Water yields and demands in south-west Western Australia

Summary of a report to the Australian Government from the CSIRO South-West Western Australia Sustainable Yields Project

December 2009
About the project

In 2007 and 2008, CSIRO produced a series of reports examining the likely water yield of surface water and groundwater catchments in the Murray-Darling Basin as a result of future climate changes and possible land management changes such as afforestation and farm dams.

On 26 March 2008, the Council of Australian Governments (COAG) agreed to expand the CSIRO assessments of sustainable yields to northern Australia, Tasmania and south-west Western Australia (SWWVA). For the first time, Australia will have a comprehensive scientific assessment of water yields in all major water systems across the country, which allows a consistent analytical framework for water policy decisions across the nation.

The CSIRO South-West Western Australia Sustainable Yields Project has estimated the likely water yields of all major fresh, marginal and brackish surface water and groundwater systems between Geraldton and Albany under the same climate and development scenarios as used in the other three projects except that the historical climate data were of shorter length (the 33-year period from 1975 to 2007). The project also has estimated future water demands and compared these with likely future yields from all water resources under all scenarios.

For the first time:
- A consistent set of future climate inputs has been compiled for use in surface water and groundwater models over the main water catchments in SWWVA.
- The impact of climate and development on water yields has been assessed.
- Future water demands have been estimated in 45 areas under three demand scenarios.
- The possible impacts of climate change and development on water dependent ecosystems have been estimated at a regional scale.
- Possible gaps between the estimated yields and demands have been identified under climate scenarios.

The project has reported the results in three main reports titled:
- Surface water yields in south-west Western Australia
- Groundwater yields in south-west Western Australia
- Water yields and demands in south-west Western Australia.

In this report, results from all of these main reports are summarised. Companion technical reports provide more detail on the methods and results.

The assessments reported here have been reviewed by expert staff within the Department of Water Western Australia, a Technical Reference Panel, external reviewers and a Steering Committee with representatives from the Australian and Western Australian governments.

Scenarios assessed

The estimation of current and future water yields to 2030 was made by considering a range of climate and development scenarios. The historical climate scenario was based on the climate of the historical past (1975 to 2007). This period was chosen because the climate in SWWVA changed in about 1975 resulting in substantially reduced streamflows. This scenario was used to assess water yields should the climate in the future prove to be similar to that of the historical past. This scenario was used as the baseline against which other scenarios are compared. Current levels of surface water and groundwater development were used. The recent climate scenario was based on the climate of the recent past (1997 to 2007). This scenario was used to assess water yields should the climate in the future prove to be similar to that of the recent past. Current levels of surface water and groundwater development were used. The future climate scenario used 15 global climate models with three estimates of temperature changes (due to global warming) to provide a spectrum of possible ~2030 climates. From this spectrum three were selected for reporting, representing a wet extreme, median and dry extreme future climate. Current levels of surface water and groundwater development were used. The future climate with future development scenario used the same climate time series as the median future climate scenario, but future levels of development were used (~2030 projections of commercial forestry plantations, farm dams and likely future irrigation developments; and increased groundwater abstractions to full allocation limits).
Overview of the project area

The geographic extent of the South-West Western Australia Sustainable Yields Project includes all fresh, marginal and brackish surface water basins from Gingin Brook, north of Perth, to Albany; and groundwater resources in the Perth and Collie basins, and the west Bremer Basin near Albany (Figure 1). This area covers all current and anticipated future water resources in SWWA suitable for irrigation, domestic water supplies and industries that require low salinity water. Inland water resources are either limited or too saline for these uses. As a result these inland areas are supplied with water from the project area.

The project area covers about 62,500 km² and contains over 1.9 million people or 89 percent of the population of Western Australia. It is concentrated over the highest rainfall part of the south-west of the state and includes all of the state’s irrigation areas with the exception of the Gascoyne (Carnarvon) and the Ord (Kimberley).

To a large extent, groundwater resources and surface water resources are spatially separated. Groundwater is a major source of water in the Perth and Collie groundwater basins and near Albany. The Perth Basin comprises flat sandy coastal plains and more elevated and clayey plateaux. The Darling Plateau east of the Perth Basin contains most of the usable surface water resources. Groundwater in this area is contained in clayey weathering zones, has low yields and is progressively more saline with distance to the east. Groundwater discharge into streams affects runoff volumes and water quality in the region. However interactions between these two water resources are only important in a few areas in the Perth and Collie groundwater basins.

> Figure 1. Groundwater resources and surface water resources in the project area
**Key finding 1**
South-west Western Australia has experienced significant climate change since the mid-1970s which has impacted on surface water and groundwater yields, and water dependent ecosystems.

**Key finding 2**
Over central and northern parts of the project area, the mean annual rainfall has been lower in the recent past than in the historical past.

**Climate**

Up to 80 percent of the annual rainfall in the project area occurs between May and October when temperatures are also at their lowest, which enables more effective conversion of rainfall to runoff and recharge. There is a strong south-west to north-east gradient in rainfall. Annually, rainfall exceeds 1200 mm in the south-west and is less than 350 mm in the north-east (Figure 2a).

The mean annual areal potential evapotranspiration (APET) varies from 1650 mm in the north to 1180 mm in the south (Figure 2b). The rainfall deficit, calculated by subtracting APET from rainfall, is negative for all except the extreme south of the project area (Figure 2c).

All climate data used were for the period 1975 to 2007 because a climate shift occurred in SWWA in the mid-1970s with subsequent rainfalls being 10 to 15 percent lower than the long-term mean (Figure 3). The post-1975 rainfall is currently used by Western Australian water managers and suppliers for planning.

In addition to the reduction in rainfall since 1975, the period between 1997 and 2007 was even drier in the northern and central parts of the project area (Figure 4). This period was used to model the impacts of a continuation of the recent climate on surface water and groundwater yields.

Rainfall in the project area is estimated to decrease by more than 10 percent by 2030 relative to the historical period in 12 of the 45 projections made using...
the global climate models (Figure 5). Furthermore, almost all 45 projections indicate at least some reduction in rainfall for the project area by 2030.

**Key finding 3**
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.

The climate and development data were used in runoff models to estimate runoff, the impact on surface water dependent ecosystems and water yields for consumptive use (Figure 6). Similarly the climate and development data were used in recharge models and then in groundwater flow models to estimate groundwater levels, the impact on groundwater dependent ecosystems and water yields for consumptive use. Estimated water demands by major user groups were compared with both surface water and groundwater yields under the climate and development scenarios.

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> Figure 4. Comparison of recent annual rainfall (1997 to 2007) with historical annual rainfall (1975 to 2007)

> Figure 5. Percent change in rainfall across the project area relative to the historical climate for each of the three global warming scenarios and all 15 global climate models (named on vertical axis). The left end of the bars indicates the high warming scenario; the right end, the low warming scenario; and the change in colour, the median warming scenario.

> Figure 6. Process used to estimate gaps between future surface water and groundwater yields and demands in the project area.
Runoff

Under the median future climate scenario, rainfall in the surface water basins declines by 8 percent and runoff by 25 percent compared with the historical climate (Table 1). The reduction in future runoff may be between 7 percent (under a continuation of the recent climate) and 42 percent (under the dry extreme future climate).

While all regions are projected to have similar percentage declines in mean annual rainfall under the median future climate relative to the historical climate (equivalent to a reduction of about 70 mm), the northern (Gingin to Murray) region (Figure 7) has the greatest proportional reduction in runoff of 30 percent (13 mm). However, as a volume this is half the 28 mm reduction in runoff projected in the central (Harvey to Preston) and southern (Busselton Coast to Demark) regions.

Under the dry extreme future climate, rainfall in the northern region declines by 16 percent, with a 53 percent reduction in streamflow. The main Integrated Water Supply Scheme (IWSS) dams which supply the region with drinking water are located in the northern region and there has already been a decline in inflows of over 50 percent from pre-1975 levels.

The percentage decline in runoff in the recent period, relative to the historical period, is less marked in the southern region. Under the median future climate the projected decline in runoff relative to the historical climate is similar (around 25 percent) in all regions across the project area.

> Table 1. Mean annual rainfall and runoff across the surface water area

<table>
<thead>
<tr>
<th>Region</th>
<th>Scenario</th>
<th>Mean annual rainfall</th>
<th>Mean annual runoff</th>
<th>Rainfall minus runoff</th>
<th>Runoff coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface water area</td>
<td>Historical climate</td>
<td>837</td>
<td>98</td>
<td>739</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>Recent climate</td>
<td>-2%</td>
<td>-7%</td>
<td>-2%</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td>Wet extreme future</td>
<td>-2%</td>
<td>-10%</td>
<td>-1%</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td>Median future climate</td>
<td>-8%</td>
<td>-25%</td>
<td>-6%</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Dry extreme future</td>
<td>-14%</td>
<td>-42%</td>
<td>-11%</td>
<td>8%</td>
</tr>
</tbody>
</table>

> Figure 7. Percent change in mean annual runoff in all surface water basins under the recent and median future climate relative to the historical climate

> The Harvey Reservoir at near capacity, WA (CSIRO)
Streamflows and surface water yields

Each millimetre of rainfall or runoff is equivalent to 1 megalitre (ML) per square kilometre in streamflow. The streamflow decline under the median future climate is equivalent to 837 gigalitres per year (GL/year) less than under the historical climate and 597 GL/year less than under the recent climate. Under the dry extreme future climate the reduction in annual streamflow is 241, 299 and 886 GL in the northern, central and southern regions respectively.

Across the whole project area the projected streamflows under the wet extreme, median and dry extreme future climate are 343, 837 and 1426 GL/year, respectively, less than under the historical climate. If the median or dry extreme climate eventuates, the runoff into IWSS and irrigation scheme dams will be even more severely impacted than they are at present. The reductions in runoff in the southern catchments will impact self-supply irrigators and streams in national parks and nature reserves.

Changes in streamflow do not translate exactly into changes in water yields, which is the water available for diversion. Yields take account of environmental constraints and the availability of sites to harvest and use the water. This is because the streamflow may be within national parks or forests downstream from cleared areas used for irrigation or in upper catchments that are too brackish for use.

Estimated changes in surface water yields under the recent, median future and dry extreme future climate are shown in Figure 8. In the main irrigation basins, the Harvey and Collie basins have high yields and a relatively high resilience to climate change compared with the Donnelly and Warren basins further south. Under the dry extreme future climate, surface water yields are likely to be significantly affected in most basins.

Key finding 4
Modelling has indicated that future mean annual surface water yields in the project area are likely to be on average 24 percent lower by 2030, with a possible range of 4 to 49 percent lower.
Surface water dependent ecosystems

The impact of climate change on surface water dependent ecosystems was assessed for 33 rivers for a 'winterfill period' between 15 June and 15 October, when gully dams intercept streamflow until they spill; and for the 'rest of the year' (16 October to 14 June) when biota require water over summer for their survival.

About half of the rivers are expected to have a 5 to 20 percent reduction in winterfill and rest-of-the-year flows if the climate of the recent (1997 to 2007) past continues until 2030. Under the median future climate about 60 percent of rivers may have a 20 to 30 percent reduction (Table 2). Under all future climate scenarios, winter runoff is more affected than is summer runoff. Climate impacts are greater in the southern Kent and Denmark rivers, and in the most northern river, Gingin Brook (Figure 8). The latter is affected by baseflow from a surrounding aquifer so further work may be required to be sure of this estimate. Runoff in these rivers during both the winter and the rest of the year, under the median future climate, is 40 to 65 percent less than under the historical climate, while it reduces by between 20 and 30 percent in the other rivers.

Climate impacts are most significant for ecological river functions that require high river flows. This includes channel scouring and inundation of the floodplain. A decrease in rainfall intensity that has accompanied the decrease in rainfall amounts in SWWA has already greatly reduced flood flows.

> Table 2. Variations in median runoff during two periods of the year under climate scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Winterfill period (15 June to 15 October)</th>
<th>The rest of the year (16 October to 14 June)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent change relative to the historical climate</td>
<td>Number of rivers affected (out of total 33)</td>
</tr>
<tr>
<td>Recent climate</td>
<td>-5% to -20%</td>
<td>15</td>
</tr>
<tr>
<td>Wet extreme future climate</td>
<td>-5% to -20%</td>
<td>30</td>
</tr>
<tr>
<td>Median future climate</td>
<td>-20% to -30%</td>
<td>20</td>
</tr>
<tr>
<td>Dry extreme future climate</td>
<td>-40% to -50%</td>
<td>19</td>
</tr>
</tbody>
</table>

Key finding 5

Under the median future climate runoff is expected to decrease by between 20 and 30 percent and especially affect surface water dependent ecosystems that depend on high flows.
Future demands for surface water

Current demands for surface water are highest in the irrigation districts in the Harvey and Collie surface water management areas and these are expected to grow in future, along with the Warren basin under the high demand scenario (Figure 9). The areas with low increases in surface water demand include areas which are fully developed or have limitations on access to water because they are in areas of state forest, nature reserves or national parks. These estimates of demand include the Integrated Water Supply Scheme (IWSS) that supplies drinking water to Perth, Mandurah and inland areas. All of the water that flows into the IWSS dams was assumed to be fully used and the estimated increases in IWSS demand of about 36 percent by 2030 was assumed to be met from other sources.

Gap between surface water yields and demands

While use of both surface water and groundwater is possible in some areas, especially where water is piped over long distances, for the purpose of this analysis the gaps between water yield and water demand are presented separately for groundwater and surface water resources. The Harvey and Collie surface water management areas have a high likelihood of developing a surface water deficit, despite their relative resilience to climate change (Figure 10). Potential growth in horticulture and industrial demands cause this gap. The Warren catchment is also likely to develop a deficit due to simultaneous increases in horticultural demands and reductions in runoff.

Key finding 6

Significant gaps between water yields and demands are expected to occur by about 2020 in the areas where surface water resources are used for irrigation.
Groundwater

Groundwater levels

Results from the three groundwater models that cover the 20,000 km² southern half of the Perth Basin were combined to estimate the change in groundwater levels under the scenarios between 2008 and 2030 (Figure 11).

The effect of vegetation, soil type, abstraction and depth to watertable on groundwater levels is significant. Groundwater levels are expected to continue to rise under the Dandaragan Plateau in the north-east part of the project area despite this being the driest modelled area because the area is cleared, the watertable is relatively deep, the soils are permeable and abstraction is modest.

Groundwater levels under the western Swan Coastal Plain are estimated to fall by less than 3 m by 2030 in all areas except the Gnangara Mound which is vegetated and has relatively high levels of abstraction. This resilience on most of the plain is due to the lack of perennial vegetation and sandy soils. In areas with high watertables, potential recharge is currently lost through groundwater flow to drains and by evapotranspiration. Despite the anticipated reduction in future rainfall, many of the shallow aquifers are expected to continue to fill each winter under all except the dry extreme future climate and the future development scenario. Once groundwater levels fall below the limit of drains and plant roots they will lose this resilience and fall in future.

Groundwater levels under most of the Blackwood Plateau fall by 3 m or more under all scenarios where there is a greater interception of rainfall and soil water by perennial vegetation, and less recharge due to clayey soils. Vegetated parts of the southern Scott Coastal Plain have lower groundwater levels under the dry extreme future climate which is similar to Gnangara but with a lesser amount of decline.

It is likely that groundwater in the Northern Perth Basin (north of the area shown in Figure 11) will continue to rise in areas with sandy soils and under cleared agricultural land, especially in higher rainfall areas. Under perennial vegetation, groundwater levels are expected to decline by up to 2 m under all future climate scenarios.

Groundwater levels in the Collie Basin, which is east of the area shown in Figure 11, generally decline under all scenarios due to both climate and abstraction for coal and power production.

The Albany Area has stable or rising levels under the historical climate, stable levels under the recent climate, and falling levels under all future climate scenarios. This behaviour appears similar to vegetated sandy areas on the Swan and Scott coastal plains.

Key finding 7

Groundwater demonstrates greater resilience to climate change where watertables are within a few metres of the surface. As these watertables fall, evaporative and drainage losses are reduced which results in increased net recharge. Groundwater levels are expected to continue to rise under dryland agriculture, which is practised over 56 percent of the Perth Basin.
Groundwater yields

Current groundwater yields are highest around Perth where the Superficial Aquifer is thick and there are up to four confined aquifers that contain water that is suitable for use. This is fortuitous because this is where the demands are greatest.

Modelling indicates that while some areas may lose significant yields under the median and dry extreme future climate, because of the large volumes of these groundwater resources, the percentage changes are often much smaller than changes in yields of surface water (Figure 12).

The reduction in groundwater resources is expected to be most significant in the Gnangara area north of Perth, the Blackwood area in the south-west, the Collie Basin and Albany Area. All of these areas have a perennial vegetative cover which reduces recharge and all except the Blackwood area also have significant levels of abstraction.

Key finding 8

Groundwater modelling has indicated that future yields in the region are likely to be on average 2 percent lower by 2030, with a range of +2 to -7 percent.

Types of GDEs were evaluated: wetlands, and GDEs with three different depths to watertable: zero to 3 m, 3 to 6 m, and 6 to 10 m.

Under both the wettest (historical) and driest (dry extreme future) climates, the risk to GDEs with a depth to watertable of zero to 3 m is greatest in the eastern Swan Coastal Plain and on the Scott Coastal Plain (Figure 13). Many areas with a shallow watertable in the western Swan Coastal Plain have low or no risks which may be due to groundwater levels being buffered by drain and evapotranspirational losses offsetting declines in rainfall. Many of these areas have been cleared so their GDE values have been reduced.

The percentage of the areas with each GDE type that have different degrees of risk under each climate scenario in the southern half of the Perth Basin is shown in Figure 14. About half of all GDEs of all types may be affected to some extent by falling groundwater levels under the dry extreme future climate and under future development. About 40 percent may be affected even if the recent climate continues until 2030 and there is no additional abstraction. This indicates how sensitive they may be to climate change. GDEs with a depth to watertable of 6 to 10 m may be the most severely affected. However, the vegetative response in areas where the watertable is deep may be in the form of a groundwater-dependent Banksia tree being replaced by another Banksia that is more drought tolerant.

The area at high to severe risk is relatively small under the wetter climate scenarios but increases markedly under the dry extreme future climate and under future development. This indicates that there may be important thresholds that may be breached under a much drier climate which may require future abstraction to be modified.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are uniquely adapted features of the Western Australian landscape, especially on the Swan and Scott coastal plains. Some vegetation can access groundwater when it is within about 10 m of the soil surface. In the southern half of the Perth Basin, depth to watertable is within 3 m under 22 percent of the area, between 3 and 6 m under a further 14 percent, and between 6 and 10 m under another 10 percent. However many areas have been cleared of native vegetation or drained so their ecological values have been reduced. Only future risks to GDEs associated with climate changes were considered. The impact of recent climate and development on GDEs, while considerable in many areas, was not included in the analysis.

The risk to GDEs was assessed using relationships that estimate the level of vegetation stress caused by the amount and rate of fall in groundwater levels as projected by groundwater models. Four...
Groundwater (cont.)

Figure 13. The risk of groundwater decline for groundwater dependent ecosystems with a depth to watertable between zero and 3 m in the southern half of the Perth Basin under the historical climate and the dry extreme future climate.

Figure 14. Percentage of the total area in specified risk category for each type of groundwater dependent ecosystem in the southern half of the Perth Basin: (a) wetlands, and those with depths to watertable of (b) zero to 3 m, (c) 3 to 6 m and (d) 6 to 10 m.
**Future demands for groundwater**

About three-quarters of all water used in the project area comes from groundwater and almost all increased water demands since the mid-1980s has been met from this source. Demand for groundwater is heavily concentrated in the Perth area (Figure 15). Demands are also expected to grow in the future in the vicinity of Perth for industry; self-supply irrigation for peri-urban horticulture; and public open space and private irrigation of lawns and gardens. Groundwater for the IWSS may also increase through the development of new coastal schemes. These may increase the competition between private users and the IWSS for groundwater. When both surface water and groundwater demands are combined, the median increase is expected to be about 35 percent but this may be up to 57 percent depending on growth factors.

**Gap between groundwater yields and demands**

Under all future scenarios groundwater in the areas around Perth, Collie and Albany is likely to develop the greatest deficits between future yields and demands (Figure 16). Unless new mining, horticultural or industrial demands develop in the Northern Perth Basin, water is likely to remain available despite this area having the lowest rainfall in the project area. While such increases are possible they are difficult to forecast using the demand estimation method used in this project.

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Key finding 10

Consumptive water demand in the region is expected to increase by about 35 percent by 2030, with a range of increase between 10 and 57 percent depending on population and economic growth factors.
Gaps between total water yield and demand

In the Australian context, water use is unusual in the project area because 71 percent of all water is self-supplied, three-quarters is groundwater and irrigated agriculture uses only 35 percent. Also, almost all irrigated agricultural use is for high value products. Water deficits cannot be easily met by transporting water from low to high value uses because the ability to move the water may not be present as is possible in riverine irrigation systems.

Figure 17 and Table 3 show the results of the combined water yield and demand gap analysis for the project area for all water resources. In overall terms, the area has a surplus of water to meet demands to 2030, except under the high demand scenario and under the dry extreme future climate. This combination of scenarios could eventuate if rapid population and economic growth continue until 2030 and the climate became much hotter and drier than is estimated by the median future climate. Under the median future climate and the medium demand scenario, an overall surplus of 266 GL/year is estimated.

Figure 17 shows that it is mainly surface water yields that are likely to decline under the future climate scenarios. However the total yield of the Superficial Aquifer is expected to also be impacted, especially under the dry extreme future climate.

Table 3. Summary of gap analysis in the project area

<table>
<thead>
<tr>
<th>Climate scenario</th>
<th>Current demand</th>
<th>Low demand (2030)</th>
<th>Medium demand (2030)</th>
<th>High demand (2030)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current available yield</td>
<td>825</td>
<td>709</td>
<td>400</td>
<td>126</td>
</tr>
<tr>
<td>Historical climate</td>
<td>875</td>
<td>760</td>
<td>450</td>
<td>176</td>
</tr>
<tr>
<td>Recent climate</td>
<td>818</td>
<td>702</td>
<td>393</td>
<td>119</td>
</tr>
<tr>
<td>Wet extreme future climate</td>
<td>848</td>
<td>732</td>
<td>423</td>
<td>149</td>
</tr>
<tr>
<td>Median future climate</td>
<td>677</td>
<td>561</td>
<td>252</td>
<td>-22</td>
</tr>
<tr>
<td>Dry extreme future climate</td>
<td>451</td>
<td>336</td>
<td>26</td>
<td>-248</td>
</tr>
</tbody>
</table>
Key finding 13
Under the dry extreme climate and under the high demand scenario the region may have an overall deficit of about 250 GL/year.

Key finding 14
Groundwater will progressively substitute for surface water as a water source where both types are available in the project area.

Limitations

The methods used in this project are suitable for regional scale estimates but to assess local impacts on water dependent ecosystems and water yields, finer scale modelling and analysis is required. This project provides guidance on where this additional management effort may be needed.

There are a number of assumptions that may have led to an overestimation of the deficit between yield and demand. These include assuming that the 2030 climate starts in 2008; demand is not restricted by water availability; the sustainable diversion limits method used to estimate surface water yields is conservative; groundwater yields were not assumed to increase if levels were rising; water efficiency measures are not introduced; and all losses in future groundwater storages were assumed to result in reductions in future yields.

Other assumptions may have resulted in an underestimation in future water deficits. These include the assumption that all water has a suitable quality to meet demands; water can be economically transported between areas of surplus to areas of deficit; no major new demands develop (only existing demands are increased in the model used); and groundwater can be accessed from areas under native vegetation for use by nearby towns and agriculture.

Further analyses could address some of these limitations and make the future estimates more rigorous.
This report presents the results of the first intensive and comprehensive water yield and demand estimation under climate change and development ever undertaken in SWWA.

The reductions in yield projected for groundwater are much less than those for surface water resources. This is because groundwater systems have negative feedback mechanisms that limit falls in levels where watertables are close to the soil surface. An increased proportion of rainfall may become recharge as watertables fall whereas runoff often declines by about three percent for every one percent decline in rainfall.

However the differences estimated need to be better evaluated using local hydrological models that take account of both groundwater and surface water processes. Such models would also enable an assessment to be made of the impact of future water regimes on wetlands and streams on a local scale.

The importance of vegetation in determining the amount of runoff and recharge under a drying climate has been shown in this project. Vegetation management so that it is better adapted to a future climate may help both ecological and hydrological values to be improved compared with the ‘do nothing different’ situation.

Based on the analyses and within the constraints of the modelling framework it appears likely that surface water sources will increasingly be replaced by groundwater sources in demand regions where they both occur, with Albany a possible exception due to the relative paucity of groundwater in this area.

For further information:

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Enquiries
More information about the project can be found at www.csiro.au/partnerships/SWSY. This information includes the full terms of reference for the project, an overview of the project methods and the project reports that have been released to-date.

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

CSIRO and the Flagships program

Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills. CSIRO initiated the National Research Flagships to address Australia’s major research challenges and opportunities. They apply large scale, long term, multidisciplinary science and aim for widespread adoption of solutions.