

# **Upper Nepean (Kangaloon) Groundwater Borefield**

## **Project Description And Preliminary Environmental Assessment Report**

**Sydney Catchment Authority**

**November 2006**

## 1. INTRODUCTION

The use of groundwater as a supplementary water supply in times of severe drought is a key element of the Government's Metropolitan Water Plan 2006. Towards this end *State Environmental Planning Policy (Sydney Metropolitan Water Supply) 2004* has facilitated the Sydney Catchment Authority (SCA) in undertaking borefield investigation since January 2005. The Premier announced on 1 November 2006 that borefield development would proceed at Upper Nepean and potentially at Leonay and Wallacia (if pilot testing confirms these sites to be prospective) following dam storage levels falling below 40%.

Groundwater is the Government's first line of defence in the event of severe drought. At least 30 billion litres (gigalitres) of groundwater each year for a period of two to three years is expected to be available from two and perhaps three sources – Upper Nepean (Kangaloon), Leonay (Western Sydney) and possibly Wallacia.

Economic studies earlier in 2006 confirm that tapping into available groundwater sources is a valuable means of delaying the trigger point to build and commission a desalination plant. The study also concluded the ability to develop both groundwater and desalination capacity in a relatively short time reinforces the adaptive approach to meeting the supply-demand balance during periods of drought.

Groundwater investigations in the Upper Nepean catchment are at the most advanced stage. Pilot testing and studies confirm the existence of a suitable groundwater resource of high yield and low salinity groundwater. The SCA is doing further investigative work into the availability of groundwater at this location. These investigations have been assessed by the SCA under Part 5 of the *Environmental Planning & Assessment Act 1979* as provided by *State Environmental Planning Policy (Sydney Metropolitan Water Supply) 2004*.

The project, the Upper Nepean (Kangaloon) Groundwater Borefield, involves the establishment of a borefield north of East Kangaloon and Kangaloon and in the southern part of the catchment area of the Nepean and Avon dams. Water will be transferred to water supply dams and to the Sydney water supply system.

As part of the project application for a concept approval under Part 3A of the *Environmental Planning & Assessment Act 1979* this project description and preliminary environmental assessment report is provided to enable the Department of Planning to establish the level and scope of the environmental assessment to accompany the application for approval. This report provides a description of the project, planning and legislative provisions relevant to the project, a discussion of community involvement in the development of the project and the likely environmental issues that may arise from the project.

## 2. DESCRIPTION OF THE PROJECT

### 2.1 Project Requirement

The use of groundwater as a supplementary water supply in times of severe drought is a key element in the NSW Government's Metropolitan Water Plan 2006.

Use of groundwater as a supplementary water supply in the current severe drought will slow the rate of depletion of dam storages and delay or avoid a decision to build a desalination plant, or if storages continue to fall in the case of extreme drought, provide additional time to allow a desalination plant to be constructed. The Upper Nepean (Kangaloon) Groundwater Borefield is assessed as capable of producing 10-15 gigalitres of water per year for two to three years, followed by a recovery period of around five to seven years.

### 2.2 Location

The Upper Nepean (Kangaloon) Groundwater Borefield is to be located in the NSW Southern Highlands in an area to the east of Bowral and north of Robertson. The borefield will be mostly on SCA land in the vicinity of Tourist Road around Kangaloon and adjoining fire trails (see Figure 1). Figure 1 also illustrates the location of investigation bores in the locality.

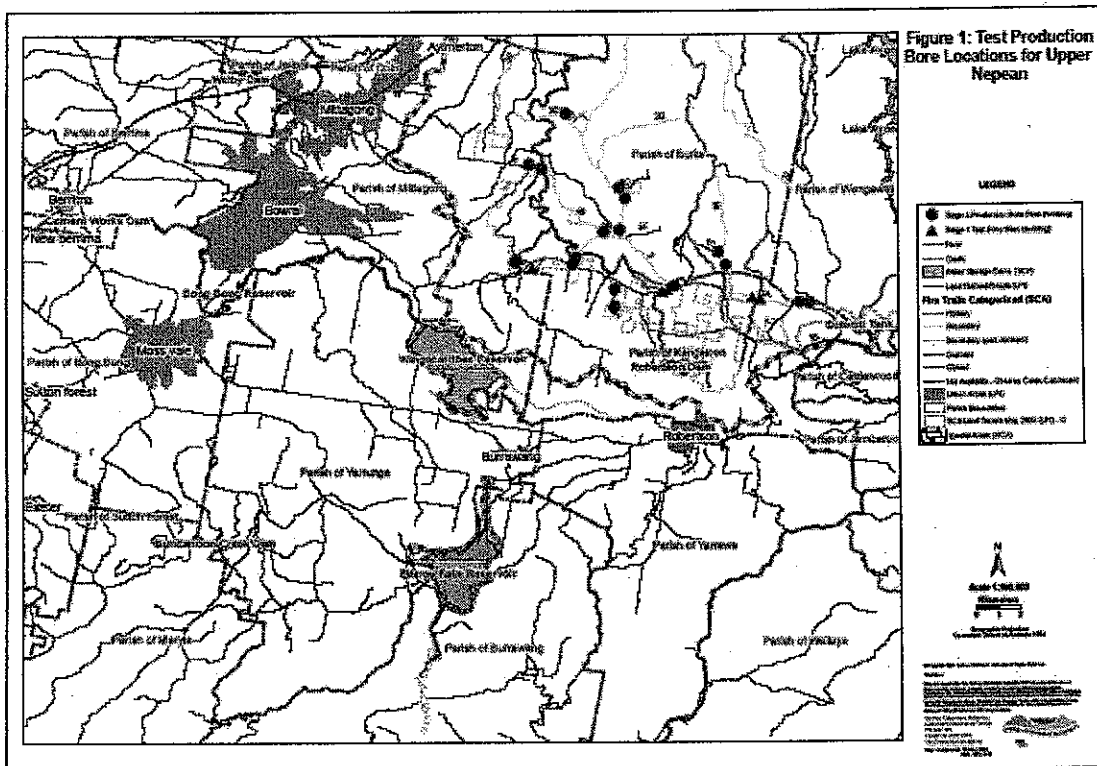
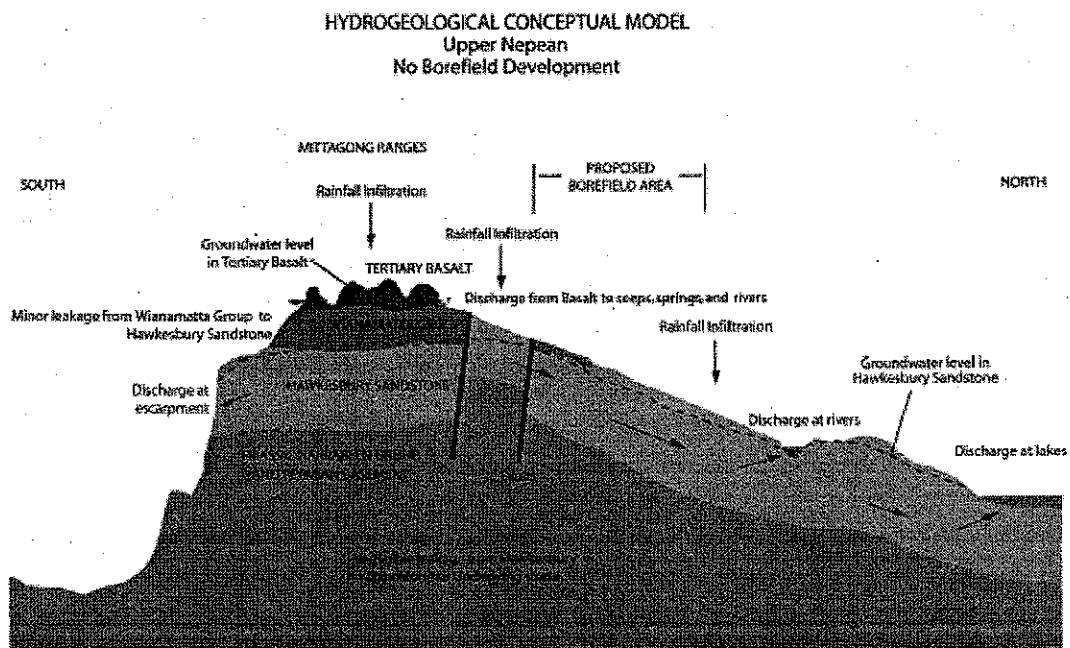


Figure 1. Locality and test bore locations

The land is within the Metropolitan Special Area, an area designated to protect water quality and supply in the SCA's catchment areas. In the locality of the proposed borefield, the area to the north of Tourist Road is natural bushland dissected with fire trails and areas managed for fire breaks. To the south the land is predominantly agricultural devoted to grazing with small parcels of SCA and Crown land. The land is located within the Wingecarribee local government area.

### 2.3 Groundwater source

The groundwater to be sourced under this project is from regional sandstone aquifers located in the Hawkesbury Sandstone strata. This strata forms part of a sandstone plateau above the Illawarra escarpment from Botany Bay and the Georges River in the north to Mittagong and Robertson in the south and the high sandstone plateau around the towns of Moss Vale, Bowral and Bundanoon. Shallower basalt aquifers also occur in the locality, mostly higher in the catchment. These feed numerous springs and provide permanent streamflows in creeks high in the catchment. Generally these shallower aquifers are not connected with the regional sandstone aquifers (see Figure 2).



**Figure 2. Hydrogeological conceptual model**

The Hawkesbury Sandstone forms a layered aquifer system, rarely exceeding 200m in thickness, with groundwater occurring at vertically discrete horizons. Groundwater recharge is entirely from local rainfall. Groundwater generally flows in a northerly direction and there is some connectivity with deeply cut river sections and where fractures occur. The degree of this connectivity is subject to further investigation.

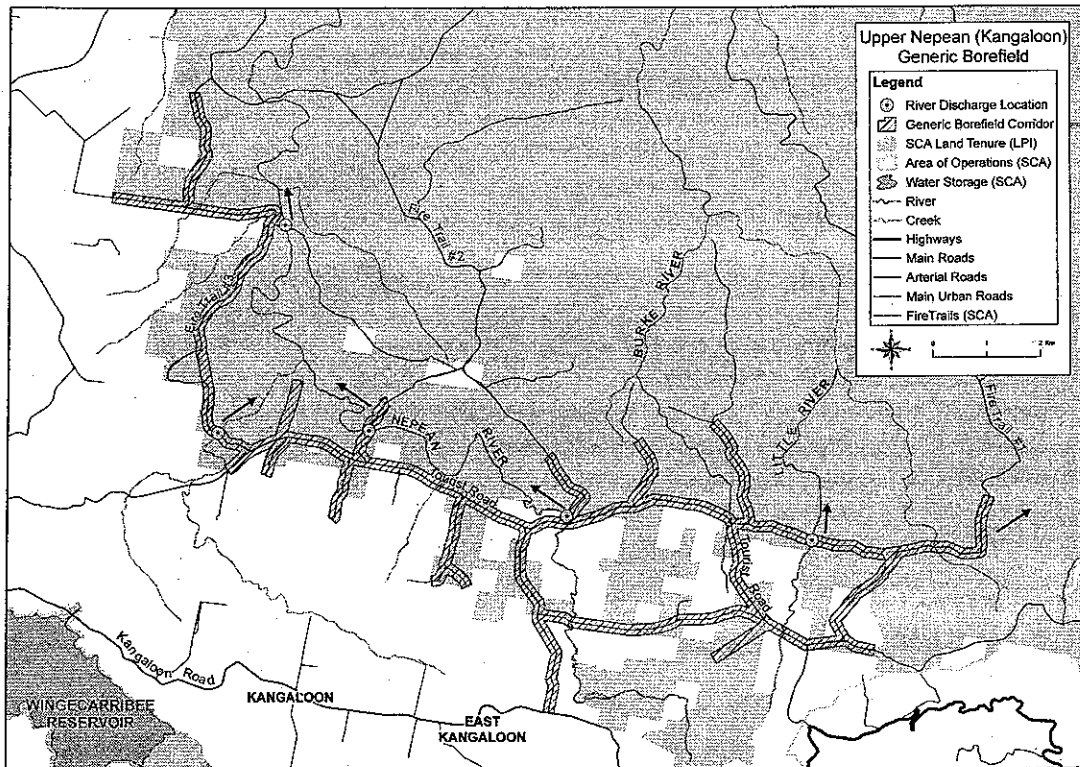
The groundwater volume in storage is large (in the order of hundreds of gigalitres), aquifer permeability is moderate-high for the fractured rock strata (in the order of metres per day) and natural flow rates are low-moderate (in the order of metres per year). Groundwater in the high permeability fracture zones is mostly 'modern' (less than 50 years old).

Water quality is high and suitable for potable supply with low salinities and low or negligible levels of nutrients, heavy metals and other contaminants. Iron concentrations are high at some locations and some treatment may be required at these locations to reduce iron concentrations prior to discharge to streams.

## **2.4 Project components**

The likely production capacity of the borefield is between 10 and 15 gigalitres per year - most likely around 13 gigalitres per year - for 2 to 3 years with likely 5 to 7 year recovery periods. The proposed borefield would consist of the following elements:

- Potential for 50 - 60 production bores (cased and screened, and equipped with submersible pumps), from 90 to 180 m deep, located approximately 500m apart along a corridor which is mostly on SCA land. The borefield layout is illustrated in Figure 3.
- An underground pipework system, pipes ranging in diameter from 100mm to 300mm to enable the water to be distributed to streams of the upper Nepean River system. Some simple water treatment may be required, for example to adjust temperature and oxygen levels and to reduce iron concentrations.
- Several water distribution methods are feasible with five river discharge locations identified as a cost effective option. Options to transfer the water to Avon Dam are also under consideration.
- Power to be provided by new 11kV distribution lines which could be either overhead or underground.
- A network of monitoring bores and gauging stations to monitor and manage borefield performance and impact.



**Figure 3. General layout of the Upper Nepean (Kangaloon) Groundwater Borefield**

### 2.3 Timeframe

The Government has determined that design and environmental assessment should proceed quickly so that it has the capacity to commence construction of the borefield as water supply levels have fallen below 40% of capacity.

The borefield would be built in segments with the first segment completed within 6 months of awarding tenders. Construction of the whole borefield is estimated take around 18 months with progressive commissioning of segments. Commencement of construction is programmed for the middle of 2007. This would see progressive commissioning of segments from early 2008 to early 2009.

### **3. PLANNING PROVISIONS**

#### **3.1 Development approval**

The Upper Nepean (Kangaloon) Groundwater Borefield is a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* applies.

The project is one that is covered by the Minister's Order of 29 July 2005 identifying projects to which Part 3A applies, ie. the development is an activity for which an environmental impact statement would be otherwise required under Part 5 of the Act and the SCA is both the proponent and determining authority.

The SCA has also sought a declaration from the Minister for Planning that groundwater borefield developments in the regional sandstone aquifers of the Sydney region are *critical infrastructure* under Part 3A of the *Environmental Planning and Assessment Act 1979*.

#### **3.2 State and regional planning provisions**

*State Environmental Planning Policy No.58 – Protecting Sydney's Water Supply* (SEPP58) applies to the project and specifies matters that must be considered when assessing impacts on water quality in the SCA's drinking water catchments. Matters to be considered are whether the activity has a neutral or beneficial effect on water quality, the sustainability of water quality management practices and compatibility with relevant environmental objectives. A 'drinking water catchment' value for this location was determined through the Healthy Rivers Commission process.

*Drinking Water Catchments Regional Environmental Plan No. 1* will apply to the project. When enacted on 1 January 2007 the plan will provide a comprehensive suite of measures to better protect the quality of water in the SCA's catchment area. Of particular relevance to the construction and operation of the borefield is the need to consider whether the project has a neutral or beneficial effect on water quality, replicating provisions currently in SEPP58.

Wingecarribee local government area is subject to the provisions of *Illawarra Regional Environmental Plan No. 1*. The provisions of this plan include measures to ensure that the interests of public authorities are protected or implemented through the planning system and requiring public authorities to have regard to the aims and objectives of the plan when making decisions.

#### **3.3 Local planning provisions**

The Upper Nepean (Kangaloon) Borefield is on land subject to the *Wingecarribee Local Environmental Plan 1989* and within Zone 5(c) (Special Uses "C" (Water Catchment) Zone) under that plan. The borefield development is within the definition of 'utility installation' under the plan and is a permissible use on the land.

#### **3.4 Other legislative requirements**

The legislative requirements relevant to the project are identified in Table 1 below.

**Table 1. Other key legislative requirements and their application**

<b>Legislation</b>	<b>Relevant requirements</b>	<b>Application to the project</b>
<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>	Approval required for any action that may have a significant impact on defined matters of national significance.	It is unlikely that the project will impact significantly on any matters of national significance due to the design of the project to avoid or mitigate such impacts. An assessment will be made of those matters covered under this Act and a referral will be made to the Australian Government.
<i>National Parks and Wildlife Act 1974</i>	Protection, preservation and management of all Aboriginal relics. Permits required to excavate or destroy Aboriginal archaeological sites. These permits are not required for a project approved under Part 3A of the <i>Environmental Planning and Assessment Act 1979</i> .	Desktop studies indicate the potential for Aboriginal sites within the borefield area. Surveys will be undertaken of this area. To minimise impacts, appropriate management actions, such as pipeline diversion, will be taken to avoid any identified sites.
<i>Protection of the Environment Operations Act 1997</i>	Protection of the environment through the prevention of pollution. The pollution of waters is an offence under this Act. An exemption from a water pollution offence is available in certain circumstances in relation to 'cold water releases'.	The borefield is a 'non-scheduled activity' under the Act and a licence may be issued but is not a requirement. The impacts of groundwater released to rivers and streams will be assessed. SCA will liaise with the Department of Environment and Conservation about the requirement for licensing the project.
<i>Water Act 1912</i>	Provides for the licensing of bores. However, the Crown is not required to obtain such licences. Provides for licensing of water sources and associated works. The SCA has a water management licence issued under the Act.	The SCA has sought licences and registration of all its bores as a means to advise the Department of Natural Resources of its activities. Most recent investigation approvals have been under Part 9 (and the SCA's water management licence). The SCA will make application for the bores comprising this project. The SCA will liaise with the Department about modifying its licence to include the groundwater source and related works.
<i>Water Management Act 2000</i>	Will provide for the future licensing of the SCA's water supply works. Provides for conditions of approval, including those dealing with 'cold water releases'.	The SCA will continue to liaise with the Department of Natural Resources about the transfer of its current licence to the <i>Water Management Act 2000</i> .
<i>Threatened Species Conservation Act 1995</i>	Protection of species of threatened flora and fauna,	Desktop and field studies have identified the potential presence in



	<p>endangered ecological communities and critical habitat. Provides for the licensing of any harm to the above and requires the preparation of species impact statements where effects are significant.</p>	<p>the vicinity of the borefield area of species, communities and habitat covered by the Act. Further surveys will be undertaken of this area. To minimise impacts, appropriate management actions will be instituted, such as contingency planning for aquifer change, locating works within already disturbed areas or pipeline diversion to avoid sensitive locations.</p>
<p><i>Fisheries Management Act 1994</i></p>	<p>Conservation of aquatic resources and protection of threatened species, populations and communities. Provides for the licensing of any harm to the above and requires the preparation of species impact statements where effects are significant. Habitat Protection Plans No. 1 (General) and No.3 (Hawkesbury-Nepean River System) apply. Permits are required to carry out 'dredging' or works that obstruct the passage of fish. However, these permits are not required for a project approved under Part 3A of the <i>Environmental Planning and Assessment Act 1979</i>.</p>	<p>Desktop and field studies have identified the potential presence in the vicinity of the borefield area of species covered by the Act. Further surveys will be undertaken of this area and an assessment made of the significance of any impact on species, and fish populations in general.</p>
<p><i>Heritage Act 1997</i></p>	<p>Conservation of natural and built heritage. Permits required to disturb an item of historic heritage. These permits are not required for a project approved under Part 3A of the <i>Environmental Planning and Assessment Act 1979</i>.</p>	<p>No significant heritage items have been identified that will be affected by the project.</p>
<p><i>Waste Avoidance and Resource Recovery Act 2003</i></p>	<p>Minimising the consumption of natural resources and the final disposal of waste by encouraging waste avoidance, reuse and recycling.</p>	<p>The project will generate waste and the hierarchy of resource management will be considered in construction and operation.</p>
<p><i>Roads Act 1993</i></p>	<p>Consent required for works that affect public roads. Consent cannot be refused for a project approved under Part 3A of the <i>Environmental Planning and Assessment Act 1979</i> and must be substantially consistent with that approval.</p>	<p>The project may require pipelines beneath roads requiring relevant consents be sought.</p>

### **3.5 Other strategies**

#### *The NSW State Groundwater Policy*

This policy sets the overall direction for groundwater management in NSW, with broad objectives and principles to guide decisions. It is complemented by a set of three component policies, including the *NSW State Groundwater Dependent Ecosystem Policy* and the *NSW State Groundwater Quality Protection Policy*.

#### *Water Sharing Plan*

The groundwater source will be covered by a water sharing plan that is currently being prepared by the Department of Natural Resources. This plan will provide appropriate protection for the water source and all water users while allowing periodic access to this drought-reserve drinking water source.

#### *Special Areas strategic plans of management*

Joint plans of management (SCA and DEC) for special areas are required to be prepared under the SCA's Act. The Special Areas Strategic Plan of Management was made by the Minister in May 2001. This covers the SCA's Metropolitan Special Area. The plans document the agencies joint goals for protecting and managing the special areas and the strategies to achieve these goals. Emphasis is on protecting water quality and ecological integrity in the special areas. The plan is currently being reviewed.

## **4. COMMUNITY INVOLVEMENT**

The SCA undertook an extensive community consultation program between May and September 2006, and this consultation is ongoing. The objectives of community engagement were to:

- Consult with the community during the groundwater investigations
- present clear and comprehensive information to stakeholders about the Government's groundwater investigation program
- inform the community of the display and consultation process in order to actively seek community comment
- conduct the consultation process in an open, transparent and responsive manner.

The consultation program targeted a range of stakeholders including local government, Government agencies, environment groups and associations, potentially affected landowners and business owners and other local residents, indigenous land councils and tribal groups. Two newsletters about the project were distributed to 18,172 householders in the Southern Highlands and the SCA maintained a project specific web page at its website. A series of targeted briefings were undertaken to inform and update key stakeholders on the progress of groundwater investigations.

### **4.1 Community reference group**

The Minister for Environment appointed a 12 member community reference group (CRG) for the proposed groundwater development in June 2006. Four members of the CRG represent organisations – Wingecarribee Shire Council (2 positions), Hawkesbury-Nepean Catchment Management Authority and NSW Farmers Association. The remaining eight members are community representatives who responded to a request for expressions of interest and were appointed on the basis of their ties to the local community. The CRG has had seven meetings over a 10 week period, one technical workshop, and a guided site visit. CRG meeting minutes are published at the SCA's website.

On request, the SCA engaged an independent hydrogeologist to help CRG review technical reports and assess the methodology, scope and completeness of groundwater investigations. The CRG is facilitated by an independent chair and will continue to meet and report to the Minister on issues relating to groundwater in the Upper Nepean.

### **4.2 Public exhibition**

All technical documentation about the groundwater proposal was publicly exhibited from 3 July 2006 until 18 September 2006. Submissions were invited from the public and received until 18 September 2006.

A summary report, technical overview report and structured 'Have Your Say' feedback form were developed to help community members understand the outcomes of technical investigations and prepare informed submissions. In total, the SCA distributed 1,330 summary reports, 1,719 'Have Your Say' forms and 599 technical overview reports during the exhibition period.

Static displays were established at Bowral Library, Warragamba Visitors Centre and at the SCA's head office in Penrith. Approximately 496 people visited the displays during the exhibition period. The summary report and technical overview report could also be downloaded from the SCA website throughout the exhibition. Between July and September, there were 1,380 hits to the groundwater page on the SCA's website.

A 1300 phone number and project email provided a communication channel for interested persons to request hard copies of technical documents, discuss the proposal or the technical outcomes with the project team, or provide a verbal submission. The SCA received 336 enquiries through the 1300 line, a further 181 calls directly to the community relations team, and 79 email enquiries.

### **4.3 Key issues**

The key issues raised through this consultation are as follows:

- the extent to which groundwater harvesting is sustainable, the extent of water level declines within the aquifer and the uncertain time for it to recover.
- the requirement for additional studies to confirm borefield sustainable yields prior to development.
- the perception that Sydney makes excessive use of water and a view that it is inequitable to call on Southern Highlands groundwater while other water sources in Sydney are seen to be not fully utilised.
- the impacts that the new borefield may have on existing springs and small, local bore water users, with particular reference to compensation for those who may be adversely impacted.
- the potential environmental impacts on ecosystems, rivers and upland swamps.

## **5. ENVIRONMENTAL ISSUES**

The SCA has undertaken an identification and preliminary assessment of the potential environmental issues associated with the construction and operation of the project. In preparing this assessment the SCA has utilised advice and existing information from other agencies and councils. The SCA has also commissioned extensive specialist environmental investigations and surveys. A full list of these studies is contained in Attachment 1.

The following are likely to be the key environmental issues for the proposed project based on these investigations.

### **5.1 Sustainable yield and level of extraction**

Under severe drought conditions, the borefield would extract water in excess of natural recharge rates and would impact the groundwater storage with water levels falling tens of metres during the pumping cycle of two to three years. To offset the short depletion cycles there are expected to be long periods of recovery when the borefield would not be operational and water levels would recover.

It is expected that if total volumes of between 30 and 45 gigalitres of water are extracted over a period of two to three years this would represent about two and a half times the natural recharge rate but only around 10% of the storage volume.

This drought cycle operation is considered sustainable and it is anticipated that further pump testing and modelling will be able to confirm this.

From the SCA's investigations, individual bore testing suggests that moderate to high supplies are available from bores tapping the entire sequence of Hawkesbury Sandstone. The current trial borefield construction and 6 month pumping trial will assist in further refining the aquifer characteristics and confirming borefield design requirements. Extensive data collection during the trial and additional computer modelling will assess the sustainable yield of a large borefield if operated for continuous periods of two to three years, permitting further refinement of sustainable yield estimates.

### **5.2 Groundwater dependent ecosystems**

Four major types of ecosystem have been assessed to ascertain any relationship or dependence on the regional sandstone aquifers in the locality. These are as follows:

1. terrestrial vegetation, including dependent fauna, that may have an drought dependence on regional groundwater
2. river base flows, with aquatic and riparian systems in or adjoining streams fed by regional groundwater as a base flow
3. aquifer ecosystems, where aquatic ecosystems occupy sandstone aquifers
4. wetlands, where communities depend on regional groundwater fed or reliant wetlands.

The assessment for the project centres on identifying any groundwater dependent ecosystems and the potential to alter the water regime experienced by these

ecosystems. Risks mostly relate to lower regional water levels in the vicinity of the borefield for periods of two to three years and changes to the characteristics of stream base flows. The degree of connectivity, level of dependence and vulnerability to change are key aspects for assessment, especially in relation to any potential change to water levels or groundwater discharge.

There are six woodland communities that are widespread across the locality. Two of these communities, Highlands Shale Tall Open Forest and Highlands Ribbon Gum Gully Forest, comprise elements of the Southern Highlands Shale Woodlands community, which is listed as endangered under the *Threatened Species Conservation Act 1995*.

Streams in the locality mostly derive their baseflows from the basalt terrain higher in the catchment. These aquifers are disconnected from the regional sandstone aquifers. In the vicinity of the borefield, extended pumping may capture groundwater that would have discharged to streams or may induce some recharge from streams. Groundwater that is discharging to incised streams in the northern part of the catchment will be unaffected.

Springs associated with the shallower aquifers maintain flows in smaller streams. The regional sandstone aquifers contribute partial flows to rivers lower in the catchment. The area around discharge points offer discrete habitats and the resultant base flows in streams may be important for aquatic and riparian communities in the locality. The actual contribution of groundwater may be important for instream fauna including fish and macroinvertebrates. Within the locality there is potential habitat for the Macquarie perch (listed as vulnerable in NSW and endangered by the Commonwealth), Sydney Hawk Dragonfly (listed as endangered in NSW) and Adams Emerald Dragonfly (listed as vulnerable in NSW).

Habitats within aquifers can be diverse with varied assemblages of fauna. For example, subterranean aquatic invertebrates (stygo fauna) and microbial communities occur in these environments. Recent surveys indicate that a potential stygo fauna community may exist in shallow groundwater at Butlers Swamp. The SCA is undertaking further monitoring of potential habitats and this will be subject to further assessment.

Wetlands have been identified as a significant element in this locality. Upland swamps are found scattered throughout the locality. They are unique at the landscape level and their distribution is restricted. Montane Peatlands and Swamps communities are listed as endangered in NSW. In May 2005 the Commonwealth listed an ecological community of peat swamps collectively referred to as Temperate Highland Peat Swamps on Sandstone as an endangered community under the *Environment Protection and Biodiversity Conservation Act 1999*. This ecological community includes Butlers Swamp and other swamps in the locality.

Drilling near upland swamps suggests that most are dry (ie there is no shallow perched water). The only swamp that appears connected to the regional sandstone aquifers is Stockyard Swamp in the eastern part of the proposed borefield. Pump tests near swamps (where perched water has been located) suggest negligible swamp connection but modelling suggests water level declines and some water loss from Stockyard Swamp once a borefield is operational. No impact was identified on perched water levels in Butlers Swamp. This is subject to further monitoring and will be further evaluated in the environmental assessment.

The degree of groundwater dependence of ecosystems in the locality is currently being assessed. However information available to date indicates that most upland swamps are not groundwater dependent and most terrestrial vegetation is similarly rainfall dependent.

There is expected to be some induced water losses from local streams in the immediate vicinity of the borefield. The most likely case suggests around 10-20% of perennial stream baseflows could be affected at the end of a two year pumping cycle. However the majority of groundwater is still derived from storage within the regional sandstone aquifers. Of course if there are any major rainfall recharge events these will provide significant runoff, allow water levels to recover and top up the subsurface storage within the sandstone. Baseflows to streams elsewhere, particularly lower in the catchment, will not be affected. The quality of groundwater that is to be discharged to the streams for transfer to the dam storages is expected to be compatible with the surface water quality of local streams.

### **5.3 Other groundwater users**

There is little private development of deep groundwater (in the sandstone aquifers) in the catchment. The modelled drawdown suggests that the lowering of the regional water level (10m at a distance of 2km) would not be enough to drain private bores but the impact may be sufficient to require some remedial action. The spring areas surrounding the Mittagong Ranges are disconnected from the regional sandstone aquifers and should not be affected by pumping. There are around 50 licensed bores within 5km of the proposed borefield.

There is a commitment to ensure that existing users are not disadvantaged if water levels fall as a direct result of borefield pumping. The location and condition of existing springs and bores will be confirmed in advance of borefield operation. If there are identified impacts then options include lowering pumps and deepening bores.

### **5.4 Transfer of water to storage**

Run-of-river transfers of groundwater to Nepean and Avon dams are being investigated, as are pipeline options. Ecological aspects have been investigated in the rivers possibly affected by this aspect of the project, including fish, macroinvertebrates and riparian vegetation. The quantities of water being added to the rivers are relatively small compared to the capacity and usual flows of the Nepean River and Doudles Folly Creek. Discharge locations will need to be constructed to prevent substantial local impacts such as scouring.

There is a similarity between the chemistry of the surface water and groundwater in the locality, and groundwater naturally drains to the perennial streams to provide base flow. The quality of groundwater is excellent for drinking water purposes but there are some differences that may impact on local aquatic environments. There may need to be local treatment of groundwater to modify its temperature, pH, oxygen levels and iron content. This treatment would be required to reflect the quality of the surface water in the locality. The effects of prolonged flows and any water quality effects will be further evaluated in the environmental assessment.

## 5.5 Landscape impacts

The borefield will be located and constructed wherever possible within areas already cleared or disturbed. This includes cleared and slashed firebreaks and fire trails within the protected forest areas of the SCA's catchment lands.

It has been identified that threatened plant species occur in these areas. The locality supports the Southern Highlands Shale Woodlands (listed as an endangered community) and populations or suitable habitat for a range of other listed plant species, including *Persoonia glaucescens* and *Pultenaea aristata*.

There may also be Aboriginal archaeological sites. Areas of archaeological potential were identified near the current investigative bore sites and others are likely in the locality. No items of European heritage have been identified to date.

Full surveys are being undertaken of the areas likely to be impacted by construction.

## 5.6 Other potential impacts

There are a range of other potential impacts that are likely to be of lesser significance due to the character of the project and the availability of measures to avoid or reduce any impacts. These impacts include those related to construction of the borefield and some general issues surrounding operation of the borefield. Other potential impacts include the following:

- Water management – Construction will result in exposure of areas to erosion, potential impacts at creek crossings for pipelines and downstream water quality impacts. Construction sites will be managed to control runoff and minimise disturbance of undisturbed areas.
- Underground coal reserves – The eastern part of the proposed borefield occurs within the Huntley Mine lease. Dewatering of the sandstone strata may minimise mine water inflows, however mining may partially drain the sandstone strata and reduce the viability of borefield development.
- Energy use – Construction would mainly involve the use of petroleum fuelled construction equipment. This use would be typical for construction sites. Electricity use during operation would be tempered by energy efficient design and operation. Overall energy use would be low. Consequently, greenhouse gases and energy are not considered key issues.
- Waste management – Construction and operation will generate small quantities of waste. Waste management measures will be developed for the project to reduce, reuse and recycle construction wastes.
- Fire risk – Construction is a potential source of fire that may spread to forested catchments and to private land. Site management will ensure that fire sources are controlled. Therefore the risk is considered to be minor.
- Noise – This will be generally limited to the construction period. There are scattered residences in the locality that would be subject to noise resulting from drilling. This would be temporary and noise criteria are not anticipated to be exceeded at residences. Bore pumps would be downhole and very silent.
- Visual amenity – The locality is a high quality visual environment. Construction will be the most intrusive element of the project but it would be temporary and



long term effects would be minor. Borefield elements (bores and pipelines) will be predominantly underground or, where visually intrusive, could be positioned this way. Power supply may be above or below ground and will be further evaluated to identify the preferable layout.

- Traffic – Tourist Road is a public road with low traffic volumes. Construction has the potential to cause local traffic delays and generate short term increases in traffic movements. These impacts will be temporary and minor.

## ATTACHMENT 1

### **Upper Nepean Groundwater Studies Commissioned by SCA (completed reports as at 31 October 2006)**

Coffey Geosciences, 2006. *Upper Nepean Borefield Development Groundwater Modelling Study – Southern Highlands*. Report SE00097/01 AG, June 2006.

Department of Commerce, 2005. *Review of Environmental Factors – Upper Nepean Catchment. Groundwater Investigation for Contingency Drought Relief – Priority Potential Borefield Sites*. Report DC05014, February 2005.

Department of Commerce, 2005. *Review of Environmental Factors – New Drilling and Testing Program – Upper Nepean Catchment. Groundwater Investigation for Contingency Drought Relief – Priority Potential Borefield Sites*. Report DC05122, August 2005.

Department of Commerce, 2006. *Compliance Report – Groundwater Pilot Testing for Contingency Drought Relief – Priority Potential Borefield Sites – Upper Nepean Catchment*. Report DC06003, February 2006.

Department of Commerce, 2006. *Upper Nepean Borefields Engineering Feasibility Study Groundwater Pilot Study Program*. Report DC05200 May 2006.

Department of Commerce and Department of Infrastructure, Planning and Natural Resources, 2005. *Area 2: Upper Nepean Catchment. Metropolitan Water Plan. Priority Groundwater Investigations for Contingency Drought Relief*. Report 05-GL31A/2, July 2005.

Department of Commerce and Department of Natural Resources, 2006. *Metropolitan Water Plan Detailed Pilot Investigation – Drilling and Pumping Tests, Upper Nepean Catchment (Kangaloon)* Report No. 06-GL31A/4 May 2006.

Parsons Brinckerhoff, 2003. *Groundwater Investigations for Contingency Drought Relief in the Sydney Region*. For Sydney Water Corporation and Sydney Catchment Authority, Report 2114127A.PR\_2984 RevE, December 2003.

Parsons Brinckerhoff, 2006. *Hydrochemical and environmental isotope sampling program – Upper Nepean groundwater investigation sites*. Project 2114237A Pr\_3461 RevC dated April 2006.

Responsive Environmental Solutions, 2005. *Construction and Environmental Management Plan Compliance Report – Stage 2 Drilling and Pilot Testing Program, Upper Nepean – Monitoring Well Installation*. Report No. 5065 RP03. December 2005.

Responsive Environmental Solutions, 2006. *Stage 2 Drilling and Pilot Testing Program, Upper Nepean – Monitoring Well Installation – Construction and Piezometer Completion*. Report No. 5065 RP04. January 2006.

Responsive Environmental Solutions, 2006. *Upper Nepean Groundwater Pilot studies - Pumping Test Interpretation and Data Logger Installation*. Project 5078 RP01 May 2006.

SCA, 2006. *Metropolitan Water Plan Groundwater Investigation Report June 2006*.

SCA, 2006. *Technical Overview Report Groundwater Investigations – Severe Drought Water Supply Sources for Sydney June 2006.*

SMEC Australia, 2005. *Scoping Study for Ecosystem Evaluation, Upper Nepean Borefield Area.* Project No. 31603.001. July 2005.

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