7 Wagga Wagga 5	11
Leeton (A)	0	320	8	0	3639	20	139	4126	880	Wagga Wagga 18 Hay 7 Temora, Deniliquin, Albury each 6	22
Murrumbidgee (A)	8	165	4	19	18	681	11	906	343	Carrathool 9Cobar 7 Woollahra 6	9
Narrandera (A)	3	83	0	0	288	6	1686	2066	646	Wagga Wagga 32 Coolamon 10 Lockhart 8	11
Total	1041	10390	1110	530	4024	810	1852	19757			
Rest of NSW ^b	142	837	59	105	463	139	288				
Next 3 largest	Wagga Wagga 13 Greater Hume, Lachlan each 6 Parkes 5	Clarence Valley 20 Wagga Wagga 14 Sydney 11	Balranald 10 Carrathool, Urana, Wakool each 8 Deniliquin 7	Berrigen 57 Conargo 11 Urana 10	Wagga Wagga 31 Coolamon 9 Randwick 7	Urana 6 Wagga Wagga 5	Coolamon 51 Wagga Wagga 26 Camden, Bland, No Usual Address each 8				
Rest of Australia ^c	18	69	23	18	19	3	14				

Table 11. Worker mobility for Selected LGAs 2011 ^a

Notes and Source: Manipulation of ABS 2017⁷². **a**. Yellow Highlight is 'Local' and is where LGA PoUR = LGA PoW. **b**. Rest of NSW = Total NSW-Local. **c**. Rest of Australia = All Australian States Total – Total NSW.

⁷² Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS <u>http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240</u>



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	PoW by LGA										
PoUR by LGA	Carrathool (A)	Griffith (C)	Hay (A)	Jerilderie (A)	Leeton (A)	Murrumbidgee (A)	Narrandera (A)	Total	Rest	Next 3 largest	Rest of Australia ^c
									NSW ^b		Australia
Carrathool (A)			_	-	-	-			260	Lachlan 15 Bland 13	0
	989	103	7	0	0	0	16	1115		Central Darling 12	
Griffith (C)	75	0660	0	0	114	46	22	0026	760	Albury 13 Bland 9	43
11 (4)	75	9009	U	U	114	45	25	9920		Wagga Wagga /	
нау (А)									155	Deniliquin 8 Walgett	11
										Central Darling each	
	12	7	1221	0	0	0	0	1240		3	
Jerilderie (A)	0	_	•	447	<u> </u>	4.65	•		321	Berrigan 87 Urana 16	11
	0	5	0	417	0	165	0	587		Denilliquin 9	
Leeton (A)									635	Wagga Wagga 14	25
										Holrovd, Deniliquin.	
										Blacktown, Bland each	
	3	271	0	0	3853	15	122	4264		3	
Murrumbidgee									310	Urana 4 Deniliquin,	3
(A)										Greater Taree,	
										Waga Woollabara	
	11	199	4	11	19	806	9	1059		each 3	
Narrandera (A)									262	Wagga Wagga 33	17
	0	87	0	3	342	8	1751	2191		Coolamon 24 Urana 13	
Total	1090	10341	1232	431	4328	1039	1921	20382			
Rest of NSW ^b	182	802	76	66	617	250	297				
Next 3 largest	Bland 27	Coolamon 16 No	Balranald 18	Berrigan 22	Wagga Wagga	Wagga Wagga 6	Coolamon 36	•			
	Wagga Wagga	Usual Address	Canargo 8	Canargo 7	37 Coolamon	Berrigan 3 Urana,	Bland 35 Wagga				
	9 Lachlan 6	(NUA) 15 Wagga	Denilíquin 5	Greater Hume	18 Albury 9	Woollahara each 3	Wagga 23				
Post of		vvagga 12		Urana each 3				•			
Australia ¢	22	56	13	6	24	13	3				

Table 12. Worker mobility for Selected LGAs 2006 ^a

Notes and Source: Manipulation of ABS 2017⁷³. **a**. Yellow Highlight is 'Local' and is where LGA POUR = LGA POW. **b**. Rest of NSW = Total NSW-Local. **c**. Rest of Australia = All Australian States Total – Total NSW.

⁷³ Australian Bureau of Statistics. (2017). TableBuilder Pro. Retrieved 14 June 2017, from ABS http://abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder?opendocument&navpos=240



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5. Final Review

This section of the report provides a review of the KPMG draft report⁷⁴ and the MDBA draft Goulburn Murray Irrigation District (GMID) dairy modelling report.⁷⁵ Comments are provided for each in turn.

KPMG Report

General Comments

There is some very thorough modelling done by KPMG for the Southern Basin communities in its draft report. Some careful thinking about how the regression tables and figures can be best presented and explained is required. Copious use of sub-headings, references and explanations in the text or as boxes in the figures will improve the presentation and explanation.

More specific comments follow. The most substantive comment relates to item 27 below on the Seasonal Worker Programme. The other most substantive comment is to ensure that MDBA and KPMG address the criticisms raised by Wheeler et al. (2018) in their review of the Northern Basin community modelling. These are summarised in the updated literature review implications (ULRI) section in this report.

In the methods Section, KPMG should insert those very good diagrams that show by town/community the distribution of key agricultural products for each of the census years with total adding to 100 percent for each town/community. It is believed these diagrams may have helped, at least in part, KPMG and MDBA to develop the 4 or 5 broad categories of communities. See Figure 9 as an example of the diagrams referred to.





Source: KPMG (2017) Southern Basin Community Modelling: Preliminary analysis, findings and evolution of SMDB modelling methodology, Draft, December, KPMG Economics, Sydney, p. 32.

 ⁷⁴ KPMG (2018). Southern Basin Community Modelling: Model Documentation – Draft, 7 June 18. Canberra: KPMG Economics.
 ⁷⁵ MDBA, 2018. Economic Modelling of Dairy Production in the Goulburn-Murray Irrigation District: Third Draft, June 2018. MDBA,



In addition to these figures what happened to all the graphs presented in KPMG (2017)⁷⁶ – Modelling Process: Preliminary Estimates (Round 1, Round 2, and Round 3) – refer to Figure 10; will any of these in updated forms be incorporated into this report because they present well?



Figure 10: Regressions and Figures for rice FTEs and rice ha

Source: KPMG (2017) Southern Basin Community Modelling: Preliminary analysis, findings and evolution of SMDB modelling methodology, Draft, December, KPMG Economics, Sydney, p. 24.

For statistical testing it was found in their initial work that KPMG (2016)⁷⁷ did not apply robust standard errors for the estimation. KPMG should choose the option "White period" in the box "Coef covariance method" when estimating the fixed-effects models. Related to this, KPMG sought our advice on key statistics KPMG should report given the small sample sizes being used and we recommended that the Hausman test statistic should be reported, because it confirms if the Fixed Effects (FE) model is correctly specified versus the Random Effects model. When performing FE estimations, the option "cluster" should be chosen. This option will produce the correction for the reported standard errors if autocorrelation and or heteroskedasticity exist.⁷⁸ KPMG advised that they did conduct the Hausman tests on all of their farm FTE models and they confirmed that fixed-effects was the preferred choice (they state that individual random effects were found to be not consistent).⁷⁹ KPMG has informed us that a short section will be added to their report of these findings.⁸⁰

KPMG should also ensure they incorporate the work they prepared on seasonal workers (separate from but connected to the Seasonal Worker Programme comments) and how this fits into their modelling and results.

⁷⁹ As communicated by Massey, T. KPMG Economics in email to Dr Blackwell on 13 June 2018.

⁸⁰ As communicated by Massey, T. KPMG Economics in email to Dr Blackwell on 13 June 2018.



⁷⁶ KPMG (2017) Southern Basin Community Modelling: Preliminary analysis, findings and evolution of SMDB modelling methodology, Draft, December, KPMG Economics, Sydney.

⁷⁷ KPMG (2017) Southern Basin Community Modelling: Preliminary analysis, findings and evolution of SMDB modelling methodology, Draft, December, KPMG Economics, Sydney, p. 24.

⁷⁸ As communicated to KPMG and MDBA in an email dated 7 November from Dr Hoang via Dr Blackwell.

The final general comment is that where KPMG use a single independent variable, these models can be improved by adding additional variables because the communities are interrelated.

Detailed comments

Front and Section 1

1. Cover page: Presently it is difficult to read a key part of title because of the lack of contrast between the text and the background colour. A suggestion is to place white header a little further up on page so there is white text on dark blue or dark text on light background.

2A. The suggested methodological diagram by Dr Townsend will help summarise key information in the executive summary as well as the methods/approach section of the report.

2B. Insert a table of contents to help guide the reader.

3. There are a tremendous amount of figures, 100 in total. KPMG should be congratulated on this effort in their modelling approach

4. P. 8, paragraph 1, 40 communities: It can be written as 40 instead of 'forty' (or both); a citation is needed here too.

5. 'Under four broad categories' - consider changing to 'using four broad categories'.

6. Remove ',' between 2016 and 'if' under No Basin Plan.

7. Same as above for Basin Plan paragraph.

8. A thorough proof read of the report will aid in its ease of reading, e.g., the first sentence of the second last paragraph on p. 8 is cumbersome. For example, it could be written as: 'The simulation model consists of a system of equations that relate key drivers with each category of a community's employment'. I imagine that is why the categories of employment are listed above on the same page. Alternatively, say exactly what is meant.

• In the final paragraph, if possible (or could be done in MDBA report?), provide more detail as to how this deep knowledge was obtained (e.g. through visits - I would list these along with dates by various officers to the towns and areas documented in the modelling to witness application of water and how this flowed to areas of employment in local economies and communities (shows a real investment in the research/modelling work beyond simply a statistical model and data by developing an *in situ* understanding of local and regional economies and communities).

9. Final paragraph on p. 8: change 'independent reviewer' to 'independent review team' (because Dr McFarlane and Dr Hoang helped with lit review and modelling respectively). Also, change end of sentence to '...regional economies, statistical analysis, review and identification of relevant literature, water reform more generally and regional and community sustainability.'

10. Figure 1.1: The commute concept is good as is how this map has been prepared and Phil's comment about PoW and PoUR work should be documented here to show the lengths to which MDBA/KPMG have gone to be careful with their modelling.

- Also, consider changing the colour of commute radii so that it contrasts with that of the colour of the ocean near Adelaide (otherwise similar colour).
- Also, Mildura is only about 35 mins from Renmark so the two towns could almost fall within one circle. For example, Costas citrus business is spread across several towns in this region and



Mildura helps supply Costas farms near Renmark with spray equipment. To solve this issue you could overlay a third circle that connects the two.

- Dr Townsend's point about using the community boundary map combined with this Figure 1.1 would be useful to show the rivers. The University of Canberra maps (main and subsequent detailed ones) also provide improved clarity (see Figure 11).
- Also if possible, an overlay of the irrigation districts would be good if visibly possible because it would show where significant water infrastructure investment has occurred in the past to support irrigated agriculture in these areas— see Figure 5 as an example in the Murrumbidgee river-basin, though the communities in the KPMG MDBA work would be smaller in geographical scale.



Figure 11: Communities map prepared by University of Canberra.

Source University of Canberra, 2018.81

11. For 3rd dot point on p. 8, insert 'shorter' in between 'with' and 'commuting'. Isn't there more data generally available for the Southern basin as well, including water and farming related data? I imagine the historical record of data, e.g., rainfall data, is longer too because the Southern Basin was probably settled by Europeans prior to the Northern Basin.

12. Fourth dot point on p. 10, instead of 'permanent' crop should the term be 'perennial' to more accurately describe these crops?

⁸¹ University of Canberra, 2018. Data for the MDBA Community Profiles and Report on Seasonal Workers Estimation. University of Canberra, Canberra, Appendix 4.

13. If possible, depending on mapping capabilities in MDBA/KPMG, it would ideal to have a map of general 'blobs' that identify the general location of these groupings on the maps - a geospatial indication for the basis for production and water use in the Southern MDB.

Section 2

14. Dr Townsend's point: Should something be provided up front in the exec summary plus introduction, that is, that modelling results should be considered in the context of a broader set of social and economic conditions and (insert 'and' here) changes occurring in each community.

15. Section 2 maybe a good place to have the diagram that shows how the model's components fit together.

16. My understanding was that the census data were already reported as FTEs through TableBuilder however this may be a new feature of the 2016 census data?

17. Provide another sentence that is explicit about which types of regression techniques (for the more technically inclined reader) to 'For estimation purposes we use regression techniques appropriate for cross section data pooled across time.' Also note here the point above in the general comments about regression techniques and statistical tests along with the updated literature review insights from Wheeler et al. (2018) on appropriate statistical techniques.

18. On the assumption that mining sector employment doesn't change, we know that mining employment can change drastically and quickly and has over the census years. Therefore is this assumption realistic? Probably not but I appreciate that for modelling water impacts *ceteris paribus* has to be assumed for some elements of model. Maybe a footnote on this would be suitable to defend any negative comments in this regard?

19. Excellent with respect to modelling cropping and grazing to separate changes from those related to water policy. Regardless, is it reasonable to assume cropping and grazing remain unchanged for reasoning given above at 18? Similarly, this assumption should be defended as per 18 above.

20. Table 2-3. Why are there only two communities that have scenario 4 modelled?

Section 3

21. Last line of text before Table 3-1, insert 'in' in-between 'employment' and 'each'.

22. P. 22 Dr Townsend's comment about explanation. If you can explain this earlier in document as noted at point 17 above you could use the 'fixed affects' term here without further explanation.

23. First paragraph, p. 23, a grammar check is needed.

24. All tables and figures should be referenced in the text throughout the document. Currently there is limited reference to the regression results in tables and figures. Figures need to be explained more in the text; what are they ascertaining and what are the key findings from each?

25. Suggest insertion of a heading for each of the groupings of figures and associated regression results to will help lead the reader through modelling results.

26. Check grammar on p. 34 second paragraph, last sentence.

27. P. 43: Term 'FNC', state the term in full and then provide abbreviation in brackets so it is obvious to reader what this is (unless have done so already).



P. 58 I think the key finding here is underestimating the employment effects (though significant and correct sign), harvesting and other activities associated with fruit, nuts and citrus (same will hold for other horticulture including vegetables) are currently labour intensive (though growers in some Australian regions are currently trying to develop machines to reduce the labour requirement). Hence the heavy reliance on the Department of Jobs and Small Business' Seasonal Worker Programme (SWP) utilising a migrant and ever growing Pacific Islander workforce (for roughly 6-9 months of the year they live and work in Australia visiting from their home country). SWP workers have been described as reliable, consistent, enduring and organised and help to fill shortages at peak times in Australian labour. Crops are currently expanding and so, water use will be expanding as is labour hired through this program. Do ABS numbers include Seasonal Worker Programme (SWP) employment? Probably not because they are 403 visa holders (rather than domestically employed and census interviewed Australians)? This issue has been comprehensively addressed by the MDBA modelling by undertaking their own surveys of farms and cross checked with farmer groups to established the use of seasonal workers, ⁸² rather than determining the particular source, i.e. domestic or foreign labour. The farm surveys used to estimate seasonal worker requirements resulted from an initial investigation by the University of Canberra that found that estimating seasonal worker demand from current data sources could not be undertaken without substantial error in the estimates.⁸³

28. P. 48, first paragraph is a bit repetitive (common text with p. 46). P. 48 should be trimmed back and re-drafted.

29. Table 3-3. Consider listing entire 40 Communities maybe in two sub columns so visually there is more balance with other columns. Presently, big space looks odd.

30. Again for these sections, **all** tables and figures should be directly referenced in the text. Currently this is limited if not, non-existent.

31. P. 52, last paragraph, 'permanent plantings', do you mean 'perennial plantings'?

32. P. 58. Does point 27 relate here as well for unskilled labour because processing may involve the SWP as well and for this reason employment impacts maybe underestimated?

MDBA GMID Dairy Modelling Report

General Comments

Overall the documentation of what was done in modelling milk production in the GMID is excellent – it explains logically what was done and how it was done. See the specific comments for how the presentation could be improved by bringing some of the summary test statistics (and additional tests that are yet to be done) forward into the document to provide evidence of significance and tests for whether assumptions are breached or not.

While the report is relatively well written, a thorough proof read will help eliminate any stumbling blocks for readers because there are some typographical and grammatical errors throughout, including a lack of use of pronouns at the beginning of sentences, incoherent sentence structure and one two without full stops. **Recommendation GMID Modelling 1 (RGMIDM1)**: A thorough proof read will eliminate any typographical and grammatical and grammatical errors.

While the page numbers are provided at the bottom hand of each page, unless one is in the footer, they do not appear because the grey shade for code is the same as the colour of the text. Unable to read the

⁸² MDBA, 2018. A short report on collection of employment data of seasonal workers in Southern Connected Basin. MDBA, Canberra. ⁸³ University of Canberra, 2018. Data for the MDBA Community Profiles and Report on Seasonal Workers Estimation. University of

Canberra, Canberra.

page number in the electronic word version – Once the document is a pdf one should be able to see them but I imagine you will have both forms of the document.

Specific Comments

Executive Summary

1. The Map is excellent though some town locations in addition to Deniliquin would help readers to understand the relative location of the community with key towns.

2. First paragraph, final phrase in brackets: Some may argue, e.g. Wheeler and others, that investment in irrigation infrastructure while improving water use efficiency, paradoxically increases water use as land under production or scale of operations increase or intensify. William Jeavons was the first to identify this paradox where, in the face of increasing efficient use of coal in the late 1800s, coal consumption increased in a wide range of industries in England (in simple terms, the paradox represents a movement along the demand curve – an expansion of supply – see Figure 12).⁸⁴ Because national reserves in England were being 'exhausted' at the time, subsequent expansion of coal supply was recommended through the development of coal reserves in the colonies including Australia and Canada.⁸⁵ Jeavons argued that, contrary to conventional wisdom, technological progress could not be used to reduce resource consumption. The paradox has his namesake as the **Jeavons paradox** or the **Jeavons effect**. **RGMIDM2**: The MDBA should explicitly address the Jeavons Paradox in regards to water-use efficiency in the MDBA and its impact on water use in the face of water recovery.



3. Modeling approach – begin sentence with 'The' before 'Purpose of the modelling was...'.

4. Define 'BP' in a list of terms or abbreviations and place in full when first mentioned with abbreviation in brackets – I guessed it may have meant 'Basin Plan' - others may not know what it stands for.

5. Multifactor linear modelling – **RGMIDM3:** Because Ordinary Least Squares is incredibly robust even in the face of breaches of some of its assumptions,⁸⁶ the multifactor modelling undertaken by the MDBA provides a initial indication of results, particularly where these are supported through suitable tests. However, it is recommended that future work of the MDBA should use panel data techniques (that encapsulate a mix of modelling cross-sectional and time series data together) in addition to the multifactor linear modelling for the relationship between the basin plan and milk production changes for the GMID and its six communities. These panel data results could then be presented alongside the linear

⁸⁶ Blackwell, B.D., Tisdell, C.A., 2010. The Marginal Values of Lifesavers and Lifeguards to Beach Users in Australia and the United States. Economic Analysis and Policy 40, 209-227. <u>https://doi.org/10.1016/S0313-5926(10)50025-0</u>



⁸⁴ Jeavons, W.S., 1866. The Coal Question: An Inquiry Concerning the Progress of the Nation and the Probable Exhaustion of Our Coal-Mines, 2nd ed. Macmillan and Company, London.

⁸⁵ Marshall, A., 1878. The Coal Question, in: Thorpe, T.A. (Ed.), Coal: Its History and Uses. Macmillan, London.

results to demonstrate any improvement or the robustness of the linear results. Indeed, the conclusion of the report identifies this as a current limitation.

6. **RGMIDM4:** Given the inclusion of milk production in a previous year to model the current year's milk production, time series modelling techniques (which form part of panel data modelling approaches) would be imperative to correct for serial correlation or autocorrelation. Therefore, full regression results and relevant test statistics for various tests for violation and correction of violations for assumptions should be provided for the models (relevant for Appendices too). Currently, t statistics and R^2 are not enough (Also, adjusted R^2 should be used instead of simply R^2). The exemplary R^2 values may also imply violations of some key assumptions. These are worth checking.

7. 2nd page of exec summary, 3rd last paragraph, what is the reason for choosing maximum differences for the following selected years when it is stated that, 'To isolate the impacts of Basin Plan, the maximum differences in the curves for 2002/03-2005/06 and 2011/12-2014/2015 were used'? Also final sentence of this paragraph needs a re-write to make sense. Sensitivity analysis is a great idea but check grammar and typos in this sentence – missing a full stop etc.

8. Table 1 Source: 'details of the estimation are (rather than is) available in section....'.

9. How do you know that the modelling is capable of explain most of the changes in the milk production? **RGMIDM5:** The statement that the modelling is capable of explaining most of the changes in milk production should be substantiated with a phrase or two such as because of high explanatory power of the models or similar? Briefly state here the evidence for this conclusion.

Remaining Sections

10. We would like to see more detail of the community consultations over the past seven years because these would have been significant. **RGMIDM6:** The provision of a table summarizing community consultation efforts of the MDBA social and economic modelling team needs to be prepared to emphasise the investment made here. The table should have dates, communities and number of people visited etc. While the consultation insights is done well with a table and discussion, there is a significant amount of time and effort invested in the consultations to inform the modelling and this should be documented in the report. An additional Table and some discussion would be sufficed.

11. The explanation of each variable for completeness and thoroughness is excellent.

12. A priori, carry over would be important to milk production where it has been used to deliver and raise production.

13. Table 2 – a column noting statistical result summaries for each variable would be useful so reader can see the summary outcomes immediately without having to refer to the Appendices. *, **, ** could be used to quickly identify if variable was significant and to what level of significance.

14. Table 3. Is data available for 2016/17? If so, include.

15. P14 (on menu viewer not on document). Add a sentence or two to explain how milk production from 2004-05 to 2015-16 were used to estimated annual milk supply from each of the six communities between 1999/00 and 2003/04 (also use consistent date years if these are the same – financial year = 2004-05 for example). This is a 'regression' – how was it done – currently not said in paragraph.

16. Presenting the modelled with actual results in graphs for each community and then with and without basin plan are excellent.



17. 3.2 The second model: add to text 'total water available' variable in list of variables used.

18. **RGMIDM7**: Because milk production is more likely to be affected by demand rather than supply, milk prices will be important in determining milk production. Therefore, the MDBA models for milk production should include the milk price. Because milk price data were limited, efforts should be made to obtain additional milk price data so it can be included in the modelling.

Conclusion

Overall, the MDBA modelling of the impacts of water recovery for the communities of the Southern Murray-Darling Basin, including the work of KPMG and University of Canberra, has been undertaken carefully, iteratively and in a comprehensive fashion, contextualized by contextual information, both quantitative and qualitative, obtained from various relevant data sources including extensive *in situ* visits to local towns and regions in the southern basin. There are a number of areas, like in any piece of work, where the MDBA can improve its future modelling and these are outlined in the executive summary of the report and more detail is provided in the body of this report.

