Report to the Sydney Catchment Authority on the Proposed Borefield at Kangaloon NSW

Upper Nepean Groundwater Community Reference Group - September 2006

Acronyms

SCA	Sydney Catchment Authority
DNR	Department of Natural Resources (NSW)
DEC	Department of Environment and Conservation (NSW)
CRG	Upper Nepean Groundwater Community Reference Group
REF	Review of Environmental Factors
EIS	Environment Impact Statement
HNCMA	Hawkesbury Nepean Catchment Management Authority
WSC	Wingecarribee Shire Council
LGA	Local Government Area

Summary

The Southern Highlands regional community, as represented by the Upper Nepean Groundwater Community Reference Group (CRG), appointed by Minister Debus, is opposed to the proposal to develop a borefield at Kangaloon NSW.

The proposal to pump high quality drinking water from the Kangaloon Aquifer for general residential and industrial use in Sydney and the Illawarra is inequitable to present and future generations of this community and does not follow ecologically sustainable development principles.

Ongoing open communication and community consultation are recommended. The community feels that this project has been rushed, and the full implications of development cannot be ascertained in the short timeframe that investigations have occurred. A five-year moratorium on development would enable adequate data input, improved modelling outcomes and more detailed ecosystem studies.

The potential for the resource to be over-extracted or contaminated is very high. Given the continuing population growth and demand from urban centres and the farming community, the Southern Highlands community fears that the borefield will be regarded as supply augmentation and not a contingency drought supply only. Due to the relative low cost of additional bores, the CRG is concerned that greater quantities than the 15 GL quoted will be extracted if the drought worsens or demand continues to grow.

Sydney and the Illawarra are situated in high rainfall areas and need to become more self-sufficient in water resources management through reusing and harvesting water. Level 3 restrictions are not onerous in severe drought, and these restrictions should be maintained or increased if the drought continues. As outlined in the Metropolitan Water Plan 2006, there are other sustainable and achievable options and strategies that can provide for the future water needs of the metropolitan area. It is those options and strategies that should

be urgently employed to adequately and properly provide for future metropolitan water requirements.

There is considerable risk and uncertainty in regard to the environmental sustainability of the proposed borefield for cyclical drought contingency supply. There is considerable uncertainty in regard to:
sourcing 15 GL for 2-3 years and recovery of the system,
consequent impacts on surface and groundwater resources,
the transfer of groundwater via rivers to water storages and
environmental impacts.

The proposed compensatory measures of deepening bores and lowering pumps of neighbouring groundwater users may not be a feasible or practical solution, however adequate compensation provisions will need to be incorporated into any approval for the project. It is imperative that the authorised use by existing users is maintained.

There is a very high risk that the proposal will adversely impact upon agricultural production and tourism in the region and land values may be degraded. These negative impacts on the local community are to be occasioned for "public good" outcomes in Sydney and the Illawarra in circumstances where there is no realistic proposal to properly compensate those who will suffer loss of income and reduction of asset values as a result.

The supporting technical documents do not satisfy issues of larger spatial and temporal scale, and the broader impacts of the proposal on rivers downstream of the borefield. The interconnectedness of surface and groundwater systems and the lag between cause and effect are not adequately addressed in the current suite of studies.

Before approval of a full-scale borefield can be contemplated, further extensive investigations and testing are essential (as recommended by Woolley and endorsed by McKibbin). The eight recommendations found in the *Peer Review of Technical Reports*, are endorsed by the CRG.

Background

Role of the Upper Nepean Community Groundwater Reference Group (CRG)

The CRG was appointed by the Minister for the Environment, the Hon. Bob Debus in June 2006. Its terms of reference are to provide a key communication channel between the NSW Government and the Southern Highlands community about the potential use of groundwater in the Upper Nepean catchment for drought contingency supply for Sydney and the Illawarra as well as an opportunity to discuss community matters regarding the full range of environmental, social and other issues which might arise from Borefield development and groundwater extraction.

The CRG recognises that its role requires two-way communication. Informally, CRG members have assisted with dissemination of information from the SCA to their

various associations and community networks and have provided input to the SCA's ongoing investigations based on local knowledge of geological and environmental features, private use of surface water and groundwater, natural springs and other relevant matters.

Membership

Mr Alex Walker	Chair
Councillor Larry Whipper	Representative, Wingecarribee Shire Council
Councillor Jim Mauger	Representative, Wingecarribee Shire Council
Ms Jenny Smith	Representative, Hawkesbury-Nepean Catchment Management Authority
Mr Jonathan Bell	Representative, NSW Farmers Association
Ms Mim Merrick	Community Representative, Burrawang
Mr Ian Tonking	Community Representative, Robertson
Mr Ray Nolan	Community Representative, Bowral
Dr Kerrie Eyding	Community Representative, Robertson
Mrs Beverly Clayton	Community Representative, Robertson
Mr Leon Hall	Community Representative, Kangaloon
Dr Barry O'Neill	Community Representative, Exeter
Dr Karen Guymer	Community Representative, Robertson

The qualifications and experience of these representatives can be found on the SCA website: **www.sca.nsw.gov.au**

Basis of Submission

From its inaugural meeting on 3rd July to 18th September, 2006 the CRG has met formally on six occasions. In addition, one technical workshop and a site inspection of the pilot borefield were held with SCA representatives.

The CRG has received presentations from the SCA on the Metropolitan Water Plan, the development of the groundwater project, technical studies conducted to date by the SCA and its contractors, the associated community consultation process and proposals for the next phases of investigation. A senior DNR representative has also presented background information on water resource management and policy, including licensing of groundwater extraction. CRG members have appreciated the quality of the presentations and the opportunities for free and open questioning and exchange of views.

Although well informed on technical aspects of the groundwater project, CRG members do not generally have the scientific background to be confident about assessing many of the key aspects. Specialised and independent advice has been sought and the SCA has agreed to fund the appointment of an experienced hydrogeologist. To this end, Mr Dan McKibbin was appointed on 18th August to

conduct a review of the technical reports and address key questions raised by CRG members. His independent advice is reflected in this submission.

Water Resources

Water Quantity

There is a good drinking water quality supply with varying but relatively high yields in the area where the borefield is proposed. The water supply should not be considered only in terms of a water supply for Sydney, as it has substantial value for the environment and existing users.

There is potential for the volume of water to be taken from the aquifer to increase from the estimated 10% of the total storage in the aquifer taken over 2-3 years, given that the SCA is sourcing the most productive fractured zones in the Hawkesbury Sandstone, and this means that the aquifer is vulnerable to over-exploitation.

A full water resources audit should be undertaken in the borefield region to ascertain all water features, including all surface water supply features and works (springs, pumps on creeks and farm dams) and groundwater works (bores, wells and excavations). This will establish baseline conditions for all lands within the predicted pumping radius of influence of the proposed borefield.

Considering the high connectivity of the ground- and surface-water systems in the borefield area and that both systems currently feed the water storages, the SCA needs to clearly demonstrate how it will avoid double accounting of the water gained from groundwater alone.

The quantity of water in this aquifer supports the water supply dams, the special area natural environment and the local farming area. The aquifer water supplies the Nepean Dam through discharge near the dam (especially in times of drought) and creates gaining streams adding water for the dam. It supplies water to nearby wetlands, which filter the water and feed the beginnings of creeks to supply the dam. Water discharge via springs such as Dudewaugh Creek also feed water to the dam. This system works well and this special area has retained its pristine environment here due to its high regional water level, its inaccessibility and lack of disturbance.

The sustainable yield of the aquifer needs to be determined so that clear limits on extraction rates and duration of pumping are articulated in the licence conditions developed by DNR.

There is concern that precipitation data has not been collected at the site of the borefield, to provide a more accurate estimate of recharge.

It seems likely that the SCA has not accurately assessed the quantity of water available, because the credibility of the data on transmissivities is questionable. (Refer to Pumping Tests below**)**.

Water Quality and Age

The studies by the SCA have revealed a high quality drinking water resource in this aquifer, which therefore must be protected from misuse and/or contamination. The precautionary principle must be applied, as the resource is servicing the environment and existing users now and in the future may be required as an emergency drinking water supply.

There needs to be greater clarity regarding the age of water at various depths in the aquifer. The use of composite sampling is not accurate enough. There is concern that the water sourced from the aquifer may be very old at depth, which would indicate that the time required for recharge could be substantially underestimated.

If older water is located within the deeper sandstone aquifers, to which recharge takes longer but from which water cannot seep to local gorges, use of that water is less likely to affect the nearby ecosystem.
Iron and manganese accumulations may cause problems in pumps and pipes.

Inefficient use of water

Loss of water supply in dams from evaporation is significant, and is one reason why sourcing water from an aquifer is advantageous; however this proposal lacks this advantage, due to the inefficient transport and storage of the water prior to end use.
The action of streamflow depletion due to groundwater pumping either capturing baseflow or inducing stream leakage needs to be clearly identified in yield calculations.
While inclusion of water losses through the stream bed in the hydrological model is commendable, it highlights the inefficiencies in the proposal, where a significant proportion of energy is expended recycling water.
In a highly connected ground- surface-water system, the identification of new storages does not necessarily increase the net yield of that system. When surface water inputs are already calculated in the supply reliability calculations, the assumption that groundwater provides 'new' additional supplies (when a significant percentage may be made up of drawn down surface water) can lead to the same water being counted twice and false-economies.

Pumping Tests

The results are questionable because the report on Pumping Test Interpretation and Data Logger Installation estimated a range of values up to $159m^2$/day, far greater than reported for local monitoring bores by McKibbin and Smith (In *Sandstone City*, Ed. G.H.McNally, B.J.Franklin), then quoted other values in their summary. Those values appear to have been ignored by Coffey, who quote other values on page 11, table 2 of the *Hydrological Modelling Report*.
Following any 6-month trial pumping test, it would be appropriate to let the aquifer recharge to original levels to obtain accurate data on recharge rates and to limit damage to the environment. Best estimates of base line conditions and total recharge are needed for an EIS if the project continues.

Drilling and Geophysical Logging

Insufficient use has been made of the geophysical logs, which would enhance the interpretation of what is foremost a sedimentary sequence with some faulting and, perhaps, fracturing. No direct evidence of the latter has been reported, other than orally from SCA representatives.
Observations by the drillers and on-site geologists, on flows from aquifers, have either

been changed or misquoted by later investigators, resulting in confusion as to the correct potential of the Hawkesbury Sandstone sequence.
Information on individual aquifer flows, including flow rate, water quality and age would have provided real data for formulation of a satisfactory hydrogeological model.

Geology

Geological Interpretation

Installation of multilevel monitoring bores as reference points is recommended in the basalt land to the south of the borefield. The objective would be the confirmation of assumptions made of the geological setting and specifically of the shale layer beneath the basalt caps, that would prove or disprove the assumption in the hydrological model that the surface springs are not connected to the sandstone aquifer.

The geological model is biased towards the known faulting and, largely inferred fracturing of the Hawkesbury Sandstone, within the proposed borefield. The inferred fracturing, reported only by J. Ross (personal communication, as a result of views by a down-hole camera, has influenced all of the subsequent investigations and their assessments of what were assumed to be "leaking aquifers").

An alternative model would include a series of semi-confined aquifers throughout the "upper" and "lower" sections of the Hawkesbury Sandstone, perhaps with those "upper" and "lower' sequences themselves being somewhat confined from each other. In other areas of this Shire, the "upper" sandstones are more iron-rich, are coloured accordingly and produce iron-tainted water, whereas the "lower" sandstones are mostly devoid of iron, are very porous, produce most of the water in any bore and it is usually free of iron and is very good quality. In this model, the more-than-average yields are due to the faulted, monoclinal feature raising the Hawkesbury Sandstone, so that it is not covered by the more impervious Wianamatta Shale and is accessible to high re-charge, possible from the high Robertson rainfall and the very suitable, flatter surface area south of Butlers Swamp and the Tourist Road.

If the above model is realistic, loss of water from the "upper" aquifers will occur naturally with the gorges, not far north of the borefield but the "lower" and, perhaps, very old water, would have to reach features such as the Avon Dam or the escarpment before it could seep at the surface.

Environment and Sustainability Issues

Interconnectedness of surface and groundwater

There has been little attention given to the impact of the groundwater pumping on an intermediate or catchment scale.
A clearer understanding of the surface to groundwater connections is required, as the provision of environmental flows and the protection of baseflows and tributary flows are a fundamental part of river management in the Hawkesbury-Nepean catchment. The Nepean River is already hydrologically and ecologically stressed due to the damming of the rivers and the volume of surface water transferred out of the catchment. Any

reduction in the baseflows currently provided by groundwater discharges during times of severe drought poses significant ecological risks to already stressed rivers. There needs to be a scientific justification for the assertions that there will be no (or negligible) impact on baseflows in streams beyond the area of drawdown.

Effect of loss of groundwater baseflows in rivers and upland swamps

The loss of baseflows in permanent streams including Doudles Folly Creek during pumping is a serious concern, given the likelihood for surface flows to also decrease during severe drought events, potentially placing these streams under hydrological stress.
Streams and wetlands in this region provide many environmental and socioeconomic services, such as fresh flows into storages and habitat for platypus. These services need protection and enhancement, not degradation.

Ecological triggers

There needs to be a set of ecological triggers for cease-to-pump.

Groundwater Dependent Ecosystems

Upland Swamps

Stockyard Swamp is a significant ecosystem that must be protected from degradation.
The short pumping tests and monitoring may not have detected effects that have a significant time lag, for example drawdown impacts in slightly less fractured sandstone could take longer to detect and may be missed altogether by monitoring bores.
Although reports state that Butlers Swamp (wetland of national significance) is not connected to the regional aquifer, further testing must be done to verify this, and the effects may not be immediate, as suggested in the prior point.

Terrestrial vegetation

Endangered plants are evident in the vicinity of the proposed borefield, and must be protected during testing and development phases of the project.
There is a risk that larger trees are sourcing water during times of severe drought from the water table, and could be prone to stress and death while the water table is drawn down on average by 40 m across the immediate borefield area. This risk is difficult to test, however some form of monitoring of tree vigour from aerial and ground surveys is strongly recommended, to provide baseline information.

Socioeconomic Issues

Unsustainable demand in Sydney

Sydney's demand for water has not been adequately addressed, because there is no mention of limiting population growth in Sydney or of ensuring that all new housing developments are self-sufficient in terms of water supply. Unsustainable demand for water is created with new housing and increasing population. Water restrictions do not address these issues, and BASIX incompletely addresses water use efficiency. The minor uptake of the tank water rebate shows that water restrictions do not have much impact on changing behaviour. Rural people are expected to supply their own water as well as

Sydney's, and this constrains rural industries in areas surrounding Sydney such as Kangaloon. The probability of the population of Sydney increasing and therefore demanding greater water is high, and so there is a high risk of the long-term over-extraction of the water resources at Kangaloon.

The Southern Highlands community expects greater accountability and sustainability of water use in Sydney, and to that end, the assessment and trial of the use of groundwater from the Botany Sands Aquifer to supply Sydney is requested as a high priority for the SCA.

Effects on local water users and landholders

The potential for bores to fail temporarily or completely is a significant socioeconomic risk for the local landholders and water users, as in some cases it may be the only water source on the property, and in other cases, the groundwater supply is essential, not just for the success of the enterprise, but for the daily survival of livestock. Measures to address drawdown effects on private bores need to be proactive not reactive. The increased cost to the landholder of pumping water greater heights is also an equity issue.

Local landholders will be impacted by more stringent land use controls that will inevitably form part of a land use management plan to protect the recharge areas, as already seen by the embargoes placed in the parishes that contain the proposed borefield. This is an equity issue between this semi-rural community and the Sydney and Illawarra urban population.

The impact of the operation of the borefield has the potential to affect the productivity and profitability of rural industries in the local area, that are reliant on groundwater for irrigation or stock and domestic purposes. The region has some of the most fertile soil types in Australia. Ferrosols have a very limited distribution nationally, and are highly valued primarily due to fertility, good drainage and resilient pore structure. The protection of agriculture and the environmental services of this region, situated close to such a large market as Sydney must be seriously considered.

Scenic amenity

The scenic amenity impacts are significant, given that this is a popular tourist drive and is in relatively pristine condition. Power poles to supply electricity are particularly concerning, and will have an unacceptable impact on the woodland vegetation and the tourism and rural residential values of Tourist Road. Underground power would mitigate these impacts.

Cost/benefit assessment

The considerable development, operational and environmental cost of the project for a relative small quantity and value of delivered water ($1.26 - $1.63 per 1000 litres) is an undesirable feature of the project and the CRG will be surprised if a proper cost/benefit appraisal was shown to endorse the project. It is disappointing that this analysis will be Cabinet-in-confidence and therefore cannot be scrutinised by this committee or publicly.

The risk of de-valuing the land adjoining the borefield is significant and fair compensation to affected landholders for such loss must be provided and included in the cost-benefit analysis of the scheme. There should also be an attempt to include the costs of losses of stream flows and other environmental degradation caused by the proposal.

Monitoring

The CRG, or similar representative group should have an ongoing role in monitoring and assessment, particularly during the further testing and monitoring phases; the environmental assessment process; and following that should the borefield become operational. The SCA has endeavoured to provide good community consultation to this point, and this will ensure a continuous dialogue with the community.

Each individual production bore requires monitoring, as do the broader impacts of the project, during all test phases and during operation.

Safeguards

The limits on annual extraction and duration of pumping cycles must be clearly stated and effectively protected from alteration over time by shifting state policy directions and decisions.

The time for aquifer recovery is estimated to be around 8 years, but it is essentially unknown and cannot be easily predicted and therefore it is important that full recovery of the aquifer is obtained before subsequent pumping cycles commence.

Statutory/Legislative Issues

Water Management Act 2000

While the CRG recognises that certain approvals have yet to be obtained, it understands environmental legislation has been amended to enable the project to be fast-tracked. This contrasts with the Government's own legislative stipulations which apply generally that "sharing of water from a water source must protect the water source and its dependent ecosystems and... must protect basis landholder rights". The Water Management Act 2000 also requires that water use be "consistent with the maintenance of productivity of land in the long term and should maximise the social and economic benefits to the community" and that "the impacts of water use on other water users should be avoided or minimised". (Water Management Act 2000, s. 5). The CRG expects that Government will strictly observe these principles in its future dealings.

Under the controlled activities provisions of the Act, the SCA must ensure that during test pumping or operational phases no damage occurs to the bed or banks of rivers.

Threatened Species and Endangered Ecological Communities

The NSW Threatened Species Conservation Act 1995, the Local Government Act 1993 and the federal Environment Protection and Biodiversity Conservation Act 1999, all emphasize our responsibilities to maintain, protect and enhance the environment for future generations. The Environmental Planning and Assessment Act 1979, requires that the principles of ecologically sustainable development (ESD) be given due recognition in the development of environmental impact statements (EIS). It is therefore incumbent on

all spheres of government to take this responsibility seriously. It is essential that this project proceed at a pace that allows full and unequivocal consideration of all the available science, irrespective of any extended timeframes, and where there are deficiencies to adopt the precautionary principle.
More effort is needed to abide by NSW and Federal laws in regard to identification and management of threatened species and the large tracts of EECs in this special area.

Groundwater Dependent Ecosystems

The following statement in the Technical Overview Report "*..,there may be some groundwater dependence associated with each of the terrestrial, wetland, aquatic and aquifer ecosystems that have been surveyed*". These areas surveyed are potentially within the area of predicted large drawdowns and include EEC's and endangered species. The long and continual pumping and the long recharge time may stop groundwater dependence for 10 or more years. This goes against the high level of protection given to this terrestrial landscape under state and federal laws.

Supporting Technical Documents

Groundwater Investigation Report

A quote from page 25 "*The SEPP (Sydney Metropolitan Water Supply) 2004 permits the SCA to carry out groundwater investigations without obtaining a development consent. Therefore any groundwater investigations can be assessed and determined by the SCA pursuant to Part 5 of the EP&A Act, unless the proposal is one that is likely to have a significant environmental effect*." There does appear that a significant environmental effect is likely with this proposal and even with investigations in this area, with 6 months trial pumping proposed and no assurance that the aquifer will totally recharge before any further testing. The extensive drawdown area during pumping will put terrestrial flora and fauna that depend on the high water table under stress.

Technical Overview Report

The comment by the independent peer review D R Woolley **"***None of the reports seen to date has provided an estimate of the likely safe yields*." P 69 is of concern, given that the target result of 15 GL per year is stated rather than working back from the sustainable or safe yield.

Hydrological Modelling Report

The wider impacts of the borefield are largely predicted by the hydrological model, and so there are significant environmental and socioeconomic risks if the model is not verified further using transient data.
The boundary conditions must be measured to provide any credibility to the model, particularly elevations at the escarpment and in the permanent streams and wetlands.

Interim Ecosystem Evaluation Report

This interim report is a good introduction to the diverse and rare natural environment of this special area. The groundwater ecosystem report is not finalised and this would have

been useful to us. It would be better to do a larger scale full area botanical and fauna study (over all seasons, even over years) before any trial pumping started. Analysis of such a proposed full study could be used for better management practices with pumping tests (and general management) and would supply more complete baseline data as well as helping this committee assess the project proposal. It is recommended that a more detailed study be undertaken before any further test pumping.

The report appears to be constrained by the assertion that there will be no impacts beyond the immediate local area.

Bore Drilling Report

Selection of the possible borefield was based on structural interpretation and that emphasis during drilling, geophysical logging and overall geological interpretation has been to the detriment of the sedimentological assessment of the many aquifers within the Hawkesbury Sandstone.

Woolley stated, "*insufficient use seems to have been made of the geophysical logging*" and "*the geophysical logs ....have not been examined by an experienced person who might be able to define aquifer zones quite (more) accurately*." When printed at the same vertical scale and with the same amplitude scales they are a valuable tool for sedimentological assessment of the total sandstone sequence across the borefield.

The "*apparent correlation between the calliper log and some of the fracturing noted during drilling*" (Woolley, 2006) is not necessarily valid. The geologists based fracturing on "iron-filled" zones or fractures. The technical officer, who commented on the bore logs, assumed that all increases in bore diameter related to fractures. They just as logically could be "washouts" in the most porous zones of the sandstone aquifers as they usually correlate with increased water yields.

There obviously is a monoclinal or horst structure present and the higher water yields are in boreholes along those structures. However, the effect of those structures could be only to raise the Hawkesbury Sandstone, and particularly its lower, more porous section (e.g. at Site 2) to the surface and into a very reactive re-charge zone. The northern boundary of the potential borefield could be where the nearby gorges commence, where up to 50 metres of the Sandstone is eroded, allowing the upper aquifers to "leak" into the rivers.