Appendix 1: Independent Panel report on public submissions to the Draft Strategy

The Independent Panel

As outlined in Chapter 1, an Independent Panel was formally appointed by the Minister for Water to consider public submissions and other feedback from the consultation program. Panel members and their credentials are listed below. The Panel was nominated on 28 February 2008 under Section 22F(1) of the *Water Act 1989*. Under this legislation, the Panel may include in its report any recommendations at its discretion. The Panel reviewed 135 public submissions to the Discussion Paper, and their final report on the key issues arising from these was submitted to the Minister on 12 May 2008. The Panel reviewed 177 public submissions to the Draft Strategy and submitted their report to the Minister on the 20 February 2009. A copy of these reports and all public submissions are available from www.ourwater.vic.gov.au/programs/sws/northern.

Table A1.1 summarises the recommendations made by the Independent Panel on the Draft Strategy and provides the Victorian Government's response to these recommendations, including cross references to where they are addressed in the Strategy.

Christine Forster (Chair), AM

Mrs Forster became a Member of the Order of Australia in 2006 in recognition of her service to the environment in the area of water resource management, through a range of consultative and advisory roles. She is Acting Chair of the Victorian Water Trust Advisory Council and a member of the Ministerial Reference Council on Climate Change Adaptation and the Future Farming Advisory Panel. She is a Director of VicSuper Pty Ltd, former Chair of the Victorian Catchment Management Council and former Board member of the Cooperative Research Centre for Catchment Hydrology and Land and Water Australia. Mrs Forster has wide-ranging experience on a number of other bodies related to water and irrigation, including Landcare. She is also a wool producer in western Victoria and has been actively involved with rural adjustment and regional development issues.

Professor Peter Cullen (Chair to February, 2008) AO, FTSE

Professor Cullen passed away on 13 March 2008. He was one of Australia's most prominent and respected water experts, using his vast knowledge and passion to persuade governments, scientists, community groups, farmers and students about the importance of sustainable water resource management. His contribution to this country's water management spanned across the states and both sides of the political divide.

Professor Cullen had many strings to his bow, respected by the scientific community as a freshwater ecologist, and looked to as a leader in water resource management and a champion of the environment. For Victoria, Professor Cullen contributed to environmental and water management for more than 30 years, and was closely involved with developing the Victorian Government's *Our Water Our Future*.

In 2003, Professor Cullen was appointed inaugural Chair of the Victorian Water Trust Advisory Council, established by the Victorian Government to advise on the investment of $320 million of Trust funds and to provide strategic advice to the government on water issues. Victoria benefited greatly from his expertise in this role, with many significant water projects assessed and recommended for investment.

Professor Cullen chaired the Independent Panel for the *Central Region Sustainable Water Strategy* during 2007. He had agreed to be part of the Independent Panel for the Northern Region Sustainable Water Strategy, which met for the first time in February 2008. Tragically, this role was cut short. His loss is keenly felt.

Professor John Langford, AM

Professor Langford is a Professorial Fellow at the University of Melbourne and Director of the Melbourne Water Research Centre. He is a member of the Victorian Water Trust Advisory Council. Professor Langford has a long history in water resource management and has an impressive list of achievements in the water industry.

Professor Langford was inaugural Executive Director of the Water Services Association of Australia, the peak body of the Australian urban water industry, from 1994 to 2003. He was the Managing Director of the Rural Water Corporation, Victoria's state-wide irrigation and rural water authority, from 1989 to 1994. Professor Langford was the Manager, Water Supply Headwork and Distribution for the Melbourne and Metropolitan Board of Works for 16 years. He is a former Chairman of the Cooperative Research Centre for Catchment Hydrology, the Cooperative Research Centre for Freshwater Ecology and the Murray-Darling Freshwater Research Centre.

Barry Steggall

Mr Steggall is the former State Deputy Leader of the National Party and Member for Swan Hill (1983-2002), and former Shadow Minister for Agriculture, Water Resources and Technology (1999-2000). He was Chair of the Murray Bulk Water Entitlements Committee (1996-1998), Swan Hill City councillor (1973-1983) and Mayor (1980-1982). As a Member of Parliament, Mr Steggall held several important positions, including Secretary of the Liberal/National Coalition (1992-1999), Senior Parliamentary Secretary to the Premier (1992-1996), Parliamentary Secretary to State Development (1996-1999), Convenor of Food Victoria (1993-1999) and Secretary Liberal/National Partnership (1999-2000). Mr Steggall is a member of the Victorian Water Trust Advisory Council and the Northern Victoria Irrigation Renewal Project Board.

Table A1.1 Government response to Draft Strategy Independent Panel report

Independent Panel: key findings and report reference	Government response	Strategy reference
Consultation and submissions		
Every effort has been made to engage people, interest groups and communities that will be affected by the policies, programs and projects proposed by the Strategy (page 5).	No response required.	Chapter 1 (section 1.4)
Objectives of the Strategy		
The final Strategy should be more explicit in articulating a sustainable water strategy for the region in the 50-year timeframe, as required by the Act (page 5).	Agree. The Strategy sets out an action plan to sustainably manage the region's water resources in light of 50-year forecasts.	Chapters 3 to 9
The final Strategy should also identify ways to increase and set priorities for increasing the volume of water in the environmental water reserve… (page 5).	Agree. The Strategy specifically addresses how the northern rivers will be managed into the future including water recovery targets.	Chapter 7 (section 7.1.1)
It is particularly important for the final Strategy to be robust and address the step change (Scenario D) where the dry conditions of the past 12 years will continue (page 5).	Agree. Strategy actions address a range of future water availability scenarios, including Scenario D.	Chapter 2 (section 2.3)
Relationship to the Murray-Darling Basin Authority's Basin Plan		
The Strategy should guide regional approaches on matters such as the review of water-sharing agreements, revising the cap on surface water diversions, setting a cap on groundwater extractions, protecting regional communities when changing water trading rules and purchasing water for the environment, priorities for environmental water recovery and integrating the management of environmental water across the Basin (page 5).	Agree. The Strategy addresses each of these issues.	Chapter 3 (sections 3.2-3.4) and Chapter 7 (section 7.1.1)
There are several issues currently unresolved – for example, 4% trade limit out of a district and 10% limit on the amount of water entitlements not attached to land (page 5).	Noted. The Strategy reflects recent Victorian Government announcements.	Chapter 5 (section 5.3.2)
Regarding the Commonwealth's water purchase program, there must be a transparent review of the implications for the operation of the system on remaining entitlement-holders. The purchase must be targeted (page 5).	Agree. The Strategy outlines recent agreement to a targeted purchase approach.	Chapter 3 (section 3.2.2)
More responsive management of the environmental water reserve		
There is an urgent need for all water processes to be more responsive in both developing and implementing policy change. The regulatory process in the Draft Strategy may not provide the level of responsiveness needed (page 6).	Noted. The Strategy consolidates the range of tools required to manage the needs of the Northern Region's rivers.	Chapter 7 (particularly section 7.1.2 and 7.3.3)
The environmental water manager will require multi-year carryover and should be empowered to trade in environmental allocations (page 6).	Noted. The Strategy provides for more flexible carryover and trade for all entitlement-holders.	Chapter 5 (section 5.2 and 5.3)
The Draft Strategy is silent on the issue of future projections for water prices. The final Strategy should articulate the principles on which future pricing will be based (page 7).	Noted. Price setting in Victoria's water sector is overseen by the ESC (www.esc.vic.gov.au).	Chapter 10 (section 10.1.2)

Draft Strategy proposal		Independent Panel findings	Government response	Strategy Reference
5.1	Objective of the system reserve	Support. The panel also supports the efforts of NVIRP and urban water corporations to reduce the volume of water needed to operate the system.	Noted.	Section 5.1.1 and section 6.1
5.2	Seasonal allocation policy	Support. Needs publicly available set of rules. Believes many submitters misunderstand the concept of a 'system reserve'.	Agree. Additional communication undertaken on the system reserve through Project Update 5 and stakeholder meetings.	Section 5.1.1
5.3	Shortening the irrigation season	Support. Needs to be transparent and consistent.	Agree.	Section 5.1.2
5.4	Final allocation date	Support.	Noted.	Section 5.1.3
5.5	Amending existing carryover rules	Support review and note a promising draft paper on the concept of a spillable water account.	Noted.	Section 5.2
		Suggest in future there should be consideration of a single high-reliability share only.	Changes to Victoria's water entitlements may be considered as part of the 15-year resource review in 2019	Reference guides 1 and 2 (pages 9-12)
5.6	Introducing carryover for groundwater	Support.	Noted	Section 5.2.5
5.7	Expansion of reticulated systems for domestic and stock	Support. Should include metering of domestic and stock water in reticulated systems.	Metering guided by the draft *National Framework for Non-Urban Metering* (with no mandatory metering of domestic and stock use currently).	Section 8.2.1
5.8	Pioneering approach to environmental management	Suggest reallocation of environmental water for critical use needs to be transparent and a loan.	This process is directed by strict policies and procedures through qualification of rights (under the *Water Act 1989*).	Reference Guide 2 (pages 11-12, sections 3.3.1)
		Suggest under Scenario D additional water entitlement for the environment is needed.	The Strategy identifies water recovery targets and outlines future opportunities to recover entitlements for the environment.	Sections 7.1.1 and 3.2.2
5.9	Victoria's priorities for water recovery	Support. Victorian Government should engage with the Commonwealth in prioritising the water recovery process within the Basin Plan.	Agree. The Strategy outlines the need for ongoing communication between the states and Commonwealth.	Sections 3.2.1, 3.2.2 and 3.4.2
5.10	Changing environmental management objectives	Suggest significant environmental damage could occur before 2019 and that a 5-year review period would be more appropriate.	The Strategy recognises the need for an adaptive approach and reviews of the Strategy (or programs within it) can occur prior to 2019.	Chapter 1 and section 7.3.3
5.11	Managing water quality	Support.	Noted	Section 7.2.1

Draft Strategy proposal		Independent Panel findings	Government response	Strategy Reference
5.12	Water quality standards for environmental watering	Support.	Noted.	Section 7.2.1
5.13	Salinity impact zones	Support.	Noted.	Section 6.3
5.14	Assessing salinity impacts	Support.	Noted.	Section 6.3
6.1	Allowing urban customers access to water markets	Support. Cost effectiveness needs further examination and public discussion is encouraged.	Agree.	Section 8.2.2
6.2	Commonwealth water purchase for the environment	Support. Multiple benefits should be targeted such as retiring unsuitable irrigation land, and co-ordination with modernisation processes.	Agree.	Sections 3.2.2, 6.1.2 and 7.1.1
6.3	Barmah choke trading rules	Support.	Noted.	Section 5.3.3
6.4	Upper limits on trade	Support. Limits should be set solely for the purpose of environmental protection.	All trading rules are set to prevent adverse third party impacts, including on the environment.	Section 5.3.3
6.5	Trading in part- or unregulated systems	Support. Upper catchment irrigators should be able to enter the water market just as downstream entitlement holders.	Agree where there are no adverse third party impacts.	Section 5.3.3
6.6	Leasing options	Support.	Noted.	Section 5.3.3
7.1	Principles for converting savings to entitlements	Support. Subject to rigorous measurement, accounting and auditing.	Agree. *Water savings protocol for the qualification of water saving from irrigation modernisation projects* developed.	Section 6.1.3
7.2	Roles and responsibilities in water savings projects	The regulatory process outlined in the Draft Strategy may not provide the level of responsiveness needed.	Noted. *Water savings protocol for the qualification of water saving from irrigation modernisation project* developed and supports the Strategy.	Section 6.1.3
7.3	Maximising the benefits of modernisation	Modernisation needs to improve the service levels for efficient use of water by all users.	Agree.	Section 6.1
		Infrastructure investment is important for maximum environmental benefit.	Agree.	Section 6.1.2
		Catchment management authorities should consult with modernisation projects to coordinate works for multiple benefits.	Agree.	Section 6.1.2
7.4	Urban drought response plans	Support.	Noted.	Section 8.1.1

Draft Strategy proposal		Independent Panel findings	Government response	Strategy Reference
7.5	Revising uniform water restriction schedules	Support. Consistent approach is required for all sources of water.	The Strategy supports restrictions based on the condition of the water resource.	Section 8.3.2
7.6	Permanent water savings rules	Support.	Noted.	Section 8.3.1
7.7	Environmental water holder	Commonwealth and Victorian Environmental Water Holder roles must be consistent and engage to ensure clear responsibilities.	Agree.	Sections 3.4.2 and 7.1.2
		Mechanisms required for the VEWH and the catchment management authorities to engage with community organisations that hold water for environmental purposes.	Noted.	Section 7.1.2
7.8	Structural works and infrastructure upgrades	Support.	Noted.	Section 7.1.2
7.9	Using consumptive water en route	Support. Accounting for increased losses will need to be addressed and clarified.	Agree.	Section 7.1.2
7.10	Reuse of return flows	Support. Measurement needs to be rigorous and transparent.	Agree.	Section 4.7
8.1	The *Murray-Darling Basin Agreement*	The Strategy may need to be reviewed post Basin Plan.	Agree. It is intended that the Strategy will be reviewed before 2019 to prepare for the implementation of the Basin Plan.	Section 10.2
		Future sharing arrangements must be more robust and be equitable across jurisdictions.	Agree.	Section 3.3
		Clear definitions of concepts such as 'system operating water', 'critical human needs', and 'sustainable diversion limits' are needed.	Agree.	Glossary
8.2	The Murray-Darling Basin Cap - surface water	Support.	Noted.	Section 3.2.1
8.3	The Murray-Darling Basin Cap - groundwater	Suggest the connectivity of groundwater and surface water be addressed and caps may have to be adjusted.	Noted.	Section 3.2.1
8.4	Access to dead storage	Support.	Noted.	Section 4.4.1
8.5	Improving bulk entitlements for unregulated systems	Support. Bulk entitlements should continue to comply with the Murray-Darling Basin Cap.	Agree. Bulk entitlements will continue to comply with the Cap until it is replaced by the limits on diversions in the Basin Plan.	Sections 4.4.2 and 3.2.1
8.6	Refining delivery bulk entitlements	Support. It needs to be clear that this proposal is about delivery share as well as storage share.	Associated text provides clarification.	Section 4.4.1 and Reference Guide 1 (pg9-10)

Draft Strategy proposal		Independent Panel findings	Government response	Strategy Reference
8.7	Quantifying system operating water	Support.	Noted.	Section 4.4.1 (specifically Action 4.15)
8.8	Allocating system operating water in dry years	Guidelines should provide for the clear separation of consumptive, environmental and system operating water.	Where possible, these will be separately quantified. Where this is not possible, it will remain system operating water, which provides benefits for both consumptive users and the environment.	Section 4.4.1
8.9	Properties of environmental entitlements	Support. The environment should have the same entitlement and flexibility as consumptive users	Agree. New environmental entitlements will have the same characteristics as consumptive entitlements, with additional flexibility where possible.	Section 4.5.1
8.10	Creating an environmental entitlement from unregulated flows	Support.	Noted.	Section 4.5.2
8.11	Passing flows for the environment	Support.	Noted.	Section 4.5.2
8.12	Barmah-Millewa Environmental Water Allocation	Support.	Noted.	Section 4.5.2
8.13	Goulburn 80 GL flood release	Support. A legal framework is required to enable delivery of overbank flows.	The risk of flooding private land will be assessed and mitigated.	Section 4.5.2
8.14	Headworks charges for new environmental entitlements	Support. The final Strategy should outline how distribution costs for environmental water will be met.	Noted.	Section 4.6.3
8.15	Delivery of environmental water in river and distribution systems	Support. Final Strategy should outline how distribution costs for environmental water will be met.	Noted.	Section 4.6.3
8.16	Guidelines for determining reasonable domestic and stock use	Support. The final Strategy should identify stressed catchments and establish a working group to trial a regulatory regime.	The Final Strategy provides for improved management of domestic and stock water use.	Section 4.2
		Planning authority may need to reticulate or use rainwater tanks rather than catchment dams.	The Strategy outlines the process to reticulate domestic and stock water supplies.	Section 8.2.1
8.17	Licensing arrangements for dairy use	Support.	Noted.	Section 4.3.4

Draft Strategy proposal		Independent Panel findings	Government response	Strategy Reference
8.18	Managing sleeper licences	Recommends that the government identify and quantify sleeper licences, review at end of current licence period and not renew unused licences.	Currently, the rights of all licence holders are recognised. Work is ongoing to quantify sleeper licences for priority unregulated rivers (www.ourwater.vic.gov.au).	Section 4.3.4
		Changes to sleeper licence conditions would only take place through the development of local management rules.	Local management rules will not prevent the activation of sleeper licences but outline arrangements governing all licensed use. Changes to licence conditions occur through management plans or upon renewal.	
8.19	Converting Section 51 licences to water shares	Support.	Noted.	Section 4.3.4
8.20	Revising groundwater PCVs to account for the expansion of Victoria's licensing regime	Support.	Noted.	Section 4.3.2
8.21	PCVs for unincorporated groundwater areas	Support.	Noted.	Section 4.3.2
8.22	Regional guidelines for licensing of unregulated supplies	Support.	Noted.	Section 4.3.1
8.23	Local management rules	Support.	Noted.	Section 4.3.1
8.24	Groundwater restrictions	Support.	Noted.	Section 4.3.3
8.25	Streamflow management plans	Support.	Noted.	Section 4.3.1
8.26	Groundwater/ surface water interactions	Support. This should be given high priority.	Agree. The upper Ovens integrated management plan will guide future management of such highly connected systems.	Section 4.3.1
8.27	Pricing in unregulated systems	Support.	Noted.	Section 10.1.2

Appendix 2: Average availability of surface and groundwater

The following tables outline the average availabllity of surface water under historical inflows (Table A2.1) and under a continuation of recent low inflows (Table A2.2).

Table A2.3 outlines the current use and available water in the Northern Region's major groundwater systems.

Table A2.1 Average surface water availability in the Northern Region based on historic inflows (GL/year)

System	Total resource	Water that can be taken under entitlements					Average environmental water	Distribution losses
	A	B	C	D	E	F	G	H
	Average annual streamflows	Regulated rivers		Unregulated rivers	Unlicensed dams	Total	Average flows at basin outlets	
		Urban use	Rural and domestic and stock					
Murray	7,618	58	1,549	21	8	1,636	4,089 ***	395
Kiewa	689	1	0	14	5	21	674	n/a
Ovens	1,758	11	26	20	20	78	1,695	n/a
Broken	308	2	37	6	23	68	184	n/a
Goulburn	3,363 **	44	1,788	29	58	1,919	1,591	475
Campaspe	352	47	72	5	44	166	162	n/a
Loddon	373	2	102	23	80	207	109	n/a
Total	10,230 **	165	3,575	119	237	4,095	4,089 ***	870

A Except for Kiewa Basin, estimates from long-term inputs to resource allocation models of basins plus estimates of usage from unregulated rivers and small dams (2004/05 use from *State Water Report 2004-05*). For Kiewa Basin, mean annual basin outflows estimated from input to Murray Basin resource allocation model plus estimates of urban use and usage from unregulated rivers and small catchment dams (2004/05 use from *State Water Report 2004/05*).

****** End of valley flows from upstream Basins excluded to avoid double counting.

B Urban bulk entitlement volumes (not updated from Discussion Paper).

C Estimates as bulk entitlement volumes for rural and domestic and stock use from regulated rivers except for Murray, Goulburn and Campaspe (not updated from Discussion Paper). For Murray, estimated to be equal to Murray/Kiewa/Ovens valley long-term average Cap minus limits on urban (B), rural/domestic and stock (C) and unregulated diversions (D) for Kiewa and Ovens, minus limits on urban (B) and unregulated diversions (D) for Murray. For Goulburn, estimated to be equal to Goulburn/Broken/Loddon valley long-term average Cap minus limits on urban (B), rural/domestic and stock (C) and unregulated diversions (D) for Broken and Loddon minus limits on urban (B) and unregulated diversions (D) for Goulburn. For Campaspe, estimated to be equal to Campaspe valley long-term average Cap minus limits on urban (B) and unregulated diversions (D) for Campaspe. Long-term average Caps estimated from modelling over long period of historical climate data at 1993/94 level of development.

D Average bulk entitlement volume for licensed diversions on unregulated rivers (from *State Water Report 2005-06*).

E Estimated to be equal to usage in 2005/06 (from State Water Report 2005/06).

G Average environmental water estimated as end of valley flows.

******* Estimated as River Murray flow at South Australian border.

Table A2.2 Average availability surface water in the Northern Region under a continuation of low inflows (GL/year)

System	Total resource	Water that can be taken under entitlements					Average environmental water	Distribution losses
	A	B	C	D	E	F	G	H
	Average annual streamflows	Regulated rivers		Unregulated rivers	Unlicensed dams	Total	Average flows at basin outlets	
		Urban use	Rural and domestic and stock					
Murray	4,430	58	1,341	21	8	1,428	2,005 ***	395
Kiewa	541	1	0	14	5	21	526	n/a
Ovens	1,411	11	25	20	20	77	1,143	n/a
Broken	166	2	19	6	23	50	55	n/a
Goulburn	1,780 **	44	1,186	29	58	1,317	489	475
Campaspe	139	47	23	5	44	103	23	n/a
Loddon	172	2	12	23	80	117	17	n/a
Total	6,441 **	165	2,606	119	237	3,113	2,005 ***	870

A Except for Kiewa Basin, estimates from long-term inputs to resource allocation models of basins plus estimates of usage from unregulated rivers and small dams (2005/06 use from *State Water Report 2005-06*). For Kiewa Basin, mean annual basin outflows estimated from input to Murray Basin resource allocation model factored down by ratio of Basin outlet (Column G) flows under Scenario D and historical plus estimates of urban use and usage from unregulated rivers and small catchment dams (= 2005/06 use from *State Water Report 2005-06*).

****** End of valley flows from upstream basin/s excluded to avoid double counting.

B Urban bulk entitlement volumes (not updated from Discussion Paper).

C Estimated as long-term average Cap under 'low inflows' minus limits on urban (B) and unregulated diversions (D) except for Ovens. For Ovens, Bulk entitlement volume factored down by ratio of modelled average use under 'low inflows' to under historical inflows. Long-term average Caps estimated from modelling over long period of 'low inflows' and demands at 1993/94 level of development.

D Bulk entitlement volumes for licensed diversions on unregulated rivers (from *State Water Report 2005-06*).

E Estimated to be equal to usage in 2005/06 (from State Water Report 2005/06).

G Average environmental water estimated as end of valley flows.

******* Estimated as River Murray flow at South Australian border.

H Volumes also included in B and C (not updated from Discussion Paper).

Table A2.3 Groundwater availability in the Northern Region

Groundwater management unit	Licensed entitlements (GL)	Volume used in 2005/06 (GL)		
		Licensed use*	Unlicensed use (domestic and stock)^	Total use (GL)
Campaspe deep lead WSPA	46.3	34.8	0.2	34.9
Shepparton WSPA	232.2	109.2	0.2	111.7
Spring Hill WSPA	5.1	2.5	0.1	2.6
Katunga WSPA	59.7	30.8	0.5	31.3
Mid Loddon WSPA	37.2	22.9	0.2	23.1
Upper Loddon WSPA	13.4	6.2	0.3	6.5
Alexandra GMA	1.7	1.0	0.02	1.0
Barnawartha GMA	2.1	0.3	0.02	0.3
Ellesmere GMA	2.3	1.4	0.03	1.4
Goorambat GMA	4.9	0.9	0.01	0.9
Kialla GMA	2.3	1.4	0.01	1.4
Kinglake GMA	2.0	1.2		1.3
Mullindolingong GMA	7.0	0.8	0.05	0.8
Murmungee GMA	16.7	7.1	0.34	7.4
Nagambie GMA	6.6	5.0	0.09	5.0
Unincorporated areas	46.2	16.2	6.5	22.6
Total	**485.7**	**241.6**	**10.9**	**252.5**

* Includes metered and estimated unmetered use.
^ Estimated assuming 2 ML/bore per annum.

Appendix 3: Factors influencing Victoria's climate

Key influences on Victoria's climate

The major influences on Australia's climate are shown in Figure A3.1. These influences have varying levels of impact in different regions at different times of the year. Details of the various influences, including the spatial extent and timing of their impacts can be found on the Bureau of Meteorology's website. The descriptions of the sub-tropical ridge and the Southern Annular Mode (SAM) below are largely taken from this source.

Of these influences, those most important for Victoria's climate are highlighted by red text in Figure A3.1. Larger-scale influences also known to have an impact but not shown, include global warming of the atmosphere and oceans due to the enhanced greenhouse effect, ozone depletion over the Antarctic, and the impact of Northern Hemisphere aerosol pollution (via impacts transmitted southwards through the Indian Ocean). Ocean currents are also important influences – both the surface currents within and linking the major ocean basins and the deeper ocean currents that form the 'global conveyor belt' linking the Pacific, Indian, Atlantic and Southern oceans.

Changes in rainfall patterns over south-east Australia in the past decade have been linked primarily to increases in mean sea level pressure over southern Australia which, in turn, are linked to

1. increasing intensity of the **sub-tropical ridge**[64,65]. This is a belt of high pressure between 30-35° south (and north). It is part of the global circulation of the atmosphere (see Figure A3.2). The position of this ridge has a seasonal cycle, being furthest north in early spring and furthest south in late summer (and the position of the mid-latitude westerlies to the south of the ridge also reflect this seasonal cycle). During the warmer half of the year (November to April), the sub-tropical ridge is generally located to the south of Australia. In autumn, the sub-tropical ridge moves northwards and remains over the continent for most of the colder half of the year (May to October). High pressure systems, which are associated with stable and dry conditions, move eastwards along the ridge. As well as changes in the intensity of the ridge over the past decade, there have been changes in its seasonal cycle, as it has been moving northwards later in autumn[66,67,68].

2. The changes in mean sea level pressure also reflect an increasing trend in the **SAM**. The SAM is a relatively short-term mode of climate variability (10+ days) characterised by a 'flip-flopping' of pressures and associated changes in storms and windiness between mid (~45ºS) and higher ~(65ºS) latitudes. During a 'positive' SAM event, the belt of strong westerly winds contracts towards the South Pole. This results in weaker than normal westerly winds and higher pressure (and more stable conditions) over southern Australia. Conversely, a 'negative' SAM event reflects an equator ward expansion of the belt of strong westerly winds, resulting in more storm systems and lower pressures over southern Australia. While there has been a generally increasing trend in 'positive' SAM over recent decades, the magnitude of the trend varies between seasons as does the strength and direction of the association between SAM and Victorian rainfall, and it does not appear to account for the changes in autumn rainfall[69]. The influence of the SAM is still an active area of research.

Overall, the changes in these influencing factors over the past decade mean that:

a) Victoria has been less exposed to the influence of the mid-latitude westerlies and the associated embedded frontal systems and low pressure systems that typically bring regular rainfall.

b) There has also been a decrease in the amount of rainfall associated with cut-off lows (low pressure systems that break off from the main belt of low pressure to the south of Australia) which are important in creating an effective 'autumn break' and in providing growing season rainfall.

Figure A3.1 Australian climate influences[69]

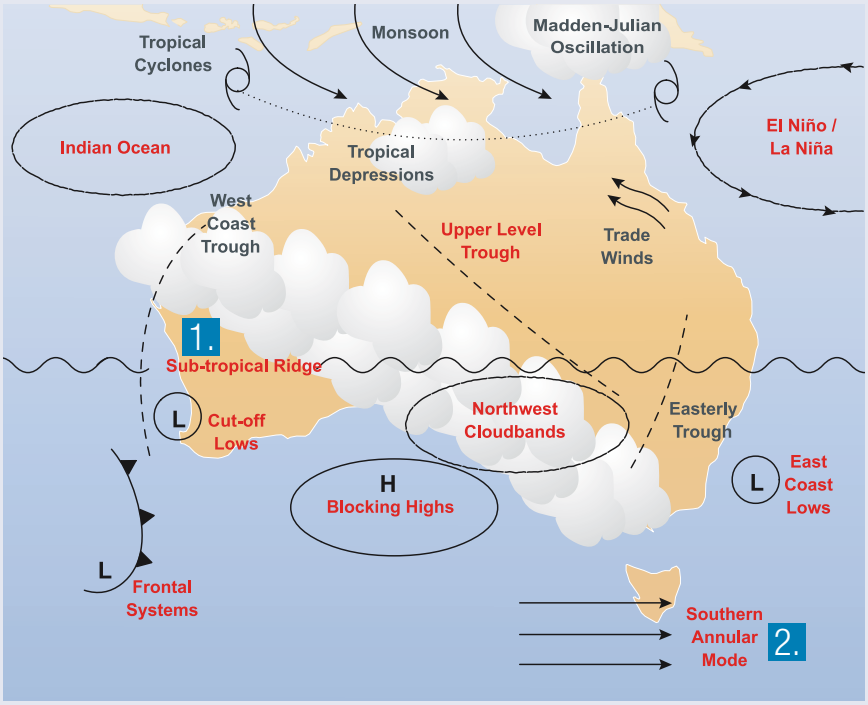
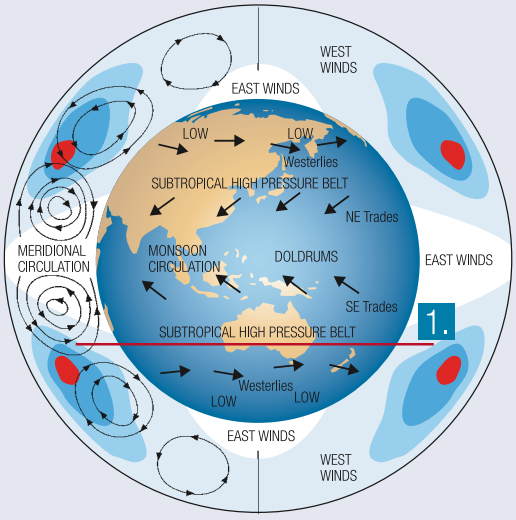
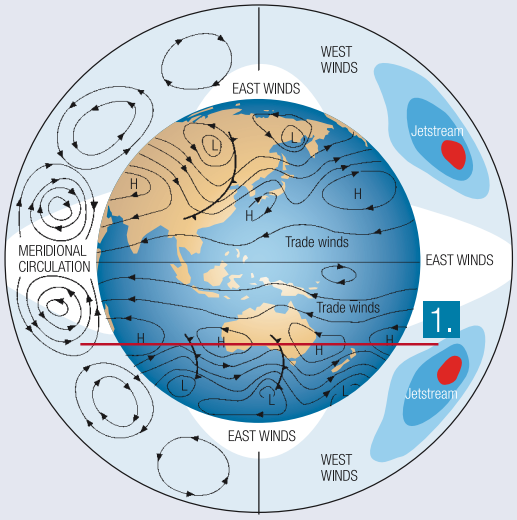


Figure A3.2 Essential features of the general circulation of the atmosphere[70,71]



Essential features



Essential features reflected in typical daily pressure pattern

Appendix 4: Existing environmental entitlements

Table A4.1 outlines the current range of environmental entitlements (including rules-based entitlements) available for the major river systems of northern Victoria, based on historical inflows.

It includes Victoria's entitlements to date under the Living Murray Initiative but not the Snowy Water Recovery Project.

Table A4.1 Existing environmental entitlements in the Northern Region

River system	High-reliability entitlement (GL)	Low-reliability entitlement (GL)	Rules-based environmental water (GL)*	Average availability (GL/year)	Comment
Murray		99		37.0	Murray Environmental Entitlement (from Living Murray conversion of sales water)
	27.6			27.5	Flora and Fauna Bulk Entitlement
			50	49.8	Barmah Environmental Water Allocations
			25	19.0	
Goulburn			80	11.9	Goulburn Murray Bulk Entitlement (flood release)
		141		80.1	Goulburn Environmental Entitlement^ - Living Murray
Campaspe		5		3.8	Campaspe environmental entitlement^ (from Living Murray conversion of sales water)
Loddon		2		1.1	Loddon bulk entitlement (from Living Murray conversion of sales water)
	2			1.9	Loddon Bulk Entitlement (for Boort wetlands)
Total				**232.1#**	

Notes:
* 'Rules-based environmental water' column relates to water that may be actively used for environmental purposes, but are not environmental entitlements. In these cases, water is re-regulated to meet consumptive requirements.
^ 'Sales water in the Goulburn and Campaspe Rivers is designated for the Living Murray, and is likely to be called out in winter-spring to meet icon site demands. They cannot be called out to meet tributary requirements alone (eg. summer low flows for drought refuge may not be met with the use of this water).
# Average environmental water availability equates to approximately 6% of total average environmental flows as measured at Basin outlets (refer Appendix 3 on availability of surface water in the Northern Region).

Appendix 5: Government's response to calls to build new dams

New dams

Many large dams have been built in Victoria over the past 150 years to supply water for towns, industry and irrigation. Some 21 storages of 10 GL or more have been built in the Northern Region, totalling more than 12,000 GL of storage capacity (see Figure A5.1). These storages have (and continue to) support current levels of water use. The State Government acknowledges that some members of the community have suggested that new dams should be built in northern Victoria. With the Murray-Darling Basin Cap in place (see page 11), Victoria is not permitted to divert more water, even if new storages are built.

The past 12 years of drought have seen the levels of the region's reservoirs drop. In light of the potential impacts of climate change, this suggests there is sufficient capacity in the region to store the available inflows. New dams are not the solution to reduced water availability, especially in times of low rainfall.

The State Government does not support the construction of new on-stream storages for the following reasons:

a) New dams do not create new water. They take water from rivers and downstream irrigators.

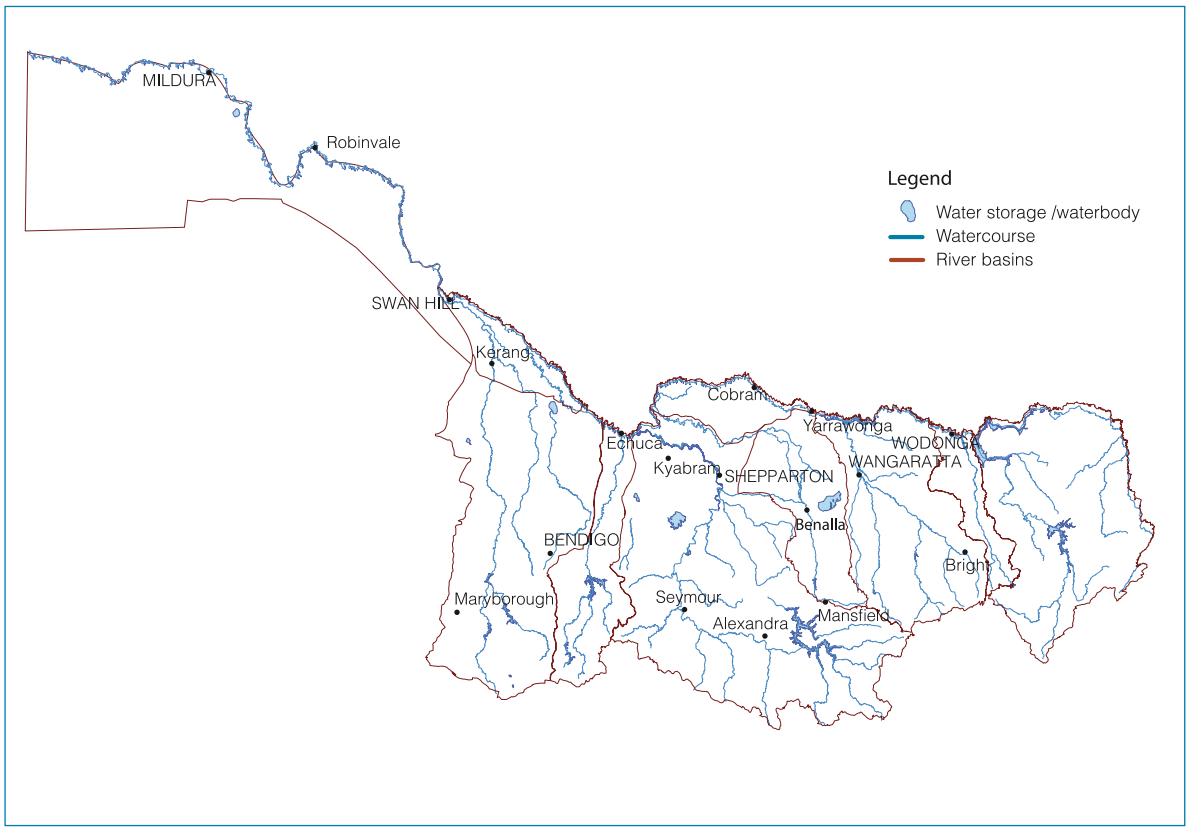
b) The amount of water that can be diverted from the region's rivers (to be stored in reservoirs) is determined by the Murray-Darling Basin Cap. Under this Cap, any increased consumptive harvesting associated with upgraded or new dams would need to be offset through equivalent reductions in other parts of the Basin. New or enlarged dams would capture flows that would otherwise have been captured further downstream or used to fulfil Victoria's commitment to provide flows to South Australia.

c) It would take large investments to create new dams – someone would need to pay for the construction and maintenance. The most cost-effective and reliable storages have already been built.

d) New dams would seriously impact on the health of rivers and wetlands, many of which are already stressed.

e) Expanding the water grid (interconnecting supply systems) reduces the need for increased storage capacity, by improving the movement of water to where and when it is needed.

Figure A5.1 Major storages in the Northern Region (GL)



Summary of hydrological impacts of enlarging Buffalo Dam

The previous section highlighted the reasons the government does not support the construction of new on-stream storages. Many of these reasons also apply to the expansion of existing storages. There has been some previous discussion, highlighted through the stakeholder engagement and submissions process for the Discussion Paper, of the option to expand Lake Buffalo, near Myrtleford.

> *" ...Government should reconsider its decision on more dams. We support the construction of Stage 2 Buffalo Dam and William Hovell Dam. This extra storage would store water in the event of a severe rain event and enable it to be used to cover existing allocations in dry periods."*
>
> - Discussion Paper submission (DP013)

Analysis was undertaken to determine the potential hydrological benefits and impacts of expanding Lake Buffalo to a storage capacity of 1,000 GL under the following water availability scenarios[62]:

- base case (long-term average, based on the historic inflows)
- Scenario B (medium climate change)
- Scenario D (continuation of recent low inflows).

A series of model runs made different assumptions about the purpose of the additional storage capacity and compliance with the Murray-Darling Basin Cap:

1. Additional storage capacity used to supply new entitlement in the Ovens system, assuming compliance with the Murray-Darling Basin Cap.
2. Additional storage capacity used to supply new entitlement in the Ovens system, assuming no compliance with the Murray-Darling Basin Cap.
3. Additional storage capacity used to supplement supply for existing entitlements in the Murray system, assuming compliance with the Murray-Darling Basin Cap.
4. Additional storage capacity used to supplement supply for existing entitlements in the Murray system, assuming non compliance with the Murray-Darling Basin Cap.

Essentially, if the additional storage capacity was allowed to result in a breach of Victoria's share of the Murray-Darling Basin Cap (model runs 2 and 4), this would result in reduced supply to New South Wales and South Australia (up to 105 GL and 400 GL respectively). In addition, it would have significant environmental impacts. For example, the number of years that the Barmah Forest was flooded could be halved (under model run 2 and a continuation of recent low inflows). Water availability for the environment could also be significantly reduced in the Ovens River. Victoria is committed to complying with the Cap under the *Murray-Darling Basin Agreement* and new *Agreement on Murray-Darling Basin Reform*.

In addition, these hydrological results demonstrate there would be unacceptable impacts to New South Wales, South Australia and the environment if Victoria did not comply with the Cap as a result of enlarging Lake Buffalo.

If the additional storage capacity was used to supply new entitlements in the Ovens system (model runs 1 and 2), this would be at the expense of existing entitlement-holders in the Murray system. In short, water availability for Murray water users could be reduced by up to 175 GL a year. Under the more severe climate change scenario, the number of years with full allocations could be reduced from 68 per cent to 52 per cent. Again, this is clearly an unacceptable impact.

The only remaining option is to use the additional storage capacity to supplement existing Murray entitlements, ensuring compliance with the Cap (model run 3). This would increase water availability for Murray water users by a maximum of 7 GL a year. This is a relatively limited benefit, given the significant economic cost of enlarging the dam. This is particularly true when the environmental impacts are considered.

The same types of impacts would occur if new dams were built elsewhere in the north-east or if existing dams, such as Lake William Hovell, were expanded. Because Victoria must remain compliant with the Cap, enlarging these dams provides limited benefit to water users. As such, the government does not support enlarging Lake Buffalo or Lake William Hovell.

The complete report is presented as Background Report 9 available at www.ourwater.vic.gov.au/programs/sws/northern.

Additional storage capacity used to supply new entitlement in the Ovens system:

1) Assuming compliance with the Murray-Darling Basin Cap an enlarged Buffalo Dam would result in:

- reduced water availability for Victorian Murray water users under all scenarios (reduction of up to 175 GL/year under the base case scenario)
- reduced reliability for Murray high-reliability water shares under all scenarios (reduced from 89 to 77 years out of 100 with full allocations under Scenario B)
- reduced reliability for Murray low-reliability water shares under all scenarios (average allocation reduced from 62 to one per cent under base case scenario)

- reduced water availability for New South Wales water users under all scenarios (reduction of up to 78 GL/year under Scenario B)
- reduced water availability for South Australia under all scenarios (reduction of up to 275 GL/year under the base case scenario)
- reduced flooding at Living Murray icon sites under all scenarios (number of years with floods at Barmah Forest reduced from 33 to 26 out of 100 under the base case scenario)
- additional water required to meet environmental flow recommendations in the Ovens River under all scenarios (an additional 330 GL/year under Scenario B).

Additional storage capacity used to supply new entitlement in the Ovens system:

2) Assuming no compliance with the Murray-Darling Basin Cap an enlarged Buffalo Dam would result in:

- reduced water availability for Victorian Murray water users under all scenarios (reduction of up to 131 GL/year under Scenario D)
- reduced reliability for Murray high-reliability water shares under all scenarios (reduced from 68 to 62 years out of 100 under Scenario D)
- slight increase in reliability for Murray low-reliability water shares under most scenarios (average allocation increased from 62 to 68 per cent under base case)
- reduced water availability for New South Wales water users under all scenarios (reduction of up to 105 GL/year under Scenario B)
- reduced water availability for South Australia under all scenarios (reduction of up to 400 GL/year under the base case scenario)
- reduced flooding at Living Murray icon sites under all scenarios (number of years with floods at Barmah Forest reduced from 15 to 8 years out of 100 under Scenario D)
- additional water required to meet environmental flow recommendations in the Ovens River under all scenarios (an additional 330 GL/year under Scenario B).

Additional storage capacity used to supplement supply for existing entitlements in the Murray system:

3) Assuming compliance with the Murray-Darling Basin Cap:

- slight increase in water availability for Victorian Murray water users under all scenarios (an increase of up to 7 GL/year under Scenarios B and D)
- slight increase in reliability for Murray high-reliability water shares under all scenarios
- reduced reliability for Murray low-reliability water shares under all scenarios (average allocation reduced from 20 to 10 per cent under Scenario D)
- slight increase in water availability for New South Wales water users under all scenarios (an increase of up to 24 GL/year under Scenario D)
- slight decrease in water availability for South Australia under most scenarios (reduction of up to 24 GL/year under Scenario D)
- little impact on flooding at Living Murray icon sites under all scenarios (number of years with flooding at Barmah Forest)
- additional water required to meet environmental flow recommendations in the Ovens River under all scenarios (an additional 240 GL/year under Scenario D).

Additional storage capacity used to supplement supply for existing entitlements in the Murray system:

4) Assuming no compliance with the Murray-Darling Basin Cap an enlarged Buffalo Dam would result in:

- slight increase in water availability for Victorian Murray water users under all scenarios (an increase of up to 55 GL/year under Scenario B)
- slight increase in reliability for Murray high-reliability water shares under all scenarios (increased from 68 to 74 years out 100 under Scenario D)
- increased reliability for Murray low-reliability water shares under all scenarios (average allocation increased from 62 to 83 per cent under base case scenario)
- potential increase in water availability for New South Wales water users under Scenario D (of 18 GL/year)
- reduced water availability for South Australia under all scenarios (reduction of up to 59 GL/year under Scenario D)
- little impact on flooding at Living Murray icon sites under all scenarios
- additional water required to meet environmental flow recommendations in the Ovens River under all scenarios (an additional 256 GL/year under Scenario D).

Table A5.1 outlines the impact on supplies to existing water users under the range of climate change scenarios and under the range of options (1-4) previously outlined.

Table A5.1 Summary of key results of the hydrological impacts of enlarging Buffalo Dam

	Change in average from current						
	Victorian Murray supply						New South Wales supply
Climate scenarios	Model run	New Ovens supply (GL/year)	Victorian Murray supplement (GL/year)	Victorian Murray diversion (GL/year)	Percentage of years with 100% HRWS	Average LRWS allocation (%)	NSW Murray diversion (GL/year)
Base case – long-term average	Current			1714	98	62	1838
	1	666		-175[1]	-2	-61	-71
	2	666		-16	-5	6	-99
	3		93	1	2	0	5
	4		104	44	2	21	-2
Scenario B – medium climate change	Current			1589	89	38	1515
	1	530		-172[2]	-12	-37	-78
	2	530		-99	-15	2	-105
	3		93	7	6	-5	5
	4		104	55	5	14	0
Scenario D – continuation of recent low inflows (1997/98-2006/07)	Current			1456	68	20	1306
	1	483		-161[3]	-10	-19	-61
	2	483		-131	-16	-1	-61
	3		324	7	6	-10	24
	4		345	78	6	12	18

Notes:
Current – No enlargement of Buffalo Dam for three climatic scenarios
Model run 1 - Enlarged Buffalo Dam storage size is 1,000 GL for New Ovens River entitlement within Victorian Murray Cap for three climatic scenarios.
Model run 2 - Enlarged Buffalo Dam storage size is 1,000 GL for New Ovens River entitlement outside Victorian Murray Cap for three climatic scenarios.
Model run 3 - Enlarged Buffalo Dam storage size is 1,000 GL for Ovens regulated supplement to meet the current Murray System commitments within Victorian Murray Cap for three climatic scenarios.
Model run 4 - Enlarged Buffalo Dam storage size is 1,000 GL for Ovens regulated supplement to meet the current Murray System commitments Outside Victorian Murray Cap for three climatic scenarios.
Modifications to the Ovens River basin environmental flow requirements to account for enlarging Buffalo Dam were not considered. It is likely that modifications to the requirements would reduce negative environmental flow impacts, however there would be a consequent decrease in water availability from Buffalo Dam for consumptive use.
1 In addition to this reduction, a Cap overrun of 460 GL/year occurred.
2 In addition to this reduction, a Cap overrun of 344 GL/year occurred.
3 In addition to this reduction, a Cap overrun of 313 GL/year occurred.

Change in average from current								
	South Australia supply	Murray icon sites - Years with floods of				Additional water required to meet environmental objectives in Ovens River		
	SA border flow (GL/year)	18,000 ML/d Barmah-Millewa Forest	25,000 ML/d Gunbower wetlands	35,000 ML/d Hattah Lakes	35,000 ML/d Lindsay-Walpolla wetlands	Lake Buffalo to Ovens River (GL/year)	Ovens River below Buffalo River to King River (GL/year)	Ovens River from King to River Murray (GL/year)
	6776	33	37	46	45	4.2	0.5	6.6
	-275	-7	-4	-2	-3	178.5	0.2	122.7
	-400	-6	-5	-5	-5	178.5	0.2	122.7
	1	-1	0	0	0	19.2	-0.3	21.2
	-37	3	0	-1	0	21.3	-0.2	24.6
	4790	22	16	26	27	21.5	1.2	33.0
	-173	-4	-4	-4	-2	164.9	0.4	164.6
	-223	-4	-4	-4	-1	164.9	0.4	164.6
	-5	-2	-2	1	0	56.6	-0.1	102.7
	-49	-3	-3	-1	-1	58.8	-0.1	107.1
	3362	15	6	8	7	40.9	1.5	51.3
	-164	-5	0	-2	-2	148.7	0.1	179.2
	-197	-7	-1	-2	-3	148.7	0.1	179.2
	-23	0	0	-1	-1	76.4	-0.2	163.0
	-59	0	0	-1	-1	83.8	-0.2	172.4

Appendix 6: Developing recovery targets for wetlands

The need for water recovery will be assessed in 30 wetland systems containing 434 high-value wetlands (see Table A6.1).

The process for developing water recovery targets is summarised on page 135. More specific details for each category of wetland are outlined in the following sections, including for:

- River Murray floodplain wetlands
- Victoria's tributary floodplain wetlands
- wetlands associated with irrigation distribution systems.

Floodplain wetlands (River Murray and Victorian tributaries)

These wetlands can be further separated into those identified as 'icon sites' through the Living Murray First Step and those currently outside of the Living Murray process. Given the interstate management arrangements of the Living Murray, and the significant resources already committed to icon sites, this Strategy focuses on the many other high-value floodplain areas.

Providing water to icon sites is likely to provide some benefits to other floodplains wetlands on the Murray due to increased in-river flows, but will not provide overbank flows to the areas that depend on them. For all sites, structural works, such as pumps or weirs, may be the only option to maintain floodplain communities under climate change, in the absence of natural overbank floods.

There has been some public feedback about the need to look beyond 'icon sites' – this was particularly strong from Traditional Owner groups. A project is underway to determine the water requirements of the 'non-icon' river red gum communities along the River Murray floodplain and the feasibility of delivering water to these areas under climate change. It will identify priority areas for watering, methods for water delivery and potential volumes and costs for a program of complementary structural works to deliver environmental water. It will also assess the potential benefits to these sites of Living Murray water. The watering requirements of these sites have already been identified (see Background Report 8). A target for water recovery and a structural works program will be developed following the completion of Living Murray modelling.

Once this process has been completed for River Murray floodplain sites, it will be applied to the wetland systems on Victoria's tributaries (see Table A6.1).

Table A6.1 Wetland systems in the Northern Region (and responsible catchment management authority)

North East CMA	North Central CMA	Goulbourn Broken CMA	Mallee CMA
Lower Ovens	Bendigo Creek	Broken Boosey Nine Mile Creek	Cardross
Murray above Hume	Boort - Loddon flood	Honey Suckle Creek Catchment	Kings Billabong Wetlands
Murray Hume-Yarrawonga	Kerang - Loddon flood	Lower Goulburn	Lindsay River
Mid Ovens	Torrumbarry - Gunbower Creek - operational	Major Plains	Murray Nyah - Murrumbidgee
	Torrumbarry - non operational	Mid Goulburn	Murray Euston-Mildura
	Torrumbarry - operational	Mosquito Depression	Murray below Nyah
	Woorinen	Muckatah Depression	Murray downstream Lock 9
		Murray Yarrawonga - Torrumbarry	Murray Mildura - Lock 10
		Upper Muckatah	Murray Murrumbidgee - Euston
		Waranga/Corop	

Wetlands associated with irrigation distribution systems

Many wetlands in northern Victoria are used to store or convey irrigation water, or have been isolated so they can only receive environmental water via the irrigation distribution system.

An initial assessment of their water requirements found that water requirements can be adequately met under the base case, and an average of an additional 10 GL per year would be required to meet Category 4 requirements under Scenario D. However, this assessment did not consider volumes that may be required to meet Category 2 requirements under Scenario D to manage salinity levels or the impacts of future changes to irrigation systems (eg. reconfiguration and changed operation to minimise losses).

Further work is underway to determine the additional volumes that may be required to meet water requirements for these wetlands, including:

1) Undertaking hydrological modelling to assess the adequacy of existing environmental entitlements in meeting minimum flow requirements under Scenario D.
2) Improving understanding of how the irrigation distribution system will operate in low allocation years. This affects our ability to deliver environmental water and can result in additional requirements for environmental water to operate the system.
3) Assessing requirements for additional water to flush accumulated salts (as a replacement for overland flooding, which is no longer feasible).
4) Progressively develop water recovery targets (if required).

Wetlands where recovery targets will not be developed

Water recovery targets will not be developed for the following systems:

- the Living Murray 'icon sites' (see page 136)
- groundwater-fed wetlands (see page 136)
- wetlands where it is not possible to manage flow regimes
- wetlands used for wastewater/sewage treatment plants.

Appendix 7: Water 'surplus' or 'deficit' for urban communities

Table A7.1 shows how urban systems could be impacted by climate change under Scenario B (medium climate change) and Scenario D (a continuation of recent low inflows), and how much water will be provided by urban water supply demand strategy actions to address supply shortfalls.

Deficits are highlighted in red or orange. They indicate that from this particular year in the given system and scenario, a higher frequency of water restrictions or a higher level of water restrictions will be necessary to ensure security of supply, even if water supply/demand actions are implemented. It does not indicate that a system will run out of water.

Since the release of the Discussion Paper, a range of actions are being implemented by urban water corporations to address urban water shortfalls. These are captured within this updated table.

Table A7.1 - Water surplus or deficit for urban systems and major actions being undertaken by water corporations (Scenarios B and D)

Year	Surplus or deficit in water availability (ML) under Scenario B – medium climate change (assumes implementation of WSDS actions)	Surplus or deficit in water availability (GL) under Scenario D – continuation of low inflows of the past 10 years (assumes implementation of WSDS actions)	Water provided by WSDS actions (ML)	Major action being taken to meet supply deficit
North East Water				
Murray River urban supply system – includes Bellbridge, Corryong, Tallangatta, Wahgunyah, Walwa, Wodonga and Yarrawonga				
Average yield: 11,898 ML/year			Unrestricted annual demand:10,622 ML/year	
2006	-40	-4,721	0	Pipeline from Barnawartha to Chiltern. Purchase of water entitlements on the market.
2015	1,841	-3,081	3,291	
2030	1,327	-3,056	6,369	
2055	339	-2,830	9,293	
Ovens/King River urban supply system* – includes Bundalong, Glenrowan, Moyhu, Oxley, Springhurst, Wangaratta and Whitfield				
Average yield: 7,022 ML/year			Unrestricted annual demand: 5,198 ML/year	
2006	-14	-69	11	Pipeline from Wangaratta to Glenrowan. Purchase of water entitlements on the market.
2015	1,152	1,002	1,196	
2030	1,526	934	1,609	
2055	811	672	1,716	
Upper Ovens River urban supply system – includes Bright, Harrietville and Myrtleford				
Average yield: 1,864 ML/year			Unrestricted annual demand: 1,876 ML/year	
2006	-177	-555	0	Construction of Bright/ Porepunkah off-stream storage.
2015	723	313	1,080	
2030	416	61	1,201	
2055	3	-111	1,342	
Broken River urban supply system – includes Benalla				
Average yield: 1,731 ML/year			Unrestricted demand: 1,817 ML/year	
2006	-124	-915	0	Diversion from Broken River, purchase of water entitlements on the market.
2015	1,309	569	1,794	
2030	695	96	1,879	
2055	49	-263	2,000	

* Figures not available for upper Murray, Kiewa and Dartmouth urban supply systems.

Year	Surplus or deficit in water availability (ML) under Scenario B – medium climate change (assumes implementation of WSDS actions)	Surplus or deficit in water availability (ML) under Scenario D – continuation of low inflows of the past 10 years (assumes implementation of WSDS actions)	Water provided by WSDS actions (ML)	Major action being taken to meet supply deficit
Central Highlands Water				
Maryborough urban supply system – including Adelaide Lead, Bet Bet, Carisbrook, Havelock, Talbot, and surrounding communities				
Average yield: 1,880 ML/year			Unrestricted demand: 2,190 ML/year	
2006	-10	900	300	Commission a new groundwater supply, purchase of additional water entitlements on the market, and use of fit-for-purpose recycled water.
2015	1,370	550	1,630	
2030	1,290	630	1,680	
2055	1,020	690	1,690	
Daylesford urban supply system – including Hepburn Springs, Musk, Sailors Hill and Shepherds Flat				
Average yield: 750 ML/year			Unrestricted demand: 810 ML/year	
2006	-60	-280	0	Use of groundwater supply following licence approval.
2015	280	90	370	
2030	480	350	670	
2055	320	320	670	
Clunes urban supply system – including some outlying properties				
Average yield: 350 ML/year			Unrestricted demand: 280 ML/year	
2006	70	-40	0	Purchase of additional groundwater licence volume.
2015	190	90	120	
2030	140	80	120	
2055	40	404	120	
Waubra urban supply system – including some outlying properties				
Average yield: 100 ML/year			Unrestricted demand: 41 ML/year	
2006	62	32	3.0	Leakage prevention.
2015	59	33	3.0	
2030	52	34	3.0	
2055	32	32	3.0	
Lexton urban supply system – including some outlying properties				
Average yield: 45 ML/year			Unrestricted demand: 32 ML/year	
2006	14	1.0	0	Leakage prevention (commited option), and investigate groundwater (future option).
2015	16	5.0	3.0	
2030	42	34	33	
2055	31	31	33	
Dean urban supply system – including some outlying properties				
Average yield: 30 ML/year			Unrestricted demand: 19 ML/year	
2006	11	2.0	0	Leakage prevention.
2015	21	1.3	1.0	
2030	18	1.3	1.0	
2055	13	1.3	2.0	

Year	Surplus or deficit in water availability (ML) under Scenario B – medium climate change (assumes implementation of WSDS actions)	Surplus or deficit in water availability (ML) under Scenario D – continuation of low inflows of the past 10 years (assumes implementation of WSDS actions)	Water provided by WSDS actions (ML)	Major action being taken to meet supply deficit
Coliban Water				
Coliban urban supply system – including Bendigo, Castlemaine, Heathcote, Kyneton				
Average yield: 38,300 ML/year			Unrestricted demand: 37,200 ML/year	
2006	-1,000	-22,000	0	Construction of the Colbinabbin to Bendigo section of the Goldfields Superpipe. Construction of the Epsom – Spring Gully Recycled Water Project.
2015	31,000	8,000	36,000	
2030	23,400	4,000	36,000	
2055	8,000	-4,000	36,000	
Murray River urban supply system – includes Cohuna, Echuca, Gunbower and Leitchville				
Average yield: 6,300 ML/year			Unrestricted demand: -6,100 ML/year	
2006	0	0	0	Purchase of additional water entitlements on the market.
2015	4,500	1,500	5,000	
2030	3,000	0	5,000	
2055	4,500	2,000	10,000	
Goulburn River urban supply system – includes Boort, Pyramid Hill, Rochester and other smaller communities				
Average yield: 2,400 ML/year			Unrestricted demand: 2,000 ML/year	
2006	300	0	0	Purchase of additional water entitlements on the market.
2015	500	100	400	
2030	800	400	1,000	
2055	300	-100	1,000	
Loddon River urban supply system – includes Bridgewater, Dunolly, Inglewood and other smaller communities				
Average yield: 820 ML/year			Unrestricted demand: 610 GML/year	
2006	200	-300	0	System interconnections for Bridgewater and Inglewood to Bendigo. System interconnection of Serpentine to Goulburn system.
2015	350	-100	200	
2030	400	0	300	
2055	460	200	500	
Campaspe River urban supply system – includes Axedale and Goornong				
Average yield: 0.22 GL/year			Unrestricted demand: 0.19 GL/year	
2006	0	0	0	Purchase of additional water entitlements on the market. System interconnection of Axedale to Bendigo.
2015	0.100	0	0.100	
2030	0	0	0.100	
2055	0	0	0.100	
Groundwater supply system – includes Elmore and Trentham				
Average yield: 470 ML/year			Unrestricted demand: 310 ML/year	
2006	0	0	0	Purchase of additional water entitlements on the market.
2015	100	-100	0	
2030	150	0	100	
2055	0	0	100	

Year	Surplus or deficit in water availability (ML) under Scenario B – medium climate change (assumes implementation of WSDS actions)	Surplus or deficit in water availability (ML) under Scenario D – continuation of low inflows of the past 10 years (assumes implementation of WSDS actions)	Water provided by WSDS actions (ML)	Major action being taken to meet supply deficit
Goulburn Valley Water				
Goulburn–Broken River urban supply system – includes Mooroopna, Nagambie, Seymour and Shepparton				
Average yield: 33,500 ML/year			Unrestricted demand: 21,500 ML/year	
2006	12,000	-300	0	Water conservation. Purchase of additional water entitlements on the market.
2015	8,800	-2,100	400	
2030	4,600	-4,400	1,700	
2055	0	-5,300	6,500	
Murray River urban supply system – includes Barmah				
Average yield: 5,590 ML/year			Unrestricted demand: 4,880 ML/year	
2006	700	-600	0	Water conservation. Purchase of additional water entitlements on the market.
2015	0	-700	300	
2030	0	-400	1,100	
2055	0	-100	2,300	
Sunday Creek urban supply system – includes Broadford and Kilmore				
Average yield: 1,530 ML/year			Unrestricted demand: 1,530 ML/year	
2006	-10	Not calculated	0	Water conservation. Construction of the Goulburn River to Broadford pipeline.
2015	0	Not calculated	500	
2030	1,600	Not calculated	2,700	
2055	400	Not calculated	2,600	
Delatite River urban supply system – includes Mansfield				
Average yield: 420 ML/year			Unrestricted demand: 74 ML/year	
2006	-300	Not calculated	0	Water conservation. Construction of an off-stream raw water storage.
2015	100	Not calculated	600	
2030	400	Not calculated	1,100	
2055	0	Not calculated	1,000	
Lower Murray Water				
Lower Murray Water urban supply system – includes all communities from Koondrook to Mildura				
Average yield: 21,300 ML/year			Unrestricted demand: 20,600 ML/year	
2006	1,800	-1,600	1,200	Purchase of additional water entitlements on the market.
2015	3,600	1,100	6.500	
2030	2,300	1,100	10,500	
2055	800	2,000	17,800	