Analysing General Purpose Water Accounting Reports:

Sean Hanley, Water Accounting Standards Development Manager, Bureau of Meteorology, Melbourne, Australia

Samuel Robinson, Water Accountant, Bureau of Meteorology, Canberra, Australia

Introduction

Water accounting, the application of formal accounting procedures to water resources, offers the prospect of improved reporting on the status of water resources, as well as more informed decision-making for a wide variety of stakeholders.

In order to achieve consistent and transparent reporting, the emerging discipline of water accounting requires support in the form of Standards, underpinned by a rigorous Water Accounting Conceptual Framework (WACF). Consistent with its water information responsibilities, the Bureau of Meteorology has issued the WACF and the Exposure Draft of Australian Water Accounting Standard 1 (published in October 2010), which guides the preparation of General Purpose Water Accounting Reports (GPWAR). The Bureau of Meteorology was advised in the development of these products by an independent expert advisory group, the Water Accounting Standards Board (WASB), and the early adopters of general purpose water accounting.

As far the Bureaus is aware, Australia is the first country to adapt a financial accounting model to the specific needs of water management, probably due to the 'opportunity, reform and rights to water that exist in Australia, making water accounting not only possible, but necessary'[1]. Building from this basis, the analysis of GPWAR must provide effective methods for reading and interpreting the information contained in the Report in order to enhance its value to users. Such analysis will enhance the use of water information as the adoption of Australian Water Accounting Standards grows.

[1] Slattery, M 'Making Every Drop Count', in Charter, June 2008 .

This document discusses what value methods of analysis can provide to a user, with the aid of illustrative examples using real data from the limited number of currently published GPWAR. These analyses are focussed on GPWAR prepared for physical catchments by regulatory agencies

Due to the embryonic nature of the development of the discipline of water accounting, limited data is available from which to draw conclusions. This paper identifies several opportunities for further research once additional data becomes available.

Reformatted water accounting statements

A comparison of different GPWAR will often be hampered by the different characteristics of the water report entity. For example, one catchment may rely on local rainfall, while another relies on flows from an upstream catchment for its water asset increases. By grouping components of a water entity according to their function, it is possible to facilitate comparisons in such areas as 'supply' and 'take' activities[2].

- 'Supply' activities are those that enable the core business of the water report entity to continue. For example the collection and storage of water in reservoirs, losses or leakages from water storages, the management of intervalley transfers, and the unaccounted-for difference.
- 'Take' activities are associated with the core business of the water entity; as such, they may include the abstractions of water by customers or license-holders, trade activity by license-holders, water held in pipes or channels used to distribute water, and losses associated with the distribution system.

While this is not the only way that the water accounting statements can be split, given the information known to date, it was considered the most practical.

By presenting the information in this way, it is possible to compare like components. At this stage of the analysis only general conclusions can be drawn from these high-level 'supply' and 'take' components. More specific insights will be drawn later when the reformatted water accounting statements are used for more detailed ratio and analysis.

An example of this high-level analysis is illustrated in **Appendix 1**, in which the published water accounting statements for the Murrumbidgee catchment are separated into 'supply' and 'take' activities. This is summarised in a table along with a sample of similar catchments in **Appendix 2**.

Using this analysis it is possible to make some general observations, such as:

- In most cases, supply water liabilities are zero. The existence of supply water liabilities indicates that the water report entity is part of a larger water market system, and license-holders in the entity actively trade allocation water out of the system.

[2] Similar to the split of 'financing' and 'operating' activities in financial accounting, described in Penman S (2004), *Financial Statement Analysis and security Valuation,* p. 276

- The relationship between the total volume diverted as basic right or unregulated licenses ('take' water asset decreases) and the volume taken as part of allocation announcements (the net of take water liability increases *less* decreases) may give an insight into the degree to which the river is regulated to manage competing demands on the water. If more water is taken as part of allocation announcements, this suggests there is a high degree of such regulation in place.
- Where 'take' water liability decreases are zero, this suggests that actual volumes of diversion are not known – rather, managers assume that license-holders take no more or less than their maximum entitled volume.

Common-size analysis

Common-size analysis is a 'standardisation of line items to eliminate the effect of size'[3]. This facilitates comparisons of different organisations that may be, for example, competitors in the same industry. An example of a common-size analysis using reformatted water accounting statements for the Murrumbidgee catchment in years 2007–10 is given in Table 1 below.

Table 1: Expected range for change between 2009 and 2010, and comparison with Murrumbidgee catchment

Statement of Changes in Water Assets and Water Liabilities[4]	**Murrumbidgee**							
	2010	**%**	**2009**	**%**	**2008**	**%**	**2007**	**%**
Supply: water asset increases	6,065,154	100	3,462,690	100	2,547,233	100	3,067,694	100
Supply: water asset decreases	4,087,936	67	2,427,452	70	1,575,837	62	2,336,578	76
Supply: water liability increases	17,108	0	10,758	0	0	0	1,940	0
Supply: water liability decreases	17,449	0	41,689	1	119,174	5	48,421	2
Supply: change in net water assets	1,977,559	33	1,066,169	31	1,090,570	43	777,597	25
Take: water asset increases	26,119	0	147,474	4	15,050	1	11,432	0
Take: water asset decreases	536,292	9	471,937	14	361,760	14	387,310	13
Take: water liability increases	1,476,100	24	1,295,183	37	1,086,120	43	969,080	32
Take: water liability decreases	443,830	7	676,500	20	456,779	18	165,182	5
Take: change in net water assets	(1,542,443)	25	(943,146)	27	(976,051)	38	(1,179,776)	38
Total change in net water assets	435,116	7	123,023	4	114,519	4	(402,179)	-13

In a GPWAR, a common-size Statement of Water Assets and Water Liabilities would yield little useful information, due to the uniform split of assets and liabilities into the 'supply' and 'take' functions. Further, while this analysis may prove useful when analysing a single catchment with the aid of a long time-series of data, it's usefulness for comparing different catchments will be limited due to the significant climatic variations between regions. In addition, the usefulness of this analysis when comparing changes over time for a single catchment is limited, since this information is apparent by simply comparing the water accounting statements as they are with no additional analysis needed.

[3] Penman S (2004), *Financial Statement Analysis and security Valuation,* p. 298
[4] The Statement of Changes in Water Assets and Water Liabilities

Trend analysis

Trend analysis requires a long time-series of data, and while this will become an increasingly important technique for analysing GPWAR as the discipline of general purpose water accounting matures, there is insufficient data available to make definitive conclusions at the present time.

There is one high-level analysis that can be performed with only two years of data, which is to compare the percentage change in specific volumes over a set period for a number of similar entities: where one entity experiences a change that is outside the expected range, it may suggest an area of particular interest to a GPWAR user.

To illustrate this method, a sample of similar catchments was taken, and the percentage change from 2009 to 2010 in each 'supply' and 'take' category was used to identify the expected range of change in each category. One of the sampled entities, the Murrumbidgee catchment, was then compared to the expected range to identify any areas of special interest.

With only two years of data available, the results cannot be used as conclusive evidence of a trend per se, but rather are useful indicators of irregular conditions or events that occurred in the 2010 reporting year that could require further investigation.

A sample worksheet setting out the percentage change in volumes from 2009 to 2010 for the individual catchments sampled for this example is given in **Appendix 3**. The results are presented in table 2, and could be interpreted as follows:

- That naturally-occurring inflows and outflows increased more than the expected range (affecting the supply water asset increases and decreases), which could suggest either that the weather conditions in the Murrumbidgee became significantly wetter than in the other catchments surveyed, or that the guaranteed annual supply coming from the Snowy Hydro scheme significantly helped to boost available supplies.
- The volume of water made available for licensed use ('take' water liability increases) increased in the Murrumbidgee at a higher rate than might be expected compared to other entities, which is a likely result of the increased amount of water that flowed into storages through wetter conditions and the guaranteed flow from Snowy Hydro.
- The result for 'supply' water liability increases is not useable in this example. Murrumbidgee is the only catchment to report Intervalley transfers, so the comparison with other entities does not provide meaningful data.

- ‘Take’ water asset increases are lower than expected, which is attributable to a significant decrease in the volume of water ‘borrowed’ by irrigators from the Snowy Hydro system. This is a unique arrangement in place for the Murrumbidgee catchment, and so again does not provide meaningful data in the context of a comparison with other entities.
- The ‘take’ change in net water assets increased more than expected, which could suggest that license holders in Murrumbidgee are increasing their bank of claims to water carried over to the following year more than license holders in other catchments. Though, upon further consideration of the carryover rules associated with this water report entity, this would seem unlikely as there are significant restrictions in the level of carryover permitted compared to other water report entities.

Importantly, underpinning the utility of trend analysis is that ‘apples’ are being compared with ‘apples’, which may not always be the case in catchment to catchment. As can be seen from the last dot point above, the initial analysis may lead to one conclusion, but on further research, the administrative conditions of the water report entity would suggest this is unlikely.

Table 2: Expected range for change between 2009 and 2010, and comparison with Murrumbidgee catchment

Expected trends 2009–10	**Lower bound**	**Upper bound**	**Murrumbidgee**	**Within expected range?**
Statement of Water Assets and Water Liabilities				
Supply: total water assets	81%	126%	122%	yes
Supply: total water liabilities	100%	100%	100%	yes
Supply: net water assets	81%	126%	121%	yes
Take: total water assets	52%	173%	170%	yes
Take: total water liabilities	62%	112%	107%	yes
Take: net water assets	60%	143%	105%	yes
Statement of Changes in Water Assets and Water Liabilities				
Supply: water asset increases	54%	163%	175%	no
Supply: water asset decreases	53%	167%	168%	no
Supply: water liability increases	85%	135%	159%	no
Supply: water liability decreases	65%	115%	42%	no
Supply: change in net water assets	11%	184%	185%	no
Take: water asset increases	51%	122%	18%	no
Take: water asset decreases	81%	135%	114%	yes
Take: water liability increases	14%	105%	114%	no
Take: water liability decreases	19%	170%	66%	yes
Take: change in net water assets	46%	156%	164%	no

Ratio analysis

A more detailed analysis is possible by using ratio analysis, which allows comparisons to be made between specific items. In these examples, ratios will be used to address several general questions about the water report entities included in the sample.

How much water was made available to consumptive water users? How much was taken? How does that compare to other catchments, or other years?

1. The 'take' margin ratio[5] is used to assess what proportion of water allocation was actually diverted or is being carried over. Looked at over time, this ratio allows a reader to track the activation of 'sleeper' and 'dozer' licenses held by users who did not previously take any or all of their allocated volume.

Description	'Take' margin: the volume of water that was supplied (to users), taken or delivered, relative to the volume that was committed to be supplied, taken or delivered
Formula	$\frac{Take:water\_liability\_increases - water\_liability\_decreases}{Take:water\_liability\_increases}$

2. The planned 'take' contribution ratio[6] measures the relationship between the volume diverted as basic rights unregulated and other opportunistic diversions relative to the volume made available to licenses via allocation.

Description	Planned 'take' contribution ratio: the relationship between basic right/unregulated/opportunistic 'take' and the volume allocated to licenses
Formula	$\frac{Take:water\_asset\_decreases}{Take:water\_liability\_increases}$

3. The planned 'take' ratio[7] enables a user to determine what proportion of water coming in from supply activities were planned or allocated to be taken by consumptive water users. This allows a GPWAR user to assess whether water use is at a level appropriate to the natural inflows.

Description	Planned 'take' ratio: per ML of water entering the supply

[5] Similar to the 'operating profit margin' ratio used in financial statement analysis, calculated as operating net income/sales
[6] A similar ratio exists in financial statement analysis: the 'financial income contribution ratio', calculated as financial net income/sales
[7] The 'expense ratio' is a similar ratio used in financial statement analysis. It is calculated as operating expenses/sales

	system, the volume of water that was planned to be taken
Formula	$\frac{Take : water\_asset\_decreases + water\_liability\_increases}{Supply : water\_asset\_increases}$

4. The actual 'take' ratio shows what proportion of natural inflows and other supply activities were actually taken by consumptive water users. This assists an assessment of whether the water use is at a level appropriate to the natural inflows.

Description	Planned 'take' ratio: per ML of water entering the supply system, the volume of water that was actually taken
Formula	$\frac{Take : water\_asset\_decreases + water\_liability\_increases - water\_liability\_decreases}{Supply : water\_asset\_increases}$

5. Return on net 'take' water assets[8] can be used to determine whether the carried over water liabilities are large or small compared to the volume of water that was taken during the reporting period.

Description	Return on net 'take' water assets: the extent to which water was not taken during the reporting period but is being carried over into the following period.
Formula	$\frac{Take : change\_in\_net\_water\_assets}{Take : net\_water\_assets}$

6. Irrigation water storage efficiency expresses the volume of water released from a storage (i.e. not lost as seepage and evaporation) as a percentage of water received into the storage[9]. This ratio is not possible for all catchments, as information at this granular detail is typically only provided in the note disclosures.

Description	Irrigation water storage efficiency is a measurement of how much water flowing into a storage is made available to take for irrigation in a reporting period, less the volumes that are lost to irrigation and seepage, or stored for a future period. This level of detail is usually provided in the statements; however, it is sometimes only provided in the notes. It cannot be calculated using the reformatted water accounting statements used for the previous ratios
Formula	$\frac{Water\_\text{sup}plied\_to\_irrigation}{Inflows\_to\_storages}$

How much water was made available to the environment? How much was taken? How does that compare to other catchments, or other years?

[8] Similar to the financial accounting ratio 'return on net operating assets': operating net income/ closing net operating assets
[9] Australian National Committee on Irrigation and Drainage (2001, Rural Water Industry Terminology and Units (2nd ed.).

7. The total planned environmental water ratio enables a user to determine what proportion of water coming in from supply activities was planned or allocated to be left for the environment.

Description	Total planned environmental water ratio: per ML of water entering the supply system, the volume of water that was planned to be left in the system
Formula	$1 - \frac{Take : water\_asset\_decreases + water\_liability\_increases}{Supply : water\_asset\_increases}$

8. The captured natural inflows ratio expresses the volume of water that is not released from a storage as a percentage of water received into the storage. Information at this granular detail is typically only provided in the note disclosures. It cannot be calculated using the reformatted water accounting statements used for most of the previous ratios.

Description	Captured natural inflows ratio: a measurement of how much water flowing into a storage is released, either for consumptive use or for environmental benefit. It allows a reader to understand the extent to which natural flows have been affected by river regulation.
Formula	$\frac{Water\_released\_from\_storages}{Inflows\_to\_storages}$

9. The percentage of annual natural system inflows held in storage is another useful ratio for measuring the degree of regulation that exists in the catchment at a higher level than the captured natural inflows ratio, which can be more storage-specific.

Description	Percentage of annual natural system inflows held in storage: per ML of water entering the supply system, the volume that is held in storage at the end of the reporting period
Formula	$\frac{Supply + Take : total\_water\_assets}{Supply : water\_asset\_increases}$

How much water was available at the beginning and end of the year? Will it be enough for the next year?

10. The purpose of the ratio return on 'supply' net water assets[10] in GPWAR is to assess the overall change in available water for the reporting period, relative to the volume that is remaining in storage.

Description	Return on 'supply' net water assets: the volume of water that was added to the pool of available water in the reporting period, relative to the volume still remaining
Formula	$\frac{Supply : change\_in\_net\_water\_assets}{Supply : net\_water\_assets}$

11. The quick ratio[11] is used to assess the ability of the water report entity to meet its present obligations.

Description	Quick ratio: the ability of a water report entity to meet its undelivered present obligations with its available and suppliable water assets.
Formula	$\frac{Supply + Take : total\_water\_assets}{Supply + Take : total\_water\_liabilities}$

12. The allocation to physical flow ratio[12] is used to assess whether the water commitments made during the current year are going to be possible in the following year, given the same reporting conditions.

Description	Allocation to physical flow ratio: the ability of a water report entity to meet its core business commitments in the following reporting period, assuming similar climatic conditions to the current reporting period.
Formula	$\frac{Take : total\_water\_liabilities + water\_asset\_decreases + water\_liability\_increases}{Supply : total\_water\_assets + change\_in\_net\_water\_assets}$

What were the climatic conditions during the year: wet, dry or median? How did this affect the water stores and water use?

[10] Similar to financial statement ratio 'return on net financial assets' calculated as financial net income/closing net financial assets

[11] There is also a 'quick ratio' used in financial accounting, calculating as current assets/current liabilities

[12] Similar to the 'debt to cash flow ratio' from financial accounting, calculated as current liabilities/cash flow from operations

13. The run-off ratio is the ratio of run-off to precipitation, used to make general comparisons between whole regions. Variations in this ratio are the result of continental scale climatic differences, not at the catchment level. This is useful for providing general information about climatic differences between catchments.

Description	The run-off ratio is calculated as run-off/precipitation, which can be calculated using the supply information from the reformatted statements.
Formula	$\frac{Supply : Water\_asset\_increases}{Supply : Water\_asset\_increases + water\_asset\_decreases}$

14. The surface water/ groundwater 'take' ratio compares the use of groundwater for consumptive use to the use of surface water. This ratio changes with the climatic conditions; in dry conditions users increase their reliance on groundwater due to a scarcity of surface water. More surface water is used in wet or median conditions, as it is generally less expensive to access.

Description	Surface water/groundwater take ratio: calculated as groundwater 'take'/ surface water 'take'. This information is only available in some catchments and is only possible using reformatted statements when they have been prepared separately for surface water and groundwater.
Formula	$\frac{Take : Surface\_water\_take}{Take : Groundwater\_take}$

Historically these type of analyses (ratio) have occurred in the water industry, but with a more simplistic approach; i.e. total water made available compared to total water taken; total water taken to total water ordered, etc. It is expected that, with a more standardised approach to water reporting (through the application of Australian Water Accounting Standards), the level and complexity of ratio analysis made available in water reporting will increase to assist decision-making in the allocation of resources.

As an illustrative example of how these ratios might assist a reader to analyse a GPWAR, they have been applied to a number of published GPWAR (see a sample in **Appendix 3**). An upper and lower bound has been calculated using the mean and variance of these ratios and, when compared with ratios from a single report, it is possible to identify irregularities that warrant further investigation by the reader.

The expected values for ratios are set out in Tables 3–6 under the general questions to which they relate. From this information, it is possible to make assessments regarding the Murrumbidgee catchment in 2010:

How much water was made available to consumptive water users? How much was taken? How does that compare to other catchments, or other years?

- There are no unusual results in this section of the analysis, suggesting that the available water was allocated and taken in a manner consistent with the other catchments in the sample. As such, there are no irregularities that would warrant further investigation
- Ratio 5 'Return on net take water assets' has a very wide range of expected values, which suggests that there is such a large variation between entities for this ratio that it is not a useful ratio with which to enable meaningful comparisons between entities.
- Without a longer time-series of data, it is not possible to assess the activation of 'sleeper' and 'dozer' licences in this catchment.
- It could be noted, however, that the volume of water taken as a proportion of total available water is consistently in the higher end of the expected range, suggesting that slightly more water is diverted in this catchment than in the other catchments included in the sample.

Table 3: Expected values for consumptive water use ratios and comparison with Murrumbidgee 2010 report

Ratios	Lower bound	Upper bound	Murrumbidgee 2010	Within expected range?
1. 'Take' margin	0.55	0.82	0.70	yes
2. Planned 'take' contribution ratio	0.08	4.37	0.36	yes
3. Planned take ratio	0.13	0.39	0.33	yes
4. Actual take ratio	0.10	0.31	0.26	yes
5. Return on net 'take' water assets	-29.93	11.60	2.63	yes
6. Irrigation water storage efficiency	-0.30	2.25	0.57	yes

How much water was made available to the environment? How much was taken? How does that compare to other catchments, or other years?

- As for consumptive water use, no irregular results that appeared for the analysis of environmental water during the 2010 reporting year. Based on the results below, it appears that environmental water in the Murrumbidgee catchment was made available in a manner consistent with the other catchments surveyed.

Table 4: Expected values for environmental water ratios compared with Murrumbidgee 2010 report

Ratios	Lower bound	Upper bound	Murrumbidgee 2010	Within expected range?
7. Total planned environmental water ratio	0.61	0.87	0.67	yes
8. Captured natural inflows ratio	0.69	1.12	0.80	yes
9. Percentage of annual natural system inflows held in storage	0.26	0.60	0.29	yes

How much water was available at the beginning and end of the year? Will it be enough for the next year?

- It can be seen from the following table that the return on net supply water assets in 2010 was higher than expected for the Murrumbidgee catchment, which confirms that the volume of water entering the system and not leaving was significantly higher in Murrumbidgee than in other catchments surveyed. This may in part be attributable to the additional flow entering the Murrumbidgee catchment from the Snowy Hydro scheme.
- The quick ratio for the catchments included in this analysis has a large variance, resulting in a wide range of expected values. This calls into question its use in enabling comparisons of GPWAR between different catchments.
- The allocation to physical flow ratio is just outside the expected range and is not greater than 1.0, suggesting that if conditions in the following reporting period are similar to the current reporting period, there is enough water available to meet commitments. Compared to the other catchment in this analysis, a larger proportion of available water would be allocated to extractive use in the following reporting period.

Table 5: Expected values for water availability ratios and comparison with Murrumbidgee 2010 report

Ratios	Lower bound	Upper bound	Murrumbidgee 2010	Within expected

				range?
10. Return on net 'supply' water assets	0.30	0.58	1.17	**no**
11. Quick ratio	-1.79	44.29	2.75	yes
12. Allocation to physical flow ratio	0.39	0.66	0.71	**no**

What were the climatic conditions during the year: wet, dry or median? How did this affect the water stores and water use?

- The run-off ratio is higher than the upper bound in the expected range, suggesting that Murrumbidgee sits in a wetter climate than the other catchments surveyed. This is an unexpected result, and may not be the result of a wetter climate in Murrumbidgee, but rather the effect of the inflows form the Snowy Hydro scheme, which have an impact only on the Murrumbidgee and Murray catchments.
- The higher than expected surface water/ groundwater ratio indicates that a greater proportion of surface water was used than groundwater in Murrumbidgee catchment relative to other catchments. This suggests that either there was relative abundance of surface water during the reporting period (as it can be expected that groundwater will only be used where surface water is scarce, due to the increased cost of accessing it) or a relative lack of accessible groundwater.

Table 6: Expected values for climatic ratios and comparison with Murrumbidgee 2010 report

Ratios	**Lower bound**	**Upper bound**	**Murrumbidgee 2010**	**Within expected range?**
13. Run-off ratio	0.53	0.56	0.60	**no**
14. Surface water/ groundwater ratio	0.59	2.26	2.57	**no**

Analysing the Note Disclosures

Information gap analysis

In most GPWAR there will be a line item for 'unaccounted-for difference'. This element of the water accounting statements is used to bring the recorded volume of a water asset or water liability – calculated using the Statement of Changes in Water Assets and Water Liabilities – to the actual measured volume. Additional information about the unaccounted-for difference should be included in the note disclosures.

This volume is the product of three potential information gaps:

- Have not identified all the relevant water assets and water liabilities, and associated changes
- Have not been able to recognise certain water assets, water liabilities, and associated changes on the water accounting statements because of a lack of information
- Large errors may be associated with the quantification approaches employed

Two ratios may assist in identifying whether the information gap is material:

1. Unaccounted-for difference and total water assets: the size of the unaccounted-for difference can be considered in relation to the size of the assets that are contained within the water report entity.

$$\frac{Unaccounted-for\_difference}{Total\_water\_assets}$$

2. Unaccounted-for difference and change in net water assets: the contribution of the unaccounted-for difference to the overall change in net water assets indicates the amount of uncertainty that is contained in that calculation.

$$\frac{Unaccounted-for\_difference}{Change\_in\_net\_water\_assets}$$

Some insights are notable from the indicators presented in Table 7:

- Relative to other published GPWAR, the unaccounted-for difference in Murrumbidgee 2010 is very small. This suggests that all the significant elements of the water report entity have been identified and can be quantified with representational faithfulness.
- The second ratio, 'unaccounted-for difference and change in net water assets', is not a useful tool for comparing between catchments, as the variation in this ratio results in a very large range of expected values.

Table 7: Expected values for information gap ratios and comparison with Murrumbidgee 2010 report

Ratios	Lower bound	Upper bound	Murrumbidgee 2010	Within expected range?
1. Unaccounted-for difference and total water assets	0.5	1.9	0.1	no
2. Unaccounted-for difference and change in net water assets	4.9	30.6	0.5	no

Quantification impact analysis

Uncertainty in water information is an inherent issue that must be kept in mind when analysing GPWAR. The Exposure Draft of Australian Water Accounting Standard 1 requires information about the quantification techniques employed and their associated accuracy to be included in the note disclosures. In particular, the potential variation in water assets and water liabilities could be an important factor in influencing report user's decision-making.

The following analysis has been performed by multiplying the reported volume and each line item's uncertainty rating in the Murrumbidgee 2010 water accounting statements. For example, the surface water asset 'River' for Murrumbidgee is reported as 30,494 with an accuracy rating of 'B' (± 25%) (see **Appendix 1**). The reported volume can be multiplied by 125% and 75% to come up with an upper and lower bound, respectively.

As can be seen in Table 8, the variation in the supply net water assets figure is very significant and reflects uncertainty about the volume of water that can be made available to water users. While surface water and groundwater assets are not split in this example, performing this analysis separately for these components is likely to provide an additional level of insight into the reliability of volumes reported for water resources.

Table 8: Quantification impact on reformatted Statement of Water Assets and Water Liabilities

Murrumbidgee Reformatting	**Lower bound**		**Reported volumes**	**Upper bound**	
Statement of Water Assets and Water Liabilities	**2010**	**± %**	**2010**	**± %**	**2010**
Supply: total water assets	1,144,148	-33	1,712,633	33	2,281,118
Supply: total water liabilities	15,397	-10	17,108	10	18,819
Supply: net water assets	1,128,751	-33	1,695,525	33	2,262,299
Take: total water assets	22,871	-25	30,494	25	38,118
Take: total water liabilities	554,661	-10	616,290	10	677,919
Take: net water assets	(531,791)	-9	(585,796)	9	(639,802)

Uncertainty in quantification can have a significant impact on ratios. The impact of this analysis on reported figures for Murrumbidgee for the years 2007–10 are presented in **Appendix 4.**

The volumes for 2010 are presented in Table 9 and compared with the expected range for each ratio that was calculated earlier for the ratio analysis. The adjustment of the reported volume has resulted in two ratios relating to the consumptive use of water moving to outside the expected range.

The planned and actual 'take' ratios are higher than the expected range when adjusted downwards. This analysis would indicate that the diversion of water may account for a larger proportion of natural inflows in the Murrumbidgee catchment than in other catchments included in the sample.

Overall, there were few significant changes in the information reported for Murrumbidgee, suggesting that while there is uncertainty associated with some volumes, overall the GPWAR is a reliable, faithful representation of the water report entity.

Table 9: Quantification impact on ratio analysis

Murrumbidgee Ratio analysis	**Expected range**		**Lower bound**	**Reported volumes**	**Upper bound**	**Within expected range?**
	Lower	**Upper**	**2010**	**2010**	**2010**	
1. 'Take' margin	0.5	0.8	0.7	0.7	0.7	yes
2. Planned 'take' contribution ratio	0.1	4.4	0.4	0.4	0.4	yes
3. Planned 'take' ratio	0.1	0.4	0.6	0.3	0.3	**no**
4. Actual 'take' ratio	0.1	0.3	0.5	0.3	0.2	**no**
5. Return on net 'take' water assets	-29.9	11.6	2.8	2.6	2.8	yes
6. Irrigation water storage efficiency	-0.3	2.2	0.6	0.6	0.6	yes
7. Total planned environmental water ratio	0.6	0.9	0.4	0.7	0.7	yes
8. Captured natural inflows ratio	0.7	1.1	0.8	0.8	0.8	yes
9. Percentage of annual natural system inflows held in storage	0.3	0.6	0.4	0.3	0.3	yes
10. Return on net 'supply' water assets	0.3	0.6	0.5	1.2	1.5	no
11. Quick ratio	-1.8	44.3	2.0	2.8	3.3	yes
12. Allocation to physical flow ratio	0.4	0.7	1.5	0.7	0.5	no
13. Run-off ratio	0.5	0.6	0.5	0.6	0.6	no
14. Surface water/ groundwater ratio	0.6	2.3	2.6	2.6	2.6	no

Conclusion

The investigation of several tools for GPWAR analysis shows the potential to assist a reader to understand the information contained in the Report and to therefore make more informed decisions about the allocation of resources. It was also found that some analyses did not provide useful information, as demonstrated using a sample of real life examples:

- Common-size analysis
- Return on net take water assets ratio
- Quick ratio

While these analyses were able to be tested using some published GPWAR, prepared in accordance with the Exposure Draft of Australian Water Accounting Standard 1 , it is not possible to produce conclusive benchmarks or evidence due to the lack of a long time-series available GPWAR. As the voluntary adoption of water accounting standards becomes more commonplace, both the spatial and temporal coverage will increase. This allows for the analysis of GPWAR to develop into a useful, important discipline of water accounting.

This paper has identified several basic analyses; however, there are several areas of future research that can be identified to further develop the new discipline of analysing GPWAR. With the preparation of GPWAR becoming more common among water managers, an investigation could be conducted to assess the extent to which analysis has enhanced the usefulness of GPWAR for users. This research could extend the focus from physical catchments to include GPWAR prepared by organisations.

There are a large number of indicators and assessments included in water sharing plans and it may prove useful to conduct research into how these existing analyses could be incorporated into new methods of analysing GPWAR. A comparison of the assumptions underpinning these water plans and the actual information reported in GPWAR would be a useful research exercise once enough data has become available (water sharing plans may be in place for a 5–10 year period). While water accounting is a new, developing discipline, it is possible to borrow from the more mature disciplines of hydrology, hydrography and others involved in water management that have already developed expertise in monitoring and reporting water information. An avenue for future research may be to access this knowledge through interviews to determine what analyses and information they use to enhance decisions.

Appendix 1: Reformatting the Murrumbidgee water accounting statements

Components classified as 'take' activities are highlighted in grey.

Statement of Water Assets and Water Liabilities

WATER ASSETS (ML)	Accuracy	Notes	30-Jun-10	30-Jun-09
SURFACE WATER ASSETS				
Surface Water Storage				
Blowering Dam	A	1	**742,803**	541,628
Burrinjuck Dam	A	1	**426,010**	385,535
Berembed Weir	A	1	**2,175**	2,175
Gogeldrie Weir	A	1	**3,750**	3,750
Hay Weir	A	1	**12,900**	12,900
Redbank Weir	A	1	**5,570**	5,570
Maude Weir	A	1	**750**	750
Tom Bullen Storage	A	1	**372**	372
River	B	2	**30,494**	17,982
Total Surface Water Storage			**1,224,824**	970,662
Claims to Water				
Intervalley Trade Account (IVT)	A	3		(227,341)
Daily Release Balance (DRB)	A		**76,946**	71,616
Total Claims to Water			**47,944**	(155,725)
TOTAL SURFACE WATER ASSETS			**1,272,768**	814,937
GROUNDWATER ASSETS				
Groundwater Storage	D	4		
Mid Murrumbidgee			**6,008**	13,279
Lower Murrumbidgee			**435,349**	363,753
TOTAL GROUNDWATER ASSETS			**441,357**	377,032
TOTAL WATER ASSETS			**1,714,125**	1,191,969
WATER LIABILITIES (ML)				
SURFACE WATER LIABILTIES				
Allocation Accounts	A	5		
General Security			**480,581**	220,602
High Security			**(1)**	0
Local Water Utility			**(2)**	0
Domestic and Stock			**(37)**	(9)
Coleambally Irrigation Conveyance			**4,265**	1,050
Murrumbidgee Irrigation Conveyance			**37,697**	46,306
Conveyance (Main River)			**860**	590
Environmental Ware Allowance 1 Account			**50,000**	50,000
Environmental Ware Allowance 2 Account	A		**13,925**	32,374
Translucent and Transparent Unmet Releases			**17,108**	0
TOTAL SURFACE WATER LIABILITIES			**604,396**	350,913
			742,803	541,628
TOTAL WATER LIABILITIES			**426,010**	385,535
NET WATER ASSETS			**1,109,729**	841,056

Statement of Changes in Water Assets and Water Liabilities

SURFACE WATER (ML)	Accuracy	Notes	30-Jun-10	30-Jun-09
WATER ASSET INCREASES				
Physical Inflows				
Blowering Dam Inflow (Natural Component)	A	6	**341,679**	32,210
Blowering Dam Inflow (Snowy Accountable Component)	A	6	**588,000**	450,000
Blowering Dam Inflow (Snowy Accountable Pre-Release)			**12,000**	138,000
Burrinjuck Dam Inflow	A	6	**463,752**	224,127
Rainfall				
Blowering			**21,975**	20,878
Burrinjuck			**25,538**	20,931
River			**25,638**	15,326
Gauged Tributaries	A	7	**274,967**	179,268
Ungauged Tributaries	C	8	**113,000**	70,000
Return Flows				
Coleambally Irrigation	A	9	**13,521**	9,277
Murrumbidgee Irrigation	A	9	**598**	197
River inflow from Aquifer	D	10	**4,845**	6,057
River Inflow from Storage Releases	A	26	**1,162,434**	939,199
Daily Release Balance Increase	A	11	**5,330**	0
IVT account increases				
Water provided to Murray via Balranald & Darlot (Clearances)	A	3	**119,567**	54,872
Murrumbidgee RAR provided to Murray via Snowy	A	3	**200,000**	200,000
Allocation account trade into Murrumbidgee	A	3	**55,659**	17,223
TOTAL WATER ASSET INCREASES			**3,428,503**	2,377,565
WATER ASSET DECREASES				
Physical Outflows				
Evaporation				
Blowering	B	14	**22,281**	24,874
Burrinjuck	B	14	**26,579**	30,985
River	C	15	**77,369**	83,404
Storage Releases	A	25		
Environmental (Burrinjuck Transparency)			**27,288**	108,279
Environmental (Burrinjuck Translucency)			**28,104**	7,609
Other			**1,107,042**	823,311
End of System Flow	A	16		
Balranald				
Other			**71,280**	60,342
IVT accountable			**115,891**	44,981
Darlot				
Other			**37,734**	21,081
IVT accountable			**3,676**	9,891
Diversions to Lowbidgee	A	17		
EWA Provided			**33,614**	22,686
Licenced Environmental			**57,233**	300
Other			**19,724**	4,925
Uncontrolled Flow Licenced Extractions	A	18	**21,916**	0
Supplementary Flow Licences Extractions	A	19	**23,552**	1,649
Basic Rights Extraction Estimate	C	20	**4,560**	4,560
River Outflow to Aquifer (Method 'A' Accounting Area)	C	10	**121,996**	114,297

IVT account decreases				
Flows provided from Murray (Via Finley Escape)	A	3	**10,444**	16,136
Allocation Account Trade out of Murrumbidgee	A	3	**166,443**	406,976
UNACCOUNTED VOLUME (Balancing Item)	**A**	**22**	**215,500**	**258,412**
TOTAL WATER ASSET DECREASES			**2,192,226**	2,044,698
WATER LIABILITY INCREASES				
Available Water Determinations	A	21		
Domestic and Stock			**34,142**	34,137
General Security			**509,804**	400,836
High Security (Aboriginal Culture)			**475**	301
High Security			**338,999**	327,193
High Security (Research)			**304**	304
High Security (Town Water Supply)			**18,781**	18,781
Local Water Utility			**22,407**	22,407
Coleambally Irrigation Conveyance			**114,688**	87,043
Conveyance (Main River)			**801**	623
Murrumbidgee Irrigation Conveyance			**172,373**	162,897
New Licences Created			**15**	0
Internal Trading of Allocation Account Water - Buyers	A	13	**190,473**	223,438
Return Flow Recredits	A	9	**619**	0
Allocation account water trade in from Murray	A	3	**55,659**	17,223
Snowy Borrow	A	12	**0**	0
Undelivered T/T releases account increase	A	11	**17,108**	0
WSP Planned Environmental Water Balance Adjustments	A	11	**0**	10,758
EWA2 Account Increase	A	11	**16,560**	0
TOTAL WATER LIABILITY INCREASES			**1,493,208**	1,305,940
WATER LIABILITY DECREASES				
Account Forfeiture	A	5		
Domestic and Stock			**7,320**	5,412
General Security - Account Conversion Forfeit			**0**	10,416
General Security			**15,002**	5,147
High Security (Aboriginal Culture)			**5**	0
High Security (High Security)			**2,356**	5,325
Local Water Utility			**9,843**	7,867
Murrumbidgee Irrigation Conveyance			**14,187**	10,407
Conveyance (Main River)			**81**	219
Coleambally Irrigation Conveyance			**3,088**	1,293
Movement of Uncontrolled Usage to General Security Account			**23**	0
Internal Trading of Allocation Account Water- Sellers	A	13	**190,473**	223,438
Allocation account trade out to Murray	A	3	**166,443**	406,976
Payback of Snowy Borrow	A	12	**17,449**	41,689
EWA Usage			35,009	0
Account Balance Corrections	A	27	**0**	0
TOTAL WATER LIABILITY DECREASES			**461,279**	718,189
CHANGE IN SURFACE WATER ASSETS			**204,348**	(254,885)

GROUNDWATER (ML)				
WATER ASSET INCREASES				
Physical Inflows				
Method 'A' Accounting Area				
Lateral Flows	C	10	**19,100**	19,764
Recharge - Rainfall	C	10	**132,083**	91,809
Recharge - Flood	C	10	**0**	0
Recharge - Irrigation	C	10	**242,791**	246,729
Aquifer Inflow from River	C	10	**121,996**	114,297
Method 'C' Accounting Area				
Recharge	D	X	**2,146,800**	760,000
TOTAL WATER ASSET INCREASES			**2,662,770**	1,232,599
WATER ASSET DECREASES				
Physical Outflows				
Method 'A' Accounting Area				
Groundwater Pumping	A	23	**316,639**	366,034
Lateral Flows	D	10	**110,727**	108,668
Evapotranspiration	D	10	**19,434**	20,908
Aquifer Outflow to River	D	10	**4,845**	6,057
Method 'C' Accounting Area				
Groundwater Pumping	C		**6,000**	6,000
GW loss			**2,140,800**	754,000
TOTAL WATER ASSET DECREASES			**2,598,445**	1,261,667
Total Water Asset Increase			**6,091,273**	3,610,164
Total Water Asset Decrease			**4,790,671**	3,306,365
Total Water Liability Increase			**1,493,208**	1,305,940
Total Water Liability Decrease			**461,279**	718,189
CHANGE IN NET WATER ASSETS			**268,673**	(283,953)

Appendix 2: Summary of a sample of reformatted water accounting statements, for the Statement of Water Assets and Water Liabilities (SWAWL) and Statement of Changes in Water Assets and Water Liabilities (SCWAWL)

SWAWL	**Murrumbidgee**		**Peel**		**Namoi**		**Macquarie**	
	2010	**2009**	**2010**	**2009**	**2010**	**2009**	**2010**	**2009**
Supply: total water assets	1,712,633	1,401,328	101,836	110,565	528,135	392,715	456,519	496,028
Supply: total water liabilities	17,108	0	0	0	0	0	0	0
Supply: net water assets	1,695,525	1,401,328	101,836	110,565	528,135	392,715	456,519	496,028
Take: total water assets	30,494	17,982	179	136	288	3,615	2,580	2,354
Take: total water liabilities	616,290	578,254	0	0	38,282	62,187	40,890	78,855
Take: net water assets	(585,796)	(560,272)	179	136	(37,994)	(58,572)	(38,310)	(76,501)
SCWAWL	**Murrumbidgee**		**Peel**		**Namoi**		**Macquarie**	
	2010	**2009**	**2010**	**2009**	**2010**	**2009**	**2010**	**2009**
Supply: water asset increases	6,065,154	3,462,690	490,730	826,022	1,743,548	1,434,719	1,978,026	1,311,297
Supply: water asset decreases	4,087,936	2,427,452	473,630	791,973	1,560,902	1,117,666	1,915,286	1,171,018
Supply: water liability increases	17,108	10,758	0	0	0	0	0	0
Supply: water liability decreases	17,449	41,689	0	0	0	0	0	0
Supply: change in net water assets	1,977,559	1,066,169	17,100	34,049	182,646	317,053	62,740	140,279
Take: water asset increases	26,119	147,474	0	0	0	0	0	0
Take: water asset decreases	536,292	471,937	13,074	8,341	199,047	214,985	39,862	47,025
Take: water liability increases	1,476,100	1,295,183	48,292	42,110	14,799	71,889	42,596	123,614
Take: water liability decreases	443,830	676,500	35,580	34,548	4,277	3,758	34,401	15,728
Take: change in net water assets	(1,542,443)	(943,146)	(25,786)	(15,903)	(209,569)	(283,116)	(48,057)	(154,911)

Appendix 3: Percentage change in 'supply' and 'take' components from reporting years 2009 to 2010

SWAWL	**Murrumbidgee**	**Peel**	**Namoi**	**Macquarie**	**Belibula**	**Lachlan**
Supply: total water assets	122%	92%	134%	92%	77%	105%
Supply: total water liabilities	100%	100%	100%	100%	100%	100%
Supply: net water assets	121%	92%	134%	92%	77%	105%
Take: total water assets	170%	132%	8%	110%	156%	102%
Take: total water liabilities	107%	100%	62%	52%	100%	101%
Take: net water assets	105%	132%	65%	50%	156%	101%
SCWAWL						
Supply: water asset increases	175%	59%	122%	151%	40%	103%
Supply: water asset decreases	168%	60%	140%	164%	40%	88%
Supply: water liability increases	159%	100%	100%	100%	100%	100%
Supply: water liability decreases	42%	100%	100%	100%	100%	100%
Supply: change in net water assets	185%	50%	58%	45%	29%	219%
Take: water asset increases	18%	100%	100%	100%	100%	100%
Take: water asset decreases	114%	157%	93%	85%	100%	100%
Take: water liability increases	114%	115%	21%	34%	24%	50%
Take: water liability decreases	66%	103%	114%	219%	5%	61%
Take: change in net water assets	164%	162%	74%	31%	79%	95%

Appendix 4: Summary of ratios for a sample of published GPWAR

Ratio	Murrumbidgee		Namoi		Macquarie		Lachlan		Pioneer	Logan	Moreton	Gold Coast
	2010	2009	2010	2009	2010	2009	2010	2009	2010	2010	2010	2010
1. 'Take' margin	0.7	0.5	0.7	0.9	0.2	0.9	0.7	0.7	1.0	1.0	1.0	1.0
2. Planned 'take' contribution ratio	0.4	0.4	13.5	3.0	0.9	0.4	15.6	7.9	0.0	0.0	0.0	0.0
3. Planned take ratio	0.3	0.5	0.1	0.2	0.0	0.1	0.2	0.2	0.1	0.0	0.0	0.4
4. Actual take ratio	0.3	0.3	0.1	0.2	0.0	0.1	0.2	0.2	0.1	0.0	0.0	0.4
5. Return on net 'take' water assets	2.6	1.7	5.5	4.8	1.3	2.0	7.0	7.5	2.9	0.0	2.8	0.0
6. Irrigation water storage efficiency	0.6	na	6.0	na	0.5	0.3	0.1	0.2	na	na	na	na
7. Total planned environmental water ratio	0.7	0.5	0.9	0.8	1.0	0.9	0.8	0.8	0.9	1.0	1.0	0.6
8. Captured natural inflows ratio	0.8	1.1	na	na	1.2	0.7	0.6	1.2	na	na	na	na
9. Percentage of annual natural system inflows held in storage	0.3	0.4	0.3	0.3	0.2	0.4	0.5	0.5	0.2	0.2	1.7	0.7
10. Return on net 'supply' water assets	1.2	0.8	0.3	0.8	0.1	0.3	0.5	0.2	0.4	0.2	0.2	0.3
11. Quick ratio	2.8	2.5	13.8	6.4	11.2	6.3	16.4	15.8	6.0	0.0	153.5	0.0
12. Allocation to physical flow ratio	0.7	1.0	0.4	0.5	0.2	0.4	0.3	0.4	0.5	0.2	0.0	0.4
13. Run-off ratio	0.60	0.59	0.53	0.56	0.51	0.53	0.57	0.53	0.52	0.51	0.61	0.56
14. Surface water/ groundwater ratio	2.6	na	0.5	na	1.9	1.4	0.1	0.1	na	na	na	na