



## COMMUNITY UPDATE # 4 - December 2003

Welcome to edition four of the Water and Rivers Commission's Community Update newsletter regarding the future planning of the South West Yarragadee Blackwood Groundwater Area. This Update covers two major themes:

- an update on the findings of the hydrogeological investigation of the SW Yarragadee aquifer; and
- the process to be followed in making a decision on the Water Corporation application for 45 GL/yr from the Yarragadee aquifer.

The project is on track to announce a decision on the licence application in April 2004. Between now and April the Commission will maintain its commitment to consult with the community on significant findings and decisions that must be made in order to make a well considered decision.

While this edition of the Community Update deals mostly with process and some content, you can be assured, we remain committed in continuing to acknowledge the issues raised with the Commission

throughout this Blackwood Groundwater Area project. The fifth Community Update for this project will describe how each of the issues, as described in Community Update No 1, has been addressed.

Since Community Update Number 3, final reports have been published for the first phase investigations of the Ecological Water Requirements (EWR's). The final Economics Study has also been published in which projections of regional growth for the South West region for the next 30 years have been made. Both reports are accessible from the South West Yarragadee website, (please see the back page of this publication), or hard copies may be sent to you upon request.

Once you've read this Community Update, both the process the Commission is now undertaking and the means by which you can continue to make comment, should be clearer.

### IMPORTANT UPDATE - ALTERNATIVE WATER CORPORATION WELLFIELDS

The South West Yarragadee - Blackwood Groundwater Area study is considering two alternative layouts for the proposed Water Corporation wellfield and both will be investigated through the modelling process to provide an understanding of the drawdowns expected from these alternatives and any resulting impacts these drawdowns may have. One wellfield layout is located entirely within the Blackwood Groundwater Area. The second layout largely overlaps the first, but is spread further north to include two wells within the Busselton-Capel Groundwater Area. Either wellfield is proposed to pump 45 GL/yr.

The need to consider an alternative wellfield has arisen from the consultation process and the recent social, cultural and environmental studies highlighting the importance of the environment and that we must work to sustain the diversity and health of our natural heritage. Notably, these studies have highlighted the iconic values associated with the Blackwood River and its tributaries. While drawdowns on the river system are expected to be minimal, the northern alternative wellfield layout has been developed in recognition of this community concern.

Modelling of this alternative layout will test the extent to which any potential drawdown impacts on the river system can be eliminated or reduced. It is not expected that any such relocation will increase competition between the Water Corporation wellfield and local groundwater users to the north. Information from the modelling and the management plan will confirm this.

The community can be assured that the rigour of assessment by the Water and Rivers Commission will be maintained throughout the assessment and decision making activities. Information relating to the investigation and the decisions will also be available for public scrutiny, including the expert hydrogeologists on the Peer Review Panel.

## Investigation findings

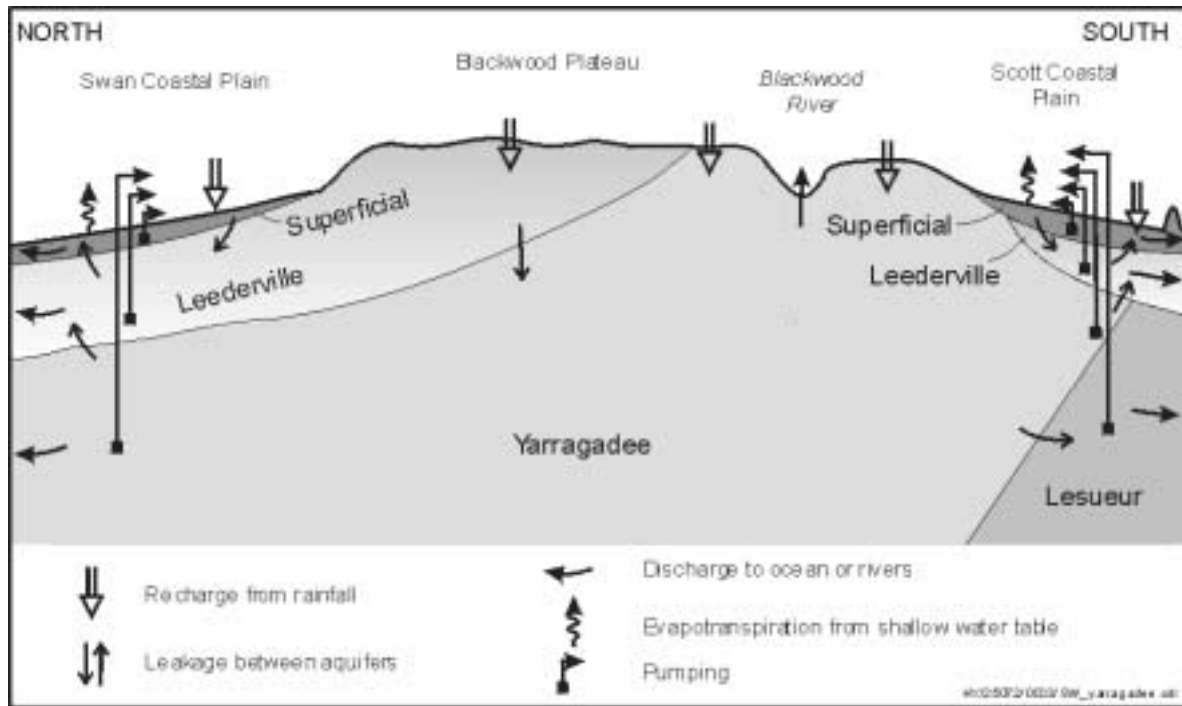
Groundwater and surface water investigations undertaken over the past year have further defined the aquifers of the Southern Perth Basin. This work is central to the process of determining sustainable groundwater use in this part of the south west.

Work to date has confirmed that the South West Yarragadee Aquifer is a major groundwater resource with the capability to supply considerably more water than is currently being drawn. The investigation work is now focused on identifying the areas from which water can be taken and quantifying how much more can be made sustainably available, taking into account impacts on the environment, the region and the resource itself.

## Southern Perth Basin

The Southern Perth Basin underlies a 6 000 km<sup>2</sup> area west of Nannup that includes the Bunbury and Busselton regions and extends to the Southern Ocean and north into Geographe Bay. Groundwater flow within the basin extends to depths exceeding 1 500 metres, and the estimated volume of water stored in the aquifer is about 400 cubic kilometres (or 400 000 GL).

The major aquifers in the Basin are the Superficial, Leederville, Yarragadee and Lesueur aquifers. These have been presented schematically in the figure below. Characteristics of these aquifers have been described in the South West Yarragadee Blackwood Groundwater Area FactSheet numbers 3 and 4.



## Schematic representation of aquifers and groundwater flow in the Southern Perth Basin

Investigations have concentrated on the Yarragadee aquifer and the overlying Leederville aquifer as being the major regional groundwater resources. The location, definition and hydrogeology of these aquifers were established by combining information from previous investigation programs with information compiled through recent research and investigations that included:

- exploratory drilling - 50 sites, 129 investigation and observation bores through approximately 15 kilometres of drilling across the Blackwood Plateau to depths to 668 m;
- airborne and ground-based geophysics;
- water quality analysis;
- recharge studies; and

- related studies on the Blackwood River hydrology and associated surface water-groundwater interaction.

## Aquifer Water Balance

A 'water balance' is a useful concept for understanding the quantities of groundwater that enter and exit different parts of the aquifer system. When the amount of water leaving the system is greater than the amount of water entering, the volume of groundwater in storage changes accordingly.

Recharge from rainfall that infiltrates through the land surface is the primary input to aquifer systems. Leakage between aquifers can be both upwards or

downwards depending on the hydraulic heads, or the pressure, at different points in the system. Water is lost to the system through groundwater pumping, discharge to rivers and oceans and through evapotranspiration losses from plants.

The calibrated South West Aquifer Modelling System (SWAMS) version 2.0 was used to estimate the water balance for average conditions of recharge and pumping. Small changes to the water balance will also occur as the model structure and calibration improves. This model is being used to investigate the availability of water from the groundwater systems under various scenarios of water demand and climate.

The water balance for the Southern Perth Basin (the study area) for the period 1998-2002 indicates total recharge to all the aquifer systems to be about 440 GL/yr. However, not all of this is available for use as a proportion needs to naturally discharge from the system to maintain seawater interfaces and support the environment.

Of this, a significant portion is input to the Yarragadee Aquifer through direct recharge and leakage from the overlying Leederville Aquifer. Downward leakage from the Leederville to the Yarragadee is variable ranging from very low in portions of the central to northerly parts of the system through to a low to moderate level of leakage where hydraulic connections exist.

Evapotranspiration is a large component of the water balance in the shallow Superficial aquifers on the Swan and Scott Coastal Plains. Discharge occurs to the Oceans and river systems, including a direct discharge from the Yarragadee Aquifer to the Blackwood River. Average annual abstraction from the Southern Perth Basin between 1998 and 2002 was 55 GL.

The water balance provides an approximate quantification of water movement within the aquifer systems. However, exactly how much of this can be drawn on a sustainable basis is currently being determined and will largely depend on the volumes of groundwater abstractions, the location of bores and any drawdown impacts associated with groundwater pumping.

As regional development proceeds and groundwater demand increases, the water balance will reflect progressive shifts through a redistribution of leakage, some reduction in discharge to oceans and rivers and a relatively small net decrease in storage. The sheer size of the Southern Perth Basin will buffer these changes but the assessment of impacts from significant proposals will ensure appropriate information is available for management decisions.

### **Aquifer Pumping Test**

A major pumping test of the Yarragadee aquifer was recently carried out in a purpose drilled test bore near Rosa Brook in the area of the proposed Water Corporation wellfield, to establish aquifer parameters estimated from work previously undertaken in the northern part of the study area.

The test has provided important information on the aquifer characteristics in the vicinity of the proposed Water Corporation wellfield, which has been incorporated into the numerical model of the groundwater system. The drawdowns observed during the pump test show the Yarragadee to be a highly transmissive aquifer (an aquifer capable of transmitting large volumes of water) and have provided valuable information on the vertical permeability (ability to conduct water either upwards or downwards) of both the Yarragadee aquifer, and overlying Leederville aquifer.

### **Blackwood River and Aquifer Interaction**

The recent drilling of four investigation bores at a site close to the Blackwood River in the Yarragadee discharge area has quantified the hydraulic connection between the aquifers and the river in that area. The results indicate that direct connection between the river and the Yarragadee aquifers exists only in the upper parts of the aquifer; the contribution of groundwater discharge from the deeper parts of the aquifer is indirect and is inhibited by numerous interbedded shales within the aquifer. Modelling results show that in the recent past (1998-2002) the groundwater discharge from the Yarragadee aquifer to the Blackwood River has been around 30 GL/year. However, it is estimated that only about half of this contributes to the flow in the river whilst the rest is taken up by evapotranspiration in the riparian zone.

The impact of pumping from the Yarragadee aquifer on flows in the Blackwood River and its tributaries in this discharge area is a major consideration in determining water availability within the limits of acceptable environmental impact. Information on the connection between the river and the aquifer is included in the numerical model.

### **Modelling the impact of pumping groundwater**

The information on current and future regional demands provided through the recently completed economics study provides the main input into the various demand scenarios being modelled to determine the level at which those demands can be met.

As has been highlighted in various forums, the Groundwater Model will be the key tool to help the Commission assess the Water Corporation's application. This tool, together with the information provided through the various social, economic and environmental studies will determine the feasibility of the 45GL/yr application from social, economic and environmental perspectives.

The model is expected to demonstrate that water availability from the Yarragadee aquifer is not a single number. It depends very much on where the pumping is undertaken, and when in time it occurs. A concentrated pattern of pumping will not result in as much water being available as if that pumping was spread over a larger area. This is an important issue in considering any competition between proposed pumping by the Water Corporation and the location of pumping to satisfy future regional demands.

In appreciating the central role of the groundwater model in the licence assessment process, the information that comprises the groundwater model and the numerical representation of the model, including the calibration, is undergoing peer review

by a panel of three independent senior hydrogeologists. A peer review report is due in late January 2004.

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## Making the decisions required to assess the 45GL/yr application

There are now two distinct but linked activities for the South West Yarragadee project. The first is the work leading to the Water and Rivers Commission Board making its decision on the Water Corporation's application. The second is the work required to develop the management plan for the Blackwood Groundwater Area. Of course, these are not mutually exclusive processes. This Update focuses mostly on the licence decision-making.

### The licensing decision:

The Commission will grant a licence to the Water Corporation if water is available. In making such a decision, the Commission must be satisfied that:

- the resource is physically capable of supplying the required water (hydrogeological capability);
- there are no significant environmental and social impacts; and
- reasonable regional water needs have been satisfied.

The Commission must also assess other water supply source options, for example desalination. This information is needed so that the final decision is one that is in the best interests of the State as well as the region.

The results from the groundwater model will provide the main source of information on the capability of the resource and on the abstraction impacts of the proposed Water Corporation wellfield.

Information from the consultant's studies provides the data that is required to assess the model outcomes.

### So how do we get the model results and what happens with the results?

The investigation team has developed a number of groundwater pumping scenarios ('the scenarios') that will be tested within the model. The scenarios are descriptions of various water use options for the SW over the next 30 years.

The water use options that have been used to develop the scenarios are:

- current groundwater use;
- existing licensed entitlements;
- existing licence applications,
- approved reserve entitlements;
- future growth expectations from the economics report; and
- the Water Corporation's 45 GL/yr application.

Combinations of each of these options have been developed. Additionally, the impact of climate change and the alternative wellfield are tested in the scenarios.

Details of each of the scenarios are presented in more detail below.

The groundwater model results for each of the scenarios tested, will predict the extent to which groundwater levels in the various aquifers of the study area (Bunbury to Dunsborough to the south coast) might be drawn down. Key sites will be looked at including sites where there is a high dependence on SW Yarragadee groundwater as well as those areas with high environmental sensitivity, such as the Blackwood River.

Once the groundwater results that describe the outcomes for each of the scenarios are complete, the Commission will assess each of the scenario outcomes against criteria that are considered to best reflect the range of social, environmental and economic objectives for the future use of the Yarragadee aquifer. These criteria reflect the views of the community in particular the high level of importance placed on the environment (Social and Cultural Values Studies) as well as the importance of regional development being satisfied (Social and Economics Study). Ecological criteria, that is, the environmentally sensitive areas, were determined in the Phase 1 EWR study.

### Assessment

The assessment process described above is undertaken through a Multi-objective Assessment.

The multi-objective assessment is the Commission's means of assessing results in a more 'complete' sense, where the objectives of the social, economic and ecologic are considered jointly. This technique is important particularly where there are conflicting objectives. For example, an economic objective might rate water for public water supply higher than water for agriculture; however, a social attitude value is that a priority use of water should be for the growing of food.

The potential consequences of not meeting each criterion provide an indication of their relative importance (low, medium or high).

The criteria will be placed in a multi-objective assessment matrix in a way that will allow the various scenarios and their effects to be assessed in terms of the extent to which they meet each of the criteria and the consequences where they do not.

How the criteria for the social, economic and environmental objectives are to be evaluated has been shown in a much summarised form in Table 1.

The final matrix used in the assessment process will have more than 20 criteria and will reflect all of the social/cultural/environmental and economic values.

The pumping scenario(s) that best meets the combinations of criteria will indicate the social, environmental and economic acceptability of the proposed Water Corporation's abstraction and the extent to which future regional groundwater needs will be able to be satisfied by the resource.

**Table 1: Multi-objective assessment criteria (summarised form with examples)**

Values	Management Objective	Criteria to reflect achievement of objective	Consequences of not meeting the criteria – either fully or partly	Relative importance of objective
Environmental	Multi-objectives to protect groundwater dependent ecosystems which include flora, fauna, wetlands, streams, habitats, etc	Multi-criteria against each management objective, eg. maximum water level drawdown (in meters) and rate of water level change (in meters/yr) in wetlands	Example: potential degradation/death of wetland vegetation; acidification of wetland; loss of habitat; impact on fauna life cycle; etc	Will vary according to relative importance of each specific criterion within the suite of environmental criteria
Social	Objectives to protect the intrinsic values and water supply in line with priority social values	Extent to which water is allocated in line with the social values identified in the Social Values report	Example: loss or reduction of social amenities associated with the intrinsic values of groundwater dependent ecosystems	Will vary according to relative importance of each specific criterion within the suite of social criteria
Cultural	Maintaining the cultural and spiritual significance of the environment and traditional land practices	Maintenance of natural systems in line with the cultural/spiritual values (Dreamtime stories, etc) that relate to the EWRs	Disrespect of the Waugal and diminution of traditional land and water practices	Will vary according to relative importance of each specific criterion within the suite of cultural criteria
Economic	Maximising the use of groundwater for both State and regional development needs	Extent to which water is allocated to highest value use with reasonable regional needs taken into account	Example: increased cost of water and potential loss of income to the State and the region through a reduction in economic growth	Will vary according to relative importance of each specific criterion within the suite of economic criteria

### Groundwater pumping scenarios

The groundwater pumping scenarios being considered for the assessment of the aquifers are described below. Each scenario will be run over a 30-year period, effectively simulating the performance of the aquifer systems under various water use regimes to the year 2033. The results will allow comparisons to be made between the effects of the various scenarios. This will be the basis for determining which scenario(s) will most effectively meet the range of objectives set in the multi-objective assessment.

#### Scenario 1: Current use

The current levels of groundwater use in the region will be modelled, assuming no change in levels of abstraction over the 30 year period to 2033. This is effectively the 'base case' scenario. Current

pumping within the area being considered by the model totals 63 GL/yr.

#### Scenario 2: Current commitments

This scenario comprises current groundwater allocation commitments, which include the full allocations of all current licences, plus all applications that have been received by the Commission to this time. This scenario also includes reserve water allocations that have been set aside for the local Water Boards and for Cable Sands. The total of all commitments within the modelled area is 145 GL/yr. The scenario assumes pumping will be constant at the rate of 145 GL/yr for the 30 year modelling period. This scenario is being run to test the ability of the resource to meet the current level of commitments if they were all fully used over the long term.

### Scenario 3: Current commitments plus Water Corporation

This scenario is the same as the Current commitments scenario, with the Water Corporation proposed wellfield pumping at 45 GL/yr for the modelled period being added. The total pumping in this scenario is therefore 190 GL/yr. This scenario will indicate any differences the Water Corporation proposal will make in terms of water level responses in critical areas.

### Scenario 4: Current use plus regional growth

This scenario comprises modelling the effects of current use continuing, with the 30 year predictions of future growth derived from the economics study being added, assuming that the growth will be linear between now and 2033. This scenario results in a total of 165 GL/yr being pumped in the year 2033. In this scenario, the assumption is that the currently unused commitments (the difference between current use and current commitments) will be taken up progressively within the growth period. This scenario does not include the Water Corporation proposed allocation.

### Scenario 5: Current use plus regional growth plus Water Corporation wellfield (alt 1)

This scenario is the same as the former, but with the Water Corporation wellfield included from 2006 to

determine what difference this pumping will make in terms of drawdowns in any areas of concern. This scenario incorporates the Water Corporation wellfield located entirely within the Blackwood Groundwater Area (alternative layout 1). This scenario assumes that abstraction will increase to 210 GL/yr by 2033.

### Scenario 6: Current use plus regional growth plus Water Corporation wellfield (alt 2)

This scenario is the same as the former, but with the alternative Water Corporation wellfield layout, which includes two wells being located within the Busselton-Capel Groundwater Area (alternative layout 2). This scenario also assumes pumping of 210 GL/yr by 2033.

### Scenario 7: Current use plus regional growth plus Water Corporation wellfield (alt 1) plus climate change

This scenario is the same as the *Current use plus regional growth plus Water Corporation wellfield (alt 1)* scenario, but with reduced recharge being applied to test the potential effects of a future drying climate. This scenario also assumes pumping of 210 GL/yr by 2033.

Table 2: Abstraction Scenarios

Abstraction Scenarios	Current Ground-water Use (GL/yr)	Current Ground-water Licence Allocations (GL/yr)	Approved Ground-water Reserves for Water Boards and mining (GL/yr)	All Licence Application (GL/yr)	Regional Growth from Economic Report (GL/yr)	Water Corporation application 45 GL/yr	Total ground-water pumping abstraction GL/yr
Scenario 1	63						63
Scenario 2		97	22	26			145
Scenario 3		97	22	26		45	190
Scenario 4	63				102		165
Scenario 5	63				102	45	210
Scenario 6	63				102	45	210
Scenario 7	63				102	45	210

### Bringing the community values into the decision making process

In phase 1 of the consultation program, the local community highlighted a number of issues and values they required be taken into consideration in the allocation and management of water resources in the region.

Full investigations of these issues, including social, cultural, and economic values have been conducted and reports produced. The major findings of these investigations were summarised in our last Community Update series. If you would like to see the full reports, they are available from the Bunbury office of the Water and Rivers Commission or can be viewed from the website. The Interim Ecological

Water Requirements investigation report is also close to being finalised.

All of the information and issues from the consultation program and investigation program will be incorporated into the decision making process, in particular into the multi-objective assessment.

Now that the values of the community have been thoroughly investigated and identified, the Water and Rivers Commission must ensure that they are considered within the State's decision making process for the allocation and management of water resources in the region. The Water and Rivers Commission is committed to doing this and will be using the multi-objective assessment matrix as the primary means.

## The decision-making timetable

The project is on track in terms of the revised project timetable. The figure below presents the timetable for this project.

By mid December 2003, the detailed criteria proposed for the assessment, together with the pumping scenarios proposed to be modelled will be made available to the community for comment. These comments will be taken into account in the final assessment matrix.

In late January 2004, the results of the modelling will be entered into the matrix and made available for community comment. This will allow the community to see what the predicted outcomes for

the range of pumping scenarios are likely to be in terms of meeting each of the criteria.

The Water and Rivers Commission will consider the matrix results and community comment and then make a recommendation on the licence application. This recommendation will then be forwarded to the EPA for assessment and advice on the environmental aspects. Finally, the Commission Board will make its decision and forward advice to the Minister for the Environment for submission to Cabinet by mid April 2004.

The Commission will provide a report to the community on its decision and the reasons for it in April.

## Licence decision timetable

