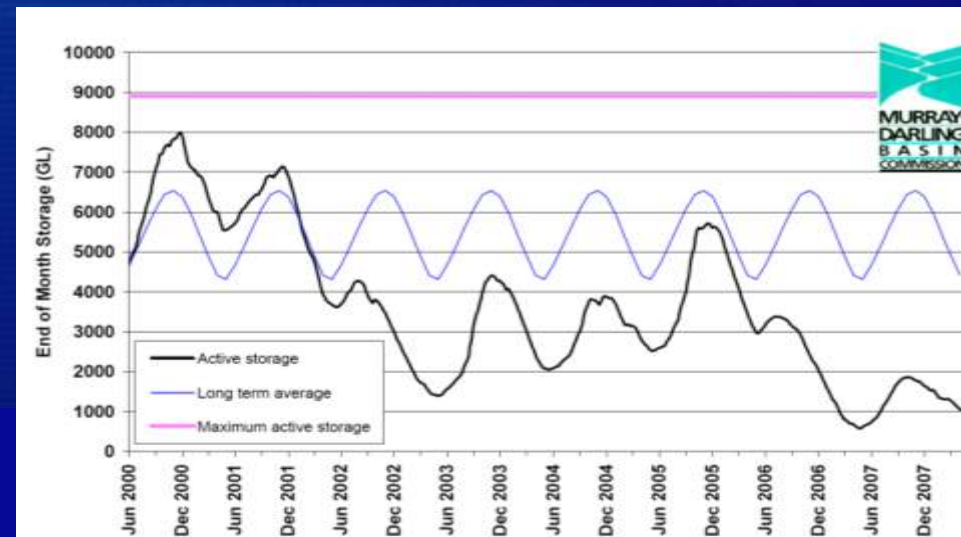
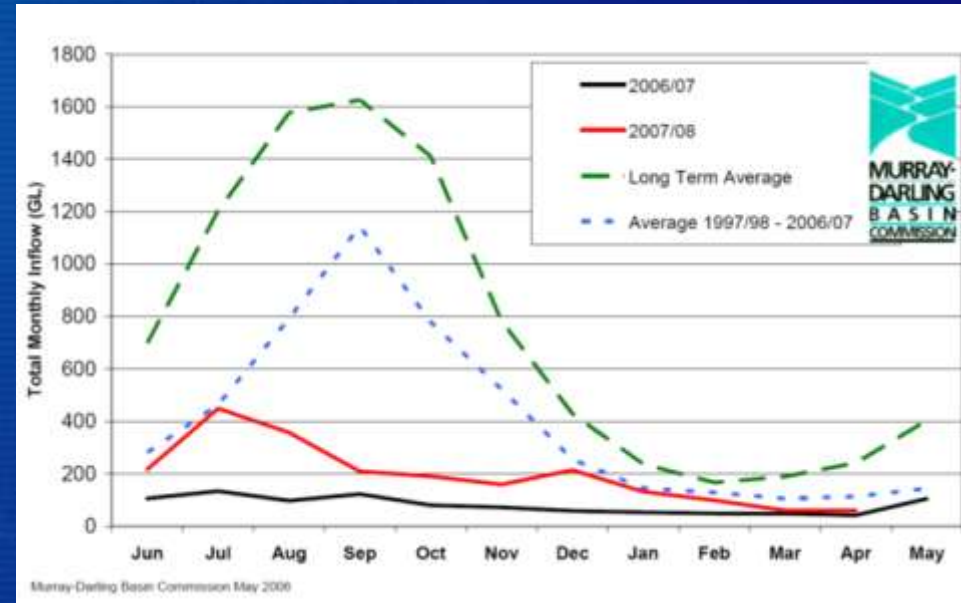


The Aussie Big Dry: Lessons From Australia

September 24, 2010
Colorado WaterWise
Denver, CO

Brad Udall
University of Colorado – NOAA
Western Water Assessment
Bradley.udall@colorado.edu

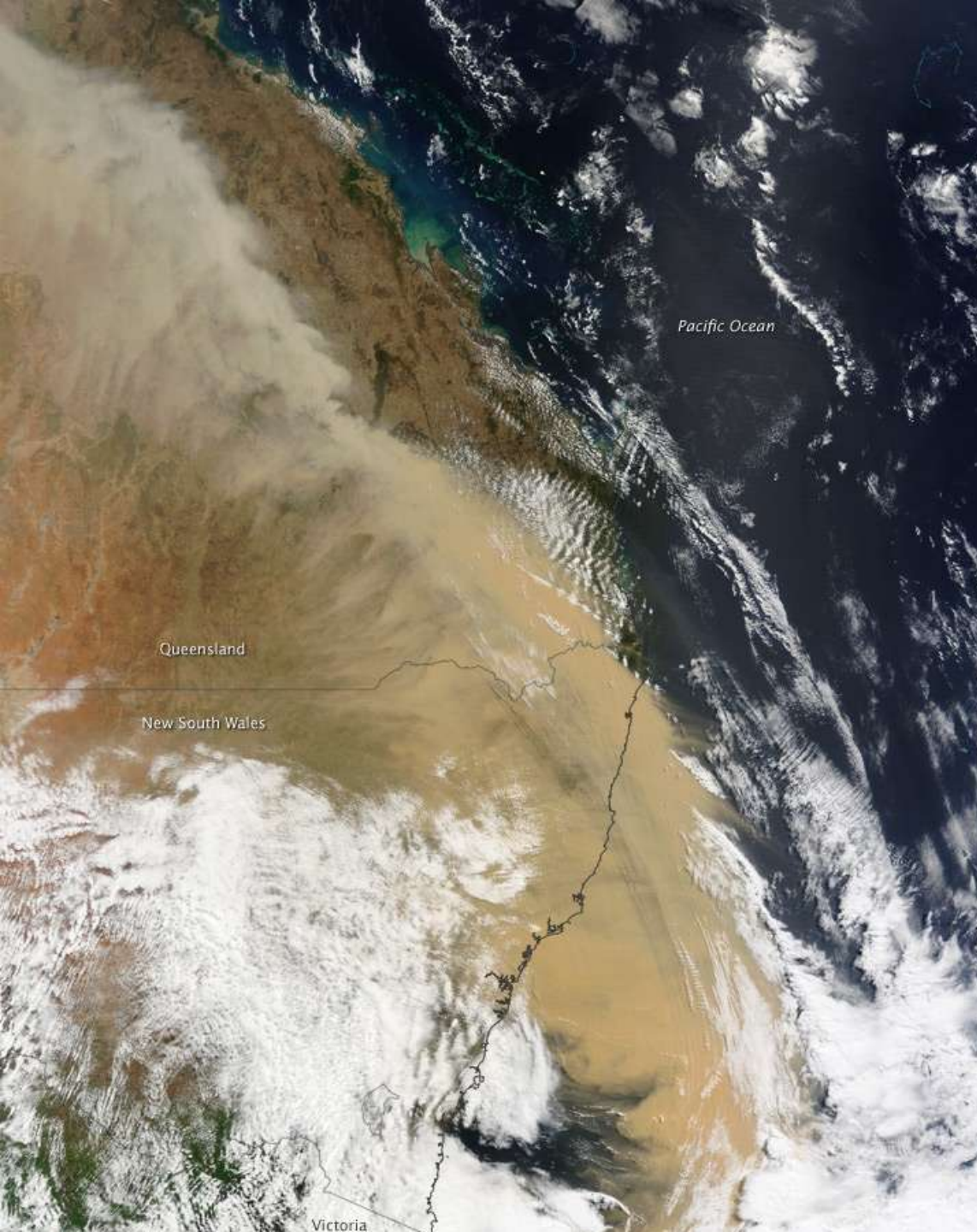


The Aussie Big Dry

- 2000 to 2010
- Unprecedented -40% to -50% reductions in runoff in large parts of the country
- It has changed..
 - Language around water
 - Government Policies
 - Water Management on all levels
 - Maybe even a government
- Could it happen here?



September 2009 Dust Storms



- [Dust](#) On You-Tube
- 3 Day Event
- Origin in MDB
- 2000 miles N-S

Major Australian Water Changes

- Policy Reform
 - 2004 National Water Initiative
 - National Water Commission
 - Water Rights Simplification
 - Water Markets
 - \$13B AUD Program = \$200B US
 - Sustainability
 - Mandatory Water Planning
- Urban Water Reform
 - Consolidation of water providers
 - Independent Price Setter
- Infrastructure
 - Large Desal Plants in Every Major City
 - Water Recycling
 - Interbasin Transfers
 - Rainwater Harvesting
 - Ag Infrastructure - \$2B in Northern Victoria
- Conservation
 - Very little outdoor watering
 - Target 155 L/P/D
- Science
 - CSIRO Sustainable Yields Study
- Environment
 - ...comes just after 'critical human needs'
 - \$3b AUD Purchase of Water held by Federal government

Overview

1. The Setting
2. Federal Actions
3. Regional Issues and Responses
4. Murray-Darling Issues
5. Conclusions

OP-ED COLUMNIST

The Aussie 'Big Dry'

By THOMAS L. FRIEDMAN


Published: May 4, 2007

SYDNEY, Australia



Fred R. Conrad/The New York Times

Thomas Friedman.

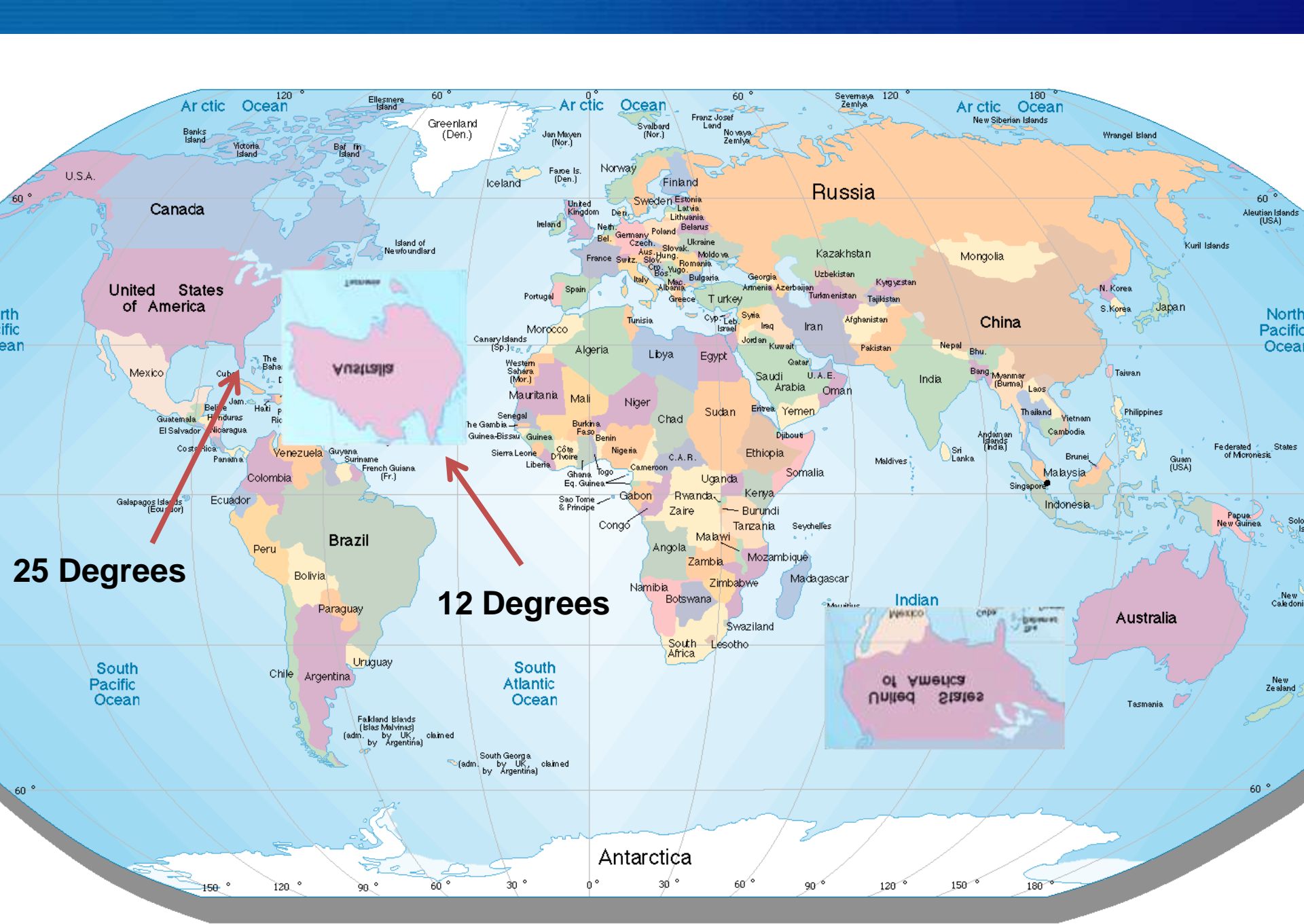
 SIGN IN TO E-MAIL OR SAVE THIS

 PRINT

Almost everywhere you travel these days, people are talking about their weather — and how it has changed. Nowhere have I found this more true, though, than in Australia, where “the big dry,” a six-year record drought, has parched the Aussie breadbasket so severely that on April 19, Prime Minister John Howard actually asked the whole country to pray for rain. “I told people you have to pray for rain,” Mr. Howard remarked to me, adding, “I said it without a hint of irony.”

And here’s what’s really funny: It actually started to rain! But not enough, which is one reason Australia is about to





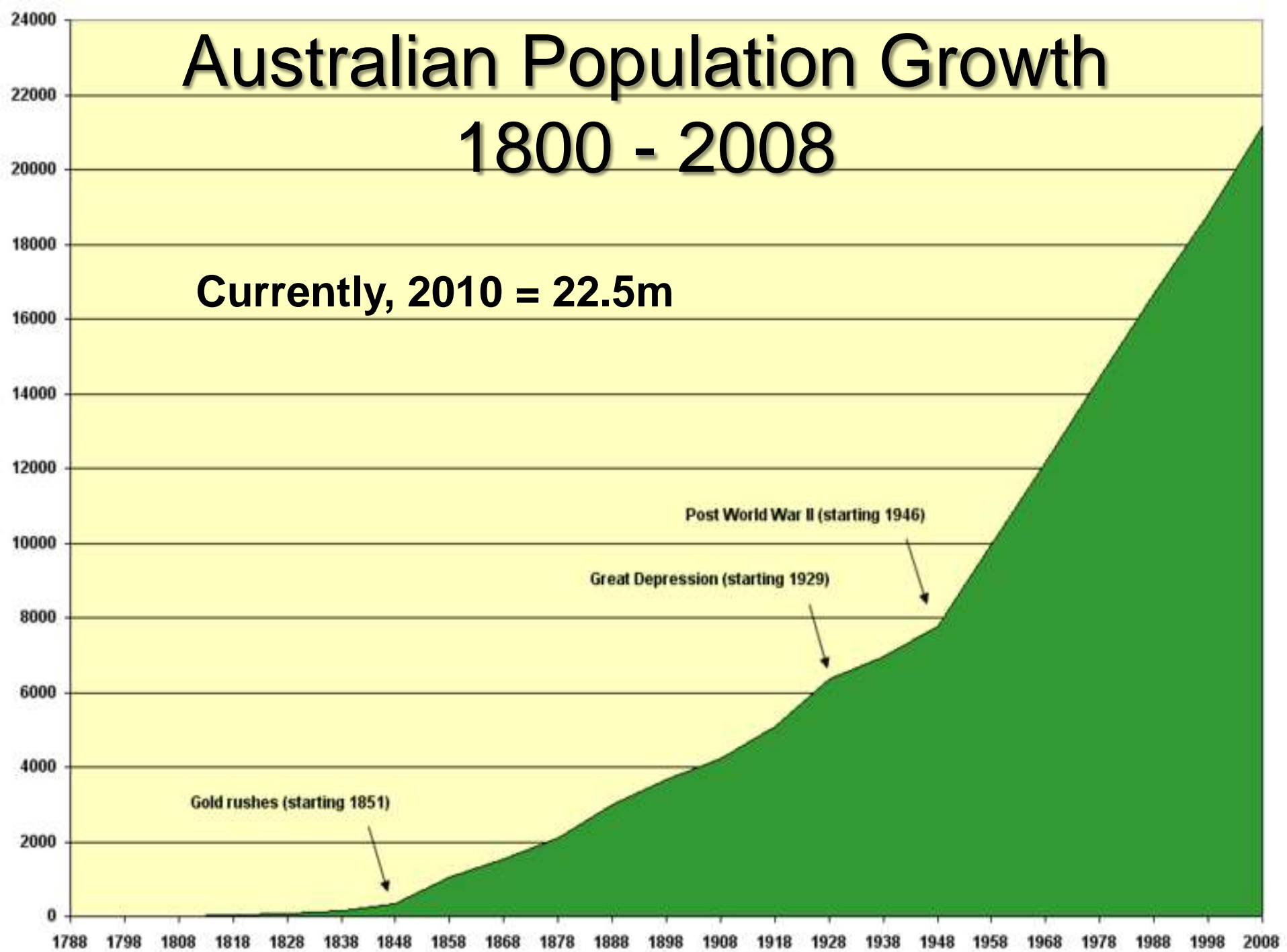
25 Degrees

12 Degrees



Australian Population Growth 1800 - 2008

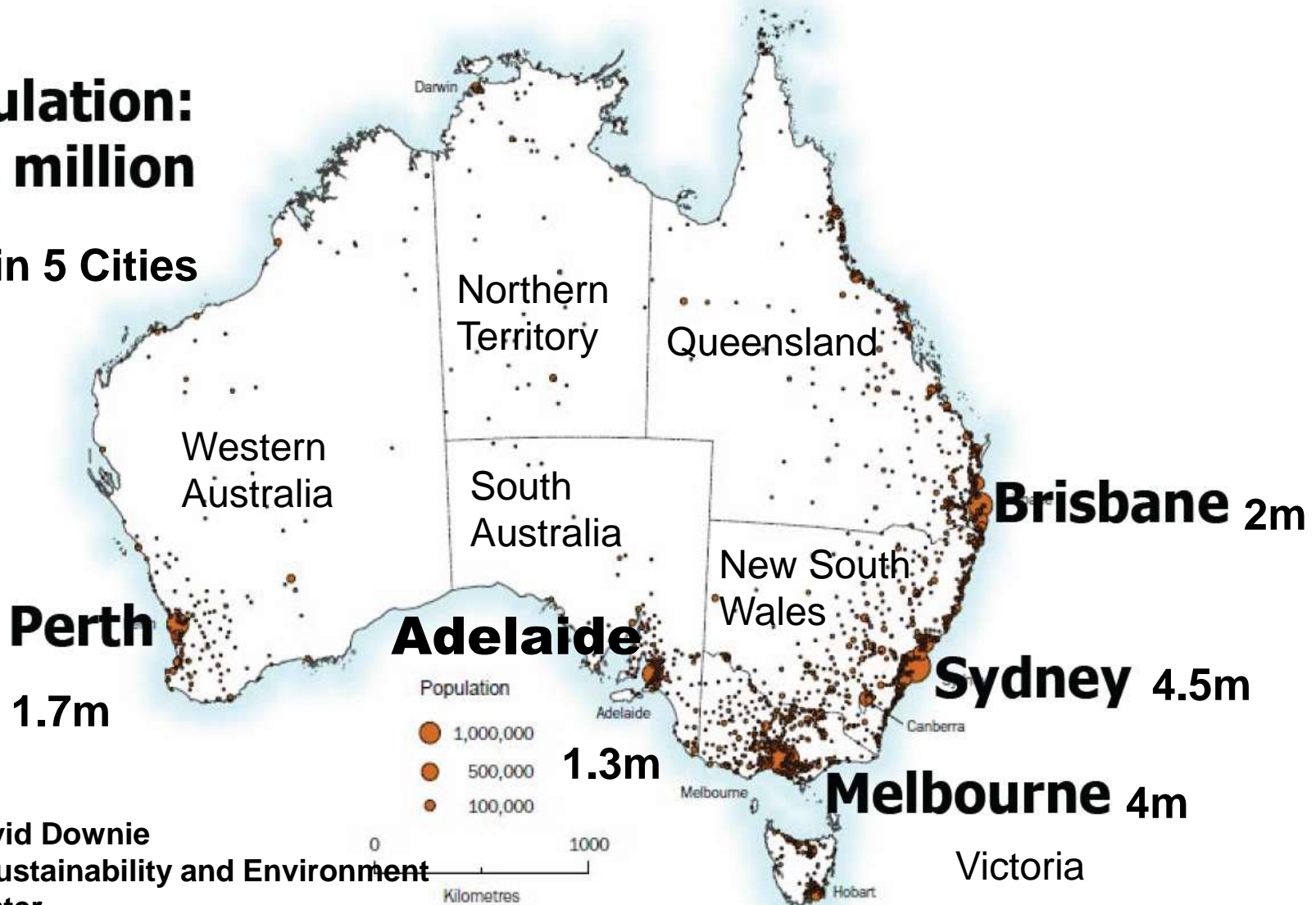
Currently, 2010 = 22.5m



Population Distribution: Australia

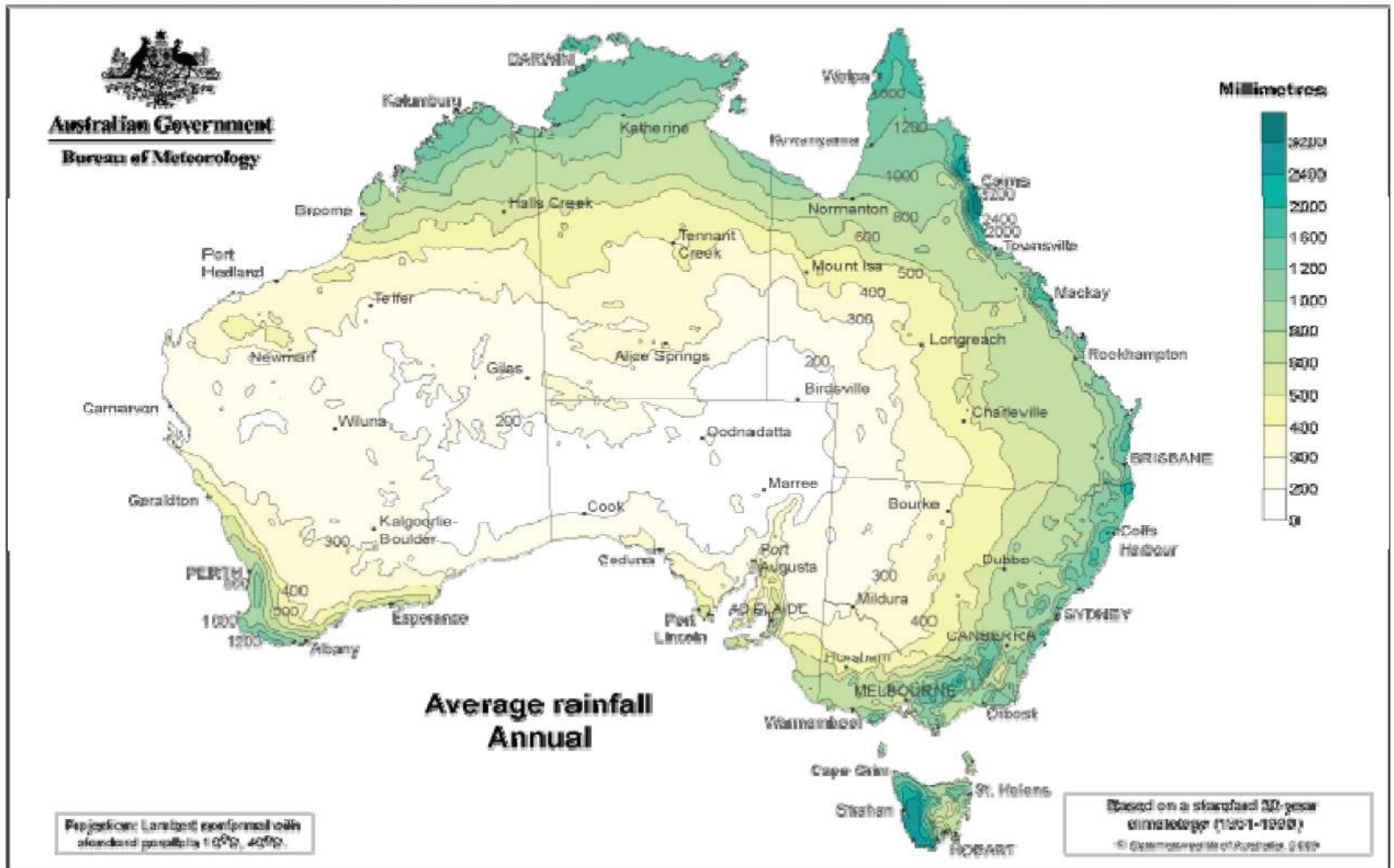
**Population:
~21 million**

13m in 5 Cities



Source: David Downie
Vic. Dept. Sustainability and Environment
Office of Water

Australia - Annual rainfall 1961 - 1990





Australia – The Driest Continent as Measured by Precip, Runoff and Runoff Efficiency

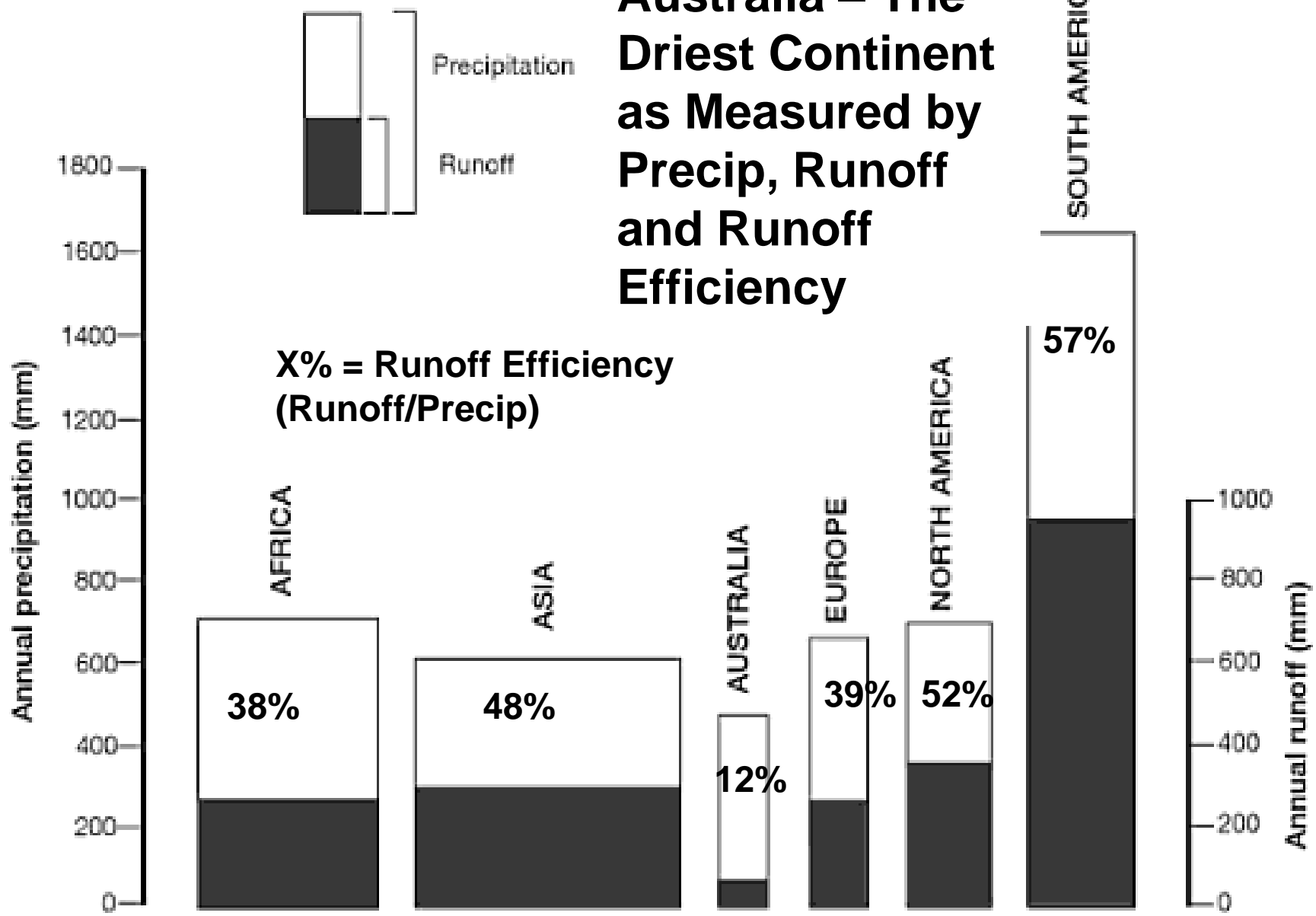
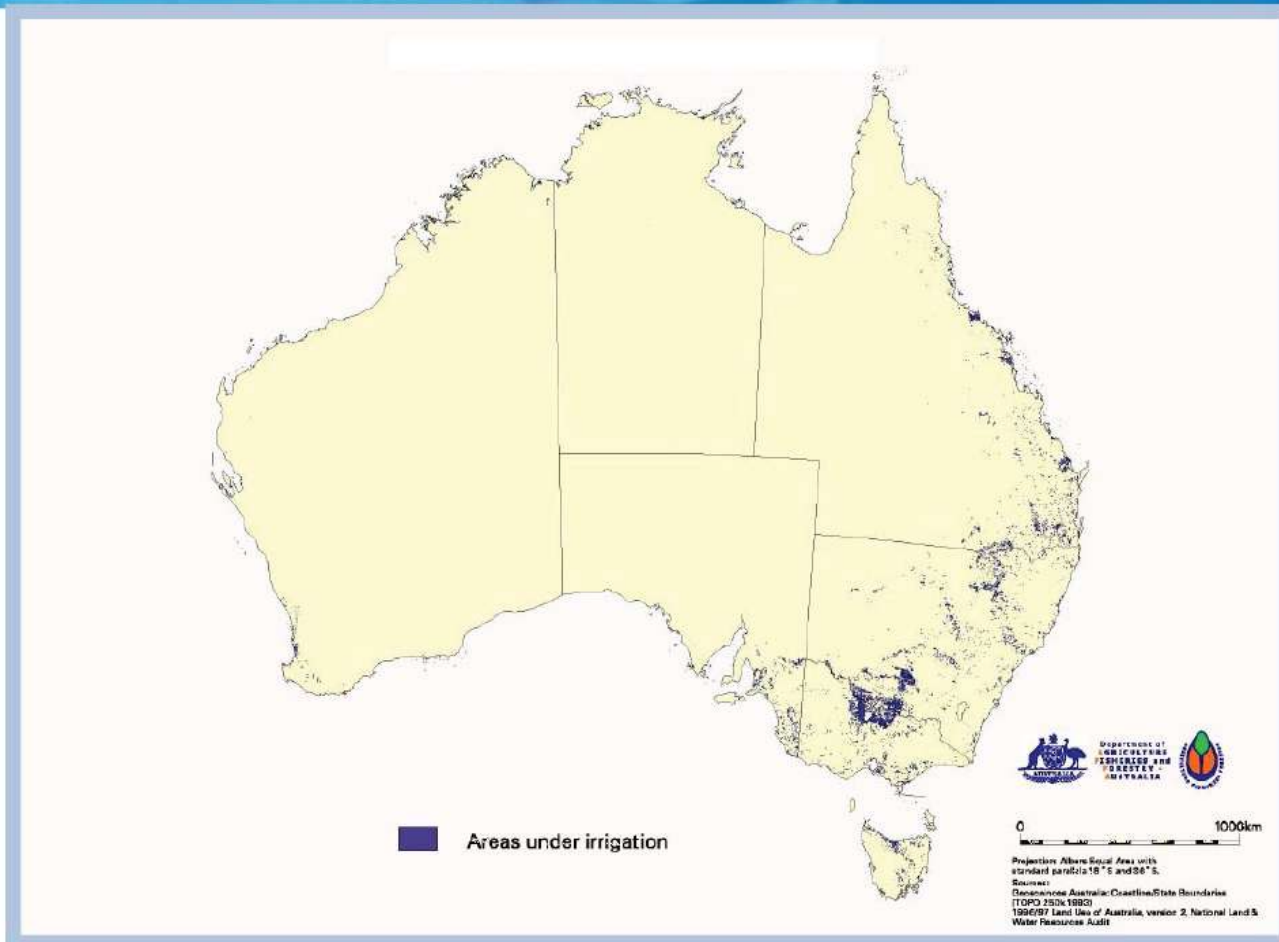


Figure 2.2 Rainfall and run-off of the continents. Source: Brown, 1983, p. 10

Irrigated agriculture in Australia

- 70-80% of water use
- 0.4% land irrigated, 99.6% non irrigated
- 25% gross value of agriculture
- Agriculture 3% GDP
 - 22% total exports (\$33.6b)
- Irrigation mainly in MDB
- Typical crops are (NSW) rice, cotton, (Vic) dairy – less than 20% on horticulture, viticulture, permanent plantings



AUSTRALIA'S CHALLENGE - OVER-ALLOCATION

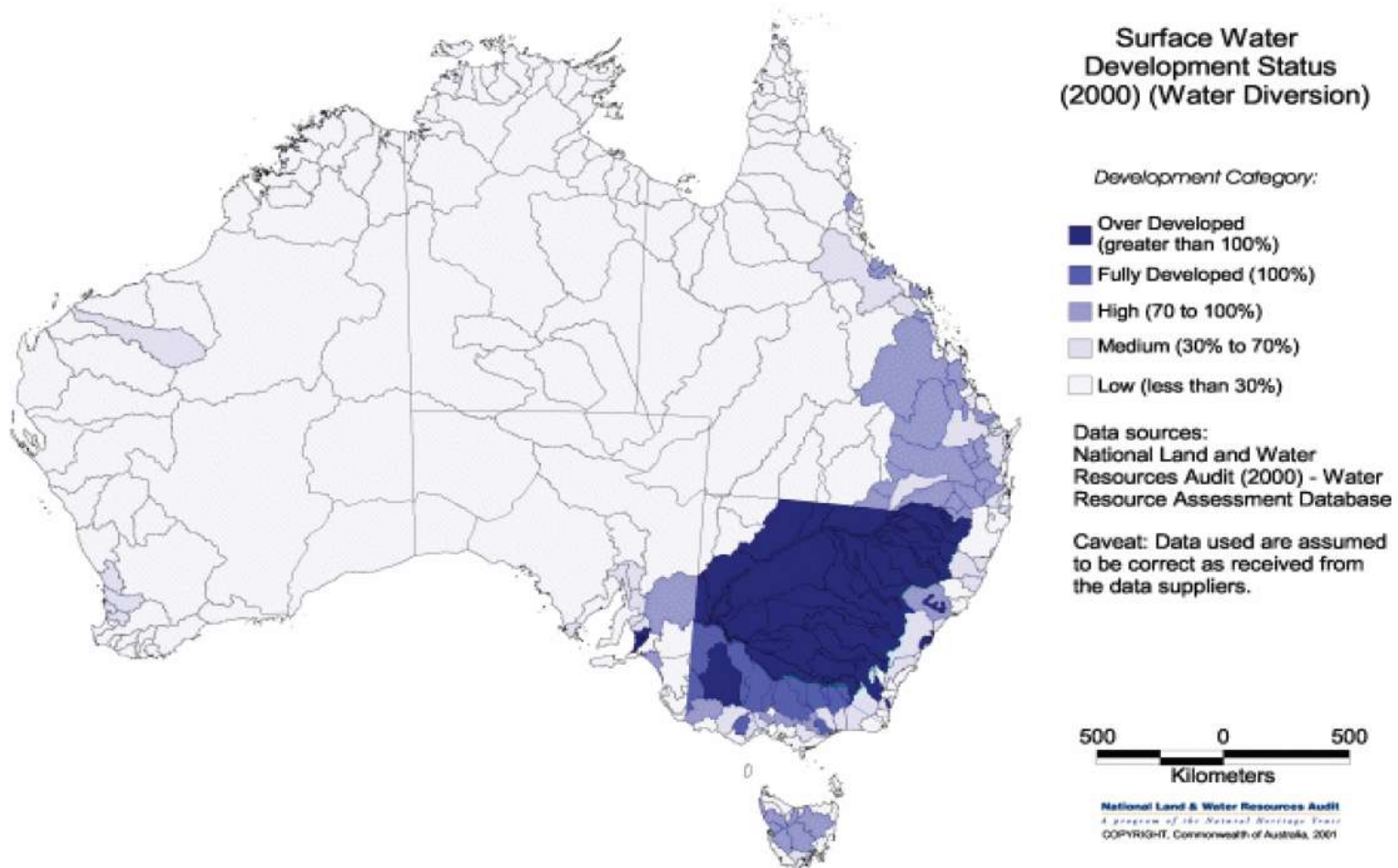
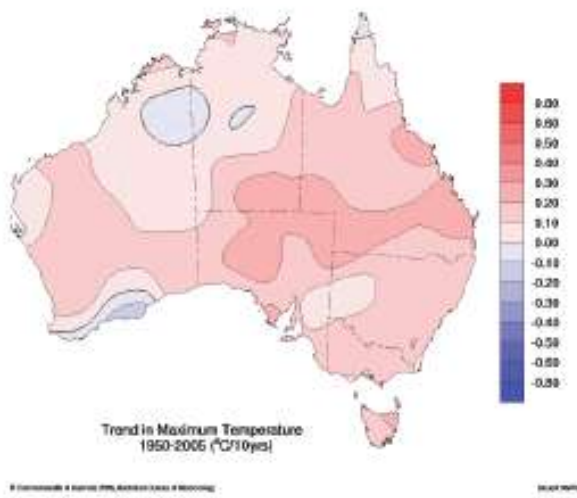


Fig. 1 Trend in annual mean maximum temperature, 1950-2005.



Trends in Max, Min and Rainfall 1950-2005

Fig. 2 Trend in annual mean minimum temperature, 1950-2005.

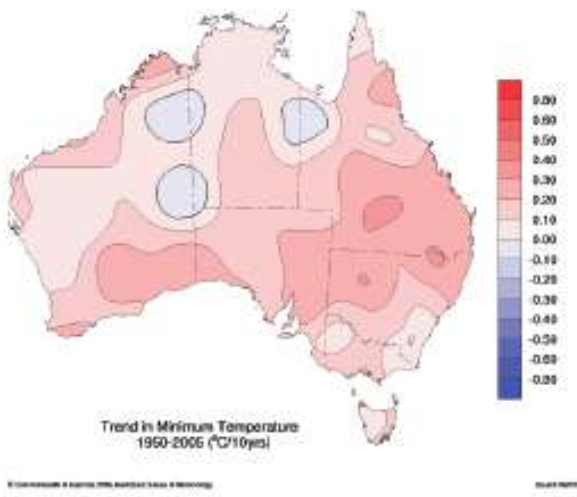
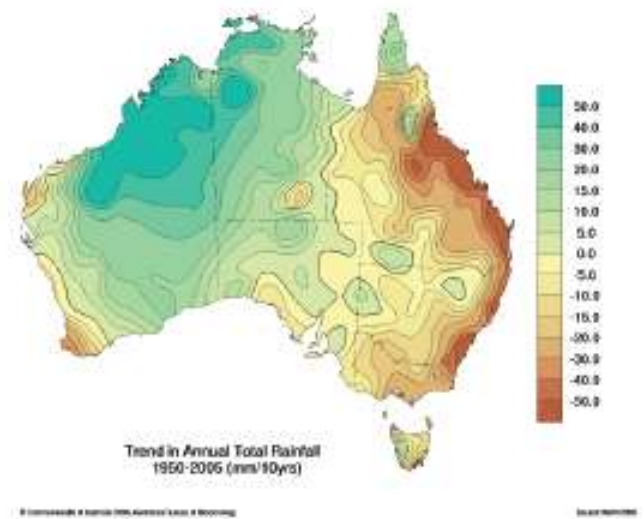


Fig. 3 Trend in annual rainfall total, 1950-2005.



A REPORTER AT LARGE

THE INFERNO

After the deadliest fires it has ever known, a nation reassesses.

BY CHRISTINE KENNEALLY



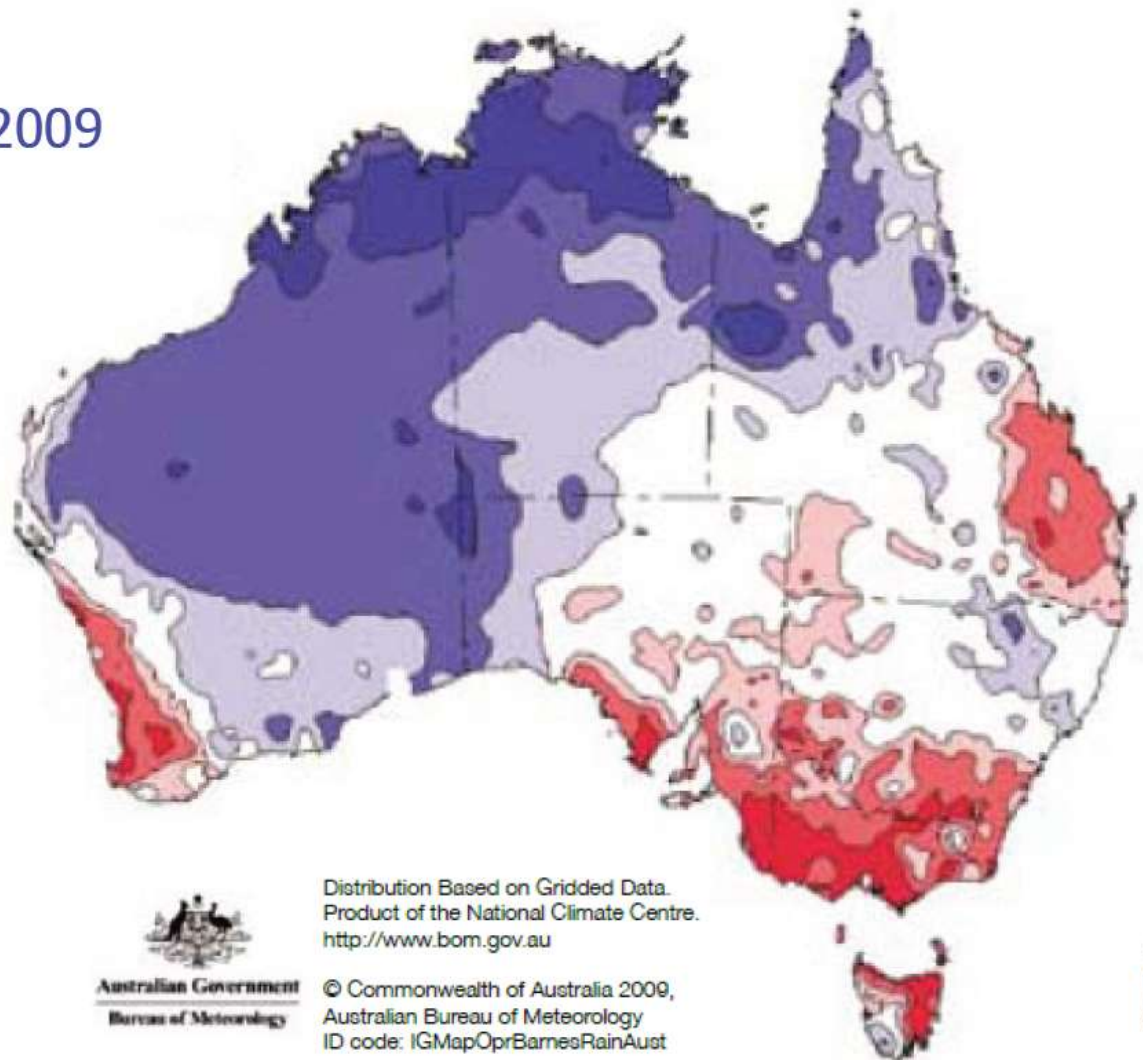
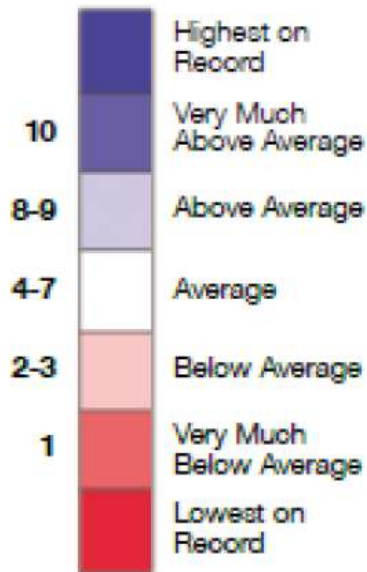
Black Saturday,
February 7, 2009,
115 F in Melbourne
173 deaths
3500 structures lost
“Worst Wildfires in
modern Australian
History”

Bushfire burning in Victoria. The energy of all the fires on Black Saturday was the equivalent of fifteen hundred Hiroshimas.

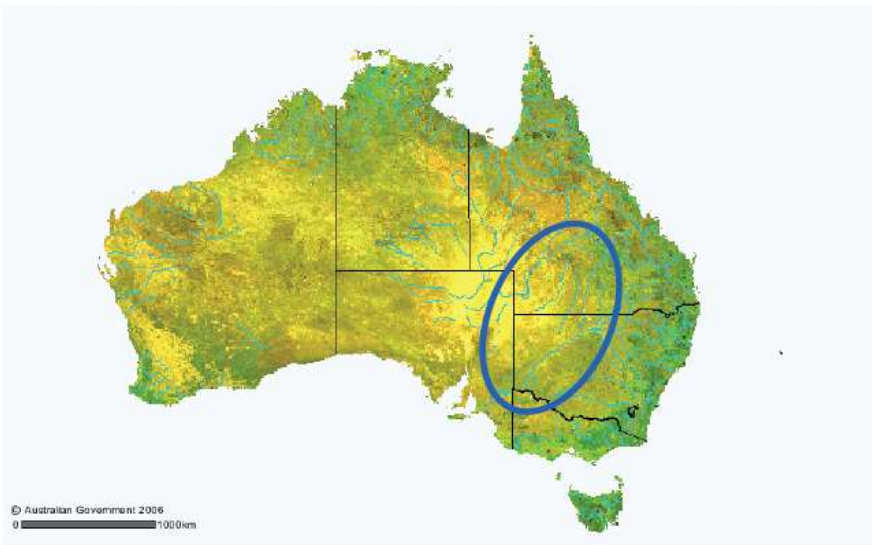
Australia - 12 years of dry conditions

Rainfall Deciles:
1 October 1996 – 31 May 2009

Rainfall Decile Ranges



Murray-Darling Basin

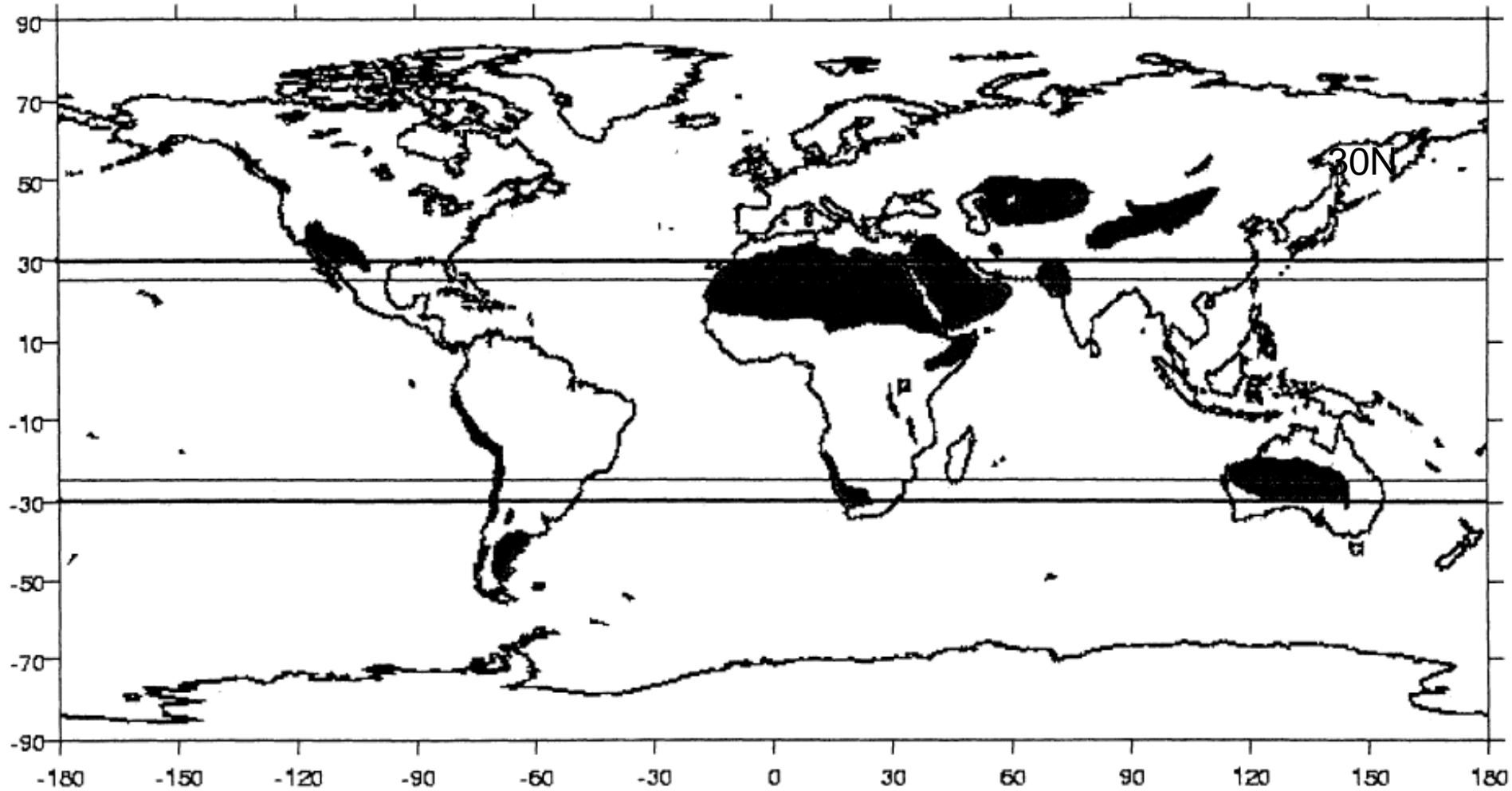


© Australian Government 2006
0 100 km

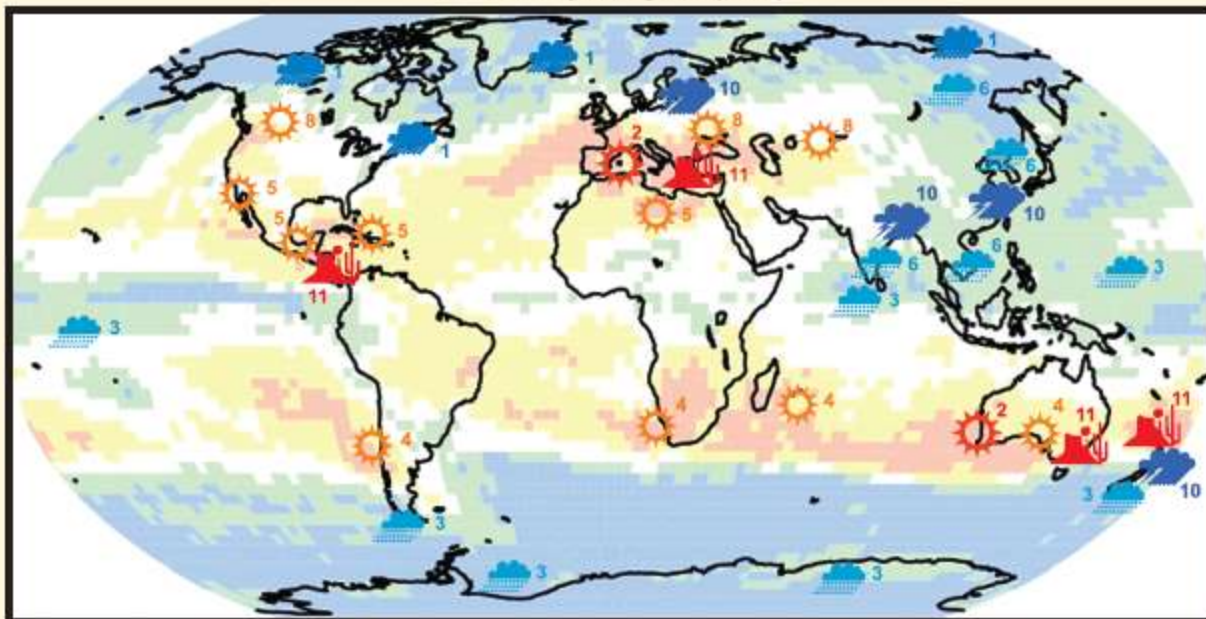
0 100 200 km

Major Deserts of the World





Dry gets Drier, Wet Wetter







June–July–August (JJA)






2007 IPCC Regional Projections Chapter 11 wg1

-  Precipitation increase in $\geq 90\%$ of simulations
-  Precipitation increase in $\geq 66\%$ of simulations
-  Precipitation decrease in $\geq 66\%$ of simulations
-  Precipitation decrease in $\geq 90\%$ of simulations

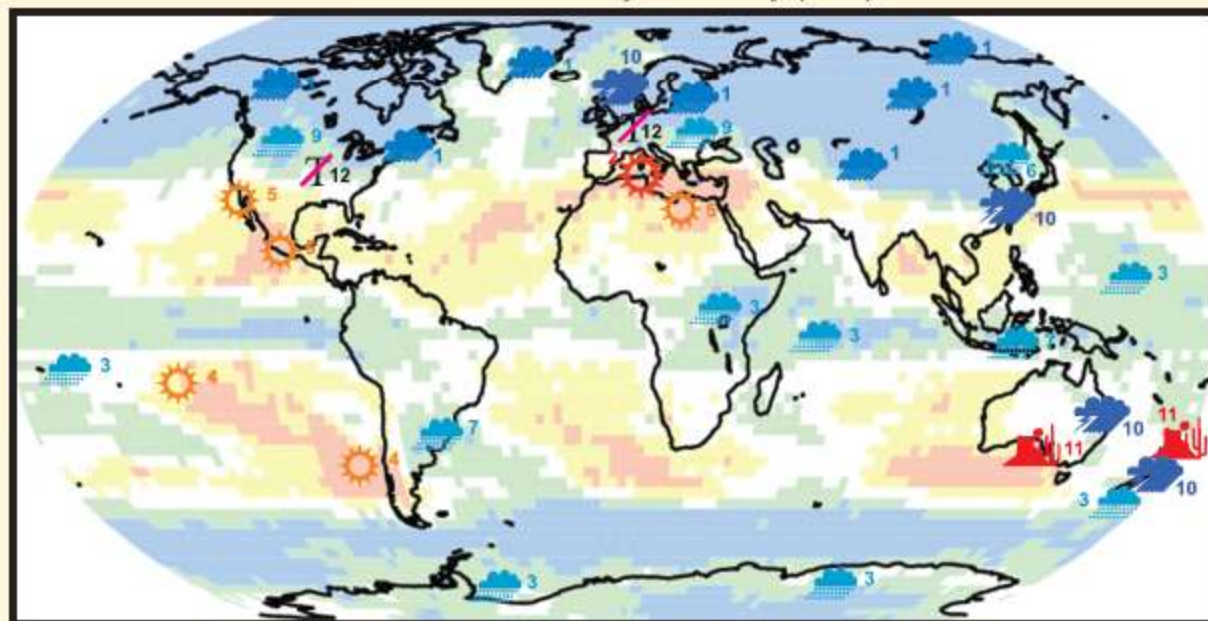
Based on regional studies assessed in chapter 11:

-  Precipitation decrease – very likely
-  Precipitation decrease – likely
-  Precipitation increase – very likely
-  Precipitation increase – likely

Chapter 11:

-  Precipitation extreme increase – likely
-  Increased drought – likely
-  Less snow – very likely

December–January–February (DJF)



Based on regional studies assessed in chapter 11:

Overview

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Water Reform Timeline

Year	Major Australian policy initiative
1994	COAG Water Reform Framework within National Competition Policy
1995	MDB Cap introduced Water reform implementation linked to federal \$
1998	MDBC commenced Pilot Interstate Water Trading
2001	National Action Plan for Salinity and Water Quality
2002	MDBC started Living Murray process
2003	COAG agreed, in principle, to implement a National Water Initiative
2004	COAG finalized National Water Initiative

2004 National Water Initiative

- Federal and State Agreement based on 1994 COAG Water Reform Plan
- Prepare water plans with provision for the environment
- Deal with over-allocated or stressed water systems
- Introduce registers of water rights and standards for water accounting
- Expand the trade in water
- Improve pricing for water storage and delivery
- Meet and manage urban water demands.
- Oversight by National Water Commission

Wong – Water for the Future

Speech 1 Year Ago – end of April, 2009

- **10-year, \$13B AUD effort = \$200B US**
- **Take Action on Climate change**
- **Water Reform**
 - **Independent MDB Authority – Basin Plans**
 - **Address Overallocation – “Sustainability”**
 - **Improve Water Markets**
 - **Reform Urban Water**
 - **Provide Better Information**
- **Use water wisely – conservation**
 - **\$5.8B**
- **Secure water supplies**
 - **\$1B to Urban Water Supplies - Desal**
- **Support healthy rivers**
 - **\$3B in MDB to purchase Environmental Water**

Penny Wong, Minister for
Climate Change and Water





BLUEPRINT FOR A NATIONAL WATER PLAN

THE WENTWORTH GROUP OF CONCERNED SCIENTISTS

SUMMARY	2
RISING TO THE CHALLENGE	5
Foundations for a National Water Plan	5
PROTECTING RIVER HEALTH	7
Environmental needs to maintain river health	7
Establishing comprehensive water accounts	7
Recovering water for the environment in stressed rivers	8
Protecting unspolled rivers	9
Investing in the science required to make better decisions	10
PROMOTING OPPORTUNITY	11
Clarifying entitlements and responsibilities	11
Removing impediments to water trading	12
ENGAGING COMMUNITIES AND ENSURING FAIRNESS	14
Engaging local communities	14
Managing environmental water	14
Improving water efficiency in towns and cities	15
Ensuring a fair transition	16
MOVING FORWARD	17



31 July 2003

The Wentworth Group is convened by WWF
 Saving Life on Earth

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Annual Rainfall (mm) in SW Australia

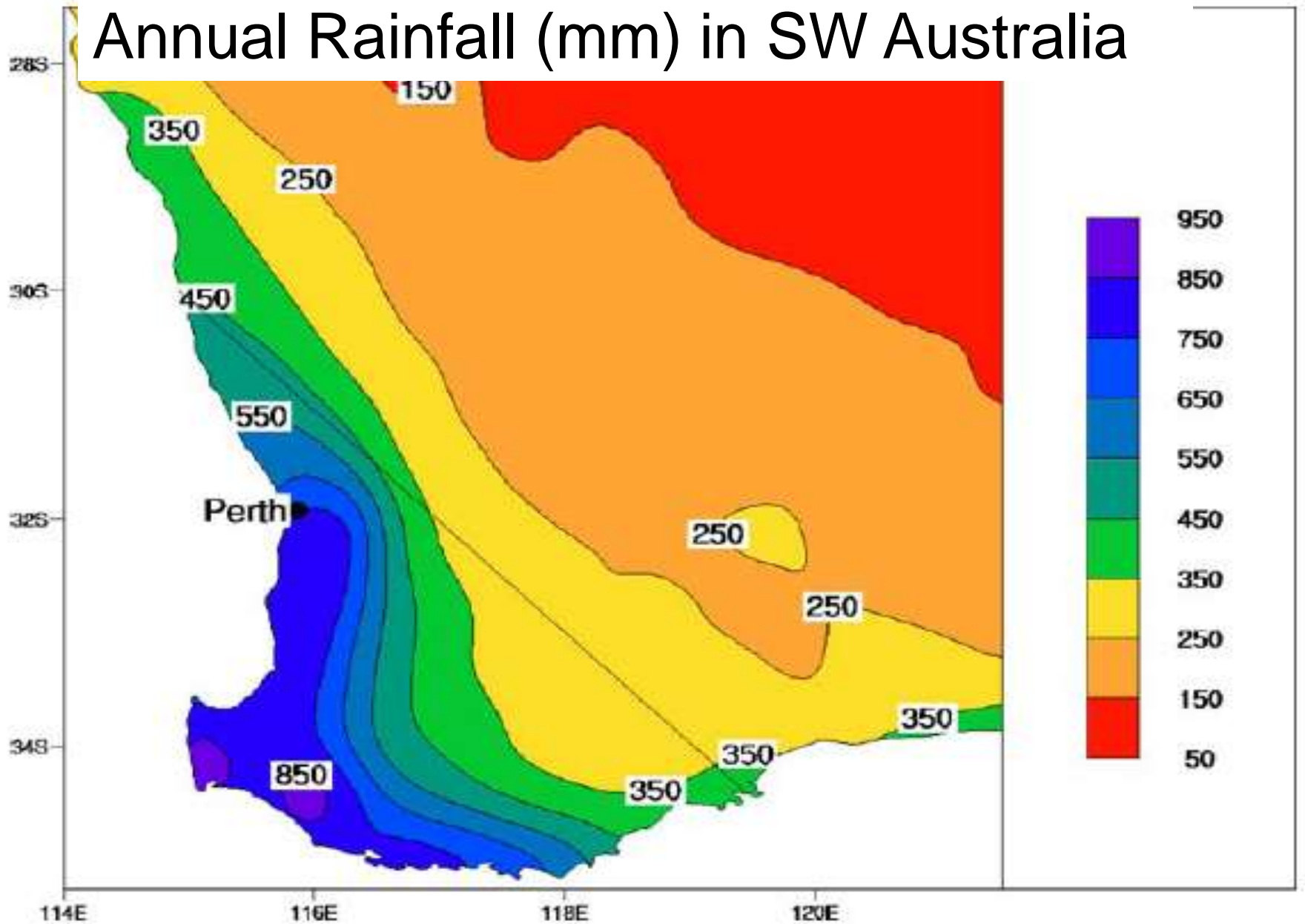
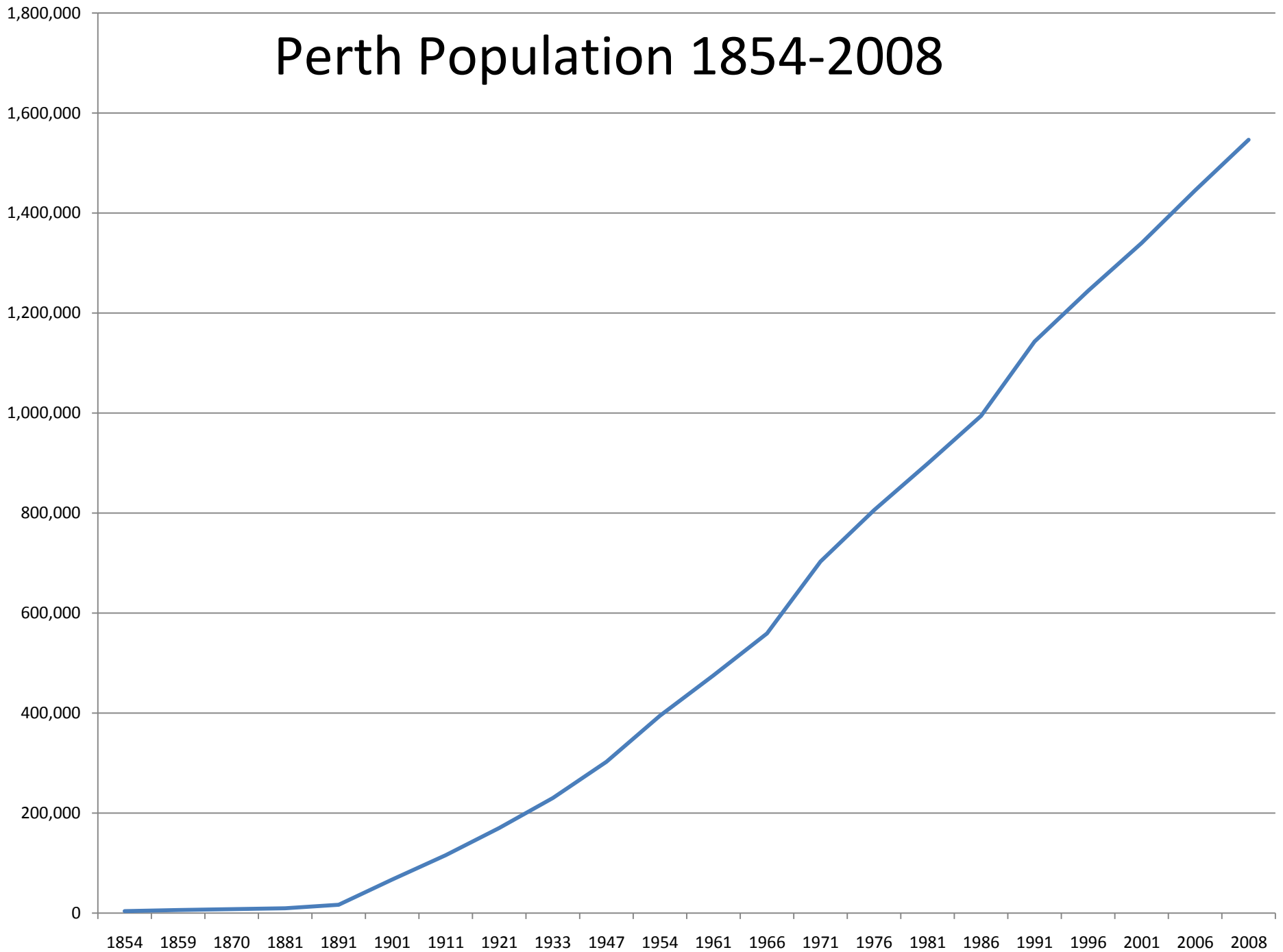


Fig. 3 Mean May to October rainfall (mm) for the period 1901 to 2000. Region southwest of the line connecting the coastline at 30°S to (35°S, 120°E) is used to define spatial rainfall averages for Southwest Western Australia

Perth Population 1854-2008





Perth

water forever



TOWARDS CLIMATE RESILIENCE
OCTOBER 2009



2009 Plan



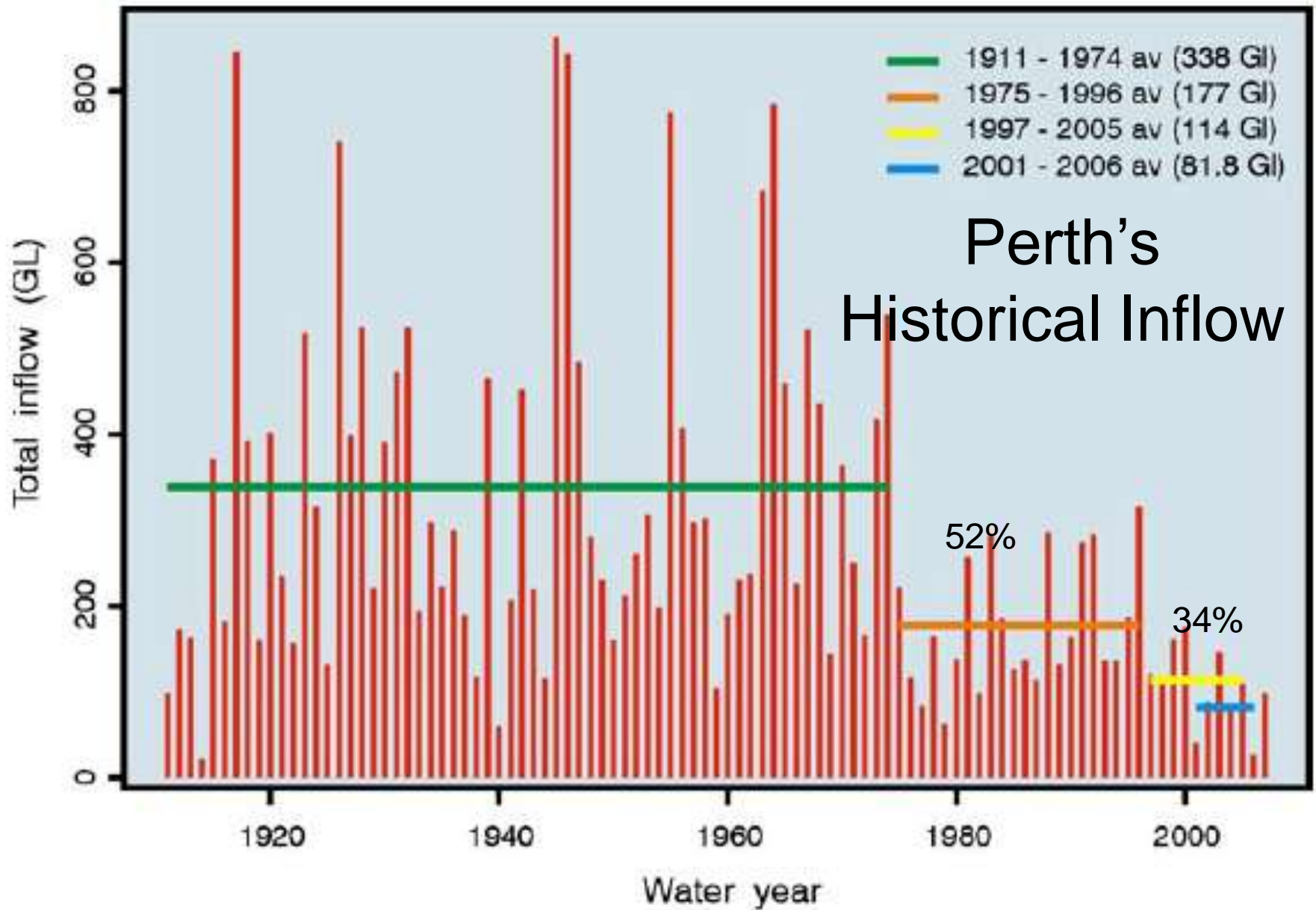
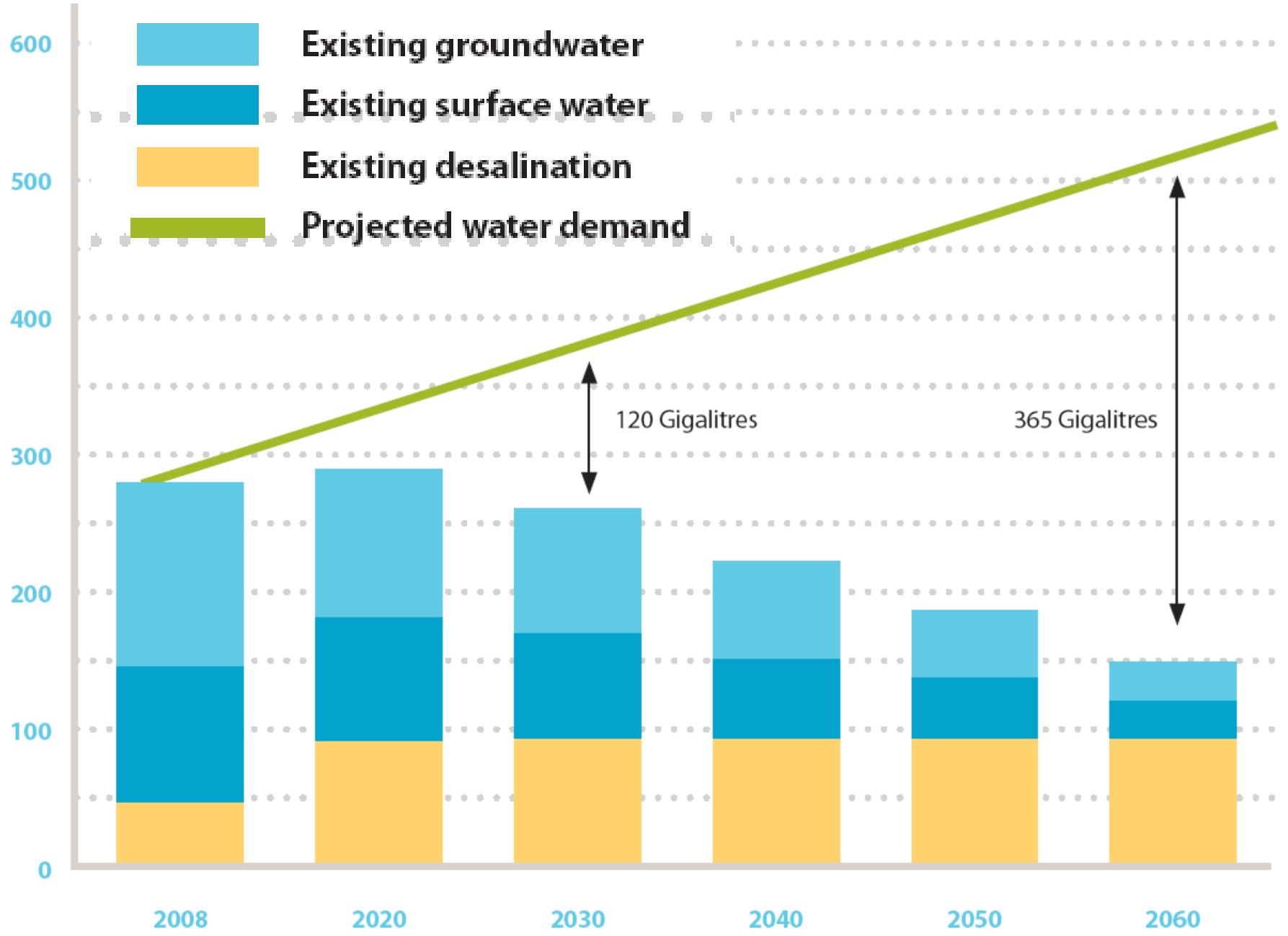


Fig. 5 Annual (May to April) inflow series (GL) for the Integrated Water Supply System. Source: <http://www.watercorporation.com.au>

Perth's Water Supply Gap to 2060



Water Corporation (Perth) Future Options for all 3 Legs



PORTFOLIO OF OPTIONS

Reduce water use	Rainfall independence	Yields 2010 - 2030	Yields 2030 - 2060	Portfolio total
Water efficiency programs				
• Homes and gardens	high	30	40	70
• Urban density	high	15	30	45
• Business, industry and services	high	5	10	15
Leakage and pressure management	high	5	10	15
Alternative water supplies				
• Rainwater tanks	low	13	7	20
• Garden bores	medium	4	0	4
• Community bores	medium	2	5	7
Subtotal		74	102	176
Increase water recycling	Rainfall independence	Yields 2010 - 2030	Yields 2030 - 2060	Portfolio total
Industry	high	20	20	40
Public open space	high	3	2	5
Agriculture (horticulture)	high	5	10	15
Residential greywater recycling	high	1	6	7
Residential dual reticulation systems	high	10	10	20
Subtotal		39	48	87
Develop new sources	Rainfall independence	Yields 2010 - 2030	Yields 2030 - 2060	Portfolio total
Groundwater replenishment	high	35	80	115
Southern seawater desalination plant expansion	high	50	0	50
Wellington dam desalination	low	0	45	45
Esperance- Kalgoorlie desalination	high	0	12	12
New desalination sites	high	50	150	200
North West metropolitan coastal groundwater	medium	25	0	25
Gingin-Jurien groundwater	medium	0	48	48
Jandakot groundwater expansion	medium	3	0	3
Wellington dewatering	medium	10	0	10
Catchment management	low	25	0	25
Gnangara water trading	medium	20	0	20
Subtotal		218	335	553
Total options to meet future supply - demand gap		331	485	816

The figures in the above table are shown in gegalitres per year.

Australian Desal Plants since 2006

- **Perth - Kwinana Desalination Plant,**
 - 50 GL/Year
 - 2006
 - \$400M AUD
 - 2nd Plant 2011 50-100 GL/Year
- **Queensland – Gold Coast**
 - Tugan, 45 GL/Year
 - \$1.2B AUD
 - 2009
- **Sydney,**
 - Kurnell, 90 GL/Year
 - \$1.9B AUD
 - 2010
- **Victoria - Wonthaggi Desalination Plant**
 - 150 to 200 GL/Year
 - 2012
- **Adelaide**
 - Port Stanvac 100 GL/Year
 - 2010 - 2012



New York Times, July 10, 2010

“Arid Australia Sips Seawater but at a Cost”

- \$13.2B from 5 cities spent on Desal
- “this is the cost of adapting to climate change”
~ Water Services Association Head
- Critics
 - More gained by conservation
 - Energy hogs – add to climate change
 - “I think we have just enough water for 22m, What are we going to do when we reach 36m?”
 - Recycling Wastewater a better alternative
 - But Brisbane’s \$1B recycling plant now mostly idle

Overview

1. The Setting
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Current Issue
June 2010
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NATIONAL GEOGRAPHIC

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[Feature Article](#) | [Photo Gallery](#) | [Changing Rains](#)

Photo Gallery

Murray-Darling Basin

Published: April 2009



→ Australian Drought

Drought, warmer temperatures, and deadly bushfires have brought farmers to their knees. See Amy Toensing's photos.

Sidebar



→ Changing Rains

As the planet warms, look for more floods where it's already wet and deeper drought where water is scarce.



Australia's Dry Run

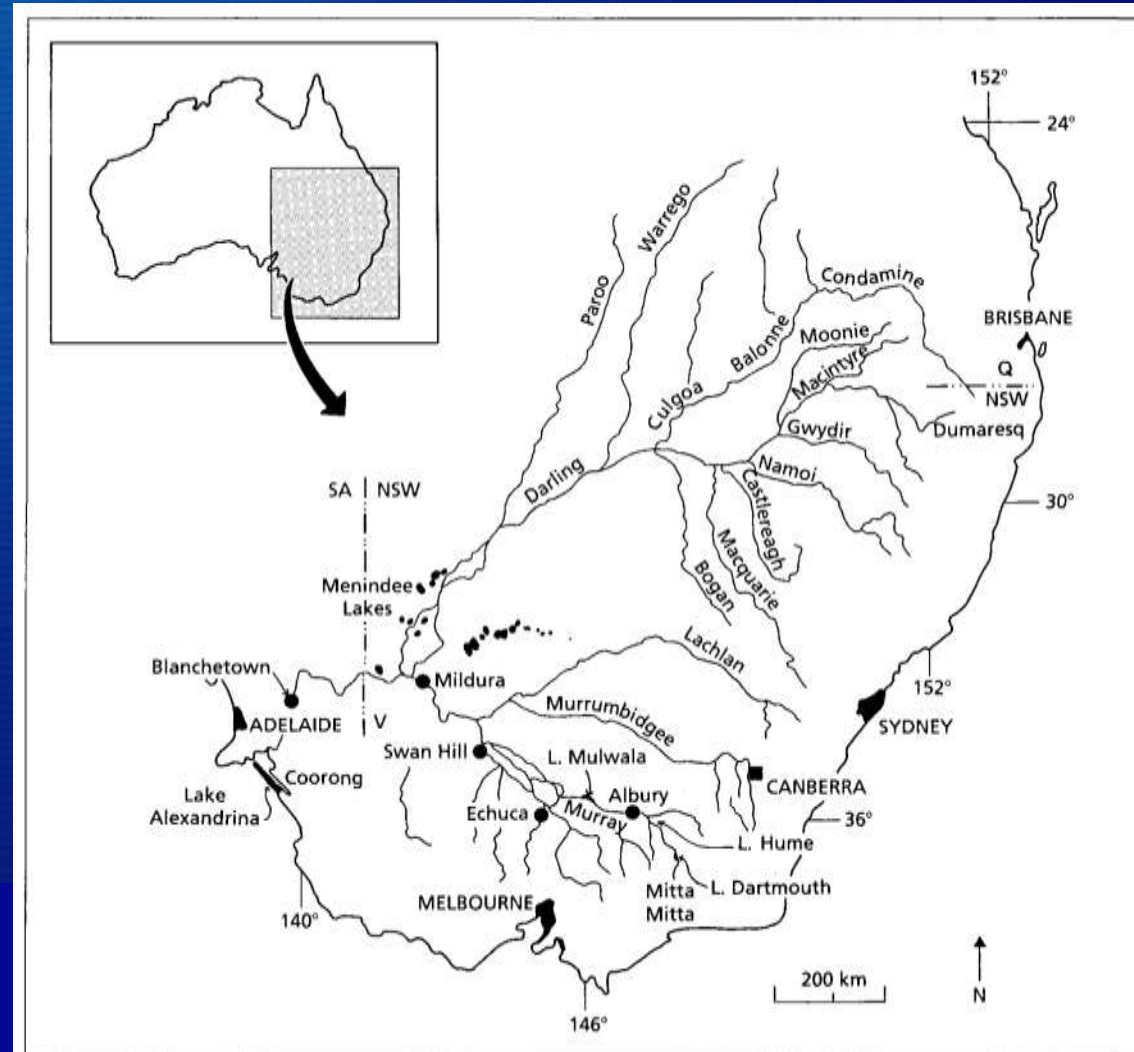
What will happen when the climate starts to change and the rivers dry up and a whole way of life comes to an end? The people of the Murray-Darling Basin are finding out right now.

By Robert Draper

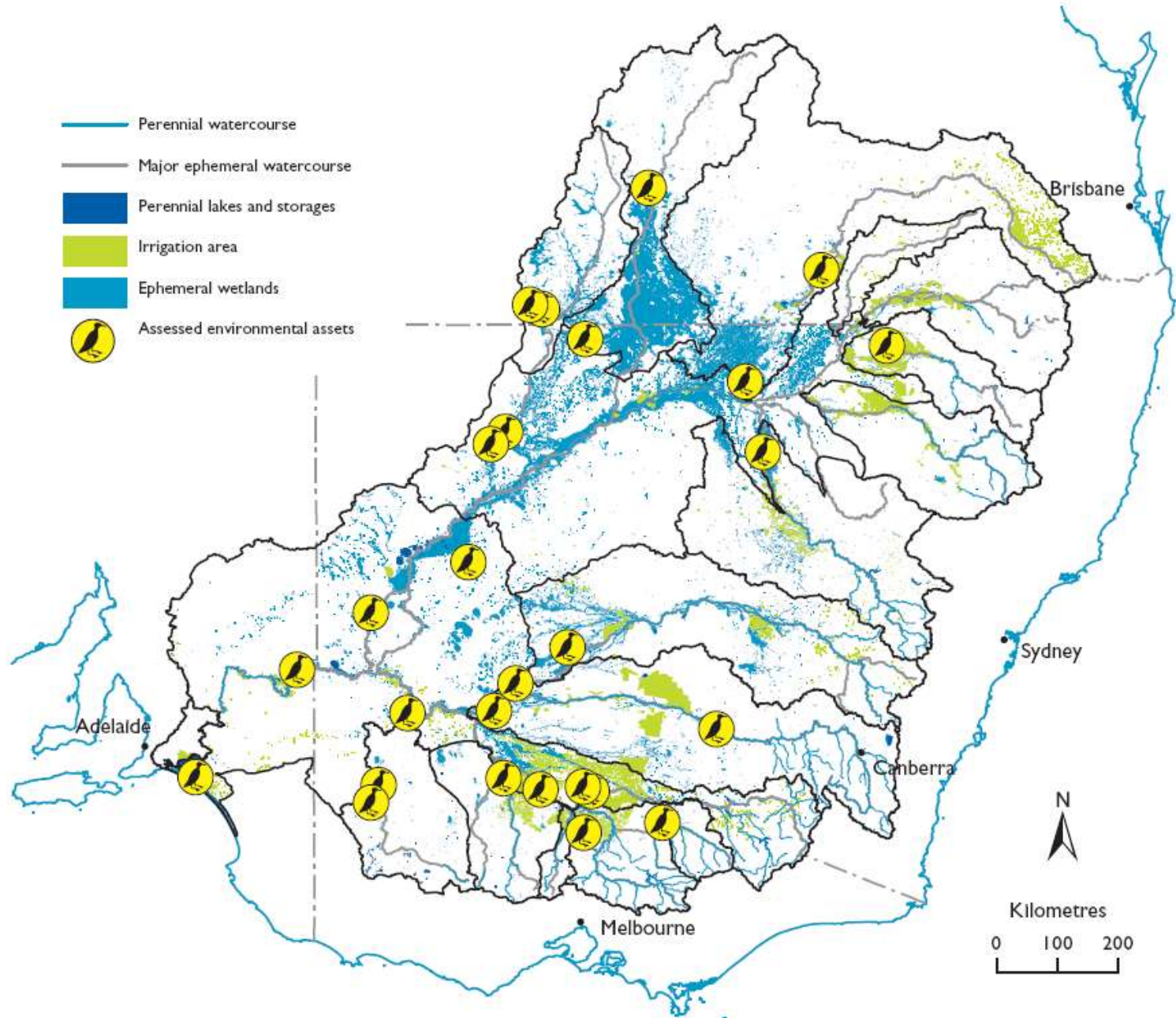
National Geographic April 2009

Murray Darling Basin Overview

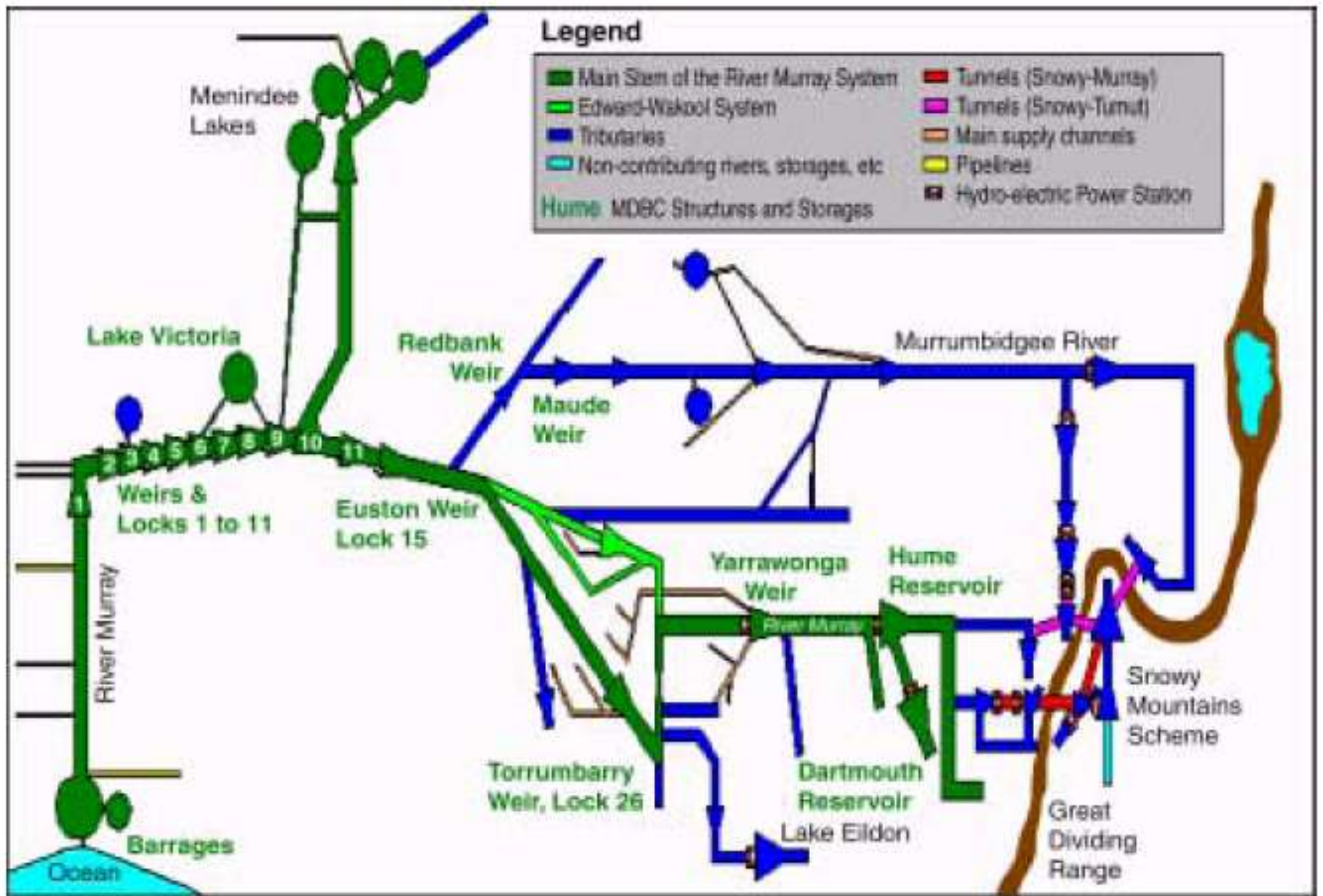
- 4 States (QLD, NSW, VIC, SA) Plus ACT
- 1,000,000 km²
- 2500 km in length
- ~23,000 GL (~18MAF)
'Usable Flow'
 - Very Lossy System
 - 14,500 GL at Confluence
- 'Low Energy' System
- Snow Melt + Rain Fed
- Total Storage ~1.5x usable,
2.6 x Use
- Most of Australia's
Irrigated Land
- Significant Wetlands
- Substantially Over Allocated
- 1915 Original Allocation



Distribution of perennial lakes, ephemeral wetlands and irrigation areas across the MDB.
The location of the major floodplain wetlands assessed in this project are indicated

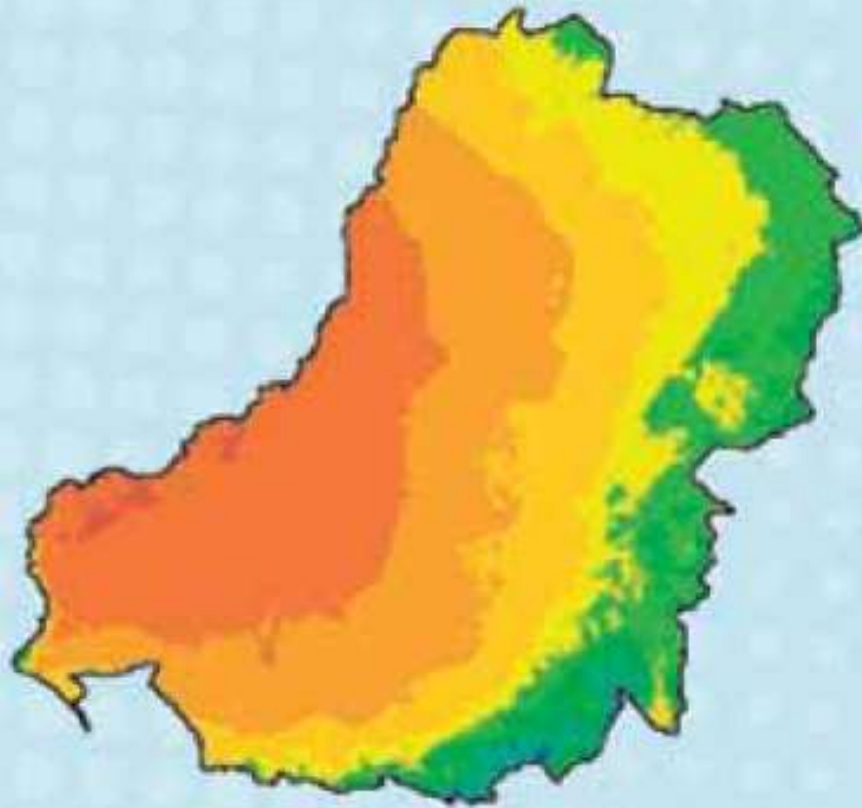


Overview of the Infrastructure in the Murray-Darling

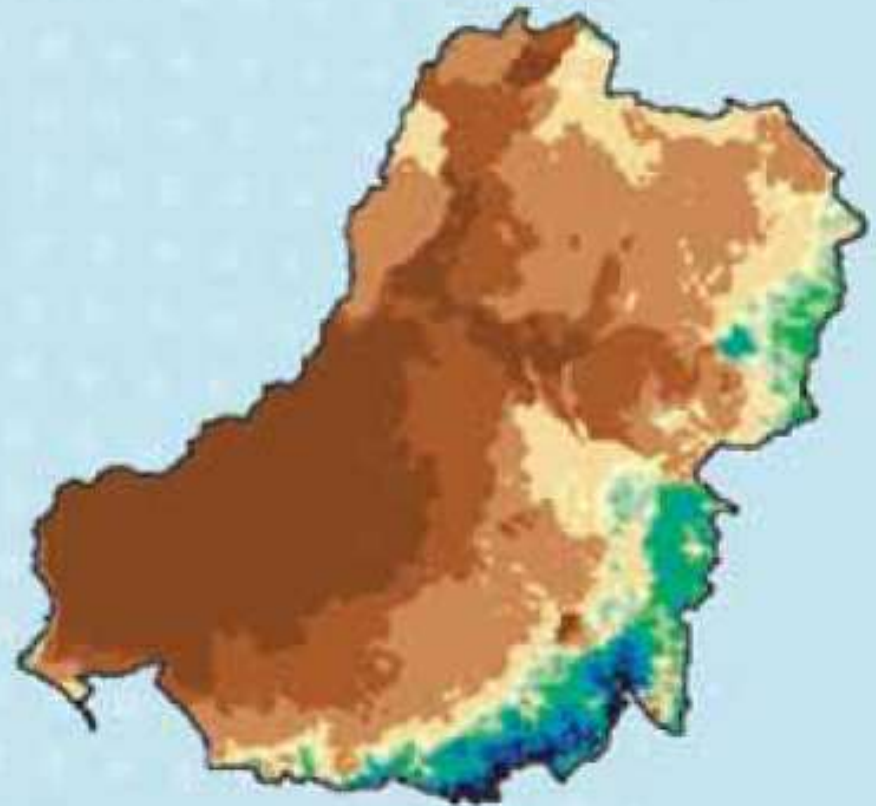


Rainfall and Runoff 1895-2006 MDB

Average annual rainfall (left) and modelled average annual runoff (right) for 1895 to 2006



Annual rainfall (mm)



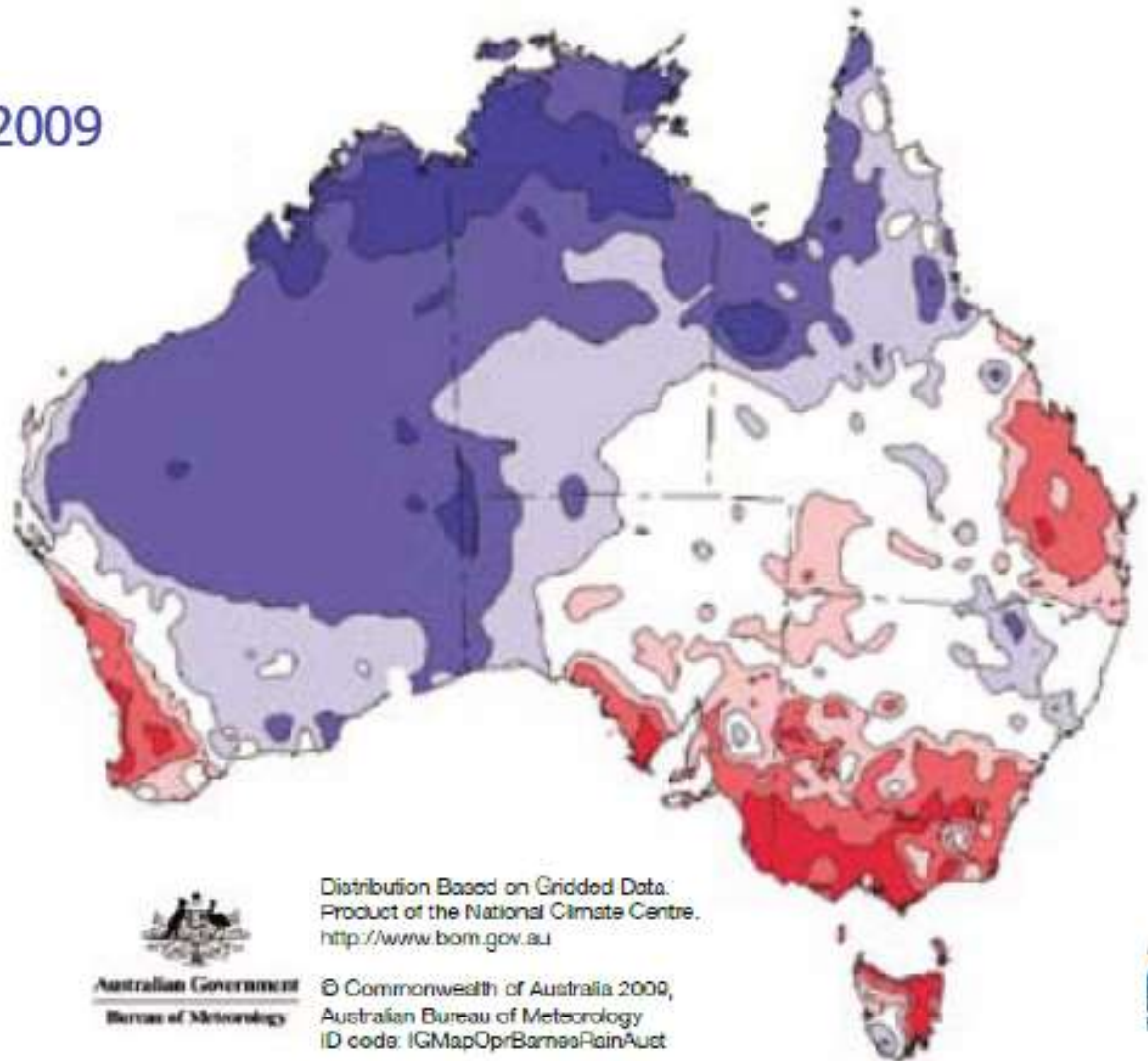
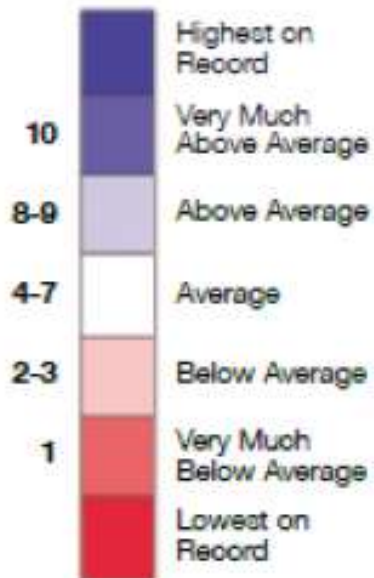
Annual runoff (mm)



MDB Rainfall During Last 13 Years

Rainfall Deciles:
1 October 1996 – 31 May 2009

Rainfall Decile Ranges



Australian Temps 2001-2005

A protracted dry and exceptionally hot period affecting NSW and most of eastern Australia, 2001-2006.

Clinton Rakich and Perry Wiles

NSW Climate Services Centre, Bureau of Meteorology

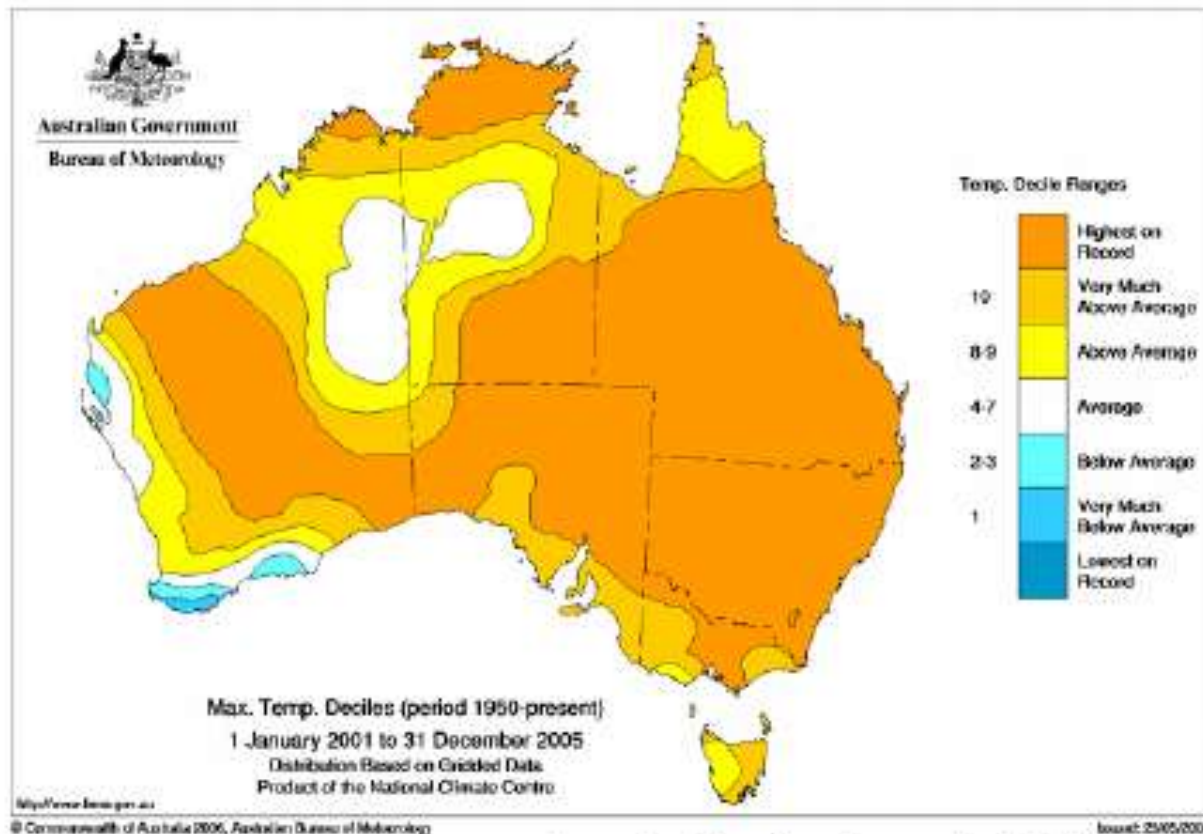
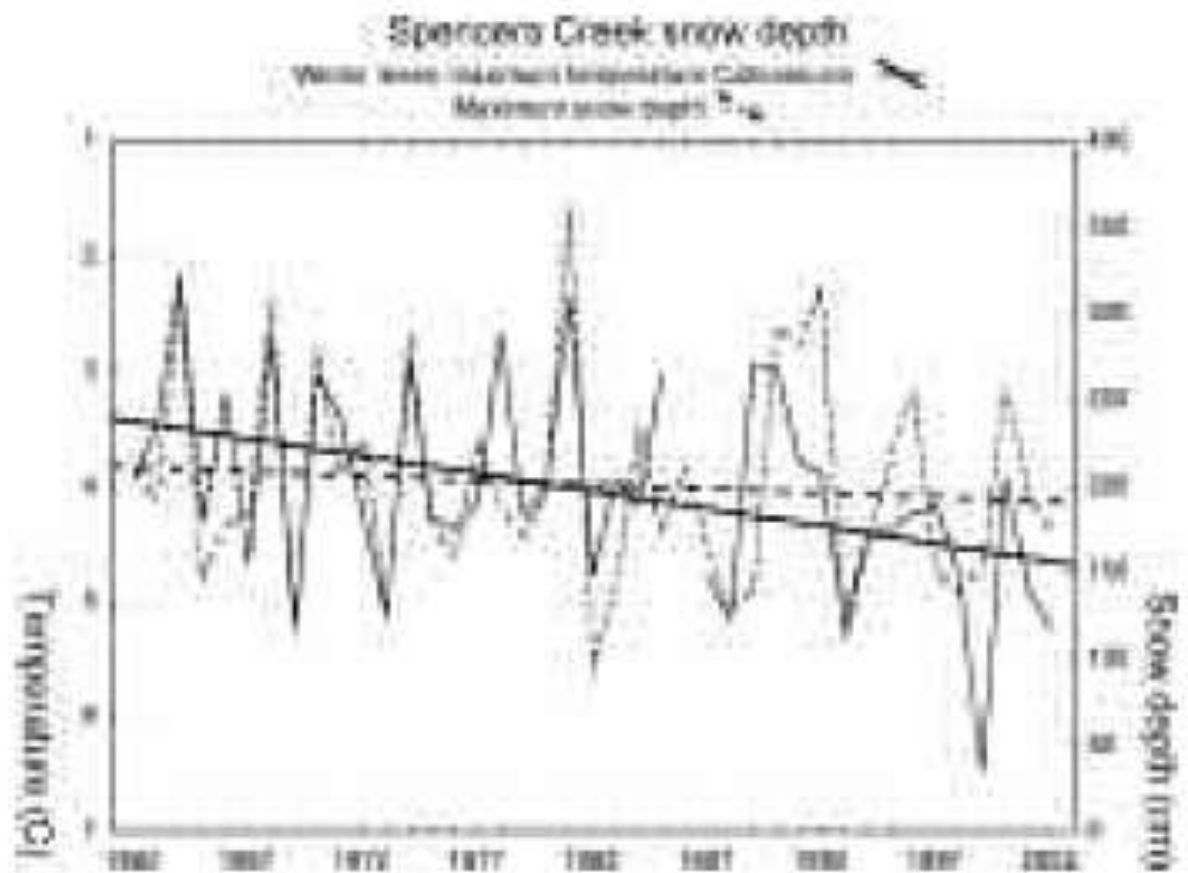


Figure 3. Australian maximum temperature deciles for the period 1 January 2001 to 31 December 2005.

Snowpack Reductions in Australian Alps

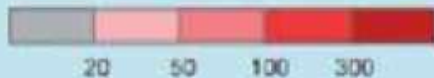
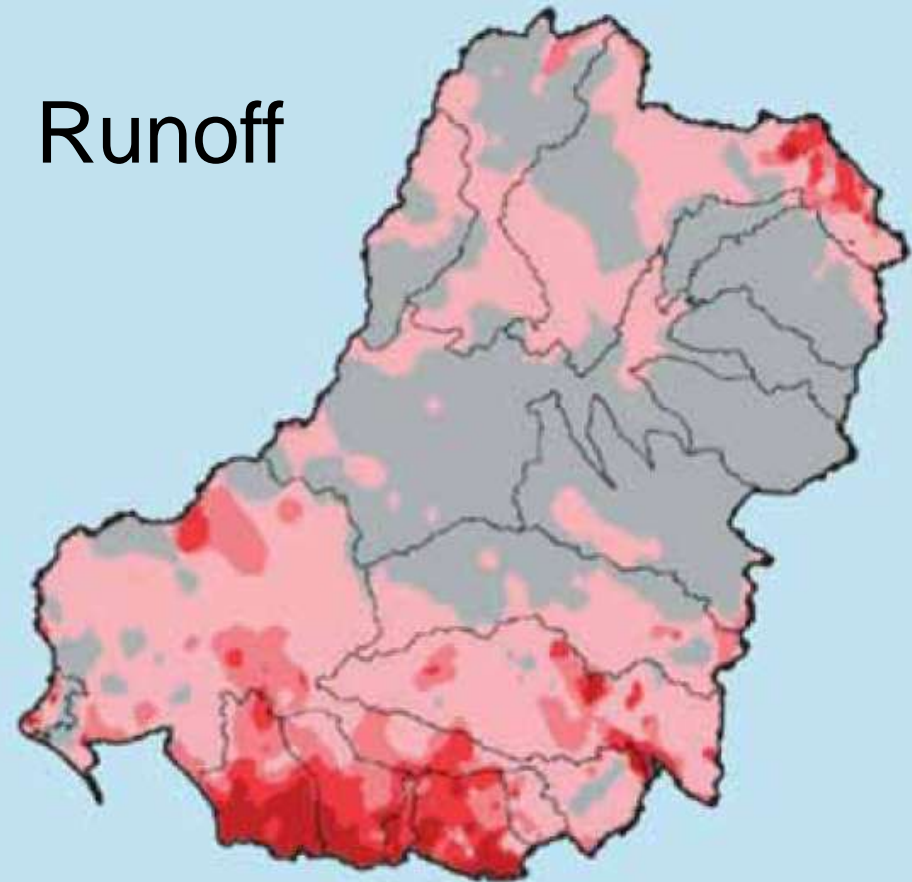
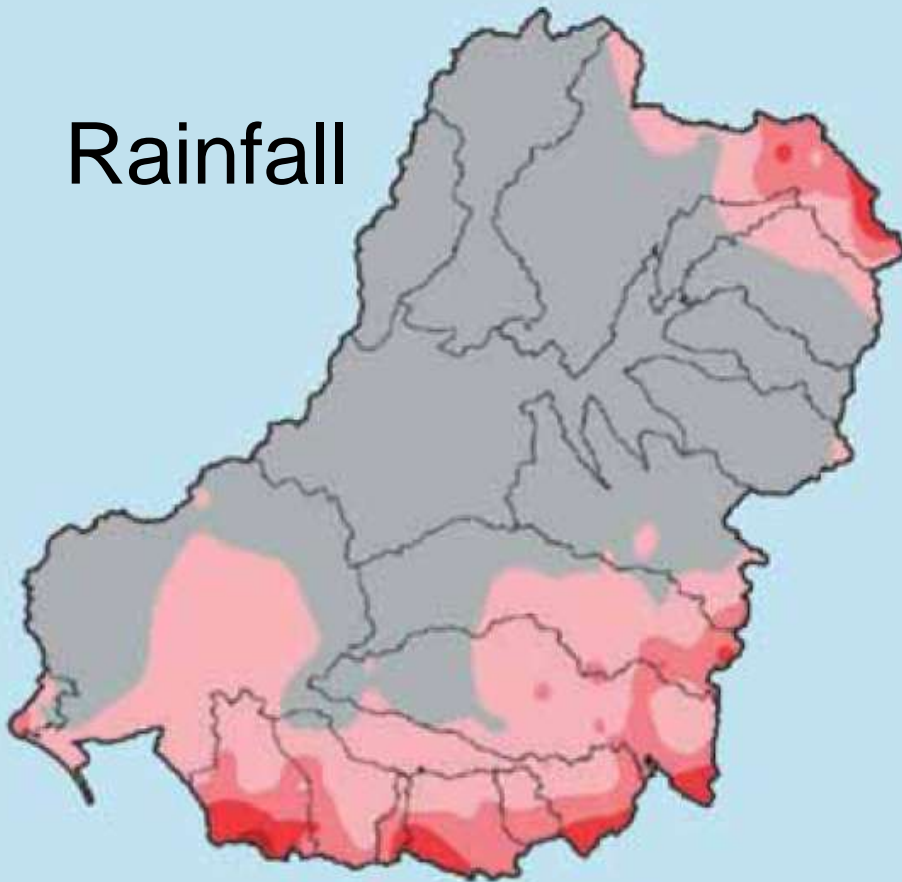
- Snowpack Trend – Dashed Line
- Maximum Winter Temp – Solid Line, Inverted Scale



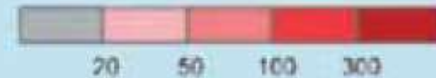
Recurrence Interval of 97-06 Drought in MDB

Rainfall

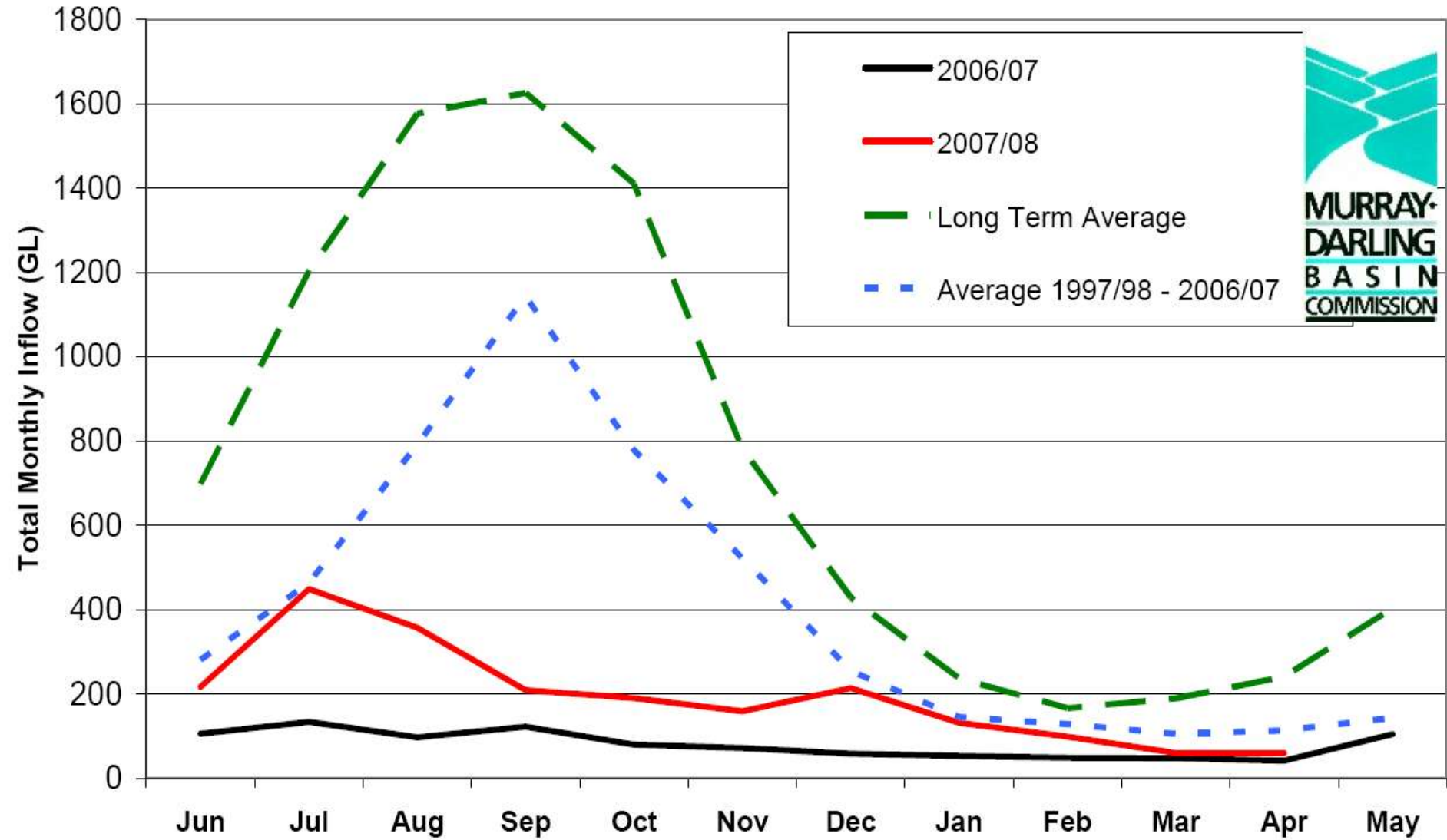
Runoff



Source: CSIRO Sustainable
Yields

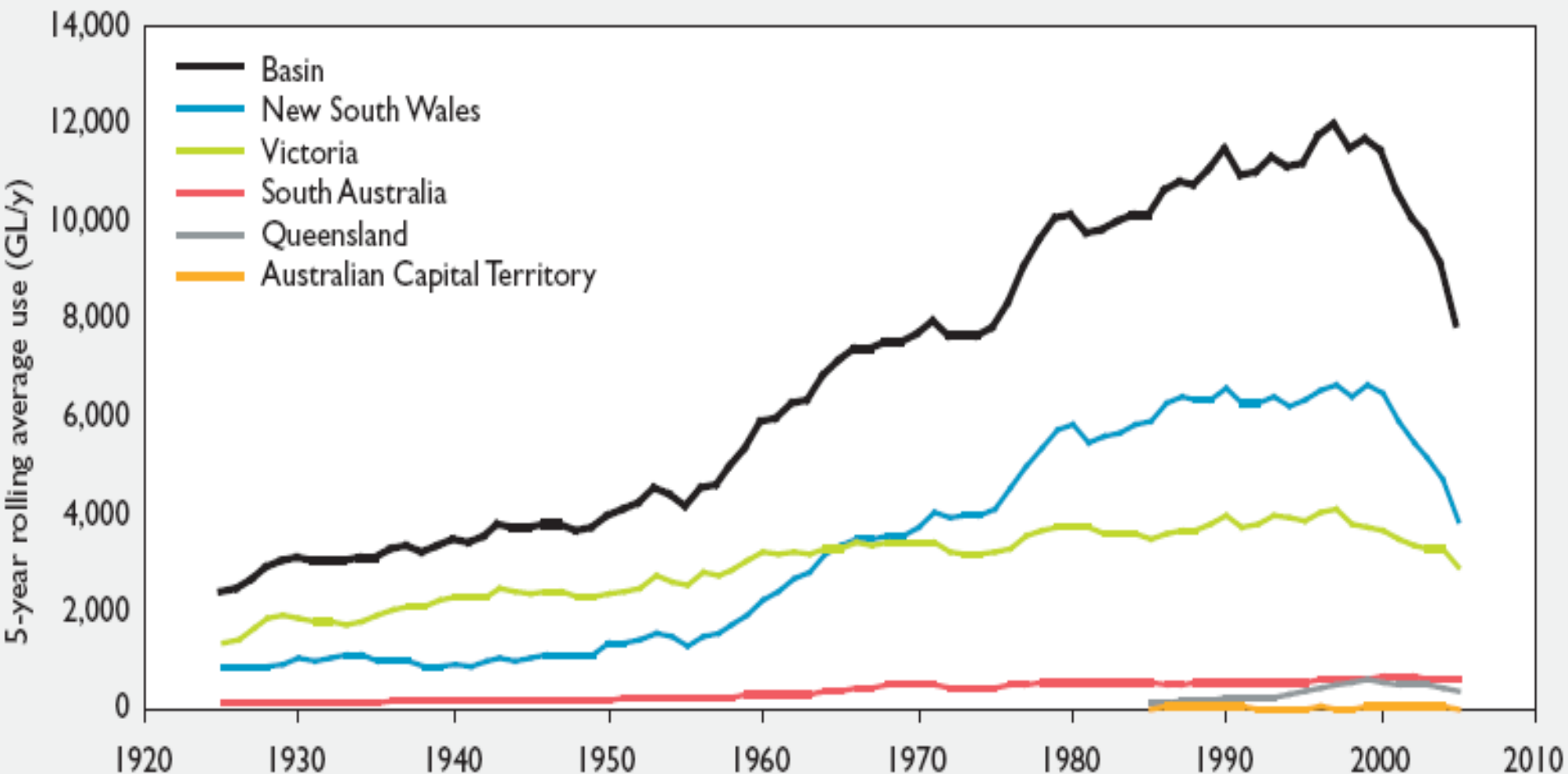


Murray Darling Annual Hydrograph



Water Use in MDB 1920-2005

Growth in total and jurisdictional surface water use in the MDB (five-year moving averages)



Source: Data from MDBC

Murray Darling Storage Normal vs. 2000-2007

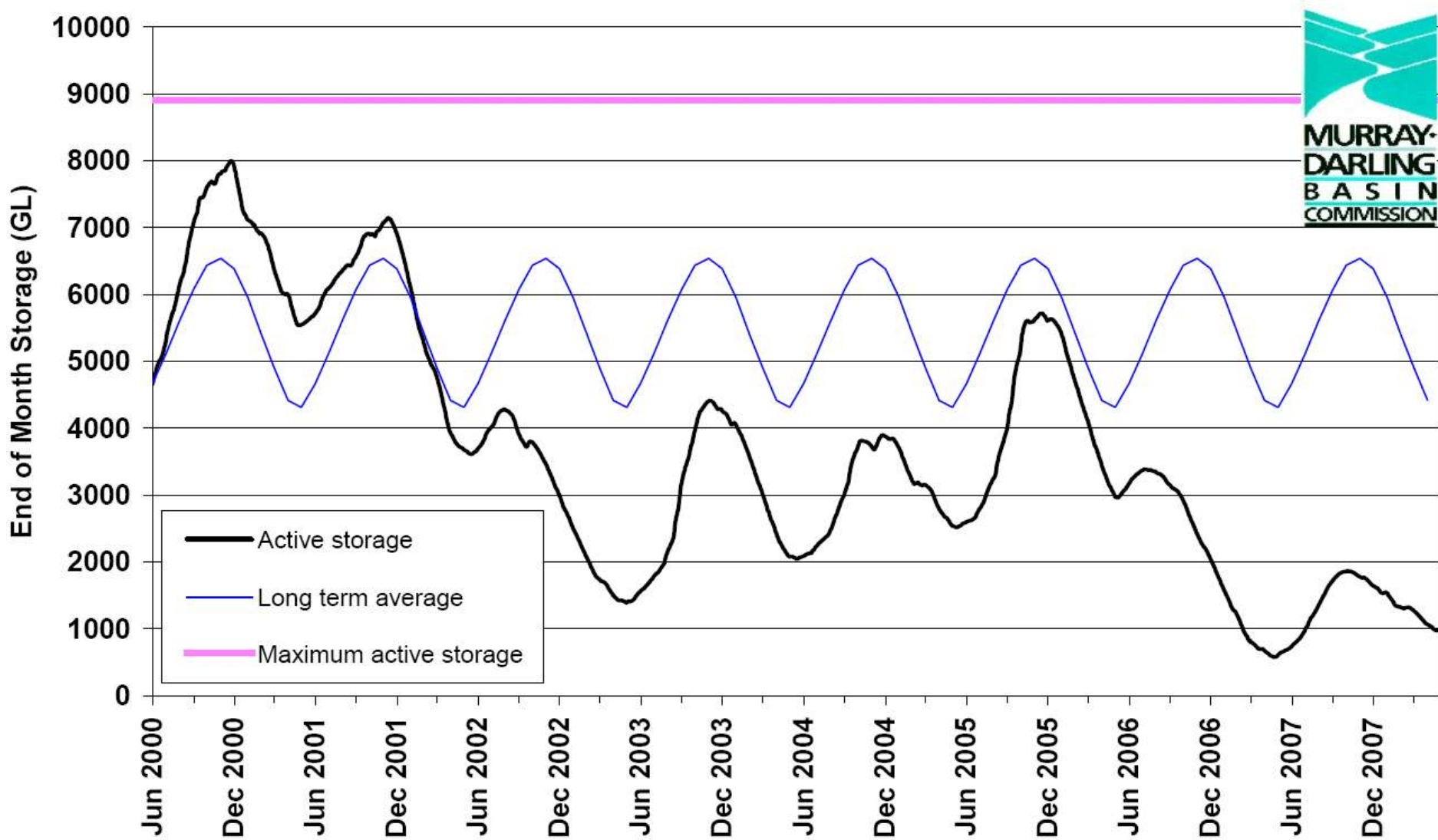
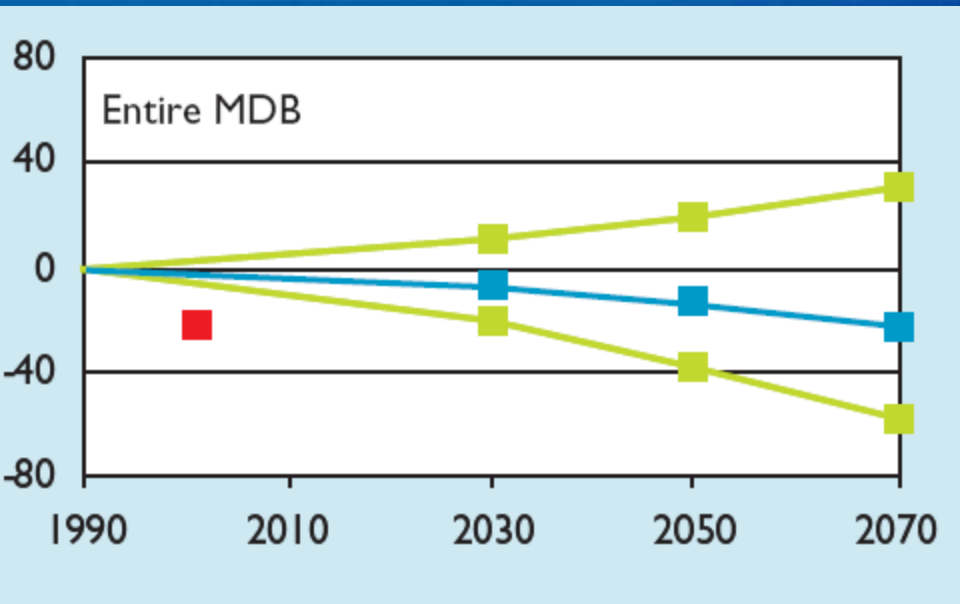
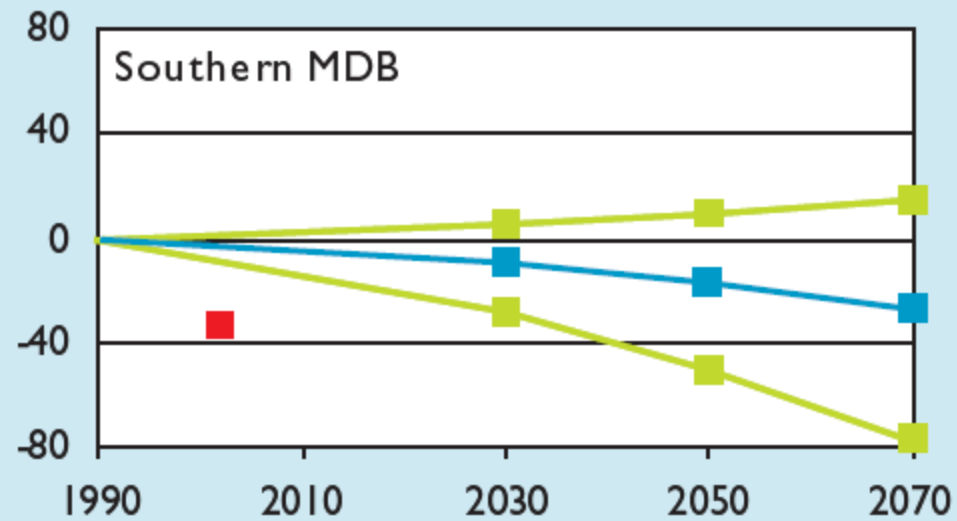
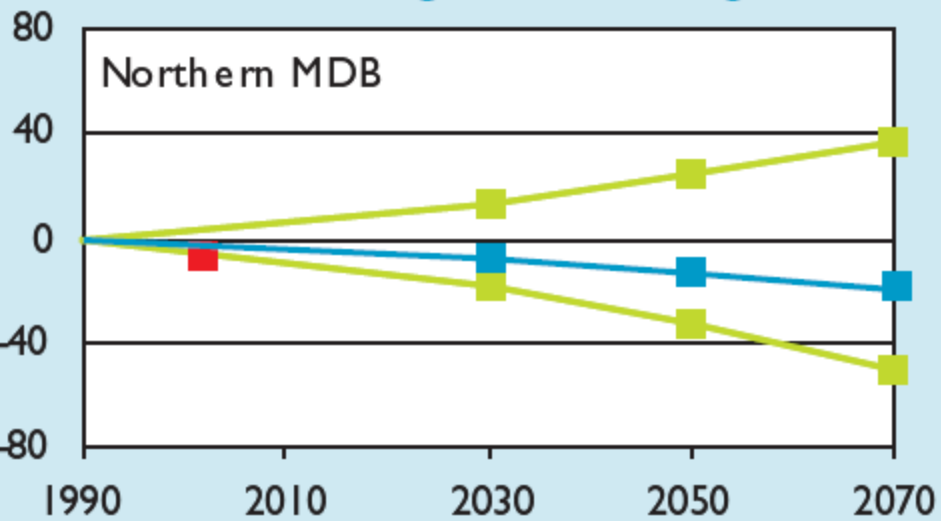


Figure 2. MDBC active storage; June 2000 to April 2008

Murray Darling Runoff Projections

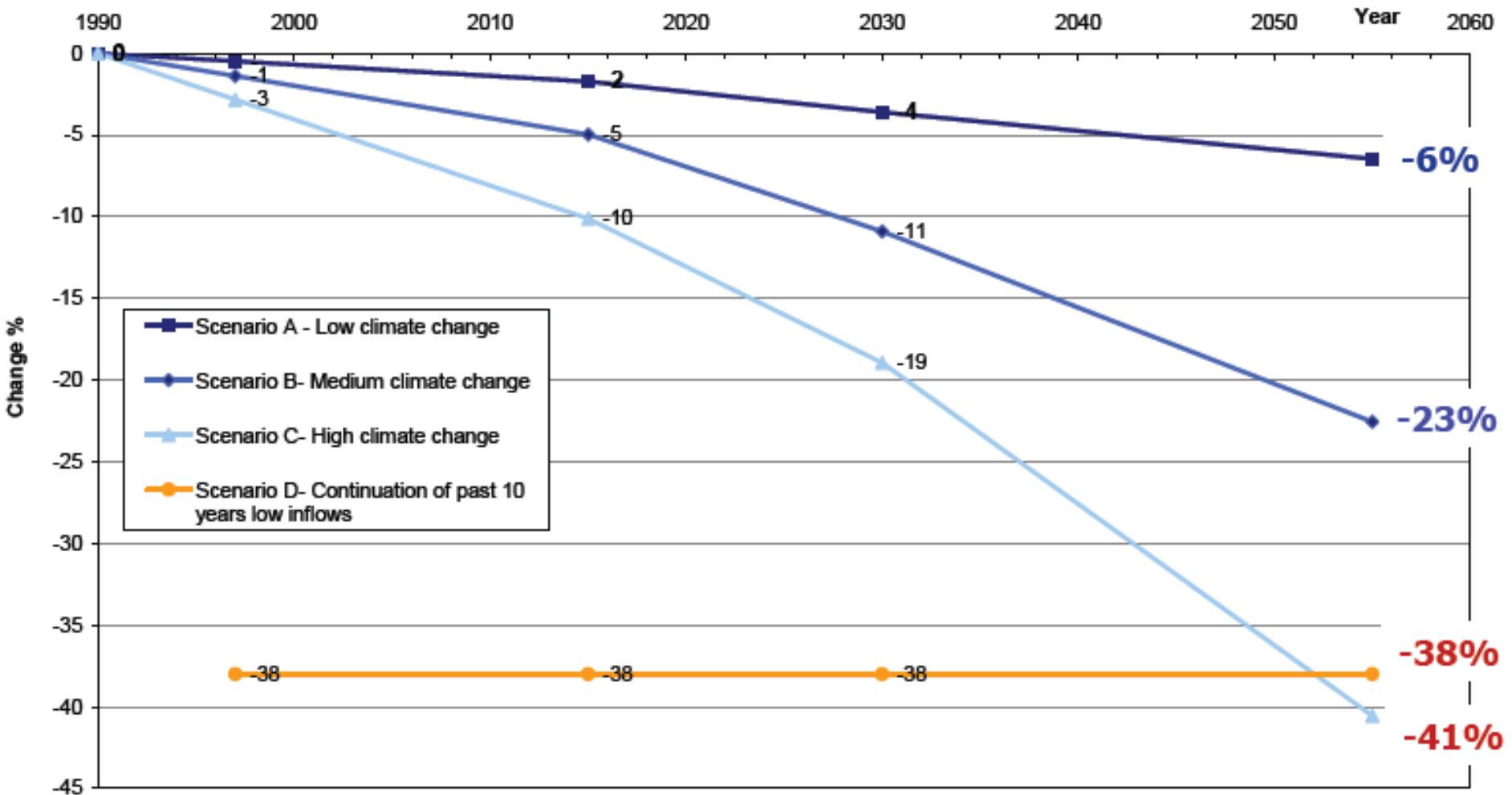


Medium global warming



Models May Not Set Lower Bound on Future Runoff

Victorian Murray River inflows 1990–2055



Closing Thoughts

- Australia has experienced very unusual climate conditions during last 10 years
- It sure looks like climate change...
 - Wet wetter and dry drier
 - Fires, Dust, -40% Runoff
- It has changed many aspects of water management
 - Some unthinkable a few years ago
- “A Collision between 19th Century Water Law, 20th Century Infrastructure and 21st Century Population and Climate Change” is already underway Downunder...
- We need to think about how we might change, too, if needed..

EXTRA SLIDES