Victorian Civil and Administrative Tribunal

Alanvale Pty Ltd & Anor v Southern Rural Water & Ors (includes Summary) (Red Dot) [2010] VCAT 480 (21 April 2010)

Last Updated: 29 April 2010

RED DOT DECISION SUMMARY

The practice of VCAT is to designate cases of interest as 'Red Dot Decisions'. A summary is published and the reasons why the decision is of interest or significance are identified. The full text of the decision follows. This Red Dot Summary does not form part of the decision or reasons for decision.

VICTORIAN CIVIL AND ADMINISTRATIVE TRIBUNAL

ADMINISTRATIVE DIVISION

PLANNING AND ENVIRONMENT LIST	VCAT REFERENCE NO. P549/2008 & P571/2008 LICENCE APPLICATION NOS. GW 05 012 & GW 4008405
IN THE MATTER OF	P549/2008 - Alanvale Pty Ltd P571/2008 - A J & K M Graham Pty Ltd v Southern Rural Water

BEFORE	Helen Gibson Deputy President; Ian Potts, Member Graeme David, Member

NATURE OF CASE	Sustainability of groundwater resource; impact of climate change and climate variability of rainfall considered
POTENTIAL GUIDELINE DECISION	Yes
REASONS WHY DECISION IS OF INTEREST OR SIGNIFICANCE	
APPLICATION – significant, interesting or unusual use or development; application of policy, provision or principle; or circumstances	Applications under section 64 of the *Water Act* 1989 to review decision of water authority not grant licences for extraction of groundwater – consideration of inputs and outputs of water balance for aquifer – sustainability of groundwater resource – impacts of climate change and climate variability on rainfall recharge of aquifer – application of precautionary principle

SUMMARY

This case concerns the strategic management of water resources and the long term sustainability of groundwater as a valuable but finite resource.

Rainfall is the key to the longer term security of this resource. However, rainfall is subject to short and long term variability, as well as long term climate change influences. There is evidence that the pattern of rainfall is in a state of change. What has happened in the past will not be the same as what we can expect to happen in the future.

Applying the precautionary principle, the Tribunal has decided that the licences, which are the subject of review in this proceeding, should not be granted due to lack of certainty about the existing and future projected availability of groundwater within the relevant groundwater management area. The serious, and potentially irreversible, environmental damage that depletion of this resource may cause means that the long term

sustainability of the resource needs to be established with more certainty before additional licenses are granted.

The transfer of unused, existing allocations is to be encouraged to make more efficient and strategic use of the available resource in light of the uncertainty surrounding the possible impacts from new allocations.

If the outcome of additional work justifies further allocations being made, some consideration needs to be given as to how a limited and scarce resource should be allocated amongst competing interests. This should be based on a more strategic, holistic approach to the requirement under the *Water Act* 1989 to take account of the purpose for which the water will be used.

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PLANNING AND ENVIRONMENT LIST

VCAT REFERENCE NOS. P549/2008 & P571/2008
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CATCHWORDS

Applications under section 64 of the *Water Act* 1989 to review decision of water authority not grant licences for extraction of groundwater – consideration of inputs and outputs of water balance for aquifer – sustainability of groundwater resource – impacts of climate change and climate variability – application of precautionary principle

APPLICANT IN P549/2008	Alanvale Pty Ltd
APPLICANT IN P571/2008	A J & K M Graham Pty Ltd
RESPONSIBLE AUTHORITY IN BOTH MATTERS	Southern Rural Water
RESPONDENTS	Dr Robert Baulch & Ors
SUBJECT LAND IN P549/2008	'Alanvale' 2790 Woolsthorpe Heywood Road Hawkesdale

SUBJECT LAND IN P549/2008	'Hepworth' Princess Highway Yambuck
WHERE HELD	Melbourne
BEFORE	Helen Gibson Deputy President; Ian Potts, Member Graeme David, Member
HEARING TYPE	Hearing
DATES OF HEARING	28 September to 1 October, 5, 6, 8, 9 October and 4 November 2009
DATE OF ORDER	21 April 2010
CITATION	Alanvale Pty Ltd & Anor v Southern Rural Water & Ors (includes Summary) (Red Dot) [2010] VCAT 480

ORDER

1. In Applications P548/2008 and P571/2008, the decision of the Responsible Authority is affirmed.
2. In licence application GW 05012 by Alanvale Pty Ltd for extraction of 1,220 Ml per annum, no licence is granted.
3. In licence application GW 4008405 by AJ and KM Graham Pty Ltd for extraction of 280Ml per annum, no licence is granted.

Helen Gibson	Ian Potts	Graeme David
Deputy President	**Member**	**Member**

APPEARANCES

For Alanvale Pty Ltd and AJ & KM Graham Pty Ltd	Mr H McM Wright QC & Mr A Finanzio of counsel instructed by Minter Ellison. They called the following witnesses: • Mr John Nolan, engineer and hydrogeologist, Hyder Consulting • Associate Professor John Webb, hydrogeologist, LaTrobe University
For Southern Rural Water Authority	Mr S Molesworth QC and Ms S Porritt of counsel instructed by Macpherson & Kelley. They called the following witnesses: • Mr Greg Hoxley, hydrogeologist,

	Sinclair Knight Merz; • Dr Anthony Kiem, hydroclimatologist, University of Newcastle • Dr Richard Benyon, forest hydrologist, recently of CSIRO
For Respondents	Dr Robert Baulch in person, Mr Ron Learmonth, Mr Kieron Moore, Mr Michael McNamara, Mr Russell Bell and Mr David Rowbottom.

INFORMATION

Description of Licence Application	Alanvale seeks a licence to extract 1220 Ml per annum for the irrigation of 204ha of lucerne and maize in support of dairy grazing operations and cutting of hay/silage. Extraction is proposed from five bores screened to depths of 122m to 144m within the Port Campbell Limestone aquifer in the Hawkesdale Groundwater Management Area. Graham seeks a licence to extract 280 Ml per annum for the irrigation of 58ha of pasture to support beef grazing operations. Extraction is proposed from two bores screened at depths of 50-70m within the Port Campbell Limestone aquifer in the Hawkesdale Groundwater Management Area.
Nature of Review Applications:	Section 64 of the *Water Act* 1989.
Nature of licence applications:	Section 51 of the *Water Act* 1989 to take and use water.
Relevant sections of the *Water Act* 1989 referred to:	Sections 1, 53 and 40(1)(b) – (m).

Cases referred to	*Castle* v *Southern Rural Water* [2008] VCAT 2440; *Western Water v Rozen & Others* [2008] VSC 382; *Telstra Corporation v Hornsby Shire Council* [2006] NSWLEC 133.

REASONS

INTRODUCTION

1. Alanvale and Graham seek groundwater extraction licences from Southern Rural Water Authority for their respective properties north-west of Port Fairy. These properties lie in the Hawkesdale Groundwater Management Area (the Hawkesdale GMA).
2. The Authority refused their applications. Alanvale and Graham seek a review of these decisions, while Dr Baulch and other local landholders support the Authority's decision.
3. We have had the benefit of detailed scientific evidence presented by both the applicants and the Authority. Dr Baulch and other landowners have given us the benefit of their direct observations about groundwater levels in their bores and the behaviour of other natural systems. The issues raised and the evidence presented are complex. At the root of all the issues and evidence is the question of the long-term sustainability of the groundwater resource.
4. Despite the applicants' contention that this is not a case about climate change, we consider that climate change gives rise to some fundamental uncertainties about key assumptions which influence a proper assessment of the long term availability of the groundwater resource. Applying the precautionary principle, we have concluded that the licences should not be granted due to a lack of certainty about the existing and future projected availability of groundwater within the Hawkesale GMA. The serious, and potentially irreversible, environmental damage that depletion of this resource may cause means that the long term sustainability of the resource needs to be established with more certainty before additional licenses are granted.
5. We are not saying there is no possibility that these licenses should ever be granted. We are saying that a better understanding of the

aquifer is required and the potential affects on it from climate change. We also consider that a more strategic approach to the overall use of groundwater and its management should guide future allocations.

SUMMARY OF PARTIES' POSITIONS

Southern Rural Water

1. The Authority's principle reasons for refusing the licence applications are as follows:
   - The Authority has currently only a preliminary understanding about the behaviour and sustainable resource levels of the aquifers in the Hawkesdale GMA, which the Alanvale and Graham applications target.
   - The preliminary understanding is that the present level of groundwater replenishment to the aquifers is in balance or possibly slightly in deficit with the current level of extraction.
   - Assessment of future climate conditions indicates that rainfall, which replenishes the aquifers (known as recharge), is likely to decrease, with a consequential lessening of available resources.
   - There is a high probability that groundwater provides base flow to surface water streams, wetlands and other ecosystems. These systems could be adversely impacted by over allocation of the groundwater resource.
   - There is a risk of increased coastal intrusion into the aquifer by seawater if the deeper limestone aquifer is over allocated, resulting in long term loss of some existing freshwater supplies which are currently being extracted.
   - Depletion of the aquifer would result in regional falls of water levels. This in turn would mean that shallow stock and domestic bores, which represent the majority of bores in the area, would need to be deepened. The Authority considers this would be an unfair and inequitable impact on these existing users.
2. Given the above concerns, the Authority argues that it is proper to apply a precautionary approach in its consideration of new

allocations. Accordingly, it is refusing to make new allocations of groundwater in the Hawkesdale GMA until such time as it has more confidence in the sustainable nature of the resource.

3. The Authority also highlights that other applications for new allocations have been refused. It submits that it would be unfair to grant the Alanvale and Graham applications without granting the others. However, to grant all the new applications would be of even more concern for the reasons given above.
4. As an alternative to seeking new allocations, the Authority says that there are sufficient unused allocations within the GMA for Alanvale and Graham to purchase existing entitlements and transfer such entitlements to meet their needs. Such trading is encouraged and indeed forms the basis of the Authority's recent approval of such transfers to Alanvale and Graham.[1]

Alanvale and Graham

1. Alanvale and Graham argue that the Authority has adopted an approach that is too conservative. In their view, consideration of these applications should not be based on the impacts of climate change or the application of the precautionary principle, but upon empirical evidence. They argue that the water balance assessment process demonstrates that there is sufficient capacity within the Hawkesdale GMA to accommodate the volumes of extraction being sought and that such allocations would not have a detrimental impact. Their argument is premised on the basis of errors or uncertainties in the approach taken by the Authority in the preliminary assessment of the groundwater resource, the water balance and the sustainable level of use. They argue that the margin of uncertainty and possible errors in the assessment undertaken on behalf of the Authority are so large that the comparatively smaller volumes being applied for would not affect the sustainability of the resource nor have the impacts suggested by the Authority.
2. The applicants argue that an unduly conservative approach is unfair. They submit that such an approach is tying up resources which are otherwise being lost as outflow from the GMA or underutilised.[2]
3. Alanvale and Graham argue that a management regime can be set in place to regulate their proposed use that can respond in a timely basis to any indications of resource depletion. They submit that licence

conditions can be prepared that could 'wind back' extraction levels if the aquifer was placed under too much stress and adverse impacts detected.

Objectors

1. Dr Baulch and other landholders in the Hawkesdale region object to the licence applications made by Alanvale and Graham. They express concern about the potential for large scale extraction to impact on their generally shallower bores, which are used for stock and domestic water supplies. They are also concerned about the potential impact to flows in the Eumeralla River and other waterways said to be fed by groundwater inflows. The depletion of such flows is not only detrimental to the environment, but has a pragmatic impact, as these flows supply water for firefighting over the fire season.

SUSTAINABLE MANAGEMENT OF GROUNDWATER

Shifting values

1. Groundwater is an extremely valuable economic and environmental resource. However, it is not limitless. As the effects of drought and climate change make themselves felt, there has been a community-wide shift in values so far as water is concerned by the public, government, business and the farming community. It is now much better appreciated what a scarce, precious and valuable resource water is.
2. This appreciation underpinned the Victorian Government's 2004 White Paper *Our Water: Our Future*. It led to significant amendments to the *Water Act 1989*, which *inter alia* introduced the capacity to transfer and trade water rights. It has also led water authorities responsible for issuing ground water licenses to abandon past, less sophisticated attitudes towards the grant of licenses and to adopt a more restrained, cautious approach.
3. Many groundwater management areas (GMAs) now have a permissible consumptive volume declared under the *Water Act 1987*. This is something that a water authority must take into account when considering licence application.[3] There are many GMAs where no new licenses can be granted because the permissible consumptive volume has been reached or exceeded.
4. In this context, an area where new licenses may still be applied for

and where there is an apparently plentiful and secure supply of groundwater is likely to be an area that will attract economic investment, especially agricultural investment.

5. This scenario is illustrated by the two licence applications, which are the subject of these proceedings. Alanvale seeks a licence to extract 1,200 MI per year and Graham a licence for 280 MI per year. Each proposes to use the water for irrigation of pastures to support dairy and beef grazing operations respectively.
6. In the Hawkesdale GMA, irrigation to produce fodder and support more intensive grazing and dairying operations represents a newer, growing use of groundwater compared to its historic and ongoing use for stock and domestic purposes.
7. When applications for new, large volume licenses are made, such as by Allanvale and Graham, other landholders reliant on shallow stock and domestic bores become worried. They are concerned that the new bores will lower the water level in the aquifer and cause their bores to go dry.
8. We acknowledge this concern, although we do not consider that the potential to use the groundwater resource by deep pumping from the aquifer should necessarily be limited solely by reason of impact on shallow groundwater users who have the capacity to maintain their supply by deepening their bores.
9. Nevertheless, potential impacts on existing users need to be understood. Balancing the competing interests of shallow aquifer users and deep aquifer users should be part of a more strategic assessment of managing overall use of the groundwater resources. Competition between these users should not fall to be decided on a case by case, ad hoc basis.
10. With the shift in values placed upon water, we consider the critical issue is the long term sustainability of the groundwater resource as distinct from minor fluctuations from year to year in groundwater levels. It is the long term sustainability that will underpin a more strategic and appropriate allocation of the resource.
11. Sustainability is the key message permeating all aspects of the *Water Act* 1989. Indeed, one of the purposes of the Act is:

1(d) to make sure that water resources are conserved and reasonably managed for sustainable use for the benefit of present and future Victorians.

1. The role of the Minister under the Act includes making sure that a program of sustainable water strategies is undertaken for the state in accordance with the Act.[4]
2. Water corporations established under the Act are bound by the following sustainable management principles:

1. **Sustainable management principles for water corporations**

Each water corporation, in performing its functions, exercising its powers and carrying out its duties must have regard to the following principles—

(a) the need to ensure that water resources are conserved and properly managed for sustainable use and for the benefit of present and future generations; and

(b) the need to encourage and facilitate community involvement in the making and implementation of arrangements relating to the use, conservation and management of water resources; and

(c) the need to integrate both long term and short term economic, environmental, social and equitable considerations; and

(d) the need for the conservation of biological diversity and ecological integrity to be a fundamental consideration; and

(e) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty as to measures to address the threat should not be used as a reason for postponing such measures.

1. When the Tribunal reviews any decision by a water corporation, it should also have regard to these principles when exercising its discretion, as well as considering other matters identified under the Act.

Our approach in this proceeding

1. There are a range of matters that we must consider under the *Water Act* 1989 when making a decision whether to grant a licence. Not all of these matters are necessarily determinative in this case. The fundamental question arising in this proceeding is, as we have noted earlier, the long term sustainability of the groundwater resources in the Hawkesdale GMA. The likely impact to water quality, impact on

other existing authorised users and the potential impacts on groundwater fed waterways are also important, relevant issues.

2. We have considered the basis of each party's arguments in response to these matters. We agree with the submissions by Alanvale and Graham that a decision should turn on a common sense interpretation of the available evidence about the condition of the aquifers and the possible impacts that the additional extraction may have. In addressing these questions however, we do not agree with them that the potential risk of adverse impact is low. We find that the level of uncertainty is too great and the potential impacts of making the wrong decision are so serious as to warrant a cautious approach.
3. In arriving at this conclusion, we recognise that these matters are the subject of considerable technical and complex expert evidence. We have sought to address the principal, determinative matters in relation to this evidence and to balance the sometimes competing views in the evidence.
4. We acknowledge that overall there has been agreement between the expert hydrogeologists about the current groundwater conditions, which are said to be in a general state of equilibrium between the volume of groundwater entering and the volume leaving the Hawkesdale GMA. That said though, there is a divergence of views in the evidence about the various factors that are leading to this equilibrium and how the groundwater system will behave under future extraction, land use and climate scenarios. We have addressed this divergence in views within these reasons.
5. We have then considered how the precautionary principle is relevant in the light of our findings on the evidence. Finally, we have had regard to those matters we are required to take into account under the *Water Act* 1989.

The burden of proof

1. On behalf of the applicants, Mr Wright suggested that the Authority has unacceptably required the applicants to prove the refusal to grant the licences to be the wrong decision. He submitted that the Authority has incorrectly adopted a high handed position that it is right about the risks because it has spent so much time and money on assessing the Hawkesdale GMA. He argued that such a presumption of correctness is invalid and that the Authority's decision and the

basis on which it has been made must be subject to scrutiny.

2. We disagree with these arguments about burden of proof. Our review is *de-novo* with the decision to be made on the basis of all the evidence and submissions put before us.
3. Our role has been to weigh up the evidence and take the preferred decision that best accords with the purposes of the Act. In this application these purposes are about ensuring a sustainable use of the groundwater resource without adverse impact to other existing or future uses and the environment.
4. Our role has also been to act as an expert tribunal and to investigate and test the soundness of all the submissions and evidence before us. We see no unfair advantage being given to either side in terms of who has had to perform what investigations. The reality is that the assessment and management of groundwater is an intricate task. There are many factors to be assessed. The complexity, and hence the time and costs of such assessments, is part and parcel of the management of the resource.
5. We see no presumption of correctness, only that the Authority has relied on certain expert advice while the applicants for review have relied on other advice. In reality, we find there is not a lot of difference in the underlying evidence from both parties. The differences lie in the views taken as to how to best approach the task of sustainable management.

THE STATUTORY REGIME FOR ALLOCATING WATER

Statutory framework

1. The *Water Act* 1989 requires that the 'taking and using' of water, be it groundwater or water from other sources, shall be licensed.[5] The Minister or a delegate, in this case the Authority, has been given power under the Act to decide whether such a licence should be granted.[6] In making such a decision whether to grant or refuse a licence, the Minister or the Authority (and now this Tribunal) are required to consider a range of matters.[7] They include the matters set out in paragraphs (b) to (m) of section 40(1). The licence may issued subject to conditions.[8]

Matters to be considered under the Act

1. The range of matters to be considered is extensive and not all are

relevant to these particular applications. We concur with the view set out in *Castle* v *Southern Rural Water*[9] about the relative importance of various considerations:

[45] The various considerations listed in s.40 (1)(b) to (m) inclusive does not indicate their ranking in order of importance. In any particular case some of these considerations may be relevant whilst others are not. Furthermore, some may be relevant but of little importance whilst others may be of considerable importance. Furthermore, the relative importance of various considerations may vary from case to case. ...

1. It is clear to us from the submissions and technical evidence presented in these proceedings that not all the extensive list of matters under section 40(1) and other sections of the Act are determinative in this matter. Those that are include:
   - In relation to the matters set out in paragraphs (b) to (m) of section 40(1) of the Act:
     – The existing and projected availability of water in the area;
     – The existing and projected quality of water in the area;
     – Any adverse effect the allocation or use of the water may have on, amongst other matters, existing authorised uses of water or on an aquifer;
     – The need to protect the environment;
     – The proper management of the aquifer;
     – The purposes for which the water is to be used; and
     – The needs of other potential applicants.
   - The permissible consumptive volume for the area[10] and whether the allocation 'will or may result' in it being exceeded for 'that year or a future year'.[11]

Permissible consumptive volume

1. In relation to the permissible consumptive volume for the Hawkesdale GMA, it is common ground that the allocation of the requested volumes would not result in it being exceeded. The Authority says however that the permissible consumptive volume for the Hawkesdale GMA was arrived at not by a technical consideration of sustainable supply, but by an administrative step that involved totalling existing and applied for allocations at a point in time. It

submitted that there cannot be a high degree of confidence that this estimate of a permissible consumptive volume will necessarily achieve a sustainable outcome.

2. Whatever the merits or lack thereof for such an approach in estimating the permissible consumptive volume, it is the volume that has been declared for the area and one that we must have regard to. If these allocations do not result in the permissible consumptive volume being exceeded, there is no ground for refusal on this basis.
3. Nevertheless, the fact that the estimate of the permissible consumptive volume is an administrative rather than a technical outcome highlights a relevant uncertainty. The uncertainty is that this permissible consumptive volume limit will not necessarily result in a long-term sustainable outcome for the Hawkesdale GMA. Accordingly, the fact that it will not be exceeded is not something that we place great weight on. Rather, the means of setting this limit highlights the need to assess most carefully the likely availability of groundwater in the area and those other relevant matters under section 40(1)(b) to (m) set out above that flow from such an assessment.

THE WATER BALANCE OF THE HAWKESDALE GMA

1. Whilst a seemingly simple question, the resolution of the long term sustainability of the groundwater resource requires consideration of a range of factors. Central to this issue is the concept of the water balance for the Hawkesdale GMA and the way it is potentially impacted by a range of matters, such as climate change and climate variability; the effects of timber plantations (land use); groundwater and surface water interactions; geological features; and current usage.
2. The Authority relies on a preliminary assessment of the groundwater resource prepared by SKM under the direction of Mr Hoxley.[12] A fundamental component of this assessment is a water balance of the groundwater system of the Hawkesdale GMA.
3. It is the waster balance approach that has led the Authority to refuse the grant of the licences. The integrity of the water balance forms the basis by which Alanvale and Graham seek to demonstrate capacity to accommodate their respective applications. It is necessary therefore, to consider this water balance method in some detail.

Description of the water balance method

1. The water balance seeks to identify and estimate the major or most significant volumes of groundwater entering and leaving the aquifers within the Hawkesdale GMA. All the experts agree that the inputs and outputs identified in the SKM 2007 assessment are appropriate and that no other components need be accounted for.[13] The components of the water balance identified in the SKM assessment are set out in the following table:

Groundwater inputs or 'gains'	**Groundwater outputs or 'losses'**
Rainfall recharge	Extraction by pumping
Seepage from streams or other surface water bodies	Evapo-transpiration, especially from deep rooted trees
Inflows from up gradient aquifers	Seepage into streams or other surface water bodies
	Outflow into adjoining groundwater management areas
	Outflows to the sea (coastal discharge)
Vertical leakage into the Port Campbell Limestone aquifer*	Vertical leakage out of the Newer Volcanics Basalt aquifer*

* The loss and gain from these pathways is said to balance and thus there is no net loss from the Hawkesdale GMA.

1. Conceptually, the balancing between inputs and outputs can be thought of as being like a large basin with some 'holes' in its base. A schematic representation of such a model is included in Appendix A.
2. Inflows represent the filling of the basin, while the 'holes' each represent an output or loss. The 'holes' are small and represent losses at certain rates. Thus the basin does not just drain straight away. In fact, if the sum total of the rates of inputs or gains equals the sum total of the rates of losses or outputs, the basin will contain a constant volume of water and the water level in the basin will stay constant.
3. If the rate of the summed inputs exceeds the rate of the summed losses, the water level in the basin will rise. *Vice versa*, if the summed rate of the outputs is greater than those of the inputs, the water level will fall.
4. In rising or falling, the change in water level may affect the rate of one or more inputs or outputs and thus the system may at some point

re-establish a new balance (a new equilibrium), with a new water level. Scientists sometimes refer to such behaviour as a system with a feedback loop.

5. This simplified water balance model has been used by Mr Hoxley and other expert hydrogeologists to represent the groundwater system within the Hawkesdale GMA. All the experts acknowledge that such an approach is regularly used in groundwater resource assessments.
6. Messrs Hoxley, Nolan and Associate Professor Webb also generally agree that the limited monitoring data on groundwater levels for the Hawkesdale GMA (and the down gradient Yangary GMA, which we discuss later) indicates a general pattern of groundwater levels holding steady within a 1m to 2.5m band of variation over the last eight to ten years or so. They agree that this behaviour shows that despite some short term variations, there is a balance between aquifer inputs and outputs.
7. Where the expert hydrogeologists diverge in their views is the quantum of some of the inputs and outputs. They also disagree on whether an increase in pumping represented by the Alanvale and Graham applications would so significantly alter the balance that a new equilibrium would be established at levels that would adversely impact other groundwater users and groundwater dependant ecosystems.
8. To take the schematic analogy further, the representation in Appendix A shows a water level above the outlets for shallow groundwater pumping and for river and other surface water bodies. The shallow pumping represents local stock and domestic bores. The evidence of the hydrogeologists and submissions from local landholders are that these bores are generally drilled only to shallow depths as only small flows from the bores are required. It also keeps the expense of drilling to a minimum. These bores therefore generally draw water from the upper part of the Port Campbell Limestone aquifer or from the overlying Newer Volcanics Basalt aquifer (where present).
9. Irrigation bores require larger flows. Accordingly, for performance and supply reasons they are drilled deeper into the Port Campbell Limestone.
10. From the schematic one can think of increasing the volume of deeper

extraction as akin to making the corresponding lower, deep pumping outlet hole larger. Greater groundwater volumes are drawn from the basin, and the water level is drawn down. If it were drawn down so much that the higher outlet hole representing the shallower stock and domestic bores is now above that level, then no groundwater is available to these bores. What occurs in reality is that the water levels fall in the aquifer to levels that may decrease the flow achievable from shallow bores or result in these bores 'going dry'.

11. A similar effect happens where shallow groundwater levels result in discharge to surface streams and other water bodies, such as wetlands. Falling groundwater levels will decrease the rate and volume of such discharges.
12. Thus the balancing of the system and assessing where a new equilibrium may occur depends in part on how the system will behave under the current and additional stress of extraction.
13. The balancing of the system will also depend on future projections of inputs. The inputs are the subject of some variability as they are all (in one way or another) subject to recharge from rainfall. Hence they are affected by climate behaviour.
14. To add further complexity to the situation, the Hawkesdale GMA is bounded to the south in part by the Yangary GMA and in part by the coastline.
15. The Yangary GMA is an area where there is widespread, intensive use of groundwater for irrigation and extensive use for stock purposes. This use and the stability of groundwater levels in this area is dependant in part on the groundwater flow from the Hawkesdale GMA into it.
16. The storage and flow of groundwater within the Hawkesdale GMA balances the pressure of seawater at the coast, which because of its greater salinity and hence greater density would otherwise push inland through the aquifers. This phenomenon occurs in all coastal aquifers and is known as coastal intrusion or seawater intrusion.
17. Whilst there is some dispute as to how far this natural phenomenon of intrusion is currently occurring, all the expert hydrogeologists agree that altering the water balance, outflows and groundwater levels at the coast would result in seawater intruding further inland. At the simplest level, the consequences of increased seawater intrusion can mean salinisation of previously useable groundwater.

Water balance figures

1. We have not included the figures calculated by the Authority and the applicants as part of the water balance table at this point because we take the view it is more important to consider the principles relating to the issues affecting the water balance.
2. The values determined under SKM's assessment have however figured largely in the assessment process and in the testing of evidence in these applications.
3. SKM produced two water balances. One is based on long term rainfall data and the other on ten years of rainfall data between 1996 and 2006. The latter represents SKM's view of a dry period that would be representative of ongoing conditions under drier climate change scenarios. The water balance values also reflect the division of the GMA into three zones by SKM, said to reflect management zones generally aligned along groundwater flow paths.
4. Much of the focus of examination of the water balances was on the latter, 1996 to 2006 dry period. These values are said to represent the average yearly balance over the ten years to 2006.
5. We have not sought to compare these values or otherwise undertake a forensic assessment of differences between SKM's values and those prepared by other experts. All are subject to varying degrees of uncertainty. The key issue is that we have found that more work is required to provide a greater level of certainty to the key inputs and outputs identified in the water balance. It is also unnecessary, in view of our findings discussed later about how the water balance method should be applied, to make a definitive finding as to what we consider the water balance to be and whether, at this particular point in time, there is 'spare' capacity to allocate the specific volumes, which have been applied for by Allanvale and Graham.

Key considerations affecting the water balance

1. Taking into account these matters and the evidence of the respective experts, we have identified the following as key considerations affecting the water balance:

- The influence of climate variability and climate change on rainfall recharge;
- The effects of timber plantations on groundwater storage;

- Groundwater and surface water interactions;
- The potential risks of and impacts from coastal intrusion.

2. By considering these influences on the water balance we have been able to assess the degree of certainty that exists in terms of our knowledge about the condition of the Hawkesdale GMA and its water balance. This has then guided our application of the precautionary principle.

CLIMATE CHANGE AND CLIMATE VARIABILITY

The significance of rainfall

1. Rainfall is fundamental to the sustainability of the Hawkesdale GMA. In the absence of any other evidence to the contrary, we accept that rainfall is the source of recharge to the Newer Volcanic Basalt and Port Campbell Limestone aquifers within the GMA. It is also the source of recharge to the aquifers hydraulically upgradient to the GMA and therefore the source of groundwater inflows from such upgradient areas. Rainfall is also the source of stream flows that in some circumstances may additionally recharge the aquifers.
2. In terms of sustainability, there is a difference between the long and short term sustainability of groundwater dependant on rainfall. This is because rainfall dependant groundwater systems respond to both longer and shorter term cycles of rainfall activity. Shorter term cycles of rainfall activity are limited to climate variability whereas longer term cycles will reflect changes due to climate change. Therefore, a distinction needs to be drawn between climate variability and climate change – a distinction we address later in these reasons.
3. The actual volume of groundwater stored[14] within the Hawkesdale GMA is immense. Estimates are in the order of 1,4000 Giga-litres (Gl)[15]. To deplete the GMA of a large proportion of this storage would result in substantial falls in groundwater pressure and levels with consequential impacts on users and the environment.
4. When authorities seek to sustainably manage groundwater, the objective is to balance the use of stored groundwater with water that comes into the system and water that naturally leaves the system. In effect, the storage should only be used minimally and in a manner that allows for inflows to top up this depletion. We find that to do

otherwise would gradually draw down the resource and ultimately lead to an unsustainable depletion.

5. This is not to say that from time to time some rebalancing of the system may not be possible. We accept the evidence of Associate Professor Webb that if a small net depletion in storage occurs, which establishes a new equilibrium that has no 'unreasonable' or 'inconsequential' impacts, then such a depletion could be contemplated. (on this point, we refer to the concepts outlined earlier about achieving a water balance and the different equilibrium conditions that could occur.)
6. We recognise that the simplification of such concepts should be treated cautiously and regard must be had to the level of understanding about the groundwater systems. The evidence demonstrates that groundwater systems are not static: they are dynamic systems, which respond to various influences over various time scales.
7. Extraction over summer periods when rainfall is low and not much recharge is occurring results in short term depletion of stored groundwater. This is manifested in a lowering of groundwater levels. With winter and/or spring rainfall (and cessation of pumping), the storage is replenished and, all other influences being equal, groundwater levels will rise. The degree of replenishment and rise in groundwater will reflect how much rainfall occurs and how much eventually makes it way into the system as recharge.
8. Plots of groundwater levels taken over a number years for the Hawkesdale and Yangary GMAs (termed hydrographs) demonstrate how extraction is seasonally expressed as falls in regional groundwater levels. Once extraction during the irrigation season ceases, groundwater levels rise. This response may be in part due to winter rainfall. It may also be in part a response to replenishment from upgradient flows or flows from unaffected portions of the aquifer. In effect, it is a form of rebalancing of the groundwater levels.
9. If there is insufficient rainfall recharge into the whole system, groundwater levels may not return to the same levels that were recorded prior to the extraction. If the rainfall is sufficient or more rain falls than is needed to replenish to these levels, the groundwater level may rise to the previous or a new, higher level.

10. For these reasons, on a season by season basis, recovery of groundwater levels in the Hawkesdale GMA has sometimes been achieved to pre-pumping levels and sometimes not. However, all the data gathered so far for the area demonstrates that eventually there has been recharge to the aquifer such that groundwater levels, when not being pumped, have risen more or less back to levels consistent with a long term stable volume of storage.
11. This confirms the position adopted by all the expert hydrogeologists that over the past period of ten years or so, the aquifer has been exploited at sustainable levels and the system is in balance.
12. It is apparent to us that the key to this behaviour in the Hawkesdale GMA, and hence the sustainability of groundwater extraction, is rainfall and its long term variability and trends.

Climate variability

1. We found Dr Kiem's evidence about climate variability to be most eloquent and helpful. Dr Kiem's evidence is that our climate is not static. He explained that there are three concepts which are integral in understanding long term rainfall trends – climate variability, climate change and anthropogenic climate change.
2. Climate variability refers to the natural variations that arise in all climate patterns, whereas he defines climate change as irreversible or persistent changes to 'normal' climate conditions. 'Normal' here would mean that which long term records indicate to be the norm. Anthropogenic climate change is unnatural, human induced change. Some climate variability will occur within both climate change and anthropogenic climate change.
3. Climate variability includes short-term, multi-year variation through to long term, multi-decadal epochs of variation. These variabilities are linked to large scale ocean-atmospheric phenomena, including El Nino/Southern Oscillation (ENSO), ENSO Modoki, Interdecadal Pacific Oscillation (IPO), Indian Ocean variability, subtropical ridge and Southern Annular Mode (SAM) phenomena. These phenomena influence rainfall patterns in various ways.
4. Ultimately, the point of this evidence, and one which we accept, is that even without climate change, south-eastern Australian rainfall and other climate conditions such as evaporation are subject to yearly, multi-year and decadal behaviour patterns that are now being

recognised and built into the science of hydrology and assessment of water resources in Australia.[16]

5. In light of Dr Kiem's evidence, it is apparent to us that it is no longer appropriate to rely on simple statistical constructs of past behaviour to predict the future. Our understanding and assessments of the behaviour of water resources in the future must be more sophisticated and incorporate this emerging understanding of inherent climate variability.
6. Dr Kiem's evidence on climate variability alone leads us to the view that one must recognise where we sit in the natural variability of the rainfall cycle.
7. An example of this is the adoption of the ten year rainfall averages from 1996 to 2006 by Mr Hoxley in his assessment of rainfall recharge for Hawkesdale. Dr Kiem notes that the decade does not represent the driest decade on record. However, it does accord with previously recorded decadal shifts to lower than long term average rainfall experienced around the early 20th century (1920's) and later in the interwar to early 1940's period.
8. The current lower level of rainfall being experienced also corresponds to a positive (drier phase) of the IPO phenomena. This contrasts to negative phases of the IPO, when rainfall conditions were wetter than long term averages, said by Dr Kiem to be the case from 1946 to 1976.
9. However, even within such decadal shifts, Dr Kiem notes that phenomena such as SAM, can influence shorter term conditions. Thus, while in a drier IPO phase in the 2000's, a SAM event in 2007 led to increased rainfall in parts of Victoria. Dr Kiem notes that these shorter term shifts due to SAM are difficult to predict. He therefore cautions that past behaviour should only be relied on where periods of similar climate characteristics are "being experienced or predicted to be experienced in the short term".
10. We take the view that in light of such unpredictable shifts in SAM phenomena, it would be unwise to rely on such phenomena to replenish aquifer systems. Their unreliability and the unpredictability of occurrences may well mean rainfall occurring at times when recharge may not be maximised (e.g. over summer or dry periods). We believe that such events would be better viewed as opportunistic events of good fortune rather than reliable trends.

11. Currently, Dr Kiem advises that Victoria is experiencing an average 4% decrease in long term rainfall that can be explained, at least in part, by climate variability phenomena he described in his evidence.
12. In light of these and other current predictions for climate variability, which indicate Victoria (and more widely south-east Australia) is to continue experiencing drier than long term average conditions, we consider that adoption of a low rainfall regime is appropriate in forecasting the rainfall driven inputs to the water balance.

Long term climate change

1. Longer term (i.e. greater than ten to twenty years) climate forecasts for Victoria point to a decrease in rainfall due to anthropogenic climate change. The magnitude of such change depends on carbon emission scenarios. By the year 2030, changes in annual rainfall may vary from 2% to 5% lower than current long term averages, based on low carbon emission scenarios. By 2070, this figure may vary from 5% to 10% under low carbon emission scenarios. It may be up to 40% lower than current long term averages under high carbon emission scenarios.
2. By 2030, annual evaporation may increase by approximately 3% with the largest change expected by way of increases over winter. By 2070, depending on emission scenarios, evaporation may increase by 4% (range of 1% to 8%) all the way to 8% (range of 2% to 16%). Increases again would be most felt over the winter periods.
3. The corresponding change in catchment behaviour is predicted to amount to decreases in surface water stream flows ranging from no change up to a 50% decrease.
4. Dr Kiem acknowledges the uncertainty of such predictions, but highlights that it is the best available science we have at this time. The implications for long term water resource management are that planning should expect at minimum a 4% decrease in rain fed water availability, coupled with short term (less than 20 year cycles) of 'wetter or drier epochs'.

Implications for groundwater management

1. Dr Kiem is not a hydrogeologist. His role was to advise on a key aspect of the water balance inputs, namely rainfall. Based on his expert knowledge of climate behaviour and the response of

catchments, his advice is that authorities should be planning for a decrease in rainfall and correspondingly less water in our catchments.

2. He notes that other experts have drawn the conclusion that groundwater and surface water systems are 'usually interconnected'. He also highlights that such interconnections are complex and subject to time lags. Therefore, responses to changes in climate regimes and surface catchment behaviour may lag. He postulates that the current response of the Hawkesdale GMA may not reflect current climate patterns.
3. Mr Nolan gave evidence that increases in short term, more intense rainfall events will lead, *prima facie*, to increases in recharge. This evidence was disputed by Dr Kiem on the basis that:
   - Predictions of short term rainfall behaviour are considered to be the most uncertain aspect of all long term climate predictions under anthropogenic climate change.
   - Long term annual rainfall is predicted to decrease, thus reducing available water for recharge.
   - Increases in evaporation and vegetation use, which are dependant on when rainfall occurs, must be taken into account.
   - Due to soil/water behaviour, more intense rainfall does not necessarily equate to increases in recharge (deep percolation of rainfall). He cites the evidence of some soils repelling water when dry – a condition known as hydrophobic soils.
4. On this particular issue, we prefer the evidence of Dr Kiem. His expertise is specifically in the field of hydroclimatology compared to Mr Nolan's expertise as an engineer and hydrogeologist. We are therefore prepared to accept Dr Kiem's evidence that increases in short term, more intense rainfall events will not necessarily lead to increases in recharge and that this cannot be relied upon as a counter to long term decreases in rainfall as a means of maintaining rainfall inputs to the water balance.
5. Overall we accept Dr Kiem's evidence as to the variability of rainfall and the very real potential for long term decreases in rainfall to be in the order of 2-5% by 2030. Equally, we accept there will be a corresponding increase in evaporation of 3%, with an increase over the critical winter recharge period. We consider it is appropriate to take such factors into account in the assessment of the Hawkesdale

GMA resource. We note that planning for drier conditions is in line with the current position adopted by the State Government and Melbourne Water.[17]

THE IMPACT OF TREE PLANTATIONS

Local impacts from tree plantations

1. Dr Baulch and other landholders put forward the premise that an increase in areas of commercial tree plantations has affected, and will continue to affect, local groundwater levels. Their principal complaint is that shallow groundwater levels appear to be falling in some landholders' stock and domestic bores. They suggest that such impacts have coincided with the increase in tree plantation areas and the related increase in groundwater use. This fall is due in part, it is suggested, to the impact of these plantations.
2. We accept the evidence that locally, the loss of groundwater and lowering of groundwater levels in proximity to tree plantations is likely to be larger than an average value across the whole of the GMA. The evidence of Dr Benyon, the investigations by Mr Nolan and the anecdotal reports by Dr Baulch and other landholders certainly points to there being some localised impacts.
3. However, in these proceedings it is not the trees that are 'on trial'. We have considered these impacts only in the context of gaining an understanding of groundwater behaviour in the GMA and the overall sustainability of the resource.

Tree water use

1. Dr Benyon described how Hawkesdale sits within a region of south-east Australia known as 'the Green Triangle'. It is an area that has seen a considerable increase in commercially grown plantation timber. He told us that in South Australia the impact of such plantations has led to the state authorities requiring an assessment of the impact of proposed plantations on groundwater and licensing the plantations to account for the assessed loss of groundwater.
2. Dr Benyon is a forest hydrologist who gave evidence on behalf of the Authority. His evidence is that, in particular circumstances, trees will use shallow groundwater in their transpiration process. Such water use has been the subject of his research in this area of Australia. SKM has relied on this research in preparing the water balance for

the Hawkesdale GMA. The application of this research has been a matter of some contention in these proceedings.

3. Without wanting to oversimplify Dr Benyon's many years of research, it amounts to the following proposition. Tree roots will seek out and draw on moisture at depth. His research indicates that fine capillary roots can source groundwater from as deep as six metres below surface. He also postulates that water from as deep as 8.5m could potentially be utilised. But there are gaps in the research he has conducted. The depth to which a tree can utilise groundwater depends on many factors, including soil conditions, the presence of root impeding layers, groundwater salinity and the age of the trees.
4. Overall, it seems to us that much of Dr Benyon's research and other research he has reviewed indicates that groundwater deeper than 8 – 8.5m would not generally be sourced by trees under a commercial ten year rotation of removal and new planting.[18]
5. Apart from direct uptake of water from the soil, plantation trees also form a closed canopy after two or three years. The canopy intercepts rainfall with some being re-evaporated. Some intercepted rainfall eventually falls to ground. There it will either run off, soak in or evaporate. Either way there is a reduced amount of water available to soak into the ground and become recharge.
6. The sum total of the intercepted rainfall and that used by the trees in expiration is termed evapo-transpiration. It is this evapo-transpiration that results in less rainfall recharge to the groundwater system. The result is that groundwater levels can fall beneath and within the vicinity of tree plantations similar to the effect of low rates of groundwater extraction by pumping.

Tree water use in the water balance

1. SKM's water balance assessment sought to quantify tree plantation water use. This was undertaken by estimating the area of shallow groundwater (defined as being at or less than five metres below surface), the area of tree plantations, and then overlaying the two. Where the areas of shallow groundwater and tree plantations coincided, an estimate of water use was made by applying an average rate derived from Dr Benyon's research. A similar approach was applied to native forest areas with the rate of water use being a proportion of that applied to plantations in recognition of a lower

density of trees per area.

2. Alanvale disputes the approach taken by SKM. The evidence of Mr Nolan and Associate Professor Webb is that:
   - The use of standing water levels does not necessarily reflect the position of the groundwater in the profile.
   - The standing water level records are spread over 30 years and are not taken from a single snapshot period.
   - Their own investigations suggest that the predictive method for mapping shallow groundwater levels overestimates this area.
   - The assessment does not take account of areas where the aquifer is confined by overlying clay layers, which could impede tree water use.
   - The use of average water use does not account for the time period between new plantings and the growth of roots to reach the water table.
3. We accept much of this evidence and consider that many of the criticisms made about estimated tree water use in the SKM water balance are justified.
4. In particular, we have concerns about the use of drilling or recorded water level data that spans across a considerable number of years in order to formulate a plan of depth to groundwater levels. The use of such data in this way is not an accepted approach for providing a 'snapshot' of groundwater level conditions.
5. Mr Hoxley agreed as much under cross examination. He acknowledged this problem and other inherent uncertainties that arise from the way the groundwater level map has been produced. He nevertheless submits that it is the best available data at this time.
6. We accept that the question of where the water table is and what use plantation trees are making of groundwater is a critical component in the water balance. It represents a shift in land use that has the potential to influence the hydrology and hydrogeology of the GMA in a significant way. It therefore represents a significant element in the water balance method.
7. Whilst there was much focus in the cross-examination on whether struck or standing water levels were used, in our view this is not the determinative issue in evaluating the accuracy or reliability of plantation tree water use. Whilst it may affect the weight that should be given to the assessment, we are more concerned about the

simplistic approach adopted and the lack of technical rigour in terms of not setting out possible errors or testing uncertainties. In short, we find that there is a considerable array of uncertainties in estimating this aspect of the water balance, which have not been tested. Many of these factors are fundamental to the accuracy of the water table level map.

8. We are also concerned about the lack of testing of basic and fundamental soil/water behaviour principles relating to recharge and groundwater responses under tree plantations.
9. Ultimately, we accept there are legitimate concerns about the impact of tree plantations on groundwater resources. However, we have little confidence in the assigned magnitude of influence exerted by tree plantations in the groundwater balance estimates.
10. We conclude that tree water use is a factor that needs to be taken into account. However, it is a factor that is only one contributory part of overall groundwater behaviour in the GMA. In our view, the estimates made by SKM on this issue have a low degree of reliability.
11. We accept that given the uncertainties and broad scale nature of the estimates of this component of the water balance, there may be some 'room to move' so to speak in respect of estimating the capacity of the GMA for additional extraction. However, this needs to be considered as part of the broader, sustainability context. We are not prepared to find that the differences between the figures ascribed to tree water use by the Authority and the applicants means there is additional capacity, which should be allocated to Alanvale and Graham. Rather, the evidence illustrates how much uncertainty surrounds this particular component of the water balance.

GROUNDWATER AND SURFACE WATER INTERACTIONS

1. The SKM water balance includes a component for baseflow into rivers. Baseflow is where groundwater seeps into and forms a flow of water within the stream bed.
2. We understand baseflow to be an all encompassing term for the interaction between all groundwater and surface water systems, including wetlands. However, the figure used in the SKM water balance is based only on an assessment of baseflow along the Eumeralla River within the GMA. That assessment provided a

baseflow per kilometre reach of the river, which has then been applied to all other waterways in the Hawkesdale GMA.

3. Mr Nolan is critical of this approach, as is Associate Professor Webb. Both contend that this approach is an over simplification of the interactions that are likely to occur. They argue that in some reaches of the Eumeralla River it is possible the stream flow is actually being lost to the aquifer (forming recharge). Associate Professor Webb, in particular, points to the historical behaviour of the Eumeralla River, which disappeared below the surface at one point and reappeared closer to the coast. Mr Nolan also points to the fact that other waterways in the GMA have shallow bed levels and are unlikely to intersect groundwater levels. If this is the situation, he argues that the streams can hardly be receiving groundwater, but rather they would be leaking into the groundwater.
4. There was no particular challenge to Mr Hoxley's means of assessing the base flow for Eumeralla River. As such, we take the assessment to be an acceptable estimation of what is occurring for that waterway.
5. The evidence does alert us though to the sensitivity of the systems to changes in groundwater behaviour. Ultimately there is, in our view, little dispute that significant reaches of the Eumeralla River are groundwater fed. However, we are concerned that the behaviour of other waterways is assumed to be the same without any testing of this assumption. While we acknowledge the lack of gauging data for these other waterways, there was no exploration of the geological conditions or other factors that may influence the interactions between the two systems of surface and groundwater. It seems that wherever a waterway was located, the simple assumption is made that it is a source of groundwater loss.
6. Apart from the Eumeralla River there are other wetland and lake systems closer to the coast, which may also be groundwater fed, although from which aquifer remains to be assessed. Such surface water systems will be vulnerable to any overexploitation of groundwater if groundwater levels are lowered to the point where surface inflows are reduced or cease altogether.
7. Our conclusion is that we lack sufficient evidence to form a view about the interaction of groundwater and surface waters across the Hawkesdale GMA as a whole.

COASTAL INTRUSIONS

1. The applicants submitted that there was "a massive outflow of groundwater to the southern ocean" with a volume more than 30 times the amount sought to be extracted. They submitted that this resource should be available for use.
2. We have set out earlier how groundwater outflows from the Hawkesdale GMA balance seawater inflows from the coast.
3. Various estimates were put to us as to where the interface was of the seawater inflows and fresher groundwater. It was suggested that we should take such estimates to mean that the location of the interface is well established. We reject such submission. The estimates are no more than theoretical calculations, which all the experts agree when questioned are subject to a number of hydrogeological variables. In the absence of definitive monitoring and assessment of the interface to seawater intrusion, we consider that the degree of coastal intrusion is poorly understood at present.
4. We understand there are currently no reported impacts from seawater intrusion. We were not presented with any reports by the Authority or landholders of bores along the coast 'turning salty'.
5. Nevertheless, all the experts agree that coastal intrusion is a risk to existing and future users. An increase in extraction that results in decreased groundwater pressures and levels at the coast will result in some change in the interface with seawater. The unanswered question is 'how much and where'?
6. We accept the evidence of Associate Professor Webb that the impacts from the Alanvale and Graham extractions, at a theoretical level, would cause little change in the current conditions. However, that does not necessarily mean that what the applicants describe as the "massive" outflow to the ocean is water "going to waste". There is a need to maintain the balance in pressure between groundwater and seawater to prevent seawater intrusion and the salinisation of bores close to the coast. Hawkesdale and Yangary GMAs are particularly vulnerable to this impact.
7. At present, we conclude the level of understanding about current conditions and the potential effects of an increase in extraction are so poor in respect of seawater intrusion that caution is required. An assessment of this effect on the Hawkesdale and Yangary GMAs

should be a priority.

SHOULD WE RELY ON THE WATER BALANCE APPROACH?

1. The water balance approach to managing groundwater resources is a construct based on the premise that maintaining the current level of aquifer storage (and so groundwater levels) is preferred in order to avoid any adverse or potentially adverse impacts on other users or the environment.
2. We perceive a difficulty with the water balance approach in its use as a water budgeting and allocation tool. The difficulty is this. If a system is in balance under its current allocation of extractive volumes, how then can any further groundwater be allocated if the management aim is to maintain that balance? We acknowledge the applicants' submission that the concept of maintaining the status quo could potentially lock up resources unnecessarily if a change in storage and a new equilibrium for groundwater levels has no adverse impacts.
3. We accept that the water balance is a useful tool to assist in understanding the response of the aquifer system(s) to changes in inputs or outputs that may ultimately affect its storage and corresponding groundwater levels. However, such a tool must be considered within the totality of other available evidence, particularly indicators of the system's physical behaviour and responses both spatially and over time. It is the lack of sufficient data of this nature and the uncertainties associated with various aspects of the water balance calculations which lead us to the conclusion that we should not rely solely on the water balance approach to deliver a definitive answer as to whether there are additional resources available for allocation.
4. We suggest a wider approach is more appropriate. By necessity this approach must seek to understand the current condition of the groundwater system and its behaviour in response to what are identified as the key components of that system. It must then have regard to future predictions regarding those key components gained from an understanding of the physical nature of the groundwater systems and all available data about its behaviour.
5. In this respect it is apparent to the Tribunal that some (at least short term) data is available by which to assess the behaviour of

groundwater levels at the 'top and bottom' of the Hawksdale GMA. Such data provides a useful insight into changes in groundwater storage (as reflected by changes in groundwater levels) and ultimately the availability of groundwater resources.

6. Associate Professor Webb took us to hydrographs of a number of bores located in the Yangary GMA, which are downstream of the Hawkesdale GMA. These bores are thus located in positions that will provide a record of responses to influences within the Hawkesdale GMA.
7. It is not necessary to go into the technical details of these bore hydrographs, but it is apparent that when examined in conjunction with various rainfall data there is a trend in the behaviour of groundwater levels. This trend is for seasonal depletion of the aquifer during summer/irrigation periods. Replenishment of the aquifer generally follows in the winter or non-irrigation period.
8. As explained by Associate Professor Webb, this replenishment is due to groundwater that remains in storage flowing into depleted areas. Such flow takes time and leads to lags in being detected, but ultimately the groundwater basin can be regarded as seeking to restore depleted storage levels. If sufficient recharge occurs, this recovery process would see groundwater levels return to or near the pre-pumping season levels. If recharge is insufficient, the recovered levels will be lower than previous non-pumping levels.
9. An examination of three hydrographs downstream of the Hawkesdale GMA shows that over such cycles from 2000 to 2003, the recovery process did not result in full restoration of groundwater levels. This trend is consistent with depleting storage. However, at the end of the 2003/04 irrigation/summer season, there is a recovery of groundwater levels to or exceeding pre-2000 levels. This recovery coincides with a large increase in cumulative residual rainfall[19] into positive levels. In previous years, the cumulative residual rainfall was negative.
10. Associate Professor Webb explained that such behaviour is typical for shallow rainfall recharge systems. Such processes are said to demonstrate how short term depletion can occur without detriment while longer term cycles replenish the system and maintain an overall long term balance.
11. As all the expert hydrogeologists agree that the Hawkesdale GMA is

in balance, we consider it follows that they must accept what Associate Professor Webb says. There will be some periods of short term depletion with replenishment and rebalancing over the longer term.

12. However, in our view, it also follows that such replenishment is dependant, one way or another, on rainfall. Therefore, as we have noted earlier, the cycle of rainfall, together with its variability and susceptibility to change, remains the key to the longer term security of the groundwater resource. Rainfall is a key component influencing the aquifer system and therefore its sustainability.

CLIMATE CHANGE AND THE PRECAUTIONARY PRINCIPLE

1. The precautionary principle provides that:

Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

1. As Osborn J said in *Western Water v Rozen & Others*[20]:

[95] The fundamental thrust of this principle is well understood. In *Leatch v National Parks and Wildlife Service*[21] Stein J said of it:

The precautionary principle is a statement of common sense and has already been applied by decision-makers in appropriate circumstances prior to the principle being spelt out. It is directed towards the prevention of serious or irreversible harm to the environment in situations of scientific uncertainty. Its premise is that where uncertainty or ignorance exists concerning the nature or scope of environmental harm (whether this follows from policies, decisions or activities), decision makers should be cautious.

1. The precautionary principle is embodied in the State Environment Protection Policy "Groundwaters of Victoria" and State Environment Protection Policy "Waters of Victoria", which are required to be taken into account by the Tribunal both as government policy under section 40(1)(j) of the *Water Act* 1989 and in accordance with section 305B of the Act. The principle is also substantially reflected in section 93 of the Act, which sets out the sustainable management principles for water corporations, and in Southern Rural Water's Guidelines for Surface and Groundwater Licensing.
2. In *Telstra Corporation v Hornsby Shire Council*[22], the New South

Wales Land and Environment Court identified that the application of the precautionary principle and the concomitant need to take precautionary measures is triggered by the satisfaction of two conditions precedent or thresholds: a threat of serious or irreversible environmental damage and scientific uncertainty as to the environmental damage.

3. We consider that both these conditions precedent are present in the current case.
4. We find there is a risk that over allocation of groundwater resources may significantly deplete the Hawkesdale GMA aquifer. We regard this as a threat of environmental damage that is both serious and potentially irreversible. We also find there is scientific uncertainty about the nature and scope of the threat. The threat may be manifested by a fall in the aquifer storage level, effects on surface water systems or intrusion of seawater and resultant salinisation of bores near the coast. However, we do not know the full extent of these threats. At best there are only theoretical calculations and conceptual understandings.
5. We regard the biggest factor potentially influencing the risk of over allocating groundwater resources in the GMA is the effect of climate change on rainfall.
6. As previously stated, we accept the evidence of Dr Keim that there is a real potential for long term decreases in rainfall due to climate change in the order of 2% to 5% by 2030. Equally, we accept there will be a corresponding increase in evaporation of approximately 3%, with an increase over the critical winter recharge period. These changes are irrespective of natural variability in the rainfall cycle. The implications for long term water resource management are that we should plan to expect a 4% decrease in rain fed water availability, with short term (less than 20 year cycles) of 'wetter or drier epochs'.
7. We consider that until the implications of the effects of climate change on rainfall recharge for the aquifer are investigated and better understood, we should apply the precautionary principle and be cautious in making decisions about the allocation of groundwater resources now.

MATTERS TO BE TAKEN INTO ACCOUNT UNDER THE ACT

1. Earlier we identified the following matters under section 40(1)of the

Water Act 1989 as those most relevant to consider:

- The existing and projected availability of water in the area;
- The existing and projected quality of water in the area;
- Any adverse effect the allocation or use of the water may have on, amongst other matters, existing authorised uses of water; or on a waterway or an aquifer;
- The need to protect the environment;
- The proper management of the aquifer;
- The purposes for which the water is to be used; and
- The needs of other potential applicants.

2. We now set out our response to these matters.

The existing and projected availability of water

1. So far as the projected availability of water is concerned, we are not satisfied on the basis of existing evidence that we can confidently find there is sufficient availability of water to justify the grant of these licences, especially having regard to the precautionary principle.
2. So far as the existing availability of water is concerned, we need to consider existing entitlements and the availability of water for purchase and transfer.
3. We were told that between half and two thirds of water allocated under existing licenses is not utilised. Mr Hoxley estimates that in 2008/09, approximately 53% of allocation was unused. This estimate includes an allowance of 1 Ml/yr for stock and domestic bores, which although required to be licensed, are not metered and have no allocated volume under the licensing regime administered by the Authority. Mr Nolan's evidence suggests there is general agreement as to this value being around 50%[23].
4. The under-utilisation of existing allocations indicates there is capacity within the system to address the needs of these current applications (and possibly additional applications) for new allocations by means of the sale and transfer of existing licence entitlements.
5. We are conscious that the management of water resources in Victoria is in a phase of transition. Trading in and transferring water rights, whether permanently or temporarily, is a new paradigm for many.
6. The system set up under the Act to facilitate the transfer of licences

indicates an intention to foster the efficient use of water. On the other hand, a market in the trade of existing allocations is unlikely to become established if every time a landholder needs additional water, the Authority is willing to grant a new licence.

7. We know that Alanvale and Graham propose to acquire additional water by way of permanent and temporary transfers of existing allocations, which are the subject of other proceedings before the Tribunal.[24] We do not know anything about the general availability of water to purchase, to what extent unused allocations are being withheld from the trading market or the state of the market. We can assume that applicants such as Alanvale are likely to require permanent allocations to justify the investment in irrigation infrastructure that would inevitably be associated with the volume of the extractions permit being sought, but we do not know these things for certain.
8. Having regard then to this paradigm shift, the under-utilisation of existing allocations weighs against new allocations. Put simply, if there are allocated but unused water volumes, these should be the first port of call rather than providing new allocations. To do otherwise is making inefficient use of this resource. It also fails to recognise the value of the resource.

The existing and projected quality of groundwater

1. Whilst there is a potential risk of coastal intrusion, we understand there are currently no reported impacts from seawater intrusion or salinisation of bores.
2. However, this is a potential effect associated with the over allocation of groundwater. The Hawkesdale and Yangary GMA's are particularly vulnerable to this impact and until more is known about this effect, it is a factor that weighs against the applications.
3. Aside from the issue of seawater intrusion, all the experts concur that additional extraction is unlikely to impact on the quality of the groundwater. In the absence of contrary evidence, we accept this position in regard to water quality impacts.

The impacts to surface water systems

1. We have set out earlier that we accept the basis of SKM's assessment for base flow in the Eumeralla River. However we do not consider

that the full extent of interactions between surface water systems and groundwater are well understood or extend beyond the conceptual.

2. For example, Mr Nolan emphasised that some surface water systems have high base levels, which would suggest no intersection with groundwater levels. Conversely, in the central area of the GMA, Associate Professor Webb's evidence suggests long periods of standing water, which might suggest shallow intersecting groundwater levels.
3. We accept that there is a two way interaction between groundwater and surface water systems and that this is an important component to consider in the management of both these water resources. We accept also that a lowering of regional groundwater levels will reduce inflows to those surface water systems currently connected in this way. We find that the Eumeralla River is one such system.
4. We therefore consider that over-extraction of groundwater and resulting falls in regional groundwater levels could have a significant and long term impact on at least the Eumeralla River and possibly other surface water systems. This factor weighs against the applications.

Impacts on existing authorised uses of water

1. We consider we must be careful to distinguish between impacts on existing uses due to limitations associated with the condition of existing bores and impacts due to falling groundwater levels across the region as a result of the non-sustainable depletion of this resource.
2. We accept that current stock and domestic use of groundwater is vulnerable to decreases in groundwater levels. The evidence is that bores used for such purposes normally have a shallow penetration into the aquifer (for a variety of reasons). This limits the available drawdown from which groundwater can be extracted. Under a scenario of falling groundwater levels, vulnerable bores would need to be deepened or new deeper bores drilled to maintain supply for these purposes.
3. We recognise that in some instances, the purported loss of a resource may also be due to other factors such as old bores becoming inefficient and coming to the end of their useful life. We regard such 'losses' and the cost of renewal to be 'part and parcel' of using

groundwater.

4. In our view, the critical issue will always be the sustainable use of the groundwater resource as a whole. So long as there is an adequate, sustainable resource available, we do not consider that new licences should be refused merely on the basis that some shallow, low volume bores may be affected by a licence for deep extraction for a high volume irrigation use. We consider that licence holders for stock and domestic use must accept that there will be naturally occurring fluctuations in the water level from time to time even with the sustainable use of the groundwater resources. This may result in the need for them to deepen an existing bore or install a deeper bore. So long as the new licence does not reduce the resource they are entitled to, the need to upgrade a bore or associated equipment to maintain access to the resource must be balanced against the overall benefits arising from new sustainable uses of groundwater.[25] Where that balance lies will depend on the individual circumstances of each case.
5. We acknowledge that this view may be at odds with current practice on the part of the Authority and contrary to expectations held by stock and domestic bore users. It appears that the past and current practice of the Authority is to give equal weighting to stock and domestic use and irrigation use when assessing potential interference impacts.
6. The Alanvale and Graham cases proceed on a similar underlying basis that apart from Dr Baulch's particular bore, which may be affected, no other bores will be unacceptably impacted by the issue of the licences being sought.
7. In the present case, we have a set of circumstances where there is a high dependence by many existing users on shallow groundwater for important stock and domestic use. We have found that it is a use which is susceptible to depletion of long term storage and falling groundwater levels. It is evident to us that such use will be subject to potential impacts without any additional deeper and more intensive extraction. This conclusion is based on the forward projections of climatologists such as Dr Kiem, who predict with some confidence a decrease in rainfall and an increase in evaporation. The consequential decrease in recharge will mean a likely shift in groundwater storage levels and a new water balance being established.

8. Whilst we do not consider there is likely to be an immediate impact on existing uses, the proposed new allocations have the potential to contribute cumulatively to a possible fall in groundwater levels as a result of climate change factors. Therefore, we are not satisfied at this stage that the new licences represent a sustainable use of the groundwater resource in the long term. If the long term use of groundwater is not sustainable across the GMA, existing uses are likely to be adversely affected. This would be an unacceptable outcome and a factor weighing against the applications.

The purposes for which this water is to be used

1. We understand from the submissions of Dr Baulch and others that farming enterprises in the Hawkesdale GMA are dominated by grazing and dairy activities. Groundwater is used to support these enterprises by its use for stock water, dairy wash down water and for domestic purposes. Historically, it has been a low intensity but extensive use. More intensive use of groundwater for growing pastures and fodder crops under irrigation represents a new, expanding form of enterprise in the area.
2. We understand some of the objections to the grant of the licences from local landholders are in part about the balance between these traditional uses and new uses.
3. We do not give much weight to submissions about what has historically occurred and the introduction of new agricultural enterprises. If more intensive farming can be conducted in a manner that is within the rights of the landholder and not in contravention of statute or planning scheme, then it is legitimate for a landholder to pursue it. Each farming enterprise is free to adopt its own approach under such circumstances.
4. We are required however to consider, if relevant, what the water is to be used for, although there is no specific policy guidance in respect to this issue. Our attention was drawn to the Government's White Paper: *Securing Our Water Future Together*, published in June 2004. While presenting broad policy directions for the future management of the State's water resources, it provides little assistance in resolving some of the more detailed matters which we are required to take into account, such as the relevance and weight to be placed on the use of water.

5. The consideration of the purposes for which the water will be used suggests that some uses may have a priority over others in certain circumstances. No doubt each application would have to be assessed on its merits and where there is competition between uses, a balance would need to be struck that best advances the purposes of the Act.
6. Having regard to such purposes, we consider that assessing how the water is to be used may be relevant to the orderly, equitable and efficient use of resources, as its use is to be of benefit to present and future Victorians. In effect such purposes call in to question what the return will be on the equity held by all Victorians in this natural resource.[26]
7. Having regard to such purposes, it is apparent that higher order uses of water resources might be preferred over lesser uses, all other matters being equal, especially if water is a scarce resource.
8. Thus a use that provides a more efficient return, such as greater production of produce per litre of water, might be preferred over other less productive uses. In some situations, an urban water supply to many households may be viewed as more important than supply to one household from a single, affected domestic bore. In another context, such as when groundwater is the only reliable source to support human habitation, we could envisage domestic supply being more important than other, agricultural uses.
9. Here we have an apparent competition between existing stock and domestic use and two applicants that seek to increase the productivity of their agricultural enterprises by irrigation for pasture and fodder.
10. On the material before us, we do not see that either of these uses is mutually exclusive. Indeed, we do not consider that our decision should be viewed as weighing one use over another. We consider that each type of use can co-exist within the capacity of the Hawkesdale GMA provided that the water is allocated on a sustainable and equitable basis.

CONCLUSIONS

Available resources and sustainability limits

1. Alanvale and Graham argue that in the light of the groundwater behaviour and responses that we have set out above, the licences

should be granted because:

- The current balanced condition of the Hawkesdale GMA does not preclude further water resource allocations at first instance.
- The allocations being sought are very small in comparison to the overall storage and represent only a few percent of the estimated recharge values calculated by either Mr Hoxley or by their own experts.
- The change in the water balance equilibrium would not result in unreasonable or unacceptable impacts. Locally, groundwater levels would only be affected in the order of centimetres, not metres, and regionally this effect would be even less. Such an impact is within the bounds of current monitored fluctuations.

2. Our findings in regard to the technical evidence are not necessarily at odds with these contentions. We accept that there is probably some additional capacity within this aquifer having regard simply to the water balance approach, notwithstanding the considerable uncertainties that surround many of the components of this model. However, we are not convinced on the basis of current evidence that the additional exploitation of the groundwater resource would necessarily be sustainable in the long term. Consequently, an application of the precautionary principle requires a refusal. In addition, even if the additional allocation of water to Alanvale and Graham could be supported on technical grounds, we consider it would be a poor strategic decision. We also reject the applicants' suggestion that licence conditions could be used to manage any uncertainties.
3. In terms of sustainability, we consider the applicants have failed to adequately consider the vital role of rainfall. In our view, rainfall is the key to the longer term security of this resource. However, rainfall is subject to short and long term variability and long term climate change influences, which have repercussions on the maintenance of groundwater storage in the Hawkesdale GMA.
4. For the reasons we have given, we consider that the pattern of rainfall is in a state of change. What has happened in the past will not be the same as what we can expect to happen in the future. Accordingly, we conclude that in the interests of sustainably managing this water resource it is appropriate to proceed cautiously for the following reasons:

- Conventional understanding indicates that groundwater systems demonstrate a lag in response to changes in various water balance inputs and outputs.
- The extent of recent recorded decreases in rainfall and increases in evaporation are yet to be fully understood.
- There is the potential for further changes in rainfall and evaporation under normal and anthropogenic climate change, with most evidence indicating a decrease in rainfall and increase in evaporation.

5. On balance, we find the above changes will result in a decrease in recharge to the Hawkesdale GMA rather than maintaining the current status quo. This is likely to lead to a long-term reduction in groundwater storage.
6. We have referred to the precautionary principle and why it is applicable in the context of this decision. Based on the precautionary principle, we consider that the uncertainties associated with the potential effects on the GMA from changes in rainfall and associated recharge, the potential seriousness of permanently depleting the groundwater storage and the risk of irreversible damage to the environment makes it inappropriate to grant these licences.

Using licence conditions to manage uncertainty

1. The applicants suggested that if there is any doubt as to the overall future impacts, then licence conditions can be included to wind back the allocations if such impacts are detected.
2. We do not agree that licence conditions should be used in this way.
3. We support the views of the Tribunal in *Castle* v *Southern Rural Water*[27] that monitoring conditions may be acceptable as a possible check on the operation of a licence, but should not be used as a substitute for a "justifiable decision to grant a licence in the first place".[28]
4. Further, we note that while there are powers available to the Minister or delegate to amend or revoke a licence granted under section 51 of the Act, the circumstances and powers to do so are limited. The objectives of the Act not only call for sustainable management of water resources, but the orderly, equitable and efficient use of the resource must also be achieved. To grant a licence subject to uncertain outcomes would, in our view, not be consistent with such

objectives.

Strategic decision making

1. We referred earlier to the fact that trading in and transferring water rights is a new paradigm for many. However, this is just one aspect of the much greater paradigm shift that has seen water generally become recognised as a valued and scarce resource. This shift to greater acknowledgement of the value of water is beginning to make itself felt with respect to groundwater. Past, less sophisticated attitudes about pumping from groundwater with little or no regard to whether these practices were sustainable, have now shifted to an appreciation that groundwater is a finite resource, which must be carefully managed.
2. Across the State, water authorities are imposing caps on extraction with the result that in many places, no new licences are being granted and the only means by which people may obtain more water is by trading and transfer of existing allocations.
3. This proceeding has been an unusual case because in most instances where people wish to challenge the decision making by a water authority, they are faced with an imbalance of resources. The water authorities have access to scientific data and analysis, licence applicants do not. In the present case though, Alanvale has matched the scientific 'firepower' of Southern Rural Water by engaging reputable scientific experts to challenge the information relied on by the Authority. As discussed, Alanvale's experts have revealed uncertainties in some of the evidence relied upon by the Authority in compiling its water balance.
4. On the material presented by Alanvale, there appears to be capacity for the further extraction of 1,220Ml without significant, immediate adverse impact. But there are a great many uncertainties and no one really knows enough to be confident of the long term sustainability of this additional level of extraction. Given this state of uncertainty, we consider it would be irresponsible to grant these licence for such a large amount of water in what is essentially an ad hoc manner without a better understanding about the long-term sustainability of the resource.
5. We know that a number of other licence applications have been made to the Authority in addition to these applications by Alanvale

and Graham. If there is any additional capacity in the aquifer, it is legitimate to ask why it should be allocated now on a first come, first served basis. In our view, a more strategic, holistic approach is required to the future allocation of whatever spare capacity may exist. No decisions should be made without more information about the aquifer generally and its relationship with the Yangary GMA, and without verifying that additional allocations are sustainable having regard to the likely effects of climate change on rainfall recharge.

6. If the outcome of additional work justifies further allocations being made, some consideration needs to be given as to how a limited and scarce resource should be allocated amongst competing interests having regard to the requirement under the *Water Act* 1989 to take account of the purpose for which the water will be used. In other words, will any possible future allocations simply be on a first come, first served basis, or will a more strategically focussed approach be adopted?

7. In the present case, for the reasons we have outlined and based on our findings and the matters required to be considered under the Act, we find that to grant further new allocations would not be within the overall objectives of the *Water Act 1989*. We will affirm the decision of the Authority and direct that no licences be granted.

Helen Gibson	Ian Potts	Graeme David
Deputy President	**Member**	**Member**

APPENDIX ASCHEMATIC REPRESENTATION OF THE WATER BALANCE MODEL FOR HAWKESDALE GMA

RainfallStream seepageLateral inflowWater levelPumping (shallow)Pumping (deep)Outflow to Yangery GMAOutflow to seaStreams and wetlandsTrees (evapo-transpiration)

Note: In this schematic there is no mention of leakage between aquifer units. Leakage from the Newer Volcanics Basalt aquifer is considered to be wholly contained within the Port Campbell Limestone aquifer and hence there is no net loss from the Hawkesdale GMA by this pathway.

[1] The approval of these transferred allocations are the subject of an appeal by Dr Baulch and others under other proceedings yet to be heard by this Tribunal.

[2] We refrain from using the term 'going to waste', which was suggested in their submissions.

[3] See section 40(1)(ba) and section 55(2B)(a) *Water Act 1989*.

[4] Section 22(1)(ac) and Part 2 Division 1B *Water Act 1989*

[5] Section 51 of the Act.

[6] Section 55 of the Act.

[7] Sections 53, 54 and 55of the Act.

[8] Section 56 of the Act. .

[9] [2008] VCAT 2440 at [45].

[10] Section 40(1)(ba) of the Act.

[11] Section 55(2B)(a) of the Act.

[12] *Preliminary Groundwater Resource Assessment for the Hawkesdale Groundwater Management Area*. Revised First Preliminary Report, Final 2, 20 December 2007. Sinclair Knight Merz.

[13] For example, Associate Professor Webb identified that infiltration from irrigation water could be considered as a further source of groundwater recharge. However he considered the overall volume of recharge entering the groundwater would be so small in comparison to the overall storage and other flows of groundwater that its absence from the water balance is inconsequential.

[14] We here distinguish a difference between what is stored and what is actually available for exploitative use. It follows from a consideration of

our reasons and an understanding of the need to maintain a balanced, sustainable groundwater system that we do not infer that what is stored equates to what is available for extraction.

[15] A Giga-litre is 1,000 Mega-litres (Ml), or one billion litres.

[16] Dr Kiem here referred to the current review of the Australian Rainfall and Runoff Guide produced by the Australian Institute of Engineers, which is being undertaken in light of this recognition of climate variability. The Rainfall and Runoff Guide is a document familiar to the Tribunal and we recognise it as the accepted standard for assessing surface water resource behaviour. We accept that such a review is evidence of how much our understanding about rainfall and hydrology is advancing from a simple static and statistical analysis of past climate parameters.

[17] Section 5.1 of the *Victorian Climate Change Green Paper*, Department of Premier and Cabinet, June 2009.

[18] This is due in no small part to the rate of root growth. Dr Benyon's research indicates average rates of root growth of 0.9m per year in the first four years of the tree's growth and 0.65m per year over later periods. Under a ten year rotation of planting and harvesting, only the shallowest of water table levels, say between 4-6m, would be utilised by trees as a water source. Dr Benyon's evidence from his Green Triangle studies indicates as much.

[19] Residual rainfall is that rainfall left over after subtraction of corrected evaporation. Cumulative residual rainfall is the sum of month by month rainfall residual over time.

[20] [2008] VSC 382

[21] (1993) 81 LGERA 270 at 282

[22] [2006] NSWLEC 133 at [128] – [148]

[23] Even though there was disagreement between him and Mr Hoxley as to how and when this value should be applied in the water balance calculations.

[24] Applications P2320/2008 and P2339/2008 made by the Dunmore Sustainability Group.

[25] We note that section 56(1)(x) provides for compensation to be made to any authorised user of groundwater that may be materially and adversely affected by a (new) use or allocation.

[26] See sections 1(c) and (d) of the *Water Act* 1989.

[27] [2008] VCAT 2440

[28] *Castle v Southern Rural Water* [2008] VCAT 2440 at [80]- [85] and [120].