www.csiro.au

Factsheet 1

Surface water yields in south-west Western Australia

Water for a Healthy Country Flagship

National Research FLAGSHIPS Water for a Healthy Country

CSIRO

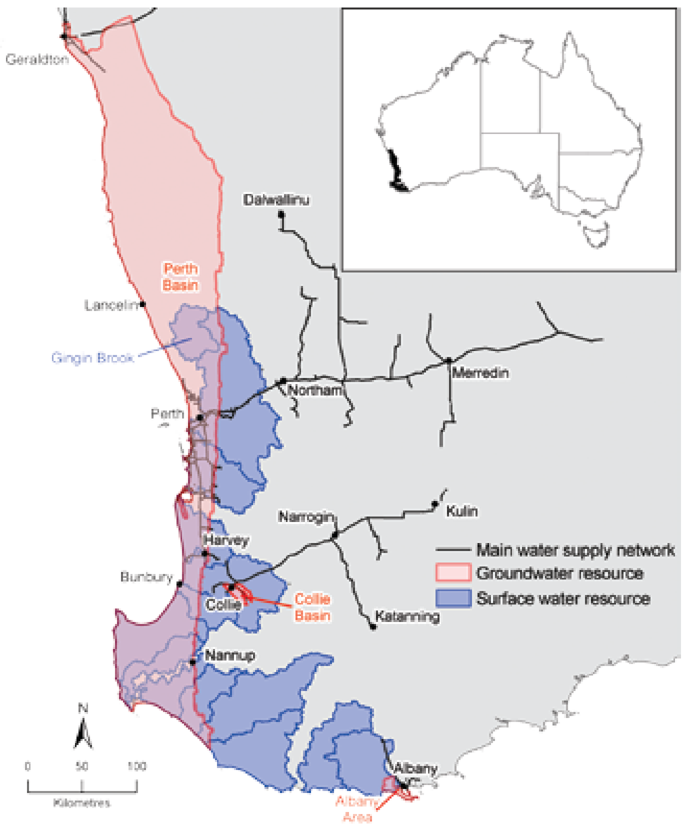
The CSIRO South-West Western Australia Sustainable Yields Project provides science to underpin the sustainable planning and management of the water resources of south-west Western Australia

Project overview

Led by CSIRO's Water for a Healthy Country Flagship, the South-West Western Australia Sustainable Yields Project is the most comprehensive assessment of the possible impacts of climate change and development on the water resources of south-west Western Australia. The objective is to provide a nationally consistent estimate of regional water availability that is useful for water managers, environmental managers and water users. This region has been severely impacted by climate change which has resulted in runoff decreasing by about half due to a 10 to 15 percent decrease in annual rainfall since about 1975. However, it is less well known how the reduction in rainfall influences groundwater recharge, groundwater levels, water dependent ecosystems and yields.

The project area occupies about 62,500 km^2 and contains the highest rainfall part of the south-west of the state with over 1.9 million people which is 89 percent of the population of Western Australia. The project estimated the likely water yield of all major fresh, marginal and brackish surface water and groundwater resources under the same climate and development scenarios as used in equivalent studies in the Murray-Darling Basin, northern Australia and Tasmania. All results are reported at 2030. The **historical climate** is based on the climate of the historical past (1975 to 2007), while the **recent climate** is based on the climate of the recent past (1997 to 2007). The **median future climate** is the median 2030 climate as projected by 15 global climate models and three global warming scenarios. The **wet extreme** and **dry extreme future** climate represent the wetter and drier bounds of the future climate.

The project also estimated future water demands and compared these with likely future yields from all water resources under these scenarios. Finally the possible impact of climate on water dependent ecosystems was assessed.



> Figure 1. Groundwater resources and surface water resources in the project area

Surface water in the region

Surface water is the cheapest water source in south-west Western Australia (SWWA) and provides about a quarter of water for domestic use, irrigation and industry in the area shown in Figure 1. The fresh and marginally saline rivers in SWWA flow through 13 surface water basins from mainly forested catchments on the Darling Plateau.

The highest annual rainfall is in the south and along the Darling Scarp in the northern and central regions of the project area (Figure 2). Up to 80 percent of the annual rainfall occurs between May and October. Temperatures are at their lowest during this period making rainfall more effective in producing runoff and recharge.

Key finding 1

In the central and northern regions of the project area the mean annual rainfall has been lower during the recent past than during the historical past

The decline in rainfall during the recent past (1997 to 2007) in the northern and central regions is particularly noticeable in autumn and early winter. The later onset of rainfall may result in catchments being drier at the start of winter and, along with an overall reduction in rainfall intensities, contribute to reduced runoff. However, the decline has not been uniform. In the southern region the recent past has not been drier than in the previous two decades.

Key finding 2

Almost all daily global climate models used by the Intergovernmental Panel on Climate Change Fourth Assessment Report predict that the climate in the region will get hotter and drier by 2030 relative to the historical period

Fourteen of the 15 daily global climate models (GCMs) used in the Intergovernmental Panel on Climate Change Fourth Assessment Report predict that the 2030 climate in SWWA will be drier than during the historical period (1975 to 2007). The 15th model estimates no significant change. The average reduction in rainfall across the surface water basins is projected to be 8 percent. This is in addition to the 10 to 15 percent reduction since the mid-1970s. In most of Australia there is a greater uncertainty in the direction of rainfall change under the projected climate. It is unusual for so much agreement between so many climate models.

Key finding 3

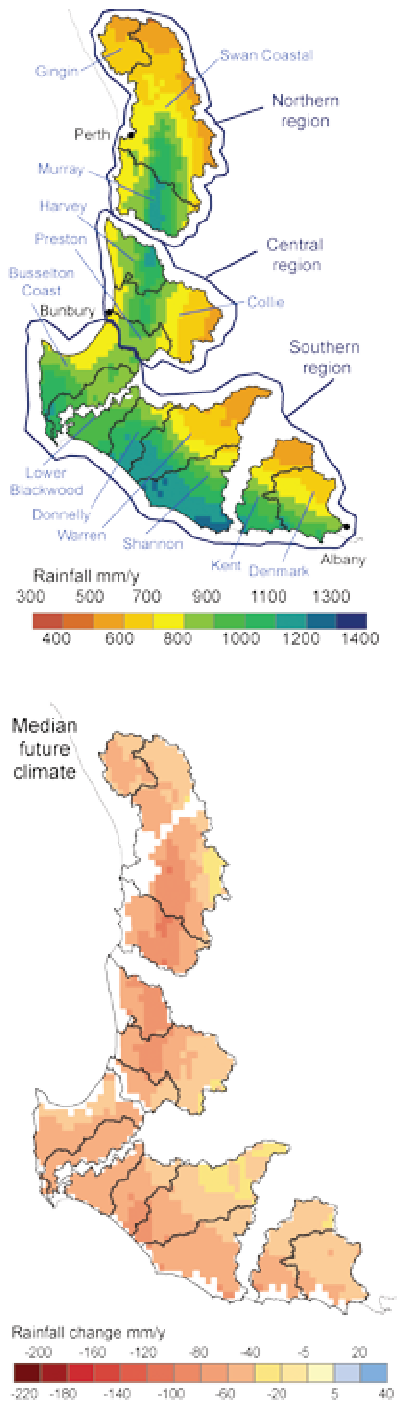
Under the historical climate, annual rainfall in excess of 900 mm occurs about once in every 5 years. This reduces to once in every 20 years under the median future climate

Averaged across the surface water basins, annual rainfall in excess of 900 mm occurs once every 5 years on average under the historical climate and this produces about 130 mm of runoff (Figure 3). Under the median future climate, an annual rainfall of 850 mm is exceeded once in 5 years which would generate only about 100 mm runoff. In addition to the lower flow, runoff variability increases substantially across all surface water basins resulting in a reduction in reliability. All regions also show an increased number of days of low or zero flows.

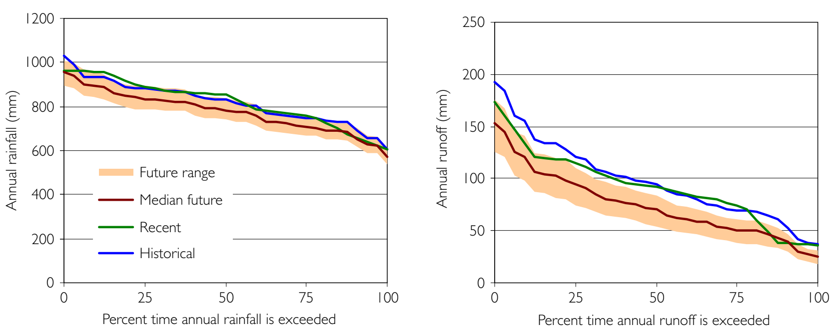
Key finding 4

Rainfall-runoff modelling indicates that the future runoff in the region is likely to be 25 percent lower by 2030 than in the historical period

Under the future climate, mean annual runoff across all surface water basins declines by 25 percent with a range of 10 to 42 percent lower than under the historical climate. The median projection is for a 30 percent decline in runoff in the northern region. This decline is in addition to the halving in runoff in these catchments since 1975. Under the recent climate some southern basins in



> Figure 2. Historical rainfall and percent change under the median future climate across the surface water basins in south-west Western Australia



> Figure 3. Frequency of annual rainfall and runoff averaged across the surface water basins

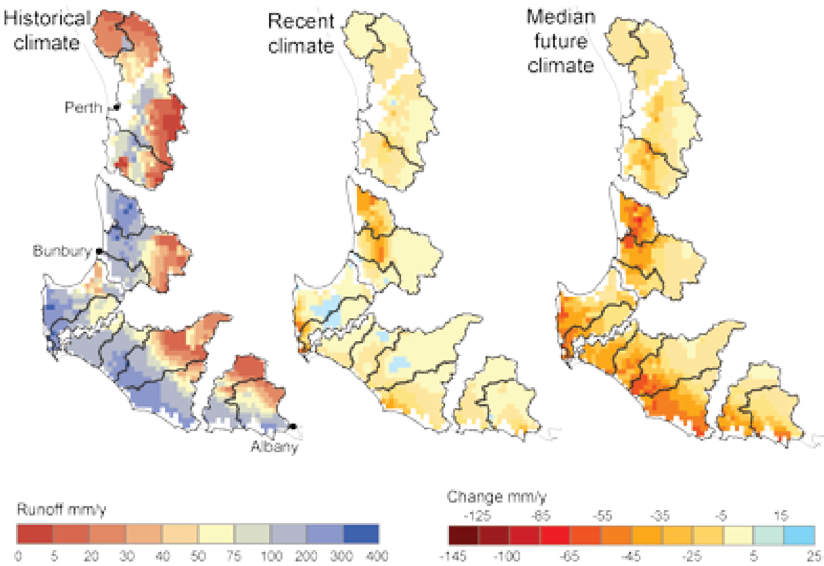
the project area receive greater rainfall and generate more runoff than under the historical climate (Figure 4), but the project area as a whole has lower rainfall and runoff. Runoff reduces in greater proportion in the northern region but the major quantity of flow decline is in the southern region. Most of the reduction in runoff in the recent period has been in the autumn and early winter (Figure 5).

Key finding 5

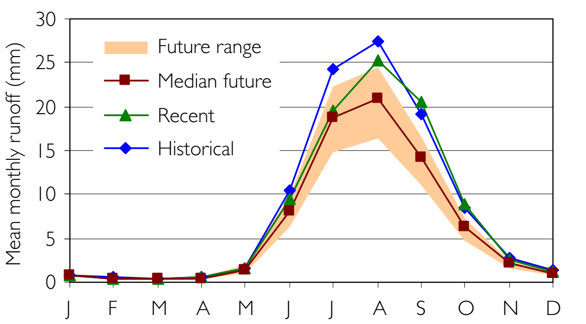
The decline in runoff from all surface water basins under the median future climate results in a decline in mean annual streamflow of more than 800 gigalitres

Under the recent and median future climate, the mean annual streamflow reduces in all surface water basins (Figure 6, Table 1). Under the recent climate the greatest volume reductions are in the Swan Coastal, Murray, Harvey and Collie basins that contain the major supply reservoirs. However, under the median future climate the greatest declines occur in the southern basins; Lower Blackwood, Shannon, Warren and Busselton Coast. Self-supply irrigation is important in the latter two basins. Mean annual streamflow does not equate to usable water yields because the water also needs to meet environmental needs and be accessible for use.

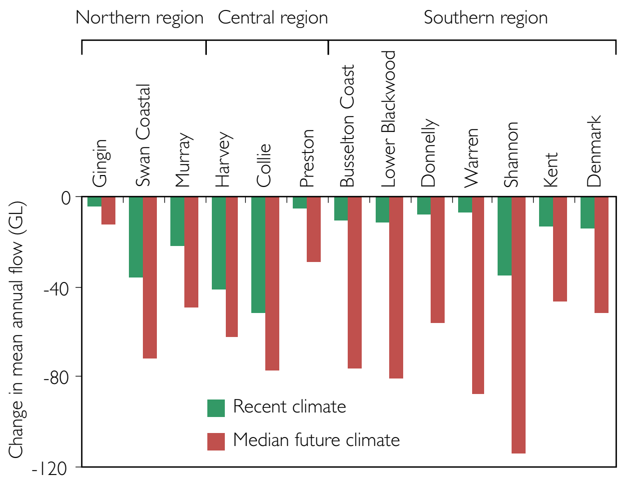
> The Warren River near Pemberton, WA (CSIRO)



> Figure 4. Runoff across the project area under the historical climate, and change in runoff under the recent and median future climate



> Figure 5. Monthly runoff averaged across all surface water basins



> Figure 6. Change in volume of streamflow in each basin under the recent and median future climate relative to the historical climate

Key finding 6

Projected growth in plantations and farm dams is expected to have a minimal effect on water yield relative to that of the future climate

An assessment of the likely future development of commercial forest plantations found that expansion was likely in few surface water catchments and more likely in intermediate rainfall agricultural areas which produce little runoff. In the catchments affected it is likely to have much less impact on runoff than the future climate. Similar assessment of the likely expansion of farm dams in the region concluded that, although there would be some impact in autumn and early winter, total impact on runoff is likely to be very small.

Key finding 7

In about half the catchments in south-west Western Australia, rainfall-runoff processes may be changing over time and model projections may over estimate future water yields

Runoff coefficients (the proportion of rainfall that becomes streamflow) have been reducing in many of the catchments in SWWA over the last 33 years. This has been observed at the same time as groundwater levels have fallen, rainfall intensity has declined and autumn has become drier. In addition forest management has changed. All of these factors may contribute to the observation that runoff is now often lower even when annual rainfall is similar. Since the models were calibrated on the whole historical record, future projections of streamflow may be over estimated if runoff processes have changed such that catchments are now less responsive to rainfall.

> Table 1. Mean annual rainfall, runoff and streamflow averaged across the surface water basins under the historical climate and the change under the recent and future climate relative to the historical climate

Scenario	Mean annual rainfall	Mean annual runoff	Streamflow volume
Historical climate	837 mm	98 mm	3411 GL
Change from historical climate			
Recent climate	-2%	-7%	-239 GL
Wet extreme future climate	-2%	-10%	-343 GL
Median future climate	-8%	-25%	-837 GL
Dry extreme future climate	-14%	-42%	-1426 GL

> Mist over the waters of Wellington Reservoir near Collie, WA (CSIRO)

For further information:

CSIRO Water for a Healthy Country Flagship
Project Leader
Dr Don McFarlane
Phone: (08) 9333 6215
Email: don.mcfarlane@csiro.au
Web: www.csiro.au/partnerships/SWSY

MCK218 Dec 2009 • SWSY_SurfaceWater_Factsheet.indd

DECEMBER 2009

Printed on recycled paper

Australian Government
Department of the Environment, Water, Heritage and the Arts

More information on the Australian Government's *Water for the Future* plan can be found at www.environment.gov.au/water