

Upper Nepean (Kangaloon) borefield project



Preferred Project Report Volume 2 – Appendices

This report is published in two parts:

Upper Nepean (Kangaloon) Borefield Project – Preferred Project Report – Volume 1 – Main Report

Upper Nepean (Kangaloon) Borefield Project – Preferred Project Report – Volume 2 – Appendices

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***Upper Nepean (Kangaloon)
Borefield Project***

Preferred Project Report

Volume 2 – Appendices

December 2008

Metropolitan Water Plan Team



Prepared by:

SYDNEY CATCHMENT AUTHORITY

Level 4, 2 – 6 Station Street

PENRITH NSW 2750

Telephone 1300 722 468, Facsimile 02 4725 2594

Email groundwaterinfo@sca.nsw.gov.au

Appendix A

Director-General's Requirements



NSW GOVERNMENT
Department of Planning

Contact: Scott Jeffries
Phone: (02) 9228 6426
Fax: (02) 9228 6366
Email: scott.jeffries@planning.nsw.gov.au

Mr Graeme Head
Chief Executive
Sydney Catchment Authority
PO Box 323
PENRITH NSW 2751

Our ref: 06_0331
Your ref: D2006/09694

Dear Mr Head

Kangaloon (Upper Nepean) Groundwater Borefields Project (Application: 06_0331) – Director-General's Requirements

I refer to your request for Director-General's requirements for the abovementioned proposal.

The Director-General's Environmental Assessment Requirements are attached, pursuant to section 75F(2) of the *Environmental Planning and Assessment Act 1979*. It should be noted that the Director-General's requirements have been prepared based on the information provided to date. Under section 75F(3) of the Act, the Director-General may alter or supplement these requirements if necessary and in light of any additional information that may be provided prior to the Proponent seeking approval for the project.

The Environmental Assessment should be prepared using valid and accepted technical and scientific tools and methodologies, focussing on key environmental impacts and robust mitigation measures to address potential impacts from the project. You should also ensure that you consult with the Department prior to submission of an Environmental Assessment to determine:

- fees applicable to the application;
- consultation and public exhibition arrangements that will apply; and
- number and format (hard-copy and/or CD-ROM) of the Environmental Assessments that will be required.

Once you have lodged the Environmental Assessment, the Department will consult with relevant authorities to determine the adequacy of the Environmental Assessment. Following this review period the Environmental Assessment will be made publicly available for a minimum period of 30 days.

You should keep the contact officer for this project, Scott Jeffries ((02) 9228 6426 or scott.jeffries@planning.nsw.gov.au), up to date with the progress of preparation of the Environmental Assessment, and seek clarification of any issues that may be unclear or may arise during this process.

Yours sincerely

Sam Haddad
Director-General 21.1.2007

KANGALOON (UPPER NEPEAN) GROUNDWATER BOREFIELDS PROJECT

DIRECTOR-GENERAL'S REQUIREMENTS UNDER PART 3A OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

Project	<p>Kangaloon (Upper Nepean) Groundwater Borefields project, comprising the development of a groundwater borefield in the Southern Highlands to provide water supply during periods of drought. The project includes all associated or ancillary works, activities, uses, structures or facilities for the purposes of each borefields project, including (but not limited to) works, activities, uses, structures or facilities for the following:</p> <ol style="list-style-type: none"> a) installation of groundwater bores and groundwater extraction systems; b) underground and surface pipes, pumps and associated infrastructure for the transfer of extracted groundwater; c) discharge of extracted groundwater into watercourses in the Upper Nepean River System; d) construction of electricity and utility service infrastructure; e) installation of monitoring bores and gauging stations.
Site	Land near Kangaloon, in the Southern Highlands, and within the Upper Nepean catchment area.
Proponent	Sydney Catchment Authority
Date of Issue	21 January 2007
Date of Expiration	21 January 2009
General Requirements	<p>The Environmental Assessment must be prepared to a high technical and scientific standard and must include:</p> <ul style="list-style-type: none"> • an executive summary; • a description of the proposal, including construction, operation, and staging; • an assessment of the environmental impacts of the project, with particular focus on the key assessment requirements specified below; • justification for undertaking the project with consideration of the benefits and impacts of the proposal; • a draft Statement of Commitments detailing measures for environmental mitigation, management and monitoring for the project; and • certification by the author of the Environment Assessment that the information contained in the Assessment is neither false nor misleading.
Key Assessment Requirements	<p>The Environmental Assessment must include assessment of the following key issues:</p> <ul style="list-style-type: none"> • Strategic Planning and Project Justification – the Environmental Assessment must clearly outline the strategic context of the project, having regard to the 2006 Metropolitan Water Plan. The Environmental Assessment must also outline the context of the project within the suite of other borefields projects under consideration by the Proponent. • Surface and Groundwater Hydrology – the Environmental Assessment must include a comprehensive assessment of the impacts of the project on surface and groundwater hydrology, including consideration of the effects of drought intensity, depletion and recovery cycles on these impacts. The Environmental Assessment must include an assessment that address the following specific issues with respect to surface and groundwater quality, quantity and flow regimes: <ul style="list-style-type: none"> ◦ details of the groundwater and surface systems to be impacted by the project, whether directly or indirectly, and how these systems are connected, interact and behave, including comment on the assumptions and uncertainties inherent in characterising these systems. The Environmental Assessment must provide details of relevant geological characteristics, including any inherent assumptions and uncertainties, and how these characteristics may affect the project and influence the project's environmental impacts; ◦ assessment of the impacts of groundwater extraction on groundwater and surface water systems, including their connections, interactions and behaviours, as a result of the project, including consideration of water quality, quantity and flow characteristics; ◦ derivation of sustainable yield information for the affected groundwater systems,

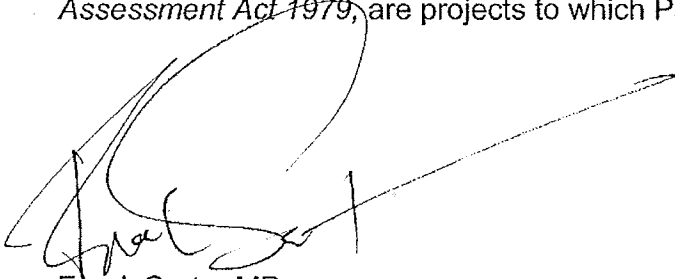
including comment on the assumptions and uncertainties inherent in these calculations, and making reference to predicted depletion and recovery cycles, rainfall, and drought intensity. The Environmental Assessment must also include a general water balance for the project, noting any expected losses through evaporation or infiltration, particularly as a result of run-of-river transfers;

- details of water quantity and quality management after extraction, including general details of pumping and pipeline requirements, details of any treatment that is proposed to be applied to groundwater before discharge to the environment, and consideration of the impacts of run-of-river transfers in terms of flow rates and water quality. The Environmental Assessment must include a detailed consideration of potential alternatives to run-of-river transfers, and justify the selection of this transfer method having regard to the relative environmental impacts of potential transfer options. The Environmental Assessment must include consideration of impacts during wet and dry weather conditions, and under flow regimes characteristic of drought and non-drought situations;
- details of how run-of-river transfers will be conducted, monitored and managed to mimic natural flow variations where reasonable and feasible, and to minimise impacts, particularly on aquatic ecology and potential erosion;
- details of how the project will be designed and operated to meet water quality criteria detailed in *Australian and New Zealand Water Quality Guidelines 2000* (ANZECC, 2000) for run-of-river transfers;
- consideration of the project against the relevant findings and recommendations of *Independent Inquiry into the Hawkesbury-Nepean River System: Final Report* (HRC, 1998) and *Independent Inquiry into the Hawkesbury-Nepean River System: Supplementary Report* (HRC, 1999);
- assessment of potential impacts on other groundwater and surface water users, including details of how existing water access rights will be protected, including with respect to both quantity and quality of water;
- details of how bores will be managed to prevent contamination of groundwater;
- presentation of framework monitoring program(s) and management plan(s) with respect to impacts on ecology associated with the project. The monitoring and management frameworks must reflect the interconnect of groundwater and surface water systems, and reflect an approach encompassing these systems;
- **Ecological Impacts** – the Environmental Assessment must include a comprehensive ecological impact assessment, including in relation to both terrestrial and aquatic ecosystems, in accordance with the DEC's *Guidelines for Threatened Species Assessment* and DPI's *Fish Habitat Protection Plan No. 1: General and Fish Habitat Protection Plan No. 3 – Hawkesbury-Nepean River System*. The Assessment must consider impacts on ecological values directly attributable to the project, as well as indirect impacts that may be associated with changes in water quality conditions and flow characteristics. The assessment of impacts on ecology must specifically address the following:
 - clear details of how the outcomes and recommendations outlined in *Baseline Groundwater Dependant Ecosystem Evaluation Study – Upper Nepean Groundwater Pilot Studies – Final Report* (SMEC, 2006) have been addressed as part of the project;
 - specific consideration of impacts on the Southern Highlands Shale Woodland Endangered Ecological Community and the Montane Peatlands and Swamps Endangered Ecological Community;
 - specific consideration of impacts on the Giant Dragonfly (*Petalura gigantea*), *Prasophyllum uroglossum*, *Gentiana wingecarriensis*, *Lysimachia vulgaris*, the Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*), Masked Owl (*Tyto novaehollandiae*), Koala (*Phascolartos cinereus*), Spotted-tail Quoll (*Dasyurus maculatus*), Long-nosed Potoroo (*Potorous tridactylus*), *Pultenaea aristata*, *Epacris purpurascens purpurascens*, *Leucopogon exolasius* and *Persoonia glauscens*. The assessment should also consider high priority fauna species identified in *Fauna of the Metropolitan, O'Hares Creek and Woronora Special Areas* (NPWS/SCA);
 - specific consideration of impacts on groundwater dependent ecosystems, including Stockyard Swamp, Butlers Swamp and terrestrial vegetation with deep roots. Assessment of impacts on groundwater dependent ecosystems should consider the approach detailed in *A Risk Based Approach to Groundwater Management for Terrestrial Groundwater Dependent Ecosystems* (Smith et al,


	<p>undated);</p> <ul style="list-style-type: none"> ◦ specific consideration of impacts on stygofauna and their habitats; ◦ specific consideration of impacts on aquatic ecology, particularly through changes in groundwater-surface water interactions or changes in the quality and quantity of water associated with run-of-river transfers. In assessing impacts on aquatic ecology, consideration must be given to both aquatic and riparian species that may be directly or indirectly affected by the project. The Environmental Assessment must clearly detail measures to be applied to address impacts of sudden or unnatural changes in flow regimes on aquatic ecology and to avoid additional barriers to fish passage are not ◦ presentation of framework monitoring program(s) and management plan(s) with respect to impacts on ecology associated with the project; <ul style="list-style-type: none"> • Land Use Planning and Resource Conflicts – the Environmental Assessment must include an assessment of the potential impacts of the project, whether direct or indirect, on surrounding land uses and natural resources, including mineral resources and forestry reserves. Where a potential conflict is identified, the Environmental Assessment must present measures to be applied to minimise and manage the conflict; • Matter of National Environmental Significance – the Environmental Assessment must consider and address the impacts of the project, if any, on matters of National Environmental Significance under the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>; • General Environmental Risk Analysis – notwithstanding the above key assessment requirements, the Environmental Assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of the additional key environmental impact(s) must be included in the Environmental Assessment.
<p>Consultation Requirements</p>	<p>You must undertake an appropriate and justified level of consultation with the following parties during the preparation of the Environmental Assessment:</p> <ul style="list-style-type: none"> • NSW Department of Environment and Conservation; • NSW Department of Primary Industries; • NSW Department of Natural Resources; • potentially-affected groundwater users; and • the local council and local community. <p>In addition, appropriate consultation with the local community should be undertaken. The Environmental Assessment must clearly indicate issues raised by stakeholders during consultation, and how those matters have been addressed in the Environmental Assessment.</p>
<p>Deemed refusal period</p>	<p>Not applicable.</p>

ORDER DECLARING DEVELOPMENT TO BE A PROJECT UNDER PART 3A OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

I, the Minister for Planning, having formed the opinion that the development referred to in the Schedule is of State and regional environmental planning significance, order that the development in the Schedule, pursuant to section 75B(1) of the *Environmental Planning and Assessment Act 1979*, are projects to which Part 3A of the Act applies.



Frank Sartor MP
Minister for Planning

Sydney,  2006

SCHEDULE

Each of the following borefields projects, as described in correspondence from the Sydney Catchment Authority to the Minister for Planning, dated 9 November 2006:

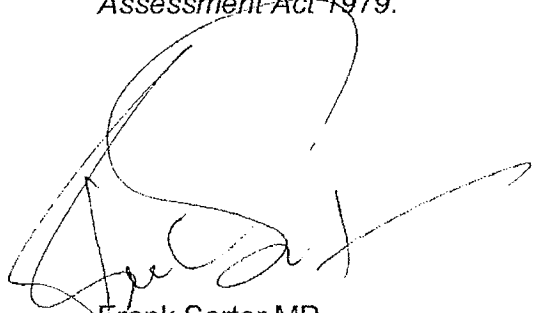
- 1) the Kangaloon borefields project within the Upper Nepean Catchment;
- 2) the Leonay-Emu Plains borefields project within the Lapstone Monocline Area; and
- 3) the Wallacia borefields project within the Lapstone Monocline Area.

Development for all associated or ancillary works, activities, uses, structures or facilities for the purposes of each borefields project, including (but not limited to) works, activities, uses, structures or facilities for the following:

- a) installation of groundwater bores and groundwater extraction systems;
 - b) underground and surface pipes, pumps and associated infrastructure for the transfer of extracted groundwater;
 - c) discharge of extracted groundwater into watercourses in the Upper Nepean River System;
 - d) construction of electricity and utility service infrastructure;
 - e) installation of monitoring bores and gauging stations.
-

**DECLARATION OF A CRITICAL INFRASTRUCTURE PROJECT UNDER SECTION 75C OF
THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979**

I, the Minister for Planning, having formed the opinion that the projects referred to in the Schedule are essential for the State for economic and social reasons, declare those projects to be a critical infrastructure projects under section 75C of the *Environmental Planning and Assessment Act 1979*.



Frank Sartor MP
Minister for Planning

Sydney,



2006

SCHEDULE 1

Each of the following borefields projects, as described in correspondence from the Sydney Catchment Authority to the Minister for Planning, dated 9 November 2006:

- 1) the Kangaloon borefields project within the Upper Nepean Catchment;
- 2) the Leonay-Emu Plains borefields project within the Lapstone Monocline Area; and
- 3) the Wallacia borefields project within the Lapstone Monocline Area

Development for all associated or ancillary works, activities, uses, structures or facilities for the purposes of each borefields project, including (but not limited to) works, activities, uses, structures or facilities for the following:

- a) installation of groundwater bores and groundwater extraction systems;
 - b) underground and surface pipes, pumps and associated infrastructure for the transfer of extracted groundwater;
 - c) discharge of extracted groundwater into watercourses in the Upper Nepean River System;
 - d) construction of electricity and utility service infrastructure;
 - e) installation of monitoring bores and gauging stations.
-



Contact: Joanna Bakopanos
Phone: (02) 9228 6461
Fax: (02) 9228 6355
Email: joanna.bakopanos@planning.nsw.gov.au

Mr Graeme Head
Chief Executive
Sydney Catchment Authority
PO Box 323
PENRITH NSW 2751

Our ref: S06/01253

Dear Mr Head,

Kangaloon Borefields Project – Supplement to the Director-General's Requirements

I refer to the Director-General's Requirements issued for the above project on 21 January 2007.

As you are aware, the project has been declared a Controlled Action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As a result, the Department of Planning, on behalf of the Minister for Planning, has confirmed to the Commonwealth that the Bilateral Agreement between the NSW and Commonwealth Governments will apply. Accordingly, the Department will undertake an environmental impact assessment of the project to satisfy the requirements of both NSW and Commonwealth legislation.

To ensure that sufficient information is provided to enable an appropriate level of assessment of relevant controlling actions, the Director-General has issued supplementary requirements for the Environmental Assessment under section 75F(3) of the *Environmental Planning and Assessment Act 1979*. A copy of the supplementary Director-General's requirements is attached.

You must ensure that the Environmental Assessment adequately addresses the Director-General's requirements issued on 21 January 2007, and the supplementary requirements attached to this letter.

Should you have any further enquiries please do not hesitate to contact Joanna Bakopanos on (02) 9228 6461.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Yolande Stone'.

Yolande Stone
Executive Director
Major Project Assessments
As delegate for the Director-General

06 AUG 2007

Supplementary Director-General's Requirements

Section 75F(3) of the *Environmental Planning and Assessment Act 1979*

The Kangaloon Borefields project (reference: 06_0331, EPBC 2006/3209) has been declared to be a Controlled Action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The relevant controlling provisions are section 18 and 18A of the EPBC Act (Listed threatened species and communities).

Under the provisions of the bilateral agreement between New South Wales and the Commonwealth, the environmental impacts of the controlled action will be assessed under Part 3A of the *Environmental Planning & Assessment Act 1979*.

To enable the assessment of impacts on the protected matters/ controlling provisions under the EPBC Act, the Director-General's requirements issued for the project on 21 January 2007 are supplemented with the following additional requirements.

The Environmental Assessment must include:

- a description of the controlled action;
- a description of the relevant impacts¹ of the controlled action;
- a description of feasible mitigation measures or compensatory measures, changes to the controlled action or procedures, which have been proposed by the proponent or suggested in public submissions, and which are intended to prevent or minimise relevant impacts;
- to the extent practicable, a description of any feasible alternatives to the controlled action that have been identified through the assessment, and their likely impact;
- an assessment of all relevant impacts that the controlled action has, will have or is likely to have on the *Temperate Highland Peat Swamps on Sandstone* ecological community, and other species or ecological communities potentially present and listed under sections 18 and 18A of the EPBC Act;
- sufficient information about the controlled action and its relevant impacts to allow an informed decision whether or not to approve the controlled action under the EPBC Act; and
- information to address the matters outlined in Schedule 4 of the Commonwealth *Environment Protection and Biodiversity Conservation Regulation 2000*.

The description and assessment of these issues in the Environmental Assessment must be integrated as far as is practicable with the description and assessment of the other flora and fauna impacts of the project. However, a separate stand alone chapter or summary specifically addressing impacts on the relevant protected matters/ controlling provisions under the EPBC Act, together with any commitments or proposed measures to mitigate such impacts, should also be included in the Environmental Assessment.

¹ The term "relevant impact" is defined in section 82 of the EPBC Act.

Appendix B

Submissions Report

Upper Nepean (Kangaloon) Borefield Project Environmental Assessment

Submissions Report

**Prepared by Donna Sowry
Community Relations Manager
Metropolitan Water Plan Projects
Sydney Catchment Authority
02 4723 9246
Donna.sowry@sca.nsw.gov.au**

October 2008

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1. Introduction

The Sydney Catchment Authority (SCA) is seeking approval for the construction and operation of the Upper Nepean (Kangaloon) borefield project under both Part 3A of the NSW *Environmental Planning & Assessment Act (1979)* (EP&A Act) and the Australian Government *Environment Protection and Biodiversity Conservation Act (1999)* (EPBC Act). The SCA prepared and publically exhibited an environmental assessment (EA) to seek this approval. The EA was on public exhibition from 2 April until 5 May 2008 at the following locations:

- Department of Planning, Information Centre, 23-33 Bridge Street, Sydney
- Nature Conservation Council of NSW, Level 2, 301 Kent Street, Sydney
- Wingecarribee Shire Council, Civic Centre, Elizabeth Street, Moss Vale.

It was also available for viewing online at the Department of Planning web site at www.planning.nsw.gov.au, with a link to this site from the SCA web site. Copies of the summary report were mailed to all residents within 2 kilometres of the proposed borefield and all community members/groups who had made previous enquires about the project.

The Department of Planning also placed advertisements and issued a media release to notify the general community that the environmental assessment was on public exhibition.

One hundred and forty seven (147) submissions were received in response to the environmental assessment public exhibition and this Submissions Report represents the SCA's response to the issues raised in the submissions.

This report contains the following sections:

- **Background:** an outline of the proposal and the technical investigations completed to date, and community consultation processes (Section 2).
- **Respondent analysis:** an overview of submissions received in response to exhibition of the environmental assessment (Section 3).
- **Issues analysis:** a summary of issues raised in submissions in the form of an issues and response table (Section 4).
- **Next steps and conclusion:** a summary of the steps to follow the submission of this report and the preferred project report (Section 5).

This submissions report analyses all the submissions received in April and May 2008. It is part of the Preferred Project Report that is submitted to the Department of Planning for the determination of the project.

2. Background

In October 2004 the NSW Government released the Metropolitan Water Plan (MWP), which identified the potential to draw on groundwater reserves to supplement Sydney's water supply in times of severe drought. The Government committed to undertake a program of preliminary groundwater investigations in seven priority areas across the Sydney geological basin to understand the extent and viability of this potential resource.

In February 2006, the Government issued a progress report on the MWP which stated that groundwater resources would be used as the first line of defence against severe drought and accessed if dam levels drop below 40 percent. This position was restated in the revised MWP that was released in May 2006. The plan directed the SCA to undertake detailed investigations in the Upper Nepean and in western Sydney to determine the extent of groundwater resources and the viability of borefield development in terms of groundwater quality, aquifer volume, flow rates, and recharge rates.

The Upper Nepean (Kangaloon) area was the first of the seven areas assessed as being a potential drought water supply. The investigation programs commenced in the Upper Nepean in March 2005 and monitoring programs have been under way for more than three years.

The commitment to develop the sandstone aquifers in the Upper Nepean catchment and to construct a borefield at Kangaloon was made on 2 November 2006 when the Premier announced that due to continuing severe drought and dam storage levels falling below 40 percent that borefield development would occur at Kangaloon. Subsequently the project applications, tender designs, and final investigations have been fast-tracked.

The project application to the Department of Planning under Part 3A of the EP&A Act was lodged on 4 December 2006, and the referral to the then Australian Department of Environment and Heritage was lodged on 21 December 2006. Director General Requirements (DGRs) were issued on 21 January 2007 with a supplement issued on 6 August 2007 after the project was declared a controlled action by the then Australian Minister for the Environment and Water under the EPBC Act.

2.1 Proposal description

This project involves the construction and operation of a borefield to supply water during severe drought periods from sandstone aquifers in the Southern Highlands. The proposal includes the construction of up to 75 production bores and 90 monitoring bores. These production bores would be linked by a pipeline along a corridor approximately 40 to 50 kilometres in length, and used to extract 10 to 15 billion litres of water a year during severe drought periods. This water will be discharged into the Nepean River for storage and use from Nepean and Avon Dams. The water will then be used to supply Sydney and the Illawarra.

The key features of the project are:

- 75 production bores (cased and screened, and equipped with submersible pumps) ranging from 90 to 180 metres deep, positioned between 500 and 750 metres apart

- a buried water transfer system, with pipes ranging in diameter from 100 to 300 millimetres enabling the water to be transferred to the Nepean River system. An estimated 50km of buried piping will be required to connect production bores with the water treatment facilities
- two water quality treatment facilities to adjust temperature and oxygen levels, and to reduce iron concentrations
- two river discharge locations – one on the Nepean River and one on Maguires Creek – from where the water will flow to the Nepean Dam
- an 11 kilovolt (kV) power network (combination of overhead and buried power lines) supplying electricity to transformers that will power the submersible pumps and water treatment facilities
- an outdoor switchboard at each bore which will house the power and control switchgear to each bore pump
- fibre optic cabling from each bore to a central location for control and communications
- a network of monitoring bores and gauging stations to monitor resource behaviour and manage borefield performance and impact
- a preventative maintenance system at each location to prevent iron scaling and bacteria blooms.

The period of operation will depend on the length of drought and the number of significant rainfall events that recharge the aquifer. If operated for two to three years, between 30 and 45 billion litres would be extracted. This amounts to around 10 percent of the storage within the local area of this groundwater source. More water would be extracted from the aquifer than is likely to be replaced by rainfall during the drought period. However, the amount likely to be extracted over a longer pumping/recovery period is about the same as would be expected to be replaced by rainfall recharge. Under these operational scenarios, with these proposed water extraction rates and volumes, the level of extraction is considered sustainable.

2.2 Investigations process

Substantial technical, scientific and environmental studies (now numbering more than 90 reports) have defined the characteristics and attributes of the groundwater resource and the natural environment of the Kangaloon borefield area. The investigation programs commenced in the Upper Nepean in March 2005 and monitoring programs have now been under way for more than three years. The pumping trials completed in 2007 and early 2008 confirmed the capacity of the aquifer system, its disconnection from surface ecosystems, and the rapid recovery of the sandstone aquifer water levels after pumping and sizeable rainfall events.

2.3 Consultation process

The SCA began an extensive community consultation program in May 2006. This included the public display of the groundwater investigation reports and supporting technical reports (June to September 2006) and the subsequent compilation of a consultation and submissions report for the NSW Government. The consultation process included the widespread distribution of newsletters, media releases and web-based materials. Groundwater surveys were also completed for most properties within two

kilometres of the borefield in 2007 to identify all local water sources and land uses. Consultation has also included the public exhibition of the EA.

The aim of the community consultation was to:

- consult the community during the groundwater investigations and borefield development concept stage
- present clear and comprehensive information to stakeholders about the Government's groundwater investigation program
- fully 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 authorities, relevant Government agencies, environmental groups and associations, potentially directly affected landowners and business owners and other local residents, indigenous land councils and tribal groups.

The SCA undertook a range of communications to facilitate stakeholder contact with the project team, engage with stakeholders, disseminate information, and identify and address issues as they emerged.

Community reference group

In June 2006, the then Minister for Environment, the Hon. Bob Debus, appointed a 12-member Community Reference Group (CRG) to assist in communicating proposals for developing the Upper Nepean groundwater source. Interested people responded to a request for expressions of interest and were appointed on the basis of their ties to the local community and their interest in issues relating to the proposal. The CRG is independently chaired, and made up of individuals with the following interests:

- environmental issues, particularly flora, fauna and water issues
- groundwater users' issues
- agricultural and grazing issues
- community and local government issues
- tourism and commercial issues.
- bushwalking and other recreational issues pertaining to the area

The CRG acts in an advisory role and is a key communication channel between Government and the Southern Highlands community about the potential to use groundwater from the Upper Nepean catchment for drought supply. CRG meetings provide a forum for the SCA to discuss matters regarding the potential extraction of groundwater and borefield development with the community.

The CRG received regular updates on all the technical studies and engineering designs. There was substantial discussion on the results of investigations, borefield designs and the assessed impact of borefield development. In late 2007 and early 2008 CRG meetings, most discussion was about the planning approval process and the format of the EA. The CRG was given a detailed briefing on the final content of the EA, two days in advance of its public release and exhibition.

The group held its inaugural meeting on 3 July 2006, with a further 14 meetings held by the time of the exhibition of the EA, as well as a technical workshop and a guided site visit. CRG meeting minutes have been published on the SCA's website to provide transparency and accountability and to accurately record the CRG deliberation process. The CRG prepared a submission in response to the EA, which is addressed in this report and supplied in full at Appendix 1.

Public Exhibition of the environmental assesment

The EA, including the supporting technical appendices was placed on public exhibition from 2 April until 5 May 2008.

Submissions were invited from the public and received until 16 May 2008 (the Department of Planning authorised extensions to the submission period). Submissions were accepted by email, post, web or fax.

All technical reports listed in the references and appendices were either publicly available or available on request. Public display and exhibition of technical documents formed the basis of community consultation. A summary report and newsletter were developed to highlight the key points of the EA.

In total, the SCA distributed 712 summary reports, 710 discs containing the reports (summary, main EA and appendices) and 56 hard copies of the full EA. A further 39 hard copy appendices were distributed.

Static displays were established at Wingecarribee Shire Council in Moss Vale, Nature Conservation Council in Sydney and the Department of Planning in Sydney.

A 1300 community information phone line and project specific email address were also established. The 1300 number was 1300 722 468. The project email was groundwaterinfo@sca.nsw.gov.au.

The 1300 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 request further information. The SCA received 141 enquiries through the 1300 line, a further 39 calls directly to the community relations team, and 31 email enquiries.

Printed communication materials

A newsletter was distributed to 18,911 householders in the Southern Highlands at the commencement of the public exhibition. The newsletter advised residents that the EA was on public exhibition, highlighted the key points in the EA, explained how to obtain a copy of the EA and invited submissions on the proposal. A copy of the newsletter is provided in Appendix 1.

The SCA also prepared a project specific web page on the website including a link to the Department of Planning website which contained the EA.

Media and advertisements

The Department of Planning placed an advertisement in the government noticeboard section of Sydney and local newspapers.

Stakeholder briefings and communication

A series of targeted briefings were undertaken to fully inform and update key stakeholders on the progress of groundwater investigations. The briefings provided an opportunity for key stakeholders to meet with project team representatives. Briefings were given to the following stakeholders:

- NSW Department of Environment & Climate Change (DECC) (previously DEC)
- NSW Department of Water & Energy (DWE) (previously DNR) (4 meetings)
- Wingecarribee Shire Council (2 meetings)
- Wingecarribee Environment & Sustainability Committee
- Save Water Alliance (SWA)
- Hawkesbury-Nepean Catchment Management Authority (HNCMA)
- Nature Conservation Council (NCC)
- Upper Nepean Groundwater Community Reference Group (UNGCRG)
- Local Kangaloon residents.

The SCA responded to stakeholder enquiries in a timely manner. Multiple points of contact were established to ensure all stakeholders could contact the project team and were aware that their feedback on groundwater investigations was invited and welcomed. The SCA provided responsive briefings to issues as required or on request.

3. Respondent analysis

Submissions received in response to the Environmental Assessment (EA) exhibition of borefield project were lodged with the Department of Planning (DoP). All submissions were provided to SCA for review and analysis. Issues were coded and classified using Darzin; a specialist consultation management software program. This program is essentially a communications database that allows meeting notes, phone calls, emails, letters and other community consultation materials to be archived and then extracted in various formats for different purposes. The following process was used for analysing the Kangaloon borefield submissions:

- submissions were logged and given a number and entered into the database
- submissions were then systematically reviewed and issues were extracted and classified.
- issues were then analysed, synthesised and distilled into themes.
- key issues were then responded to in the issues and response table.

In extracting the issues, there were many that were identical due to there being a number of form emails and submissions that were sent in by individuals to the DoP. These issues only appear once in the issues and responses table even though they were received multiple times. Of the remaining issues that were received, there were many that were very similar in content and the issues that were raised. Consequently in an effort to summarise the main issues and responses, SCA has retained only the main (more detailed) issues in the issues and responses table. There are more than 900 responses presented to the more than 4700 individual comments and issues raised in the 147 submissions.

Submissions are identified in this report using their Darzin identification number (usually quoted in brackets in this section or in the table in Chapter 4).

3.1 Classification Tree

The following classifications were used for the submissions

- 1.00.00
 - 1.01.00 Support
 - 1.02.00 Object
 - 1.03.00 Did Not Say
- 2.00.00 Environmental Impacts / Issues
 - 2.01.00 Water Systems
 - 2.01.01 Rivers Creeks
 - 2.01.02 Springs
 - 2.01.03 Groundwater
 - 2.01.04 Dams/Tanks
 - 2.02.00 Water Quality
 - 2.02.01 Turbidity
 - 2.02.02 Dissolved Oxygen
 - 2.02.03 Temperature
 - 2.02.04 Iron and Manganese
 - 2.02.05 Salinity
 - 2.03.00 Water Release and Transfer
 - 2.03.01 Transfer method
 - 2.03.02 Discharge Structures
 - 2.03.03 Bank Erosion
 - 2.03.04 Location of Discharge Structures

- 2.03.05 Water Treatment Plants/Chemicals
- 2.04.00 Ecosystems
 - 2.04.01 Aquatic Flora/Fauna
 - 2.04.02 Terrestrial Flora/Fauna
 - 2.04.03 Swamps
 - 2.04.04 Aquifer (Stygofauna)
 - 2.04.05 Threatened Species/EEC
- 2.05.00 Landscape
 - 2.05.01 Ground Subsidence
 - 2.05.02 Clearing
- 2.06.00 Aboriginal and Cultural Heritage
- 2.07.00 Groundwater Technical Issue/Gap/Uncertainty
 - 2.07.01 Rainfall/Seasonal Variation
 - 2.07.02 Borefield Yield and Capacity
 - 2.07.03 Aquifer water age/dating/origin
 - 2.07.04 Aquifer flow rate direction
 - 2.07.05 Recharge and Discharge - areas and rates
 - 2.07.06 Artificial recharge
 - 2.07.07 Drawdown rates and time lag
 - 2.07.08 Zone of influence/Area of drawdown
 - 2.07.09 Ecosystem dependence
 - 2.07.10 Aquifer connectivity
 - 2.07.11 Surface water connectivity
 - 2.07.12 Technical expertise and research adequacy
 - 2.07.13 Modelling methodology/approach/predictions
 - 2.07.14 System yield
 - 2.07.15 Pumping trial
 - 2.07.16 Climate Change
- 2.08.00 Geology and Geological structure
- 3.00.00 Socio-Economic Impact/Issues
- 3.01.00 Beneficial Uses and Water as a Resource
 - 3.01.01 Drinking Water use
 - 3.01.02 Agricultural use
 - 3.01.03 Livestock use
 - 3.01.04 Rural residential/domestic use
 - 3.01.05 Commercial use
- 3.02.00 Infrastructure layout/placement
 - 3.02.01 Easements
 - 3.02.02 Property acquisitions
 - 3.02.03 Water Right acquisitions
 - 3.02.04 Property values
 - 3.02.05 Visual impacts
- 3.03.00 Tourism
- 3.04.00 Hierarchy of Use
- 3.05.00 Land Use Restrictions/Infrastructure
- 3.06.00 Layout and Design
 - 3.06.01 Power
 - 3.06.02 Bores
 - 3.06.03 Pipes
 - 3.06.04 Water treatment
- 3.07.00 Construction Impacts/Issues
 - 3.07.01 Noise
 - 3.07.02 Traffic
 - 3.07.03 Dust
 - 3.07.04 Contamination
 - 3.07.05 Weeds and Feral Animals
- 3.08.00 Impacts to Bores/Springs
 - 3.08.01 Compensation
 - 3.08.02 Deepen/replace bore
 - 3.08.03 Total alternative supply
- 3.09.00 Governance
 - 3.09.01 MWP

- 3.09.02 NSW Planning Approvals
- 3.09.03 Australian Govt planning approvals
- 3.09.04 Timing of the project
- 3.09.05 Continue pumping the aquifer
- 3.10.00 Other Water sources
 - 3.10.01 Recycling
 - 3.10.02 Desalination
 - 3.10.03 New Dam
 - 3.10.04 Groundwater in other areas
 - 3.10.05 Stormwater harvesting and rainwater tanks
 - 3.10.06 Improve system efficiency
 - 3.10.07 Demand management
- 3.11.00 Feasibility
 - 3.11.01 Cost of water
 - 3.11.02 Overall project cost
 - 3.11.03 Cost of benefit vs environmental risk
- 4.00.00 Management, Monitoring and Operations
- 4.01.00 Operational strategy/approach
 - 4.01.01 Operational start/operational stop points
 - 4.01.02 Pumping periods
 - 4.01.03 Extraction regime
 - 4.01.04 License conditions
 - 4.01.05 Policy direction/change
- 4.02.00 Monitoring plan
 - 4.02.01 Groundwater monitoring
 - 4.02.02 Surface water monitoring
 - 4.02.03 Ecosystem monitoring
- 4.03.00 Adaptive management
 - 4.03.01 Scenario specific mitigation measures
- 4.04.00 Efficiency of transfer
 - 4.04.01 Evaporation
 - 4.04.02 Infiltration/losses
- 4.05.00 Regulatory approach
 - 4.05.01 Water sharing plans/embargo/licensing
 - 4.05.02 Impacts/regulation
 - 4.05.03 ESD principles/precautionary principle
 - 4.05.04 NWI
- 4.06.00 Operational Issues
 - 4.06.01 Noise
 - 4.06.02 Bushfire
 - 4.06.03 Communication with adjoining landholders
 - 4.06.04 Traffic
 - 4.06.05 Water treatment
- 5.00.00 Design
- 5.04.00 Power
 - 5.04.01 Concept
 - 5.04.02 Layout
 - 5.04.03 Alternatives/renewables
- 6.00.00 Community Consultation
- 6.01.00 Community Consultation program
 - 6.01.01 Community Consultation during planning
 - 6.01.02 Community Consultation during construction
 - 6.01.03 Community Consultation during operation
- 6.02.00 Peer reviews and audits
- 7.00.00 Miscellaneous
 - 7.00.01 Fire management
 - 7.00.02 Cycleway
 - 7.00.03 SCA

3.2 Number of submissions

The SCA received a total of 147 submissions during the consultation period. Thirty one (31) submissions were from groups and 116 submissions were from individuals.

3.3 Contact group

Of the total 147 submissions received, the majority were from individuals from the Southern Highlands area. Five (5) submissions were received from NSW Government agencies or local government:

- NSW Department of Primary Industries (submission reference number 26)
- Department of Environment and Climate Change (submission reference number 79)
- Department of Water and Energy (submission reference number 124)
- Wingecarribee Shire Council (submission reference number 78 and 81)
- Hawkesbury Nepean Catchment Management Authority (submission reference number 80)

Submissions were received from the following organisations, community or special interest groups:

- Upper Nepean Groundwater Community Reference Group (submission reference number 84)
- Southern Highlands Business Chamber Inc (submission reference number 4 & 83)
- Save Water Alliance (submission reference number 12, 46, 121, 132, 133, 136)
- Robertson Ratepayers Association (submission reference number 8)
- National Parks Association of NSW (submission reference number 25)
- NSW Farmers Association (submission reference number 27)
- Nature Conservation Council of NSW (submission reference number 44)
- Illawarra Escarpment coalition (submission reference number 53)
- Kiama Greens (submission reference number 65)
- National Parks Association, Southern Sydney Branch (submission reference number 68)
- Blue Mountains Conservation Society (submission reference number 108)
- Illawarra Greens (submission reference number 116)
- The Australian Orchid Council Inc (submission reference number 119)
- The Australasian Native Orchid Society Inc (submission reference number 120)
- Illawarra Community & Environment Connection (submission reference number 122)
- Rivers SOS (submission reference number 126)
- Robertson Environment Protection Society (submission reference number 127 & 147)
- Gujarat NRE FCGL Pty Ltd (submission reference number 135)

The submission from the peak advisory group (the Upper Nepean CRG) is attached at Appendix 2.

As indicated in Figure 1, almost 80 percent of submissions were received from individuals. Seventeen (17) and three percent of submissions respectively were received from community or special interest groups, government agencies and local council.

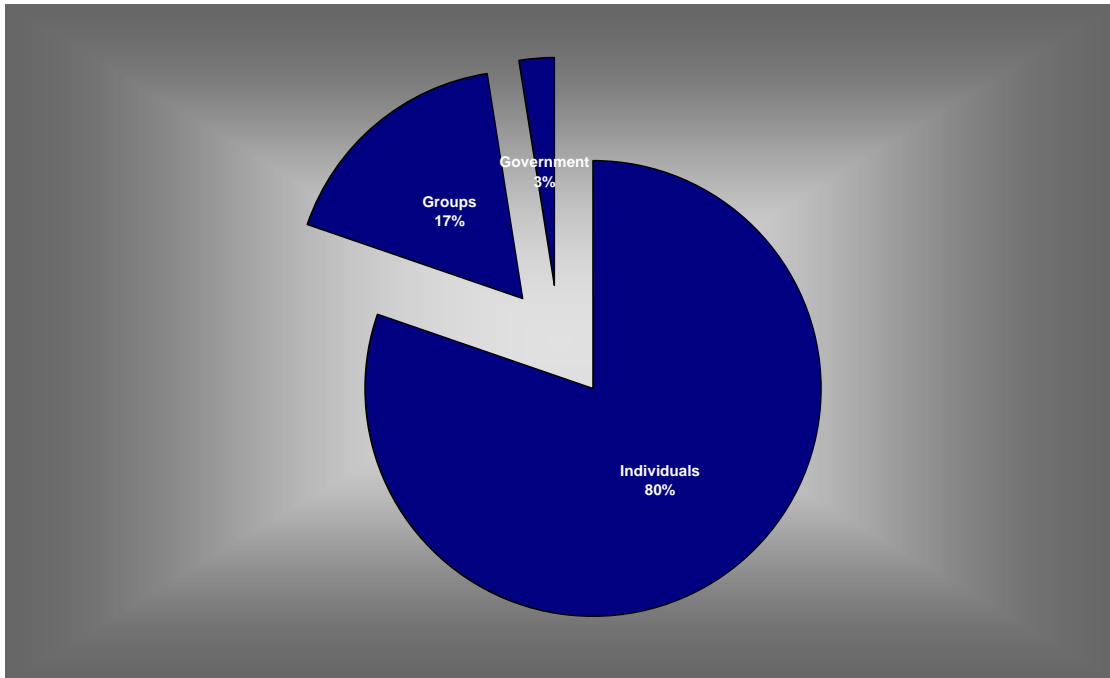


Figure 1 – Contact group

3.4 Geographical region

As indicated in Figure 2, 76 percent of all respondents were from the Southern Highlands and 13 percent were from Sydney. Of the remaining respondents, 6 percent were from the Illawarra region, 3 percent from the Kiama area and 2 percent from other areas.

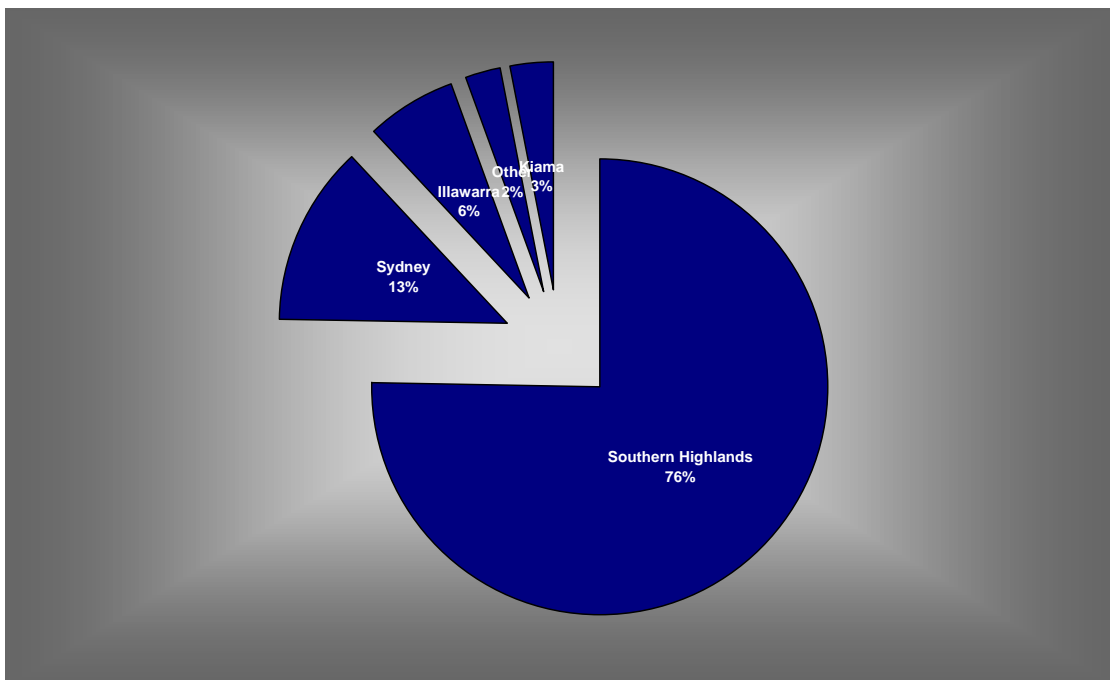


Figure 2 – Geographic area of interest of submissions

4. Issues analysis

4.1 Issues and responses

The table below outlines the key issues that have emerged through the submissions and provides the Sydney Catchment Authority's (SCA) response. The key issues are actual quotes from individual submissions.

	Issues	Responses
2.00.00 Environmental Impacts / Issues (51 comments recorded)		
82	The health of the Kangaloon Aquifer and subsoils will be jeopardized and may take hundreds of years to recover. Large scale soil erosion may occur causing major problems for future water catchment areas. This is a massive risk with major unknown environmental consequences.	Recovery of aquifer water levels will be actively managed. Soils will not be affected by borefield extraction. The borefield construction is low impact as evidenced by the regeneration of vegetation after bore construction and the pumping trial activities. No large scale erosion of soil will result and contractors will be managed to address potential local impacts.
97	This Government is being very short sighted to think that 75 bores sunk 90-150m into the sandstone aquifer and extracting 0.5 to 1 million litres per day will have no impact on the environment, I believe there will be an impact	The EA has provided a comprehensive identification and assessment of potential impacts.
81	After long and ongoing exposure to the results of test trials and many presentations from the SCA, I am still not convinced that there will not be any long-term consequences of the project upon the local Environment.	The studies are substantial and conclude that borefield development and operation is viable. If there are additional uncertainties, these can best be resolved by increased and targeted monitoring, and an adaptive management approach to borefield operations.
5	We do not accept that the environmental impact on the area can be assessed in the contained studies to be minimal nor do we accept that the environmental impact can be predicted with any certainty. Therefore we see significant environmental and ecological risk in the: wholesale extraction of groundwater.	The SCA has commissioned and completed substantial technical, scientific and environmental investigations (numbering more than 90 studies) on the groundwater resource at Kangaloon and the local environment of the proposed borefield area. The investigation programs began in the Upper Nepean (Kangaloon) in March 2005 and monitoring programs have been under way for more than three years. The scientific method and logic that has been used for these reports is rigorous and is considered best practice. Investigations have been staged, conclusions reviewed and the important recommendations acted upon. This approach is endorsed by all peer reviewers. No flaws have been identified with the investigation and assessment process.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 3, 7, 9, 18, 21, 24, 25, 28, 30, 32, 34, 35, 40, 41, 65, 73, 84, 87, 97, 98, 100, 101, 114, 116, 125, 128, 133, 140		

2.01.00 Water Systems (10 comments recorded)		
125	The Water catchment area in which the water is to be 'harvested' already provides water to the Sydney system through natural drainage into the as yet unspoiled rivers and creeks.	Baseflow derived from several groundwater aquifers does contribute to the water supply that collects in the Nepean Dam. However the main baseflow sources are the basalt springs in the elevated portion of the catchment and drainage from sandstone strata in the gorge landscape to the north of the borefield. Studies have shown that baseflow contributions from sandstone aquifers to streamflow in the vicinity of the borefield are minimal. Most of this water is in transit to the groundwater discharge areas located lower in the catchment. Modelling has shown that baseflows will continue to flow to rivers except in the immediate area of the borefield where groundwater is accessed early and directly. The natural rate of groundwater flow is of the order of metres per year and therefore occasionally taking water from storage in the sandstone aquifer system in the upper parts of the catchment will have limited influence on the primary baseflows across the catchment
44	The project will impact the current natural hydrology of the area including natural flows supplying the reservoir and surrounding ecosystems,	Several substantial studies have been completed during the pilot testing and pumping trial stages that show that surface water - groundwater connectivity is limited in this part of the catchment. Deep sandstone aquifers are poorly connected to permanent streams and are not connected to upland swamps - the project is not expected to impact local streams or ecosystems but will be the subject of ongoing monitoring.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 7, 44, 47, 59, 66, 116		
2.01.01 Rivers Creeks (130 comments recorded)		
96	The conclusion from McLean and others was based on the observation that during a pumping trial only 5% of the groundwater pumped originated from streamflow as measured by tracers. However, the measure of 5% was for the full time of the trial. At the completion of the trial pumping, the pumping bore had high concentrations of tracer present, though the report does not provide the exact amount. Though the report is correct in concluding that only about 5% of the water extracted from the bore originated from the creek, this was over the time of the pumping. The data clearly show that the proportion of streamflow extracted as groundwater increased markedly over time and at the end of the pumping trial the proportion of streamflow intercepted was much higher than 10%. This latter time period is more likely to be representative of longer term conditions than the conclusion reported by SCA.	Latest tritium results suggest that surface water losses (induced recharge) are less than 5-10 percent of the pumped volumes. There is no evidence to support losses of 10 percent or higher, although the latest transient modelling suggests that losses (combined induced recharge and captured discharge) may be as high as 20 percent during periods of extraction. Once the stream becomes disconnected from the underlying fractured sandstone (and this happened at Doudles Folly Creek within 48 hours of the commencement of the pumping tests), the leakage from the stream is limited and is determined by the vertical hydraulic gradient and the permeability of the fracture zones. Conversely once regional groundwater levels recover to the base of the stream then no further losses will occur to groundwater. During the pumping test, recovery to stream bed level occurred within 10 days.

124	A discussion of potential impacts on both low and zero flow periods in relation to the NSW River Flow Objectives is required. It is often assumed that if streams are ephemeral that no impact will occur (refer to section 4.5.1 2nd paragraph). The ecology of these streams is adapted to periods of drying but may not be adapted to extended periods of drying which may be caused by production pumping	Water in ephemeral streams is derived from runoff and the basalt springs higher in the catchment and there is no hydraulic connection with the sandstone aquifers when they flow across the Hawkesbury Sandstone terrain. As the aquifer and water in ephemeral streams are hydraulically disconnected, pumping the sandstone aquifers cannot influence or dry out the streams in any way.
20, 41	or the vegetation and large trees that would suffer as the water table drops with the emptying of the aquifers and springs.	There is no evidence to suggest that terrestrial vegetation is dependent on the groundwater in the fractured sandstone in the borefield area. Available water level and other monitoring data, and technical studies (Lesryk, SMEC, PB) indicate vegetation depends predominantly on surface water.
6, 11, 13, 15, 17, 22, 23, 33, 34, 36, 83, 86, 118, 131	This is not a new water source. The borefield simply advances the delivery time of water draining into the Nepean Dam. By draining the Aquifer at times of severe drought, the SCA threatens to disrupt the natural flow of water from the Aquifer to the river. The SCA documentation shows that this aquifer water drains slowly and naturally to the Nepean Reservoir. Leave this natural flow of water from the Aquifer to the Rivers alone.	The important issue here is the timescale at which water flows through the sandstone strata to discharge as baseflow lower in the catchment. This residence and flow time is of the order of thousands to tens of thousands of years. The sandstone groundwater is water that would not be available during any drought period hence the borefield strategy is to take part of the storage volume during drought close to the recharge area, and allow the depleted storage to recharge and recover at the conclusion of each drought period.
96	These conclusions about the volume of induced recharge caused by groundwater extraction from the proposed borefield will result in two types of impacts. Firstly, water will be induced from the regulated systems of Doudles Folly Creek. This will result losses of surface water flow and a misrepresentation of the amount of water that can be added to the overall water supply for Sydney. Secondly, induced recharge from unregulated streams will cause changes to the flow duration characteristics of these streams and possible impacts on in-stream ecosystems.	Research and development (R&D) studies, the pumping trial and the transient modelling studies suggest that stream connectivity is low and losses are around 5-20 percent across the area. The induced recharge from streams is very low in comparison to actual stream flow and the volumes of groundwater that are expected to be pumped. Impacts to unregulated (permanent) streams by inducing recharge are minor because of low connectivity along the Nepean River and expected similar conditions along other unregulated streams. Impacts on ecosystems are not expected however baseflow and ecosystem monitoring is proposed on important unregulated streams.

96	<p>There are two types of impacts from groundwater extraction on streamflow. Firstly, when a drawdown cone from groundwater pumping intercepts a stream or river, water can be induced out of the stream into the groundwater system. This water then becomes additional recharge to groundwater and is termed induced recharge. Secondly, when water is extracted from a borehole, it changes the water balance in the aquifer such that an equivalent volume of water must be lost from discharge somewhere else in the aquifer. This holds due to the requirement to conserve the mass of water in the overall system — that is, one can't create additional water just by pumping. This change in the discharge characteristics usually relates in lower groundwater discharge rates to streamflow at some stage in the future after pumping. This volume is termed captured discharge. The impact of this latter process is felt at the site where the groundwater would have discharged had pumping not occurred. This can be many kilometres away from the pumping site and is determined by the nature of the discharge processes in the aquifer.</p> <p>47. The EA provides estimates of the impact of groundwater extraction from the proposed borefield on the areas surface water. These estimates were derived from two primary sources - Coffey Geosciences (2006) and McLean and others (2008). The estimates only relate to the potential to cause induced recharge and do not relate to captured discharge.</p>	<p>The EA discusses the processes and effects of borefield pumping on the local streams. In this catchment the connectivity is poor and the impacts to streams are relatively minor. Testing and research to date indicates that induced recharge is less than 5-10 percent of the water pumped at Doudles Folly Creek (unlikely to be more than 3 or 4 bores that would influence the creek so the sum total of effects would be less than 0.5-1 ML per day) and less at other sites. Similarly the captured discharge component (based on modelling studies is low and is expected to be of the same order of magnitude). Ongoing monitoring of baseflows will assist in verifying and managing any impacts.</p>
18, 30, 35, 41	<p>No satisfactory answers have been given by the SCA to the farmer's pleas, to where they would get their water from for their stock, when their creeks, bores and springs run dry.</p>	<p>No impact on ephemeral creeks and springs is likely because these water sources are disconnected from the sandstone aquifer. If there was an identifiable impact, the NSW Government has made a commitment regarding the sustainability of existing private water supplies with the undertaking that existing users will not be disadvantaged. The options available to maintain supplies include lowering pumps and deepening bores. This will not be at the expense of landowners.</p> <p>Also should private bore users experience a reduction in water supply that is clearly attributable to the operation of the project, modifications will be made to existing bores and/or pumps, or compensatory measures will be offered. Measures may include modification to existing bores (e.g. lowering of pumps or deepening/replacing bores) or the provision of alternative water supplies, not at the landowner's expense.</p>

1	The proposal mixes water derived from different catchments which is also contrary to best practice.	There is no mixed water for this proposal - the groundwater is recharged locally in the Upper Nepean catchment (and eventually discharges to streams in the same catchment). Surface water and groundwater catchment boundaries are generally contiguous.
1	It is suggested that the creek beds that will carry groundwater to Sydney are damaged by cracking from long wall mining allowing water to flow from the creek bed back into the ground through these cracks. I do not know if this correct. If true I therefore question the practicality of the proposal and the assumptions made from trial pumping.	There are no operational longwall mines within the borefield area, and there is only one lease under a small portion of the eastern borefield area.
18, 20, 28, 30, 35, 40, 41	No consideration has been given to the creeks that would dry up due to draw down	Discharges from the basalt springs higher in the catchment contribute most to the baseflow of the permanent rivers and creeks in the project area. The streams in the sandstone section of the catchment also contribute some baseflow (hence are described as connected-gaining). Modelling predictions are that the Nepean River (in the central area of the Upper Nepean (Kangaloon) borefield) will change from a slightly gaining stream (where flow increases because of discharge from groundwater storage) to a slightly losing stream (where water from the stream seeps into the groundwater storage). Doudles Folly Creek and creek systems to the east (Dudewaugh, Burke, and Little River) will remain gaining streams, although the volumes discharging will be slightly smaller. No negative impacts are expected on baseflows downstream of the two project discharge locations and the area of influence of the borefield. Overall only a minor impact on permanent stream flow is anticipated as a result of the groundwater pumping. Ongoing monitoring of stream and groundwater levels (including ecosystem conditions if required) will determine long-term trends and management responses.
78	Similarly a target that restores water extracted from rivers to sustainable levels directly contradicts geomorphic and hydro geological processes of aquifer's i.e. one of the principal characteristics of an aquifer is that, in time, water is released from the aquifer to rivers and streams thus in part sustaining these systems.	The main groundwater discharge areas located lower in the catchment in the incised gorge portion of the catchment are not impacted by the borefield proposal. Permanent streams in the borefield area have poor connectivity and are relatively unaffected by changed gradients - the major impact to streams is the transfer of treated groundwater to the Nepean Dam via the Nepean River - impacts are described in the EA

18, 20, 28, 30, 35, 40, 41	The damage to the Illawarra and its water supply will be irreversible, and this is in an area that already supplies Sydney with daily water that drains naturally into the Nepean.	The project contributes to the long term security of supply to Sydney and the Illawarra as part of the Governments Metropolitan Water Plan (MWP). There is no impact on the hydrology of the Illawarra escarpment or coastal streams. Pumping trials show no impact at distance and certainly none as far away as the Illawarra escarpment. Drawdowns were only within 1-2km and groundwater recharge after each of the pumping trials was localised and was not from areas "outside the borefield". The transient modelling shows drawdowns over a larger area but the area does not extend to the Illawarra escarpment except under long term pumping and extreme drought.
84, 96	The research showed some significant differences in aquatic habitat that were due to changes in flow levels and changes in in-stream habitat from the pumping trial discharge	No ecosystem changes were identified or were caused by the pumping trial activities. The 6-monthly ecosystem studies did however identify some seasonal changes
91	Lowering the groundwater level for sustained periods could have a major effect on the wetlands and canopy trees, especially if pumping is carried out during severe droughts as proposed. Groundwater may also fail to flow into the catchment streams,	There is no evidence to suggest that terrestrial vegetation is dependent on the groundwater in the fractured sandstone in the borefield area. Available water level and other monitoring data, and technical studies (Lesryk, SMEC, PB) indicate vegetation depends predominantly on surface water.
96	This is of concern as pumping may affect this highly pristine creek, also, further down the creek there are two waterfalls with 7 and 11 metre drops (CMA map) which were not monitored but could be sites of groundwater discharge due to their lower elevation and may be affected due to pumping. This creek already drains to the Nepean Reservoir so if the creek is affected by pumping then less than the extracted water is actually gained	The Tourist Rd pumping trial with upstream and downstream gauging stations did not detect any streamflow losses along this section of the Nepean River. Also the area of influence associated with pumping bores is a few hundred metres so more remote features (like these waterfall areas which may be groundwater discharge features) are unlikely to be impacted. Monitoring will be in place to detect stream losses when the borefield is operational.
53	This pumping process would not really 'increase supply security' for Illawarra as its supply comes from Cordeaux and other dams closer than Warragamba. In fact, Illawarra creeks in the area below Kangaloon would probably be starved and water security decreased (in a similar way to what has happened when mining companies disrupt the natural flows into Illawarra's creeks.)	Potable water to the Illawarra is solely supplied from a pumping station at Avon Dam which is linked to Nepean Dam. This dam will receive all flows from the borefield. There is no evidence from monitoring during the pumping trials or the groundwater modelling that discharges to streams on the Illawarra coastal plain will be impacted.
1	To assert that there "was no impact" just cannot be right. The level of the Nepean river immediately downstream of the discharge points of pumping must have been raised if nothing else	The monitoring during the pumping trial (when 4 ML per day was being discharged to the Nepean River suggested no adverse impact to the stream - water levels were raised a few centimetres but the levels were within the natural levels for low baseflow situations

84	A third concern is the potential upstream drawdown on the Nepean River, which was not monitored during the pumping test. Any drawdown upstream will impede water entering the reservoir and affect the ecology of the area.	The was no drawdown in observation bores south of Tourist Rd during the Tourist Rd pumping trial, and while it is true that there was no stream monitoring south of the upstream location at the Tourist Rd bridge, the extent of drawdowns surrounding the closest production bore 2F suggest there would not have been any impact on river flows upstream of this location.
1	The proposal trials have mixed ground water with water running in river systems which is contrary to good practice. The ecology of the river environments must surely be affected by mixing water taken from the ground at Kangaloon and mixing it with surface flows. The proposal is "pollution" as defined in POEO Act. Was a pollution licence obtained for the investigation programs referred to in your Newsletter No. 4?	Groundwater naturally discharges to the Nepean River so the ecology (especially during low baseflow situations) adapts to occasions with higher groundwater components to the flow. Also the groundwater is mostly the same water quality as the surface water (with the exception of iron, manganese, dissolved oxygen and temperature which will all be removed or adjusted by the water treatment facilities). Discussions with DECC prior to the pumping trials confirmed that a Protection of the Environment Operations (POEO) Act licence was not required for the investigation program provided monitoring programs were in place.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 8, 9, 16, 25, 26, 32, 34, 38, 39, 44, 65, 70, 73, 75, 79, 90, 92, 95, 108, 114, 116, 119, 120, 122, 126, 127, 128, 140		
2.01.02 Springs (39 comments recorded)		
124	The document refers to springs sourced from basalt aquifers and states that there is unlikely to be any connectivity between the basalt and sandstone aquifers. Is it possible that springs could be sourced from the sandstone aquifer? The report has not identified ecosystems that may rely on springs in the area yet it refers to potential loss of water from springs and compensation.	Springs cannot be sourced by water from the sandstone aquifer where the basalt rocks occur high in the catchment and tens of metres above the top of the sandstone strata. Sandstone groundwater does not flow uphill but rather flows to the north following the topography and the dip of the strata. SCA studies show no connectivity between the sandstone and the basalt aquifer systems along the Mittagong Ranges and this disconnection is expected to be maintained even if a borefield were constructed and operational for a long period. Monitoring will be in place to monitor spring levels and flow at key sites. The comment regarding compensation if springs were affected is a precautionary measure and does not imply there is connectivity between the two aquifers.
96	The EA acknowledges that the groundwater system around Mt Butler is different to the rest of the area, whereby the Basalt aquifer sits directly on and intrudes the sandstone aquifer. This presents a major risk to Butlers Swamp in that pumping in the vicinity of Mt Butler will affect water levels in the Basalt and, ultimately, flows from springs surrounding the Basalt. These springs play a potentially important role in the hydrology of the swamp. Much more definitive work is required in the area before all risk has been properly dealt with.	There are springs in the Mt Butler area that appear to be in direct contact with the sandstone strata so these sites will be monitored more closely. The comprehensive investigations completed at Butlers Swamp (which is the north of Mt Butler) indicate it is entirely supported by rainfall recharge. There is no spring flow to the swamp and there is no deep groundwater linkage supporting the swamp. This disconnection ensures the swamp will not be impacted by the proposal. Monitoring will further ensure that Butlers Swamp will not be impacted by the borefield proposal.

98	Some farmers in the area have reported springs drying up. I believe the SCA have not included this information in their reports.	The SCA has kept in close contact with the community during the entire investigation process. One complaint has been received during the last three years about springs drying as a result of SCA pumping. It is believed that the springs were affected by the severe drought conditions. At the time of the complaint, the SCA had not commenced any pumping trials in the area. In fact, pumping trials commenced six months after this claim and no impacts were identified.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 9, 18, 20, 21, 28, 30, 32, 35, 40, 41, 53, 70, 73, 75, 82, 84, 90, 92, 93, 94, 95, 122, 128		
2.01.03 Groundwater (210 comments recorded)		
82	Over 150km of land above the aquifer - all Trees, plants, animals, soils, subsoil's, micro organisms will all be negatively affected by the reduced soil water-moisture content, when the water-table drops	Pumping the (disconnected) sandstone aquifers does not affect soil moisture levels or perched water bearing zones.
96	For years farmers have been encouraged to conserve the groundwater and to become involved with catchment management, which has led to improvements in water quality. This proposal negates the goodwill previously generated	The borefield will be operated within sustainable limits for sandstone aquifers as defined by DWE. The SCA will continue its efforts together with farmers to improve catchment management and water quality. It is anticipated local farmers will continue to value the local and broader community benefit of such approaches. Improved land management and other conservation measures have been implemented over the last decade. This borefield proposal has been factored into sustainable yield calculations for the sandstone aquifers in this area and therefore should not compromise long term water balances and catchment health.
78	Similarly a target that restores water extracted from rivers to sustainable levels directly contradicts geomorphic and hydro geological processes of aquifer's i.e. one of the principal characteristics of an aquifer is that, in time, water is released from the aquifer to rivers and streams thus in part sustaining these systems.	The primary groundwater discharge areas for these sandstone aquifers will not be affected by this borefield proposal. While it is true the catchment hydrology and water balances will be changed for a relatively small time during extreme droughts, the impacts will be small and manageable. The catchment hydrology and hydrogeology within the borefield area will be monitored.
133	That is especially true when talking about massive interference with the groundwater in a Fractured Sandstone Aquifer. All aspects of the environment of the Aquifer are affected by the presence of groundwater just under the surface of the fractured, porous rock base which is the Sandstone substrate.	The EA describes the anticipated environmental impacts of the proposal. The extraction of groundwater will be within the sustainable yield of the regional aquifer (Nepean sandstones) and no significant impacts are expected to the natural environment. Monitoring will be in place to monitor baseflows and key ecosystems when the borefield is operational.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 6, 8, 9, 11, 13, 15,16, 17, 18, 22, 23, 24, 25, 26, 28, 30, 33, 34, 35, 36, 38, 39, 41, 44, 46, 52, 53, 55, 65, 75, 82, 83, 84, 86, 87, 97, 99, 101, 103, 104, 105, 106, 107, 108, 110, 111, 112, 113, 114, 116, 117, 118, 122, 126, 127, 128, 131, 135		

2.01.04 Dams/Tanks (2 comments recorded)		
123	We have till now relied on the dam on our property along with our house water tanks for water supply. Can you guarantee that our dams water supply will not be affected?	The project will not affect surface runoff to private dams.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 91		
2.02.00 Water Quality (132 comments recorded)		
6, 11, 13, 15, 16, 22, 23, 33, 34, 36, 38, 39	Also the aquifer is intact, and is not subject to evaporation or contamination.	The project will not change these values and groundwater will be left in natural storage until required during severe and extreme drought conditions
124	Nutrient levels in receiving waters are not assessed.	There are no nutrients in the groundwater being pumped, so it is not important that the nutrients in the receiving waters be assessed. There is a neutral or beneficial effect of pumping groundwater to the Nepean River.
124	It is difficult to assess the effect of discharge of groundwater on dissolved oxygen water and temperature without also assessing the effect of flow.	Dissolved oxygen and temperature will be adjusted at the water treatment plant to ambient conditions. The EA assessed the potential impact of groundwater discharge to surface water quality in the context of the stream hydrology and aquatic ecosystems. Different groundwater discharge volumes (and resultant flows) will not impact the aquatic habitats or water quality in stream.
44	changes in water quality and river flow that will affect aquatic habitats, and habitat flooding.	Dissolved oxygen and temperature will be adjusted at the water treatment plant to ambient conditions. The EA assessed impacts on aquatic habitats and concluded there were no water quality impacts and only limited flow impacts. Slightly elevated flows have a local and short term effect, and platypus burrows are unaffected.
18, 28, 30, 35, 40, 41	If the past is anything to go by, in 1998 Wingecarribee dam had all its fish population die, when too much Aluminum Sulphate was introduced to the dams water.	There are no parallels with Wingecarribee Reservoir and this borefield proposal and the proposed water treatment options.

96	Water quality samples were collected after six weeks of groundwater recovery. The ANZECC (2000) guidelines and threshold criteria for pH, dissolved oxygen, iron, manganese and nitrogen and phosphorus nutrients were exceeded in groundwater, surface water and discharge water. Apart from iron and manganese there were no significant differences with the upstream water. This is of concern due to these elements (and others) being outside the ANZECC guidelines and discharging into the upper Nepean River (previously a class '5' waterway (specially protected).	These are natural attributes of the catchment. It is not unusual for the water quality in individual streams to be outside ANZECC guidelines and the guidelines recognise that this occurs. Groundwater in Hawkesbury Sandstone has typically high levels of iron and to a lesser extent, manganese. Similarly the surface waters have high levels of iron.
125	The water so far has not been as pure as originally stated. The quality of water being pumped into the creeks has fallen below the standards set by the SCA.	The groundwater quality is compatible with the Nepean River surface water quality, and there have been no changes over time. Water treatment will address the iron, dissolved oxygen and temperature differences.
44	Pumping tests at the Butlers Swamp Trail demonstrate that the ANZECC (2000) guidelines were exceeded in pH, dissolved oxygen, iron, as well as manganese, nitrogen and phosphorus nutrients in the discharged water, groundwater, and the surface water. ⁷ This is a water quality concern as the water discharges into the Upper Nepean River, a specially protected MCA waterway.	Water treatment will address the iron, dissolved oxygen and temperature differences. Manganese concentrations are similar to stream concentrations and will not pose an issue to instream ecology. The nitrogen, phosphorus concentrations in discharged groundwater associated with the Tourist Rd pumping trial were marginally above the ANZECC criteria on selected occasions but generally below the concentrations occurring instream. Observed levels are not a concern.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 8, 9, 20, 22, 24, 25, 37, 46, 48, 49, 50, 51, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 68, 69, 71, 72, 74, 76, 77, 78, 79, 83, 84, 86, 87, 91, 99, 103, 104, 105, 107, 108, 110, 111, 112, 113, 114, 116, 117, 118, 119, 120, 127, 131, 132, 133, 138, 139, 140, 141, 142, 143, 144, 145		
2.02.03 Temperature (2 comments recorded)		
124	Is it possible that a strong correlation between surface water temperature and air temperature could occur regardless of an increase in water temperature caused by input of groundwater?	Yes, there is a strong diurnal correlation between surface water temperature and air temperature. Groundwater temperatures will be adjusted to be compatible with surface water
124	Figure 5.4 indicates a difference of 2°C in water temperature between the 2 upstream and downstream sampling locations on the sampling occasion.	Table 4.6 in the EA shows up to a 2°C difference between surface water and groundwater temperatures in June 2007 during the trial – the target for any production scheme is to be within 1°C because of the more rigorous water treatment with a 2°C threshold being the maximum divergence.

2.02.04 Iron and Manganese (132 comments recorded)		
114	This iron (totalling 24,750 kg/ month) and associated sludge water is proposed to be taken away in tankers and dumped at an appropriate landfill site. It has the potential to pollute streams in its oxygenated form, with associated bacteria forming oily looking scums in slow flowing rivers or pools. Alum is also proposed to be used in treatment near the Nepean River (previously a class 'S' waterway (specially protected)) which is a concern. Other minerals and chemicals may also be involved.	Iron sludge will be dried before being trucked to landfill - no sludges will be released to the Nepean River under normal operating conditions and hence there is no pollution potential. If a large over bank flood occurred that inundated the collection ponds, some iron would be lost in floodwaters but the dilution effect would be very large.
78	The waste management of iron residue extracted the water is a matter that requires further clarification particularly the matter of how the waste product is managed.	Iron sludge generated from the water treatment process will be discharged into two collection ponds at each WTP site (one filling and the other drying). Ponds will be bunded so that sludge accumulates, dries and is then removed every six months at a minimum. If a large over bank flood occurred that inundated the collection ponds, some iron would be lost in floodwaters but the dilution effect would be very large.
84	Iron concentrations are sufficient to cause problems with production bores, pumps, and pipes. The water treatment facilities for iron removal are extensive, including aeration and sand filtration. Backwashing of the sand filter will be required every few days, and this backwash then needs treatment using Aluminium sulphate to settle the solids. The use of this chemical adjacent to the Nepean River (previously a class 'S' specially protected waterway) is of concern.	The amount of alum to be added to the collection ponds to accelerate flocculation is minimal. All ponds are bunded and lined so there is limited potential for chemicals to escape to the Nepean River. If a large over bank flood occurred that inundated the collection ponds, some iron would be lost in floodwaters but the dilution effect would be very large.
18, 28, 30, 35, 41	The E.A. made no mention of earth tremors that could so easily unsettle the settling ponds and the large amount of extremely toxic iron that would have to be removed 24 hours a day.	Earth tremors do not crack ground - a severe earthquake would be required to cause such damage. Also the water collection ponds are less susceptible to any such damage (in the extremely rare event that it did occur) because there is unconsolidated alluvium above the sandstone bedrock at this location and these sediments would compact slightly rather than crack
24	Pollution - the pumping trials have highlighted problems with fouling of bores, pumps and pipes.	This is a natural phenomenon in water bores and is easily treated

18, 28, 30, 35, 40	These aerial photos revealed not only the alarming devastation to the area, but a very large swathe of orange iron sludge making its way down the contours of the landscape towards a water course.	Natural iron sludges or deposits rarely occur in the landscape, and they would not migrate except if being eroded and transported by water. SCA is unaware of any natural iron sludge areas. The aeration fountains that were in place for the pumping trials caused minor iron sludge accumulation in the detention areas but this did not migrate. Subsequent regrowth in these areas has seen the iron oxides being consumed into the soil profile and it has not left any permanent impact. The proposed water treatment plants and sludge collection ponds will be a dedicated facility to contain all the iron sludge generated in any permanent borefield.
97	Waste sludge from the removal of manganese, iron and other impurities from the water to deem it drinkable has the potential to seep into the local wetlands and swamps causing pollution. This waste sludge (iron) is attacked by bacteria which in turn removes oxygen from the water killing life in any wetland it may flow.	Sludge will only be generated at the water treatment plants and be contained in the collection ponds. There is no potential to impact swamps or wetlands.
54	Not all the iron will be separated in the settling ponds and volumes will spill into the creeks taking the water to the Nepean River. The results of this will be higher iron content in the streams that when naturally broken down by water borne organisms create an oil type slick on the stream surface reducing oxygenation of the water and killing off parts of the streams.	The aeration and sand filtration process is highly efficient for iron removal and concentrations below 0.5 mg/L are expected in the discharge water. No impact on the ecology of the streams is expected. Iron staining already occurs with discharging groundwater in the natural environment - water quality and ecosystems will be monitored during any pumping cycle
84, 96	That would be less likely to have consequences for existing users. There could be a separation of old, "iron-free" water in the lower aquifers from the younger, "iron-rich" water in the upper aquifers. However, the SCA have failed to prove the total variation of water quality or age within separate aquifers as the bores have taken mixed water, due to the design of the bores themselves. The assessment of water quality was based on cumulative water samples down the boreholes and iron content, for example, was determined only for the total cumulative sample from the completed bore.	The fractured aquifers within the sandstone strata are naturally linked and it is not possible to take just "low iron" groundwater. Every production bore has aquifers at different depths, the nature of the sandstone also differs from site to site, and consequently there are different iron concentrations from different bores and areas.

84, 96	The pumping trial produced large amounts of iron sludge, which spilled over the retention pond with the extracted water towards Dudewaugh Creek approximately 100 metres away. This aerated iron can cause pollution of the creek as associated bacteria breaks it down and forms an oily substance especially in pools and slow flowing streams. This spill needed to be independently assessed and is an indication of a lack of safeguards with pumping and a general lack of independent monitoring.	The pumping trials and the aeration fountains that were in place for both the pumping trials were successful and caused iron sludge to accumulate in the main detention areas. The final detention pond at the Stockyard Swamp site retained some iron oxides that were not deposited in the extensive laterite area upgradient. Minor iron staining was evident at the pond overflow but there was no iron sludge deposited downstream in the swampy area towards Dudewaugh Creek. Subsequently in both trial areas, the iron has been consumed into the soil profile has not left any permanent impact. There were no spills during the pumping trials, and the detention areas operated as expected. The temporary iron treatment arrangements were approved in a Review of Environmental Factors under the SEPP, and auditing/compliance reporting has indicated regeneration and no long term impacts.
84, 96	That the SCA investigate the extraction of only the water within the basal aquifers of the Hawkesbury Sandstone. Our interpretation of their data is that it is the oldest and the most pure and may not require any treatment for iron.	The fractured aquifers within the sandstone strata are naturally linked and it is not possible to take just "low iron" groundwater or groundwater from the basal aquifers.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 6, 8, 11, 13, 15, 16, 20, 21, 22, 23, 33, 34, 36, 38, 39, 40, 44, 46, 48, 49, 50, 51, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 68, 69, 71, 72, 74, 76, 77, 83, 86, 87, 91, 98, 99, 101, 103, 104, 105, 107, 110, 111, 112, 113, 117, 118, 120, 122, 124, 127, 129, 131, 132, 138, 139, 140, 141, 142, 143, 144, 145		
2.02.05 Salinity (3 comments recorded)		
82	Medium/long term pumping, unpredictable rainfall due to global warming, many trees die, soil & eco systems change, may cause a massive increase in salinity and erosion	Salinity in the Australian arid and semi-arid landscapes is generally the result of deforestation and rising water tables. While there is some salinity associated with shales in the Kangaloon area, pumping does not influence the shale and hence salinity will not be an issue in this landscape. Also with the proposed buried infrastructure, there is no potential for erosion.
3	There is no indication of the possibility of mobilisation of salt as the ancient water is consumed and replaced by more modern water	Modern groundwater is mostly fresher than the older water at depth and should actually improve the quality of the groundwater over time
2.03.00 Water Release and Transfer (1 comments recorded)		
124	Potential impacts of discharge of groundwater to stream	The monitoring during the pumping trial (when 4 ML per day was being discharged to the Nepean River) suggested no impact to the stream. Water levels were raised a few centimetres but the levels were within the natural levels for low baseflow situations.

2.03.04 Location of Discharge Structures (2 comments recorded)		
124	Would it be possible for the water to be piped to a discharge point further downstream that is already impacted by Shoalhaven releases?	Area 4 of the proposed borefield will discharge in an area already affected by Shoalhaven transfers - the costs involved in transporting water from Areas 1, 2 and 3 to below the confluence of Doudles Folly Creek and the Nepean River would be high and are not justifiable for a drought water supply scheme. Also the impact of constructing the pipeline, through natural bushland to this area, plus additional pumping costs, would cause more environmental impact than the proposed scheme at the Tourist Rd location.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 54		
2.03.05 Water Treatment Plants/Chemicals (27 comments recorded)		
123	We understand that the said property may be used for the purpose of water settlement ponds. It is not unreasonable to assume that the breeding of mosquitos will increase if an expanse of water is created. Can you guarentee that our daughters will not be affected by potential mosquito breeding ponds?	Substantial areas of open water exist across the region. The drying ponds are a minor increase in that area and are the equivalent of a large farm dam. Each pond will be less than 2ha in area, and during the infrequent operational periods, one pond will be drying while the other is filling. The ponds during the much longer non operational times will be dry.
119, 120	This amount of iron and associated sludge, (estimated to be 24,750 kg per month) is to be removed by tankers and dumped. at an appropriate landfill facility in its oxygenated form it has the potential to pollute water bodies with bacteria forming an oily scum in slow moving streams or pools. The proposal to use Alum to a treatment gives further cause for concern regarding pollution of the Nepean River (a class “S” waterway) and with this in mind I ask what other chemicals will he used.	Iron sludge will be dried before being trucked to landfill - no sludges will be released to the Nepean River and hence there is no pollution potential.
21	The ugliness and size of a water treatment plant and ponds to remove iron from water (which happens through natural process if left to run along its natural course)	The water treatment facilities along Tourist Road and Fire Trail Number Three will be located, designed and landscaped to minimise visual impact. Disturbed areas will be rehabilitated quickly with native local species. For this reason there will be minimal visual impact and changes to the landscape.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 18, 20, 28, 30, 35, 40, 41, 54, 78, 84, 91, 93, 94, 101, 116, 122, 124		

2.04.00 Ecosystems (206 comments recorded)		
79	Possible impacts on groundwater dependent ecosystems resulting from the extraction from the Kangaloon aquifer, recognising the possible connection with threatened species	Pumping trials have shown that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers at this time. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.
82	The major concerns are short, medium and long term (<10, 20, 50+ years) environmental damage to eco systems & infrastructure, above & below the aquifer- radius 150km.	The SCA has commissioned and completed substantial technical, scientific and environmental investigations (numbering more than 90 studies) on the groundwater source at Kangaloon and the local environment of the proposed borefield area. Further, the zone of influence of the proposed borefield, based on these studies and the results of the pumping trials is not expected to be greater than 2 to 2.5km.
140	that test pumping is done over at least one full weather cycle (i.e. drought, complete recharge and drought) there is a significant risk the long-term availability of the resources be will depleted and there will be adverse impacts on the environment	The pumping trials completed to date are the best examples of this. The next stage would be to construct all or part of the borefield and to operate it for an extended period of time. The numerical modelling suggests there will be local depletion of groundwater in the sandstone aquifers during pumping but this void recharges with normal rainfall patterns.
82	The project may impact on ecosystems lowering the regional water table. Pumping might dry the uppermost sections and some permeable parts of the sandstone aquifer. note:- the KBR report did not list all the swamps in the area. Swamps & wetlands are essential for healthy river systems. i.e. healthy catchments.	Pumping trials have shown that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers at this time. While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.

97	I strongly request this Government conduct an extensive environmental study before continuing with this Upper Nepean (Kangaloon) borefield project. Please listen to the scientific facts already undertaken by Conservation groups and consider the native fauna, flora and residents of the Southern Highlands	<p>The SCA has commissioned and completed substantial technical, scientific and environmental investigations (numbering more than 90 studies) on the groundwater source at Kangaloon and the local environment of the proposed borefield area. The investigation programs began in the Upper Nepean (Kangaloon) in March 2005 and monitoring programs have been under way for more than three years. Two pumping trials have been completed to simulate borefield extraction over extended periods and monitor the condition of surrounding ecosystems.</p> <p>The first pumping trial program near Butlers Swamp was carried out from late February 2007 to June 2007. There was no impact on the swamp or the Nepean River during this trial, and more than 450 million litres of water was pumped to the Nepean Dam.</p> <p>A second pumping trial at Stockyard Swamp ran from October 2007 to January 2008. During the trial 170 million litres of water was pumped without impacting swamp water levels.</p> <p>The EA is a substantial body of work documenting extensive investigations into the aquifer, the local environment, and the potential effects of the borefield. The evidence from this work suggests limited environmental impact.</p>
48	Construction impacts, such as habitat destruction, vegetation clearing, and pollution,	<p>The construction impacts will be minimised by using disturbed areas wherever possible and locating boreholes and pipelines such that there is only minimal removal of established vegetation. Listed threatened species and hollow trees will be avoided. It is likely that construction impacts on threatened biota will be limited to some woodland ecosystem areas. Threatened fauna and aquatic species are not likely to be disturbed to any significant degree by construction. Location of species will be identified in advance of construction and protected from any disturbance. Construction will be rigorously managed to further limit potential impacts.</p>

129	I understand that surveys of flora & fauna over recent years have highlighted the large number of endangered species in this area, which can be classified as an ecological "hotspot". Reference has been made to surveys in Spring and Autumn, but this will have missed species that thrive in intermediate seasons (and which may not appear at all in some years, unless conditions are absolutely right). To fully understand the range and nature of the biological diversity in these communities longer term studies are needed, My own interest is in mycology - how many fungi did your research find? Were lichens and liverworts included?	Threatened species were identified and mapped by SMEC in late 2007 in a special study arising out of the baseline assessment studies. Autumn and spring ecosystem monitoring is considered best practice for establishing baseline conditions and assessing ecosystem content, diversity, and health. Fungi, lichens and liverworts were not separately surveyed.
133	In the SMEC Report "Baseline Groundwater Dependent Ecosystems Evaluation Study" (September 2006) there is a Peer Review conducted by Professor Derek Eamus, Dr Hose and Assoc Prof Dangerfield, their concluding remarks are as follows: i) "There is much work to be done, however, before the following key question can be answered: what level of groundwater extraction is sustainable and what level does not pose an unacceptable threat to groundwater dependent ecosystems? This is the core question that must be addressed by the SCA prior to groundwater abstraction." Peer Review: Eamus, Hose and Dangerfield. p14 of Appendix 9 of the SMEC report. b) That single most profound question by Eamus et al remains unanswered by the SCA to this date.	This peer review attaches to the original SMEC baseline study from Spring 2006 prior to any of the later studies being concluded. Much more work has been completed since that time. Subsequent studies have indicated that there is no dependence associated with upland swamps, only minor connectivity with stream baseflows, and no known connectivity with terrestrial vegetation. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational. There is sufficient certainty about groundwater dependence (or the lack thereof) to proceed with borefield development.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 6, 7, 8, 11, 13, 15, 16, 19, 22, 23, 33, 34, 36, 37, 38, 39, 44, 46, 49, 50, 51, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 68, 69, 71, 72, 74, 76, 77, 80, 83, 84, 86, 87, 89, 90, 93, 94, 95, 96, 99, 101, 103, 104, 105, 107, 110, 111, 112, 113, 114, 117, 118, 122, 127, 131, 132, 138, 139, 141, 142, 143, 144, 145		
2.04.01 Aquatic Flora/Fauna (90 comments recorded)		
54	The project will have significant impact on the local flora and fauna and in particular impact threatened species	The EA involved extensive investigation, sampling, monitoring and modelling, and these studies concluded the impacts would not be significant.
44	changes in water quality and river flow that will affect aquatic habitats, and habitat flooding.	Operational impacts are expected to be minor and both biological and physical monitoring systems will be in place to provide an early indication of any ecosystem impact.

44	A general drying out of the landscape	<p>The EA involved extensive investigation, sampling, monitoring and modelling, and these studies concluded the impacts would not be significant.</p> <p>As an example two pumping trials have been carried out that would replicate borefield pumping in the areas of Butlers Swamp and Stockyard Swamp. Several reports on the pumping trials are included in the appendices of the EA. These reports indicate that shallow groundwater is perched and there is no additional drying out of the landscape as a result of pumping.</p>
124	A discussion of potential impacts on both low and zero flow periods in relation to the NSW River Flow Objectives is required. It is often assumed that if streams are ephemeral that no impact will occur (refer to section 4.5.1 2nd paragraph). The ecology of these streams is adapted to periods of drying but may not be adapted to extended periods of drying which may be caused by production pumping	Water in ephemeral streams is derived from the basalt springs higher in the catchment and there is no hydraulic connection with the sandstone aquifers when they flow across the Hawkesbury Sandstone terrain. As the aquifer and water in ephemeral streams are hydraulically disconnected, pumping the sandstone aquifers cannot influence or dry out the streams in any way.
124	In addition, invertebrates use the hyperheic zone beneath the surface of the stream as a refuge during dry periods.	The hyporheic zone will not be impacted by the proposal. These pools within the permanent streams will not dry out or disappear
124	It is recommended that groundwater levels in these streams be monitored during periods of drying to assess potential impacts of pumping on the hyperheic zone. This also applies to the reverse situation whereby low flow periods are reduced by the addition of water to the stream (refer to Section 9.3.2 under heading entitled Nepean River upstream of Doudles Folly Creek first paragraph)	Stream flows and levels will be monitored during operational cycles
124	Macroinvertebrate larvae (including dragonfly larvae) hatch in spring and require a certain water temperature for hatching. Particular care should be taken in relation to monitoring and control of the temperature of water inflow during this period. In addition, it is possible that a constant elevation in flow may influence egg deposition (proponent should refer to literature).	Flows and levels will be within the natural range of streamflows (except that flows will be more elevated during the extreme dry periods when this borefield would be operational). Temperature monitoring of water quality will be part of the monitoring during operational cycles.

124	The report discusses potential impacts on platypus populations in relation to the Shoalhaven releases but does not discuss potential impact from input of water from the bore field (refer to section 9.4.3 under heading entitled Water quality). It is possible that the addition of 35 to 40 ML per day to the Nepean River upstream of Doudles Folly Creek will significantly increase the velocity of water in the riffle zones. Note that the 30 ML/day release from Chichester Dam significantly increased velocities in riffles in the Chichester River downstream of the dam. The riffle zone contains the greatest diversity of macroinvertebrates compared to other habitats and it is therefore highly likely that platypus would forage for macroinvertebrates in riffles. It is also not stated in the report that a constant elevation of 0.25 m will not affect access to burrows.	Flow thresholds are set for the river.
26	Native fish populations are potentially affected by temporal changes to natural groundwater discharge	Water quality, stream flows and levels will be monitored during operational cycles. Changes are not expected to affect fish populations.
84, 96	The research showed some significant differences in aquatic habitat that were due to changes in flow levels and changes in in-stream habitat from the pumping trial discharge	No ecosystem changes were identified or were caused by the pumping trial activities. The six-monthly ecosystem studies did however identify some seasonal changes
84, 96	The Nepean River has significant platypus habitat, which was impacted by some earth bank erosion and the presence of iron flocculation.	The borefield proposal is not expected to cause earth bank erosion (stage increases will be less than 25cm) or increased iron flocculation (iron will be removed).
84	An increase in physical deformities in Mountain Galaxias was noted in both frequency and number of sites	This is not related to borefield investigations or likely operational practices
26	The fish populations are mostly upstream of major barrier dams and an impact is not indicated by the data provided thus far. However, ongoing monitoring of stream flow correlated with groundwater extraction and the ability to limit extractions to mitigate potential impacts, are recommended.	Water quality, stream flows and levels will be monitored during operational cycles

78	<p>The following relates specifically to the Draft Statement of Commitments; Action #4 refers to the Construction Environmental Management Plan (CEMP) which details the practises and procedures to be implemented to mitigate environmental impacts. Whilst the CEMP is supported, site specific issues have not yet been identified. In relation specifically to flora and fauna issues the presence/absence of significant habitat trees, threatened species, endangered communities have yet to be established. Council is concerned with the sequencing of the project in terms of releasing the EA and then if approved developing a CEMP. There appears no provision in the process to manage or assess the significance of isolated features e.g. a threatened plant, a remnant EEC</p>	<p>The CEMP documents how the construction contractors will comply with these requirements during the construction of the project.</p> <p>The EA documents the substantial investigation and identification of all these aspects. The project has been designed to minimise impacts on the environment, particularly to threatened species and communities. The EA and the Statement of Commitments define how the environment will be protected.</p>
119	<p>Apart from the certainty of a loss of orchid species, other flora and fauna will be adversely affected and several of these are endemic rare or threatened.</p>	<p>There is no certainty of loss of any flora or fauna species. All sensitive areas and known threatened species will be protected. The EA has not identified any loss of species and listed species will be avoided.</p>
79	<p>Baseline flora surveys should be expanded by establishing permanent monitoring sites within each upland swamp, building on the 10 quadrat sites that have already been established by SMEC (2007). Ideally, there would be at least one permanent monitoring plot established for each of the 17 swamp sites (as identified in Parsons Brinckerhoff 2007), because the swamps are fragmented within the study area and may behave variably.</p>	<p>Monitoring of key sites will be undertaken during and after operational cycles, however only those swamps in the area of influence of the borefield are likely to be included in the monitoring program. Studies have proven that upland swamps are disconnected from the regional sandstone aquifers.</p>
97	<p>Water being pumped into rivers would result in flooding of burrows, hollows and nests habited by native wildlife along the banks, These rivers generally run slowly and at a specific peak level. Platypus and other animals may die due to the increased flow of water which is uncharacteristic of the rivers in which they live.</p>	<p>The borefield proposal is not expected to cause earth bank erosion or flooding of burrows (stage increases will be less than 25cm) and there will be ramping up and down of flows over several days. Platypus would be more susceptible to flash floods where river heights change by metres over several hours.</p>
82	<p>Over 150km of land above the aquifer - all trees, plants, animals, soils, subsoil's, micro organisms will all be negatively affected by the reduced soil water-moisture content, when the water-table drops</p>	<p>Pumping the sandstone aquifers does not affect soil moisture levels or saturated perched water zones because they are hydraulically disconnected.</p>

68	identified as having a greater concentration of endangered vertebrates than any other ecosystem in the region by NPWS.	Listed species are addressed in the EA.
96	An increase in physical deformities in Mountain Galaxias was noted in both frequency and number of sites.	Not related to borefield investigations or likely operational practices
127	The project does not appear to have a neutral or beneficial effect on the landscape. There are risks to the catchment area from all aspects of this proposal.	Impacts on the landscape have been minimised. A neutral or beneficial effect (NorBE) test is provided in the EA documentation. There are no negative instream impacts associated with the proposal.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 5, 6, 8, 9, 11, 13, 15, 16, 18, 20, 21, 22, 23, 24, 28, 29, 30, 33, 34, 35, 36, 38, 39, 40, 41, 46, 83, 86, 87, 97, 98, 114, 118, 122, 128, 131, 133		
2.04.02 Terrestrial Flora/Fauna (217 comments recorded)		
82	When the water table is dropped, soils /sub soils dry out.	Pumping the sandstone aquifers does not affect soil moisture levels or saturated perched water zones because they are hydraulically disconnected.
6, 8, 11, 13, 15, 16, 22, 23, 33, 34, 36, 38, 39, 84, 86, 96, 114, 118, 127, 131	The regional groundwater level here is generally 5 to 20 metres below the surface although, at a few sites, the regional water table is close to the surface (EA p15). Vegetation could depend on this groundwater with canopy trees being the most obvious example, especially in times of drought when pumping is proposed.	In many instances the final water level in the bores is a pressure level and (while similar) may not represent the actual water table. The water table in a lot of instances is within the solid sandstone and this water is not available to terrestrial vegetation. It would only be available in instances where there was a near surface open fracture. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.
124	It is recommended that further investigation is conducted in relation to potential access to groundwater and that rigorous monitoring of the woodland communities (particularly EECs) is conducted. This should include both monitoring of water levels in the vicinity of the vegetation and also floristic monitoring.	Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.
124	A precautionary approach should be taken in relation to connectivity between aquifers (basalt and sandstone), connectivity between upland swamps and sandstone aquifer, groundwater dependence of woodland vegetation and contribution of groundwater to base flow of streams.	Monitoring of spring levels/flows in basalt and sandstone water levels is under way and will continue. Pumping trials have shown that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers at this time. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.

124	Section 6.4.2 of the document states that it is considered likely that deep-rooted vegetation within the vicinity of Stockyard Swamp may be utilising groundwater but that the effect of pumping on this vegetation will not be assessed. The recommendations in relation to monitoring of this vegetation need to be adopted. Monitoring of this vegetation needs to occur on a long-term basis.	There is no known deep rooted vegetation in the vicinity of Stockyard Swamp. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.
114	when trees show stress it is already too late to save them.	The potential for terrestrial vegetation to be dependent on the regional sandstone aquifer is considered low. Monitoring of perched water tables suggest they do not fluctuate under pumping conditions. Monitoring of perched water levels in the vicinity of terrestrial vegetation communities will be assessed and a staged approach will be adopted. At the present time (in representative sandstone areas) there are two locations in Area 1, one location in Area 2, two locations in Area 3, and none in Area 4.
133	There are numerous Orchid species there, particularly in Butler's Swamp and Stockyard Swamp, and along the roadside verge (the slashed grassland area) along Tourist Road, and along Kirkland Road. The devastation which would be caused by numerous trucks, bulldozers and construction crews clearing an easement, of some 4.5 metres (as proposed by the SCA) will inevitably destroy this precious habitat.	All sensitive areas and known threatened species will be protected. If special trenching and construction methods are required near sensitive areas, then these will be identified and included in the CEMP requirements
96	I am concerned about the hydrologic regime comprising the groundwater and surface water, and the extent to which any changes to the regime may impact on farmers abilities to continue to farm in the area as well as the effects upon flora and fauna within the swamp and riparian habitats. I emphasise that it is the responsibility of SCA to prove there will be no adverse impacts.	The EA has comprehensively documented the hydrological and environmental settings, and any adverse impacts will be managed to minimise their effect. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.
133	The report by LesryK (Attachment K to the EA) purports to assess this issue. It is quite inadequate. Just because those consultant did not see a particular species along the pipeline corridor does not mean that species is not present. The "desktop survey" they apparently conducted (to supplement their brief field trip) is inadequate as it failed to produce a full list of the species involved.	The Lesryk survey of the corridor together with the baseline studies conducted by SMEC over four seasons adequately describes the flora and fauna of the area.
119, 120	Apart from the certainty of a loss of orchid species, other flora and fauna will be adversely affected and several of these are endemic rare or threatened.	There is no certainty of loss of any flora or fauna species. All sensitive areas and known threatened species will be protected. The EA has not identified the loss of species and listed species will be avoided.

119, 120	<p>Further to this is another Prasophyllum species, discovered in the last few years on the Tourist Rd verge between Butlers Swamp and Kirkland Rd. This species is yet to be formally described and I fear it will disappear before formal recognition occurs. Another species is named Thelymitra Kangaloonica (Kangaloon Sun Orchid) and is localised in that area among tall sedges and rushes in grey silty soil in open swamps, which are seasonally wet. Extraction of water from its habitat will also see it slowly disappear to be a mere photo in a book. Due to a reliance on soil borne mycorrhiza none of these species are amenable to pot culture and are extremely specific in their choice of habitat. It would be a tragedy if any or all of these species were to disappear from their current habitat, as such a tragedy is avoidable. In total there are at a minimum, 50 species and three natural hybrids known to occur in the areas affected by the Kangaloon Aquifer. How many will exist in 10 years time?</p>	<p>There is no certainty of loss of any flora or fauna species. All sensitive areas and known threatened species will be protected. The EA has not identified the loss of species and listed species will be avoided.</p>
119	<p>During the late 1970's a local farmer began an operation to mine peat from the periphery of the Wingecarribee Swamp in the habitat of an orchid species which relied on a wet habitat for its survival. This orchid is Prasophyllum fuscum (syn P. uroglossum), commonly known as the Wingecarribee Leek Orchid. The species is endemic, albeit in small numbers, to the swamp but is now limited to 18 individuals and is considered Critically Endangered. The peat mining operation had the effect of draining water from the orchid habitat and naturally the species suffered great losses in number. Successive NSW governments were neglectful in their duties and the peat mining continued well beyond the permitted time. This environmental damage has not and will not be rectified</p>	<p>Local swamps will be unaffected by the proposal. Previous activities at Wingecarribee Swamp are not relevant to this proposal.</p>
122	<p>Acknowledged damage is likely to occur during the construction phase due to vegetation clearing, excavation near streams, and other factors. It is acknowledged that limited damage will occur to biota such as some woodland ecosystem areas. It is further stated that impacts to fauna and aquatic species are not likely to be significant. This infers there will be impacts.</p>	<p>The EA addresses all potential impacts of the project. The EA does not state there will be no impacts. It states that impacts are minor and manageable.</p>

25	We object in the strongest terms to: • deep-rooted ecological communities in the bore field area being denied the moisture they need to survive and flourish;	Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers at the present time. While upper parts of the sandstone aquifer may be dewatered, the impacts on the ecosystems are expected to be negligible. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.
25	to pollution of their habitat with iron-manganese sludge;	Iron sludge will be removed and dried at the water treatment plants only. No sludges will be released to the Nepean River or near terrestrial vegetation, and hence there is no pollution potential
79	further investigations, under a range of climatic conditions, should be undertaken to determine whether upland swamps and riparian woodlands in the area are dependent on groundwater;	The EA has comprehensively documented the hydrological and environmental settings, and any adverse impacts will be managed to minimize their effect. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and become operational.
21	Living here amongst bushland we are so blessed as we share our lives with many native animals, one being the Koala, Every now and then our families, with their children are lucky enough to sit around and watch a koala find his new territory or a mother and baby asleep in a tree. With clearing of trees, upgrading electricity, adding electricity who knows this may be a thing of the past for us and the koalas too in this area.	Minimal trees will be removed as part of this borefield proposal. In the most sensitive koala habitat area located east of Butlers Swamp, all power is proposed to be underground. There will be no significant impact to koala habitat.
79	Baseline flora surveys should be expanded by establishing permanent monitoring sites within each upland swamp, building on the 10 quadrat sites that have already been established by SMEC (2007). Ideally, there would be at least one permanent monitoring plot established for each of the 17 swamp sites (as identified in Parsons Brinckerhoff 2007), because the swamps are fragmented within the study area and may behave variably.	Monitoring of key sites will be undertaken during and after operational cycles, however only those swamps in the area of influence of the borefield are likely to be included in the monitoring program. Studies have proven that upland swamps are disconnected from the regional sandstone aquifers.
78	With regards to the EA document and the process more generally, there is still (this is acknowledged in the documentation) considerable work to be done with regards to quantifying the environmental impacts. It is difficult to assess the documentation and establish likely impacts given the paucity of site specific information e.g. vegetation impacts resulting from STP construction, impacts on threatened species/endangered communities, roadside vegetation, road surface conditions, impacts on culverts and drains etc	There is substantial discussion in the specialist assessment reports in the Appendix volume of the EA.

78	The effect these works will have on table drains and natural vegetation are to be minimise	The EA documents how impacts will be minimised. No borefield construction activities are proposed close to roads and table drains except along Kirkland Rd, Rowlands Rd, and small portions of Moresby Hill Rd and Mt Murray Rd.
79	Annual flora surveys should be conducted between groundwater extraction periods to build on baseline data and determine natural trends and changes in vegetation. This way, any changes resulting from groundwater extraction can be more readily identified. Survey should begin immediately and at the same time of the year as has previously occurred (i.e. spring or autumn).	Additional baseline surveys will commence in advance of any construction and operational periods. An ongoing monitoring program will address the recovery periods. If there is any possibility of a linkage between regional groundwater and terrestrial vegetation then additional baseline monitoring would be considered in the monitoring and management program.
133	The EA does not consider for one moment the impact of gross disruption of the Kangaloon Aquifer upon the Illawarra Escarpment, which itself is a high profile environment, much valued by the people of the Illawarra region. The Escarpment contains numerous threatened species on both the relevant State and Federal Endangered Species legislation. As the SCA's own published documents are now known to show that after trial pumping ceased, other groundwater from outside the borefield came into the Kangaloon Aquifer (from outside the borefield) that means that the SCAs narrowly defined area of impact from the pumping is inadequate. That casts into doubt their operational disclaimers of impacts outside the area of the immediate borefield (2Km from the nearest bore). That statistical definition of the restriction of the area of impact is now known to be worthless, and must be abandoned.	Pumping trials show no impact at distance and certainly none as far away as the Illawarra escarpment. Drawdowns were only within 1-2km and groundwater recharge after each of the pumping trials was localised and was not from areas "outside the borefield". The numerical modelling predicts impacts at greater distances with drawdowns only reaching the escarpment under extreme drought conditions and after a decade of pumping. This is an extremely unlikely scenario and monitoring systems would be in place to ensure that sensitive areas are protected.

79	<p>Adaptive management</p> <p>The population of <i>Persoonia glaucescens</i> in the study area is a very significant one and should be protected from both the direct and indirect impacts of the construction and operation of the borefield. As a member of the Proteaceae family, this species is particularly vulnerable to infection by <i>Phytophthora c/nnamomi</i>. Consequently, in addition to other safeguards discussed in Lesryk 2007 and Vol 1 of the main report, any water pumped from adjacent bores should be directed away from this species to avoid creating conditions that might be conducive to infection. The recommendations in section 9 of Lesryk (2007), section 5 of Parsons Brinkerhoff (2007) and section 6 of SMEC (2007) should be fully incorporated with the CEMP and QEMP for the Kangaloon project.</p>	<p>The construction impacts will be minimised by using disturbed areas wherever possible and locating boreholes and pipelines such that there is only minimal removal of established vegetation. Listed threatened species and hollow trees will be avoided. It is likely that construction impacts on threatened biota will be limited to some woodland ecosystem areas. Threatened fauna and aquatic species are not likely to be disturbed to any significant degree by construction and the special requirements for <i>Persoonia glaucescens</i> are noted. No water will be discharged close to these populations. Location of species will be identified in advance of construction and protected from any disturbance in the CEMP arrangements.</p>
32	<p>It is simply untrue to claim, as you do, an outcome of “ minimal impact on the environment”. We can cite to you with certainty that you will kill many of the mature trees on Doudle’s Folly Creek and on our hillside over the bores, trees that are magnificent examples of eucalyptus made possible only by the rich red basalt soil and by plentiful water.</p>	<p>Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.</p>
140	<p>Sudden changes in depth to water tables may cause severe stress and partial/complete mortality in large trees that cannot grow their root systems rapidly enough to maintain adequate water supplies to their canopies (Le Maitre et al. 1999). Lowering of the groundwater table can have significant impacts on terrestrial, riparian and wetland vegetation communities, with impacts including reduced seedling recruitment and altered vegetation dynamics as well as partial or complete mortality of species. Often these responses are not obvious in the short term (e.g. over the trial pumping periods), with community responses delayed (from years to decades) until drought and/or extraction lowers the water table to the point where it passes the threshold of community resilience and there is mass mortality (Le Maitre et al. 1999).</p>	<p>This comment assumes that terrestrial vegetation is connected and is dependent. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers at this time. While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible as perched water tables are unaffected. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p>

140	<p>Groundwater extraction from unconfined (phreatic) aquifers upsets the natural balance by producing an additional loss from the aquifer. Initially, such a loss comes from the storage but ultimately it comes from induced recharge from the unsaturated zone (i.e. percolation from dry water storage and fractures). Induced recharge may reduce soil moisture, including that within the root zone. In addition, lowering of the capillary fringe as the water table drops may result in this source of water becoming beyond the reach of some root systems. Such processes have the potential to affect terrestrial vegetation communities reliant upon groundwater during dry periods.</p> <p>While induced recharge may affect surface vegetation by reducing access to water within the unsaturated zone, root systems may also affect groundwater recharge through extracting water from the unsaturated zone (i.e. transpiration) without any direct abstraction from ground water (Le Maitre et al. 1999).</p>	<p>Pumping these (disconnected) semi-confined and confined sandstone aquifers does not affect soil moisture levels or saturated perched water zones.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 5, 9, 15, 18, 20, 22, 24, 28, 29, 30, 35, 40, 41, 44, 46, 48, 49, 50, 51, 53, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 68, 69, 71, 72, 73, 74, 76, 77, 83, 85, 87, 89, 91, 97, 99, 101, 103, 104, 105, 107, 110, 111, 112, 113, 117, 128, 129, 131, 132, 138, 139, 141, 142, 143, 144, 145</p>		
<p>2.04.03 Swamps (67 comments recorded)</p>		
79	<p>Baseline flora surveys should be expanded by establishing permanent monitoring sites within each upland swamp, building on the 10 quadrat sites that have already been established by SMEC (2007). Ideally, there would be at least one permanent monitoring plot established for each of the 17 swamp sites (as identified in Parsons Brinckerhoff 2007), because the swamps are fragmented within the study area and may behave variably.</p>	<p>Monitoring of key sites will be undertaken during and after operational cycles, however only those swamps in the area of influence of the borefield are likely to be included in the monitoring program. Studies have proven that upland swamps are disconnected from the regional sandstone aquifers.</p>
124	<p>The degree of connectivity between the different upland swamps may differ due to locations of fractures. It should not be assumed that there is no connectivity between surface/groundwater in all swamps based on monitoring conducted for the 2 major upland swamps. Monitoring of both surface water levels (and sub-surface water levels when dry) should be conducted for all upland swamps in the area of potential impact. Water levels can then be related to production pumping in nearby production bores. Note that the impact of production pumping at the Ourimbah bore field was observed in a monitoring bore adjacent to a wetland and a dramatic decrease in water level in the wetland was also observed compared to other wetlands in the area. Further investigation into potential connectivity is currently being conducted.</p>	<p>Monitoring of key sites will be undertaken during and after operational cycles, however only those swamps in the area of influence of the borefield are likely to be included in the monitoring program. Studies have proven that upland swamps are disconnected from the regional sandstone aquifers.</p>

79	appropriate measures be taken to limit impacts on upland swamp habitats during construction of bores and the pipeline	The EA identifies measures to be taken. All sensitive areas and known threatened species will be protected. If special trenching and construction methods are required near sensitive areas, then these will be identified and included in the CEMP requirements
108	<p>'for the elevated perched water zones at several upland swamp sites, the variations in water levels suggest that the perched water storage is entirely rainfall—dependant, there is 'no linkage with the regional sandstone aquifer, and these zones' go dry when lower rainfall periods occur. The significant points to be made here are: (i) all watertables, perched or otherwise, are rainfall—dependent -- it is the amount of water beneath the perched watertable that influences drying out and rainfall-response times; (ii) a low level of vertical hydraulic conductivity between the perched and main watertables is not necessarily precluded by any of the observations, despite the pumping trial having ... no apparent impact on the disconnected upland swamps... (p9-6). This point is made irrespective of the graphs in Figures 4.16 and 4.17 (p4.32), which clearly demonstrate the differing rates of response to rainfall events. however, Figure 4.17 on the scale of the pumping trial, suggests that the perched watertable was gradually falling until replenished by the rain fall event. Whilst it can be argued that the fall purely reflects lack of precipitation, a case can be made far exacerbated slow bleeding from the perched watertable during the progression of the pumping test. The possibility of very slow bleeding of a perched swamp, during prolonged pumping (2-3 years) of the borefield, has not been precluded. This matter is critical because the swamps are at their most vulnerable when severely stressed by prolonged drought. The small component of bleeding could be the tipping factor between ultimate recovery' and total collapse.</p>	Pumping trials have shown that upland swamps are perched and disconnected and not impacted by pumping. As there is an unsaturated zone beneath these perched systems they cannot be influenced by pumping. The only processes at work within perched water tables (whether they are associated with upland swamps or terrestrial vegetation) are evaporation, transpiration and natural drainage. None of these processes are influenced in any way by pumping from the disconnected sandstone aquifers. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.

133	The EA fails to properly account for the integration of Butler's Swamp and Stockyard Swamp and all other "Temperate Highland Peat Swamps on Sandstone" (known in NSW DECC terminology as "Upland Swamps") into the hydrology of the region. These are "Groundwater Dependent Ecosystems", albeit of varying "sensitivity". None-the-less the EA fails to adequately assess their vulnerability to gross interference with the groundwater, as is proposed by the SCA. Thus the EA also fails to account for the numerous endangered species (flora and fauna, including stygofauna) which are known to reside within these precious habitats. In that regard the EA fails to comply with the DG's Requirements and the DG's Supplementary Requirements.	These aspects are extensively covered in the the EA, and particularly the specialist technical reports supporting the EA documentation (Vol 2 - Appendices). Pumping trials have shown that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers and work on stygofauna populations is continuing. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.
133	I would point out that the Federal Environment Department established (with the concurrence of the SCA) that this classification applies to all the "Upland Swamps" in the Kangaloon Borefield. That is in direct contradiction of advice to the Dept of Planning, within the EA, that the EPBC Act listing for Temperate Peat Swamps on Sandstone applies only to Butler's Swamp. That information is wrong. Its inclusion in the EA is mischievous, and might, if not corrected, lead astray the Dept of Planning in its assessment of the EA in regard to the EPBC Act. That would have implications for the Dept of Planning's responsibilities under the Federal/NSW Bilateral Agreement.	The EA notes the listing only specifically identifies Butlers Swamp in this locality. It goes on to identify 17 other swamps that are consistent with the EEC. The EA assesses the potential impacts on all swamps.
133	Photo D — Butler's Swamp — vibrant growth, Photo taken in January 2007, before the flooding. How was this swamp so healthy, at the end of a 10 year drought, if not accessing some groundwater? It is a classic "Groundwater Dependent Ecosystem".	The swamp has been extensively investigated and it is definitely supported by rainfall and shallow perched water. There are no springs feeding the swamp and there are no linkages to the deeper regional groundwater in the sandstone.
96	The EA acknowledges that the Robertson Basalt outcrop at Mt Butler lies directly on the Hawkesbury Sandstone, and that in all probability, it intrudes through the sandstone, The EA does not provide any further analysis of how this might affect the hydrogeology of the area, and specifically how important this is to the hydrology of Butlers Swamp.	Springs emanating from this basalt intrusion and water levels in the adjacent sandstone aquifer are being monitoring (including a new site constructed in September 2008). There are no connection or dependency implications for Butlers Swamp

79	<p>Specific monitoring related conditions</p> <p>The groundwater in all upland swamp environments in the study area should be monitored, regardless of whether the modelling suggests the swamps are in contact with the groundwater or not. As per the commitment in the EAR, establish monitoring bores (where they do not currently exist) at the 17 identified swamp sites within the project area (Fig 1-1: Parsons Brinckerhoff, 2007), prior to production bores becoming operational.</p> <p>Prior to pumping, further data should be gathered as suggested by Woolley (2008) to refine water level contour maps and identify groundwater discharge areas and swamps maintained by groundwater discharges.</p>	<p>Monitoring of key sites will be undertaken during and after operational cycles, however only those swamps in the area of influence of the borefield are likely to be included in the monitoring program. Studies have proven that upland swamps are disconnected from the regional sandstone aquifers.</p> <p>Stockyard Swamp (and surrounding smaller swamps) being the largest swamp area within the borefield, and the swamp where regional and perched water tables are closest, remains the most significant monitoring site. Additional data has recently been collected in the vicinity of Stockyard Swamp to address the residual issues raised by Woolley.</p>
96	<p>The alternative conceptual model for groundwater flow in the vicinity of Mt Butler would allow groundwater to recharge through the Basalt to the underlying sandstone aquifer, either by direct downward flow or by flow down the Basalt intrusion and then laterally out into the sandstone. As pumping in the sandstone aquifer causes water levels to fall, this would create a drawdown in the Basalt itself. This drawdown would affect the volume of flow from the springs associated with the basalt, and therefore be implicated in causing possible reductions in the flow of spring water to the swamp during dry times.</p>	<p>Mt Butler is a volcanic intrusion. The intrusion has caused extensive fracturing of the adjacent rock mass but is thought to have a lower permeability core. Being an intrusion, there is no underlying sandstone except on the fringes where basalt sills have intruded the highly fractured sandstone. Basalt is in contact with the sandstone in this area and there are no apparent confining shale layers. It is a local recharge area with substantial springs around the fringe of this topographic feature - lateral flow is responsible for the many permanent and semi-permanent springs. Limited (if any) recharge of the sandstone aquifers is expected via the basalt. There were no reported reductions in spring flow or sandstone water levels in this area during the four month Tourist Rd pumping trial. Mapping has shown there are no springs feeding Butlers Swamp so the scenario proposed is unlikely.</p>
96	<p>The EA concludes that there is no possibility of impact on Butlers Swamp from the extraction of groundwater from the borefield because the hydrographs of the various monitoring bores at that site show that the water levels in the sandstone aquifer are not connected vertically with the Swamp at that site.</p> <p>39. However it is possible that there is a more complex pathway of water to the Swamp, and that impacts will take time to be felt. This more complex pathway has been provided to SCA previously, but has never been analysed or debated.</p>	<p>The swamp has been extensively investigated and it is definitely supported by rainfall and shallow perched water. There are no springs feeding the swamp and there are no linkages to the deeper regional groundwater in the sandstone.</p>

108	<p>What criteria were used to gauge impacts on swamps and adjacent streams? In view of the significant rainfall events during the period, and bearing in mind that the swamps are rainfall dependent and supposedly related to perched watertables, how can any impact attributable to pumping be discounted? Is it reasonable to extrapolate continuous regional flow of groundwater (determined how?) in relation to a 7—bore pumping test during a period of significant rainfall, to 75—bore production under conditions of prolonged drought? The cumulative flow disruption must be far more extensive.</p>	<p>Water levels, water quality and the use of control sites was the approach used to assess the swamp impacts (or the lack of impact). For the respective areas around Butlers Swamp and Stockyard Swamp, the drawdowns and impacts will be the same irrespective of whether there are 7 or 75 bores pumping. Predictive modelling has also assisted in identifying baseflow impacts. The 7 bores in the vicinity of Butlers Swamp (and the 3 at Stockyard Swamp) will be pumped at the same or lesser rates than was undertaken during the pumping trial. There will be no new or additional pumping bores or stresses on the sandstone aquifers in these areas.</p>
79	<p>If at any time the data analysis shows that the perched water level of the swamps is being impacted by the groundwater extraction, halt extraction immediately. Monitor water levels within the swamp sites weekly and survey the flora seasonally during this time; seek independent expert advice before continuing with extraction.</p>	<p>This response is appropriate if there is a definitive link between perched water table level decline and regional water level decline. Data loggers are installed at key sites that capture water level data continuously. The response time for drawdowns in shallow sandstone aquifers is much less than at production sites, therefore a quarterly data download is considered appropriate. Water table trends will be assessed at this time and compared to other sites without nearby pumping. If the rate of water level decline is greater than the natural sites then data will be checked, local extraction will be reduced or halted, and additional swamp monitoring will be undertaken (Note that perched water levels will not recover even with no pumping as this system is totally rainfall dependent).</p>
96	<p>Insufficient investigation of the possibility of very slow bleeding of a perched swamp during prolonged pumping at a time when swamps would be stressed due to drought conditions — the component of bleeding could constitute a tipping factor between ultimate recovery and total collapse.</p>	<p>Pumping trials have shown that upland swamps are perched and disconnected and not impacted by pumping. As there is an unsaturated zone beneath these perched systems they cannot be influenced by pumping. The only processes at work within perched water tables (whether they are associated with upland swamps or terrestrial vegetation) are evaporation, transpiration and natural drainage. None of these processes are influenced in any way by pumping from the disconnected sandstone aquifers.</p> <p>Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p>

96	notes that although an impact on the upland swamps is ‘unlikely’, doubt remains in the context of protracted (2—3 years) pumping. In attempting to deal with differences between hydrographs (e.g. Fig. 4.17), it is important to consider the relative magnitudes of the rainfall events, protracted pumping and slow bleeding through low hydraulic conductivity.	Pumping trials at Butlers Swamp and Stockyard Swamp have shown that upland swamps are perched and disconnected and not impacted by pumping. As there is an unsaturated zone beneath these perched systems they cannot be influenced by pumping. The only processes at work within perched water tables (whether they are associated with upland swamps or terrestrial vegetation) are evaporation, transpiration and natural drainage). None of these processes are influenced in any way by pumping from the disconnected sandstone aquifers. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.
133	Butler’s Swamp and Stockyard Swamps are relatively undisturbed representative examples of Temperate Highland Peat Swamps on Sandstone. Other local Swamps in this category have been subjected to massive disturbance, occasioned by previous water catchment activities and works conducted by the Applicant and its predecessors. This fact alone indicates that any hydrological disturbance to Butler’s Swamp and Stockyard Swamp is highly likely to be significant. Together they are the best examples of this highly specific ecosystem still remaining (i.e., subject to the least disturbance — to date). Stockyard Swamp is conceded by SMEC as being more potentially susceptible to damage, and the results of any damage as likely to be more severe for this Endangered Ecological Community.	All sensitive areas and known threatened species will be protected. Special trenching and construction methods near sensitive swamp areas will be considered to protect perched water tables, and then identified and included in the CEMP requirements
133	The SCA appears to present the case that the key wetland communities in the Aquifer area are not hydrologically connected with the Aquifer. This is a self-serving argument, which they have attempted to maintain, without satisfactorily responding to the professional advice of their professional Peer Reviewer, Prof Derek Eamus In his Peer review to the SMEC Report, Professor Eamus listed 3 alternative ways of establishing beyond doubt the groundwater dependence of these Swamps. Personal communications with Mr. Graeme Head and Mr. John Ross confirm that these recommendations have not been followed up—“because we do not need to”. (Discussions with Messrs Wilson and Eddy and Messrs Ross and Head (then Chief Executive, SCA — 1 February 2007).	The Eamus peer review attaches to the original SMEC baseline study from Spring 2006 prior to any of the later studies being concluded. Subsequent studies have indicated that there is no dependence associated with upland swamps, only minor connectivity with stream baseflows, and no known connectivity with terrestrial vegetation. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational. There is sufficient certainty about groundwater dependence (or the lack thereof) to proceed with borefield development.

133	However, I would simply point to the lack of assessment of what "Drying" is meant to mean in regard to Stockyard swamp, what impact on nationally and State-level threatened species is anticipated, and what "feasible mitigation measures" are proposed. (I cannot find any mention of any such measures, despite the specific request by the Director-General that such measures be addressed.)	There will be no "drying" of perched water tables caused by groundwater pumping. No mitigation measures are therefore proposed because of there being no connection or impact to the upland swamps. Perched water table and ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.
140	While the various studies indicate (and a conclusion that we agree with) that wetlands located within the basalt are unlikely to be affected by groundwater extraction from the Hawkesbury Sandstone aquifer (including Butlers Swamp), the studies do not conclusively show that wetlands such as Stockyard Swamp are disconnected.	Latest pumping trial data and results for Stockyard Swamp (at the conclusion of the three month trial) clearly show the systems are disconnected.
133	The SCA's assertion that Butler's Swamp is not connected with the Aquifer flies in the face of visual evidence (Photograph A attachment to Appendix B) Bearing in mind that Photo A was taken at the end of an extended drought period, on 6 February 2007 (prior to the rain which fell over the weekend of 10/11 February 2007). This was after a cycle of 3 El Nino patterns over 10 years. This photo shows "vibrant growth" in a patch at the centre of Butler's Swamp. What is the water source for this patch of plants within the swamp, if not groundwater? There were sections of the Swamp in which the plants were clearly suffering great water-stress See Photos B and C, taken on 19 July 2006 These show areas around the edge of part of the swamp which were clearly under great water stress. But the Photo A shows that there were patches of vibrant growth within the swamp not suffering drought stress. If Butlers Swamp is not hydrologically connected with the Aquifer, how were these plants thriving (after 10 years of drought)? Remember that that Photo A was taken just 10 days before drought-breaking rains fell in January 2007.	The results and conclusion from the pumping trials that the swamps are not connected to the sandstone aquifers are conclusive and have been supported by all peer reviewers. The swamp has been extensively investigated and it is definitely supported by rainfall and shallow perched water. There are no springs feeding the swamp and there are no linkages to the deeper regional groundwater in the sandstone.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 2, 44, 46, 48, 68, 78, 81, 82, 84, 91, 97, 119, 120		
2.04.04 Aquifer (Stygofauna) (13 comments recorded)		
122	It is suggested that draining may impact on aquifer ecosystems (pg. 19) and that further monitoring is necessary due to long lead times for impacts to become apparent as well as to minimise any potential impacts to any groundwater dependent ecosystems (pg. 22).	Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.

124	The report does not discuss potential impacts on cave ecosystems (refer section 4.6.5). It is possible that these ecosystems are not present but a statement needs to be made to the effect that a search of the database was conducted and that no cave ecosystems have been identified in the area.	There are no karst or cave ecosystems associated with this sandstone aquifer system (cave ecosystems are solely related to limestone geology and aquifer systems)
124	Aquatic stygofauna need to be assessed as part of the monitoring program.	An extensive baseline assessment has been completed and this indicates that stygofauna populations exist at most sites sampled, they are particularly prevalent in the shallower, small diameter monitoring bores and wells. Additional sampling is planned if the borefield is constructed and operated.
44	The water table in the project area is near surface and is generally only 5-20m below the ground surface. Groundwater dependent ecosystems would be cut off from this important source during times of pumping and recharge of the aquifer as a result of expected drawdown of up to 80m. Great stress to flora and fauna dependent on these ecosystems will be incurred, This is all during times of drought when groundwater dependent ecosystems rely more heavily upon groundwater reserves.	In many instances the final water level in the bores is a pressure level and (while similar) may not represent the actual water table - the water table in a lot of instances is within the solid sandstone and this water is not available to terrestrial vegetation. It would only be available in instances where there was a near surface open fracture. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. While upper parts of the sandstone aquifer may be dewatered, the impacts on the ecosystems are expected to be negligible.
133	If there is no connectivity between Butler's Swamp and the deep groundwater environment, how did the Stygofauna get there?	There are open cracks and fractures elsewhere in the sandstone landscape that provide opportunities for stygofauna to migrate - there is no special link or relationship between swamps and stygofauna
The following submissions also made comment on this issue - the content was similar to the selected issues above – 25, 46, 54, 114, 140		
2.04.05 Threatened Species/EEC (86 comments recorded)		
48, 49, 50, 51, 56, 57, 58, 59, 60, 61, 63, 64, 68, 69, 71, 72, 74, 76, 77, 87, 138, 139, 141, 142, 143, 144, 145	This includes four types of groundwater dependent ecosystems, several of which occur in the project area and are listed as endangered under the NSW TSC Act 1995 and the EPBC Act 1999. In addition, 26 threatened flora species and 45 threatened fauna are likely to occur in the project area.	Impacts are identified and mitigation measures are proposed in the EA. Construction impacts will be minimised wherever possible. Listed threatened species and hollow trees will be avoided. Threatened fauna and aquatic species are not likely to be disturbed to any significant degree by construction because of the flexibility of pipeline routes. The location of identified threatened species will be mapped in advance of construction and protected from any disturbance.

119, 120	All of the above leads to my final concerns and these are in regard to the populations of terrestrial orchids and their habitat which is now not only damaged but also restricted to all. Members of numerous orchid societies have been visiting the Tourist Road area for over 40 years (without incident) to study and monitor the 53 species of orchids which occur in the area of Tourist Road including Stockyard Swamp, Butlers Swamp, Kirkland Road and the Wingecarribee Swamp.	Construction impacts will be minimised wherever possible. Listed threatened species and hollow trees will be avoided. Threatened fauna and aquatic species are not likely to be disturbed to any significant degree by construction because of the flexibility of pipeline routes. The location of identified threatened species will be mapped in advance of construction and protected from any disturbance. Construction will be rigorously managed to further limit potential impacts.
124	There are a number of threatened dragonfly species that may be present in the streams of the area.	Stream discharges are within the natural range of flows and are not expected to influence this habitat
79	<p>Impacts on threatened species and their habitat</p> <p>In order to complete and enhance the threatened species surveys and ensure they are adequate to evaluate the direct and indirect impact of both the borefield configuration and of individual bores, the following additional surveys are recommended to be required as part of any approval:</p> <ul style="list-style-type: none"> • Ongoing biannual surveys should be used to provide a sound basis from which to detect ecosystem changes due to groundwater extraction. These should continue for a minimum of five years post extraction. • The biannual surveys should be required to collect condition data (in addition to species diversity and distinctiveness data) to provide a sound basis from which to monitor changes to vegetation health as a result of groundwater extraction. • The biannual surveys should include <i>Lysimachia vulgaris</i> var. <i>davurica</i> and <i>Petalura gigantea</i>. These two species should also be targeted in future surveys I monitoring of groundwater dependent ecosystems as set out below. 	Additional monitoring will be in accordance with the statement of commitments, the conditions of approval and respective licence conditions/monitoring plans negotiated with DWE and DECC.
108	the view that it should firstly be established whether or not threatened species are present. Once that is known with certainty, the nature of their life cycles will be better appreciated and the capacity to evaluate adverse operational impacts will be better understood. At this stage, the report is offering guesswork, and that is totally unacceptable within the context of threatened species.	An assessment of threatened species within the borefield corridor has been completed but extra comprehensive studies and a new survey will occur in advance and in combination with the construction and operation programs.

133	The issue of migratory species is barely mentioned in the entire EA. I have found only references to the Rufous Fantail as the single example of a "Migratory Species" listed under the EPBC Act. That species is not at risk.	Migratory species are not at risk from the borefield development as there are no linkages with their habitat to the regional groundwater in the sandstone aquifers.
133	The "Conservation Advice" under the original EPBC Listing Advice specifies: "The priority recovery and threat abatement actions required for this ecological community are: <ul style="list-style-type: none"> • identify seasonal and long-term fluctuations in the water flows and water quality regimes within the swamps; and • minimise impacts from changes to water flow and water quality. Reference: http://www.environment.gov.au/biodiversity/threatened/communities/temperate-highland-peat-swamps.html#conservation 12. It was, in part, that Conservation Advice to the Federal Minister under the listing of this Endangered Ecological Community which prompted the Federal Minister to deem such a threatening action as lowering the water table under such a Listed Endangered Ecological Community" to be a "Controlled Action".	The upland swamps in this area are all rainfall dependent. Surface water/perched water levels and water quality associated with these swamps will be unaffected by the project. The perched water tables are disconnected from the regional water table and there is no risk of lowering the perched water table by lowering the regional water table.
140	At present there has been no formal condition analysis to track changes to the health of vegetation communities (wetlands and woodland communities) as a result of climate change and the current drought dominated regime. Such a condition analysis would form an important baseline for the assessment of groundwater extraction on these communities, especially when compared to reference conditions. Over the last drought period, noticeable changes in vegetation condition were evident as a result of water stress caused by prolonged drought. It will be important over the lifetime (and beyond) of the proposed borefield to monitoring such changes to determine whether groundwater extraction is further exacerbating the impacts of water stress during drought periods. Particular as many of these communities are threatened, plus provided habitat for threatened species. Early detection of change in vegetation condition will be essential for successful mitigation of impacts.	Ecosystems are both changeable and adaptable to many changes including drought. To differentiate climate change, from natural drought responses or from any borefield pumping impacts will be challenging. SCA is proposing to monitor the physical parameters of groundwater levels and water quality in the first instance with a key sites ecosystem monitoring program. More intensive ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.

133	<p>However, what about the Latham's Snipe? I personally wrote about that species being found in the Kangaloon Aquifer area, over the last two years, and the "desktop research" has failed to pick up those references. Japanese (Lathams) Snipe (Capella hardwiclii.) http://peonyden.blogspot.com/2007/11/japanes-snipc-are-back-in-kanaloon.html</p>	<p>Migratory species are not at risk from the borefield development as there are no linkages with their habitat and the regional groundwater in the sandstone aquifers. The Snipe's preferred habitat is swampy vegetation adjacent to coastal and freshwater wetlands, but also they are migrate through cropping and pasture areas.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 21, 25, 44, 48, 53, 54, 65, 78, 81, 84, 85, 89, 90, 91, 95, 96, 132, 146</p>		
<p>2.05.01 Ground Subsidence (6 comments recorded)</p>		
82	<p>Earthquakes- Risk to Aquifer Fault lines Kangaloon & Robertson Areas. Earthquakes - In 2007 Coal Cliff 3.1 R_Scale ,In 2003 Southern Highlands 4.3 R-Scale. Fault lines around the aquifer may be at risk due to the 75 production bores pressure pumping procedures, on underground rock/subsoil geology.</p>	<p>Earthquakes in the Southern Highlands are always deep seated events many kilometres below surface. Groundwater pumping to depths of 100m will not create movement on fractures or deep fault lines</p>
82	<p>Sink Holes – land subsidence Sink holes may occur when large volumes of water is pumped from the aquifer, the below ground geology will be changed . The entire infrastructure built on the land above the aquifer may be at risk, 'This is over 150 km of Towns, Villages, Farms, Vineyards, roads, railway lines etc. 45,000 people live in Southern Highlands, how may homes, businesses, farms are build on land above the aquifer?</p>	<p>Sink holes are a natural feature of limestone aquifers where karst and cave features exist. These do not exist and will not be formed in this sandstone landscape</p>
123	<p>Our house was approved for building in 1987 based on the Building Requirements at that time. A time that did not include drilling for underground water. We have serious concerns that any future drillings may affect the stability of our home.</p>	<p>Drilling and groundwater extraction from a consolidated rock such as sandstone will not create subsidence or instability. There is no risk to buildings or other infrastructure in the borefield area</p>
140	<p>Incipient aquifer dewatering could lead to aquifer deformation that, when combined with drawing water from the deeper, inherently less permeable (macro-scale) part of the aquifer, could lead to a reduced hydraulic conductivity and inevitable consequences such 'accelerated' well dewatering. This might be combated by considering managed aquifer recharge (via well injection).</p>	<p>Drilling and groundwater extraction from a consolidated rock such as sandstone will not create subsidence or deformation. Managed aquifer recharge is possible in this type of aquifer system but is not contemplated as part of this borefield development.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 5</p>		

2.05.02 Clearing (84 comments recorded)		
119, 120	This level of damage will be compounded by the already high level of damage to roadside vegetation from the construction of 35 kilometres of pipeline and power lines.	Minimal vegetation clearance is proposed, and the bulk of the infrastructure will be underground, or screened from public roads and private lands.
6, 8, 11, 13, 15, 16, 22, 23, 33, 34, 36, 38, 39, 86, 118, 131	With regard to the borefield, this proposal would use mains power, requiring new infrastructure to be installed. Vast numbers of trees will need to be cleared in this process — most obviously along Tourist Road, Kirkland Road and Moresby Hill Road in East Kangaloon.	Existing power lines and corridors will be used to upgrade power supplies to the area. No additional vegetation clearing is required in these areas. Power lines will be placed underground in sensitive areas along Tourist Rd to avoid impact and improve visibility. Power lines in the SCA lands may require some selective clearing but alignments will be kept to disturbed areas where possible.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 21, 22, 24, 29, 44, 46, 48, 49, 50, 51, 53, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 68, 69, 71, 72, 74, 76, 77, 78, 83, 84, 87, 91, 96, 97, 99, 103, 104, 105, 107, 110, 111, 112, 113, 116, 117, 122, 129, 132, 133, 138, 139, 141, 142, 143, 144, 145, 146		
2.05.03 Mining Impacts (25 comments recorded)		
135	Drilling logs from boreholes used for coal exploration indicate that the Wongawilli coal seam is at a depth of 270 metres in the vicinity of the Stockyard Swamp area. This would indicate that the stratigraphical representation, particularly the depth of each geological sequence as shown in the Environmental Assessment, is incorrect and or inaccurate. The Environmental Assessment shows the Wongawilli coal seam at a depth of 750 metres.	The stratigraphical representation provided in Table 4.5 is meant to be typical of the geology and hydrogeology in the Southern Coalfields. It does not represent the actual depths to different geologies in the borefield area.
116	We have been alarmed to discover through the work of that major damage may be being done to waterways serving Sydney and Illawarra water supplies through mining subsidence	There is no active coal mining in the borefield area and only one lease in the eastern area in the area surrounding Stockyard Swamp
135	This would require an undertaking that future underground mining would be permitted, that supporting infrastructure (such as pipelines and power lines) will be constructed in such a manner to accommodate subsidence.	If borefield infrastructure was in place, the onus would be on the mining company to ensure that the infrastructure was not compromised. If the borefield development occurred later after mining, then the borefield would have to be designed to deal with more fractured Hawkesbury Sandstone and possibly undulating ground

78	<p>What is the potential effect on the structural integrity of the fractured sandstone if large volumes of water are extracted! especially if the cap of 10-15 GL is exceeded. Could mass failure of these geological sequences occur as a result of extraction of high volumes of water? The recent Inquiry into the Southern Coalfields received a significant number of submissions relating to subsidence as a result of longwall mining. What evidence exists to suggest that longwall mining will impact on the integrity of the aquifers and hence this groundwater resource? Has the SCA undertaken any inter departmental inquiries to establish the risk of longwall mining on the structural integrity of the aquifers?</p>	<p>There are no impacts to the integrity of the sandstone from pumping groundwater. The sandstone rock mass is too competent to be affected. Partial water extraction is quite different to the processes that operate when a coal seam is longwall mined</p> <p>SCA commissioned a report into the subsidence effects of pumping groundwater from these sandstone aquifers which found that the impacts were negligible. No studies have been undertaken on the impact of longwall mining on the area as there are no proposals to mine under the borefield at this time. Also this is work that the mining company would have to complete to obtain their mining approval.</p>
26	<p>NSW DPI would like to highlight that although there are no current mining or gas developments in the proposed borefield area, there is moderate to high petroleum potential (especially coal seam methane) underneath the project area. Petroleum Exploration licence (PEL) 2, held by Sydney Gas covers the project area and there is an area just north of Kangaloon which is part of a potential gas resource. For these reasons it is recommended that a condition be considered which introduces a depth restriction of 100 metres for water extraction so that deviated drilling can be carried out beneath the producing aquifer.</p>	<p>Production bores will be to the base of the Hawkesbury Sandstone (around 160m in the deepest areas) but pump intakes are most unlikely to be located deeper than 100m below ground level.</p> <p>Gas resources are in the deeper coal measure and sandstone units which are unaffected by this borefield proposal.</p>
18, 28, 30, 35, 41	<p>The EA made no mention of earth tremors that could so easily unsettle the settling ponds and the large amount of extremely toxic iron that would have to be removed 24 hours a day.</p>	<p>Earth tremors do not crack ground. A severe earthquake would be required to cause such damage. Also the water collection ponds are less susceptible to any such damage (in the extremely rare event that it did occur) because there is unconsolidated alluvium above the sandstone bedrock at this location and these sediments would compact slightly, rather than crack</p>
135	<p>Also it would be appropriate for the Sydney Catchment Authority to provide an undertaking that it will work with India NRE Minerals Limited (the mine operator) to develop a mining plan and extraction layout that optimises coal recovery with minimal impact upon the groundwater harvesting potential of the Stockyard Swamp area.</p>	<p>It is premature to enter into an agreement if there is no mining proposal - SCA is in discussion with mining companies that operate in the Southern Coalfields and the borefield development is well known to Gujarat Wongawilli.</p>
135	<p>We still believe that both activities could co-exist as long as the operations of the borefield do not prohibit future mining and cause the unnecessary sterilisation of valuable coal resources and a loss of revenue to all concerned.</p>	<p>The construction and operation of the borefield would not preclude future mining.</p>

135	In this respect the Environmental Assessment would appear to be deficient in respect of the following matters: <ul style="list-style-type: none"> • The report fails to identify coal mining as an activity or industry within the vicinity of the borefield. • The report does not acknowledge that the eastern extent of the proposed borefield overlies the south western corner of the NRE Avondale Colliery and Mining Lease No. 1565. • The report does not recognise that the boreholes in the eastern section of the borefield are within the colliery holding as the Mining Lease starts 20 metres below the surface. • The report fails to acknowledge the potential for coal sterilisation with related impacts upon mine viability, revenue from coal sales and potential lost royalties. 	Coal mining and the current leases and operations are described in Section 4.10 of the EA. The EA shows that portion of the borefield corridor within the mining lease (Figure 4.33) and by comparison with Figure 7.2, the proposed production bores in this area can be inferred. Groundwater within the fractured rock aquifers of the Hawkesbury Sandstone is owned by the State and is managed and allocated under the Water Act and Water Management Act by DWE. There is no mention of coal sterilisation because it is envisaged that provided there is no major disturbance and drainage of groundwater from the Hawkesbury Sandstone, the two land uses can co-exist
140	Potential impacts of coalmines to the north-east of the project area (if these collieries are being dewatered) has not been addressed.	Coal mines to the north west are not within the area of influence of this borefield proposal
5	It has become evident that long wall mining activities undertaken relatively recently beneath the Nepean has led to cracking of the creek beds that are intended to carry the extracted groundwater to Sydney. This being so whatever assumptions are drawn from the testing regime must be deemed irrelevant since much of the water so extracted will be lost before it reaches its intended destination.	The effects of mining beneath the SCA's transfer routes are closely monitored and impacts are rectified. The Nepean River downstream of Broughtons Pass is not used to transport water to Sydney. Water is diverted into the Upper Canal. Also it is likely that most of this groundwater will be used to secure water supplies to the Illawarra via the Avon dam pump station.
135	It is noted that the eastern extent of the proposed borefield (identified as Area 3) associated with Stockyard Swamp, overlies part of the proposed mining operations of NRE Avondale Colliery and Mining Lease No. 1565.	This is correct.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 53, 119, 120, 122, 126		

2.06.00 Aboriginal and Cultural Heritage (3 comments recorded)

79

Impacts on Aboriginal cultural heritage values
The assessment has been undertaken in accordance with DECC's Aboriginal Cultural Heritage Standards and Guidelines Kit (1997), and Interim Community Consultation Requirements for Applicants (2004). There is no reference to DECC's Guide/Thea for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (2005), and these should be adopted for the remaining lifecycle of the project. All excavations should be undertaken by hand to ensure appropriate quality and control of archaeological information obtained during the program. All excavations should also seek to undertake appropriate archaeological analysis, including geomorphological studies, lithic analysis and appropriate dating where possible. In accordance with the recommendations in Navin Officer (2007), an archaeological subsurface investigation will be conducted in all areas of high and moderate archaeological sensitivity, including sites that are associated with potential archaeological deposits. DECC does not support the recommendation for archaeological monitoring during the implementation of the borefields (Navin Officer Pty Limited, 2007). The necessary investigations and/or salvage of archaeological sites and/or areas of sensitivity should be developed and undertaken prior to any construction works. The proponent should ensure that an Aboriginal Heritage Information Management System (AHIMS) site card be reproduced for all sites and/or potential archaeological deposits (PADs) identified within the project area prior to any archaeological investigation or development. These site cards should be revised following any investigations of the sites and/or PADs to ensure a detailed archaeological record of the sites discovered in the area are lodged with DECC. A report should be sent to Planning and Heritage Section, Metropolitan Branch (PC Box A290, Sydney South, NSW 1232) and the AHIMS library (PO Box A290, Sydney South, NSW 1232) on all archaeological investigations and excavations that are undertaken as part of this project.

The Cultural Heritage Assessment was prepared in conjunction with all DECC interim and final guidelines. The SCA does not accept a rigorous process is necessary given the amount of assessment completed to date. Consequently it intends to adopt the recommendations of the Cultural Heritage Assessment as endorsed by the local Aboriginal communities and representatives (as detailed in the draft statement of commitments)

In accordance with the recommendations in Navin Officer (2007), an archaeological subsurface investigation will be conducted in all areas of high and moderate archaeological sensitivity, including sites that are associated with potential archaeological deposits.

Consultation will occur with Aboriginal stakeholder groups about the location of proposed works that will affect identified items of cultural importance and to determine appropriate management options.

79	Impacts of the project on Aboriginal cultural heritage values, The construction of a pipework system, additional power lines and the production borefield has the potential to disturb Aboriginal cultural heritage.	<p>It is proposed in the draft statement of commitments that sites already identified and areas of high sensitivity will be investigated pre-construction. Given the large area of the proposed borefield infrastructure the areas of moderate sensitivity will be inspected again and possibly investigated if the sensitivity is medium-high.</p> <p>The location of the pipeline and other components of the project infrastructure will be determined in consultation with the Aboriginal community and a qualified heritage specialist. Locations will be designed to avoid impacts on Aboriginal artefacts or features of importance to the Aboriginal community, as identified in the work of Biosis (2006) and Navin Officer (2007), which is detailed in Section 4.11.3 of the environmental assessment.</p> <p>In accordance with the recommendations in Navin Officer (2007), an archaeological subsurface investigation will be conducted in all areas of high archaeological sensitivity, including sites that are associated with potential archaeological deposits. Consultation will continue with Aboriginal stakeholder groups about the location of proposed works that will affect identified items of cultural importance and to determine appropriate management options.</p>
133	I refer you to a submission made by Mr. Peter Falk, a representative of the Traditional Owners of the Kangaloon District. Mr. Falk is concerned that clearing along road easements be done in such a way as to not threaten, endanger, (or unduly expose to public view) recognised Aboriginal “scar trees”. This applies particularly to Kirkland Road - the wet forested area, and to Tourist Road. Photo A: Possible “Scar Tree” — East Kangaloon — directly in line with proposed powerline and pipeline easement.	<p>The scar trees of East Kangaloon would be avoided as detailed in the draft statement of commitments (such trees are already identified in Navin Officer, 2007). The location of individual bores, the pipeline and other components of the project infrastructure will be determined in consultation with the Aboriginal community and a qualified heritage specialist. Locations will be designed to avoid impacts on Aboriginal artefacts or features of importance to the Aboriginal community, as identified in the work of Biosis (2006) and Navin Officer (2007), which is detailed in Section 4.11.3 of the environmental assessment.</p> <p>In accordance with the recommendations in Navin Officer (2007), an archaeological subsurface investigation will be conducted in all areas of high archaeological sensitivity, including sites that are associated with potential archaeological deposits. Consultation will occur with Aboriginal stakeholder groups about the location of proposed works that will affect identified items of cultural importance and to determine appropriate management options.</p>

2.07.00 Groundwater Technical Issue/Gap/Uncertainty (1 comments recorded)		
128	The EA therefore can not provide—any data on the effect of production bores in these corridors on groundwater and the environment.	There are substantial studies on the resource and environmental impacts of borefield development. Most reports can be found in Volume 2 - Appendices
2.07.01 Rainfall/Seasonal Variation (9 comments recorded)		
101	<p>There remains considerable uncertainty about the long term effects of sustained pumping. The test pumping for 6 months was overtaken by above average rainfall in 2007 of the type that had not been experienced in the proceeding 6 or 7 years of drought. In fact, annual rainfall in calendar 2007 at 68 inches, on my property, in the centre of the borefield area, was the highest recorded there in at least the preceding 20 years. Recent reports suggest there is considerable uncertainty as to whether bores were replenished after test pumping as a consequence of rainfall or as a consequence of water flows within the aquifer'. I understand that it has not been (and probably cannot be) conclusively demonstrated that it was the latter, because water was extracted from differing levels in the aquifer. However the information contradicts earlier reports by the proponents consultants that the rapid recharge was the result of rainfall. Post hoc is not necessarily propter hoc. If the majority of the water required to replenish the areas of the aquifer under the borefield is coming from elsewhere in the aquifer, there are at least two consequences:</p> <p>other parts of the aquifer are being depleted with unknown consequences, and the major rainfall events which are experienced in the area from time to time in non-drought periods cannot necessarily be relied on to recharge the aquifer. There will therefore be a net loss to the aquifer which may take much longer than the estimated 5-7 years to recharge.</p>	<p>Water levels were high at the commencement of both pumping trials (after rain) but drier conditions prevailed during each of the trials. Irrespective of the starting water levels, it is the performance of the pumping bores, interference drawdowns, impacts on shallow perched systems and the extent of drawdowns that were key data obtained from the trials. This information is equally valid from a wetter period as well as a drought period, as it relates to the physical attributes of the sandstone - primarily the permeability and connectivity attributes of the aquifer.</p> <p>There was significant rainfall recharge reporting to the fractured aquifers but there was also water migrating laterally in the deeper aquifers (as the signature of the water sampled at each of the pumping sites after the recovery period indicated that the groundwater had not changed in quality or age). Simply stated this means the aquifer storage is large and that rainfall recharge (although substantial) is still a relatively small volume in comparison to the aquifer storage - hence while water levels fully recover, and recharge is quick, the age of the water does not change quickly because of the large aquifer storage volume.</p>

96	<p>The recharge from rainfall to the broader proposed borefield can be estimated by taking the area of the aquifer up-gradient from the borefield and applying a factor of 5% of long term average rainfall for that area, minus 30% to account for environmental provisions. The area of aquifer up-gradient from the proposed borefield has been estimated from Figure 1 to be 115 km². This has been deduced by taking a bounding flowline that runs from the high water levels east of Bowral, running further east under Wingecarribee Reservoir, north of Robertson and abutting the escarpment south of Stockyard Swamp.</p>	<p>Five percent is a reasonable but slightly conservative approximation to the expected long term recharge to the regional aquifer. The recent modelling (Coffey, 2008) suggests around four percent and eight to sixteen percent was the assessed rate (URS, 2007) based on the large recharge events in 2007. 30% to the environment is a previous default value proposed by DWE in lieu of any regional or site specific studies.</p> <p>The work that SCA has undertaken is in reasonable agreement with the recharge estimates by others and the environmental requirements in the borefield area have been assessed and are lower than 30 percent of the long term average rainfall recharge.</p>
82	<p>Rain recharge does not occur - in times of drought.</p>	<p>There are always some rain events during drought which will provide occasional recharge. However the borefield development is based on the large storage of the groundwater aquifer being able to provide additional water when required and the fact that rain will fully recharge the aquifers at the conclusion of the drought</p>
140	<p>Global warming indications are that temperatures and evapotranspiration will increase and precipitation will decrease in the Hawkesbury-Nepean Catchment (Warner 2002). In the Hawkesbury-Nepean, temperatures are expected to rise by 0.4 — 2C by 2030, while precipitation trends for the same periods is +5 to -15% (Warner 2002), which would result in reduced runoff and groundwater recharge, and decreased water resources. Higher temperatures reduce the effectiveness of precipitation by promoting evaporation and transpiration, thus reducing runoff, percolation and discharge to rivers and groundwater aquifers.</p>	<p>These global warming indications are out of date. New climate change modelling for SE Australia and SCA's catchments is currently under way and will be progressively reported in 2008 and 2009 by CSIRO. Earlier studies suggesting much lower rainfall patterns have been updated for coastal SE Australia. Similar rainfall with increases in the extremes of rainfall patterns with perhaps less runoff due to drier profiles and higher temperatures is currently one of the most likely outcomes. If this outcome is correct, then a new groundwater resource and drought borefield could be most useful as it would be protected from evaporation, and recharged by extreme rainfall events.</p>

140	<p>Flood (FDR) and drought (DDR) dominated regimes have been identified from over 200 years of flood records for Windsor and these periods are 30-50 years in duration (Warner 2002). The last flood dominated regime for the Hawkesbury-Nepean Catchment started in 1949, and it is expected that the catchment is now within a drought dominated regime (R. Warner, pers comm.). Such conditions will be exacerbated by global warming, even without global warming; return to a drought dominated regime is expected to result in similar conditions to early last century when water resources were far shorter than those experienced today (Warner 2002). Warner (2003) predicted that a return to a drought dominated regime could mean that the average annual yield in all dams could be down by 30% or more. If this trend was accompanied by higher temperatures caused by global warming, the loss in yield could be around 40-45%.</p>	<p>These global warming indications are out of date. New climate change modelling for SE Australia and SCA's catchments is currently under way and will be progressively reported in 2008 and 2009 by CSIRO. Earlier studies suggesting much lower rainfall patterns have been updated for coastal SE Australia. Similar rainfall with increases in the extremes of rainfall patterns with perhaps less runoff due to drier profiles and higher temperatures is currently one of the most likely outcomes. If this outcome is correct, then a new groundwater resource and drought borefield could be most useful as it would be protected from evaporation, and recharged by extreme rainfall events.</p> <p>Any reduction in runoff may be balanced by increased infiltration and recharge to groundwater.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 128</p>		

2.07.02 Borefield Yield and Capacity (60 comments recorded)		
132	<p>The imposition of embargoes on new commercial water groundwater licences in specified areas of the Belanglo, Bundanoon, Murrimba and Wingello parishes by the DNR on 16 December 2005. And, further embargoes that increased the number of parishes embargoed to seven, certainly substantiate considerable concern in relation to overtaxed groundwater resources in the region.</p>	<p>The prospect of an SCA borefield was factored into DWE's decision to embargo the parishes surrounding Kangaloon in late 2005, and does not comprise the sustainability of the sandstone resource.</p>
124	<p>An attempt is made to quantify the likely groundwater storage volumes for an area of 150 km around the borefield using assumed aquifer parameters (bulk porosity, saturated thickness and infiltration fraction). The values selected for these generic calculations have not been justified in the discussion, and it is unclear whether they relate to the primary or secondary porosity characteristics of the sandstone. Information provided by SCA (John Ross, Project Manager, pen comm.) indicates that the values were modified from published information being reduced to better suit the characteristics of the sandstone in the proposal area, and reflect a combination of both matrix and fracture permeability. There must be clarification within the documentation of the derivation of the values used in the calculations to provide confidence that there is sufficient groundwater in storage to buffer the impacts of the proposed magnitude of borefield extraction.</p> <p>The discussion also does not consider the possible 'equivalence that could be inherent in the calculations due to the values selected. It is possible that the bulk porosity of the rock mass (based on widespread enhanced fracturing) could be significantly greater than the value selected. Similarly, there is some evidence that the infiltration fraction could be significantly higher than that adopted for the calculations (page 4-23). It is therefore possible that there could be a significant volume of groundwater stored in the fractured rock environment, and considerably less being contributed by the bulk of the sandstone mass (from matrix storage). That is, the same calculated outcomes could be derived from increasing the porosity and infiltration fraction values, and decreasing the adopted saturated thickness and area of enhanced permeability (to suit the fracture patterns).</p>	<p>Storage volumes are quoted in the EA to present information about the size and scale of the resource. They have been based on bulk porosities of 1 percent, 3 percent and 5 percent. Bulk porosity relates to both the primary and secondary porosity of the saturated Hawkesbury Sandstone across its full depth. Values are comparable with estimates of effective porosity provided in DIPNR, 2004 (3 percent) and estimates of specific yield (1.5 percent) that have been derived from the recent numerical modelling (Coffey, 2008) . Note that porosity is the sum of specific yield and specific retention.</p>

124	<p>Whilst the Tourist Road pumping trial continued for four months without any hydraulic limits (eg. barrier boundaries typical of fractured rock behaviour under pumping stresses) becoming evident, it is entirely possible that under longer durations significant declines in pumping water levels could eventuate due to the fracture systems being progressively dewatered. Should the calculated groundwater storage volumes be affected by equivalence between the adopted parameter values as indicated above, then little confidence can be placed on the resulting values, and this will have implications for the perceived sustainability of the pumping based on this generic approach.</p>	<p>The sustainability is defined by long term performance, and rates of recharge and recovery after extended pumping cycles. The storage estimates have been presented in the EA to show there is a very large volume of groundwater in storage over the borefield area and the proposed extraction rates are compatible with long term recharge rates and using the groundwater storage as a reservoir or buffer during drought.</p>
128	<p>Proposed Area 2 borefield has insufficient data for a project of this scale The EA envisages that the borefield could produce 10-15 GL of water per annum for two years. This equates to 10-15 million tonnes of water per annum — a substantial project.</p> <ul style="list-style-type: none"> • Some 23 production bores will be located in Area 2. • The expected production from Area 2 is not specified in the report- rather, production yield is based on average rates for the entire field, recognising that production rates will vary from bore to bore. <p>There is insufficient data to specify where the water for this “critical infrastructure” will come from</p>	<p>Proposed production bore locations were provided on the figures in Chapter 7 of the EA with more detail on the individual area plans in Appendix S. The approximate (average) production rates for each of the four areas are Area 1 - 6.5 ML/d; Area 2 - 11.8 ML/d; Area 3 - 16.8 ML/d and Area 4 - 6 ML/d to provide an average 41 ML/d or 15000 ML per year. Rates are based on either the known (after drilling and pump testing), expected (after drilling) or likely (extrapolated from nearby sites) rates at each bore site. The recent numerical modelling is based on these estimates - the maximum pumping rate for the whole borefield would not exceed 50 ML/d.</p>
128	<p>If dam levels fall due to a regional drought, pumping from Kangaloon: — may not generate the planned water volume</p>	<p>The water available in storage and pumping trials indicates that it can be extracted in reasonable quantities to provide a useful resource during drought. Based on the quite variable permeabilities across the area, an expected volume of 10 to 15 GL per annum has been proposed during extended drought periods. The recent transient modelling has confirmed that extraction rates towards the lower end of this range are sustainable.</p>
114	<p>I suggest that as the massive quantity of water that is anticipated to be drained from this aquifer in “severe drought” is an amount that has never been so drawn before, the scientists of this document don’t really know what will happen to the area’s ecosystem and by inference the whole water supply system which is dependant on it.</p>	<p>The EA documents the project’s substantial investigation, pumping trials, modelling, and assessment conclusions. This is the best available advice without actually building and operating the borefield. All evidence prescribed in the EA indicates the potential for a sustainable supply of water from the sandstone aquifer.</p> <p>Standard and incremental scientific methods for groundwater investigations and borefield development have been applied.</p>

96	Further, the lack of consideration of the broader groundwater budget and documentation of the impacts of the groundwater budget due to the proposal within the context of sustainable yield for the Southern Highlands is contrary to the Director General's Requirements (DGRs).	The broader groundwater occurrence and the context of this borefield in relation to other groundwater users in the Southern Highlands has been addressed in the EA. Water balances and groundwater budgets are produced as part of the modelling output. Estimates are provided in the EA and have recently been updated with the finalisation of the latest transient numerical modelling studies.
96	The average rainfall for the area of recharge being considered here has been estimated from Figure 11 of Coffey Geoscience to be about 1425 mm/yr. Applying the derivation method used by SCA previously, provides an estimate of total recharge to the area of about 8,200 ML/yr. Applying the 30% factor to account for environmental provisions, the amount available for consumptive use would be about 5,740 ML/yr.	These calculations are a reasonable first order estimate of recharge. The SCA proposal is to take a maximum 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons.
96	There are fundamental flaws in the conceptual model of the hydrogeology of the area. When considered, these flaws lead to the conclusion that the volume of water described in the EA as being available for use is, in reality, much less.. If the proposal proceeds at the extraction rates suggested, then the aquifer will be placed in major deficit. Further, if the aquifer cannot support the levels of extraction suggested, then the SCA will have wasted public funds.	The conceptual model has been described in the EA (and revised again as part of the transient modeling studies) and reviewed by independent peer reviewers and DWE, and is supported by these experts. The model is not considered flawed but SCA agrees that there will be short term deficits when the borefield is operational (and hence water levels will fall) but longer term it will be in surplus and water levels will recover to pre-usage levels.
108	<p>...the initial predictive simulations indicate that the borefield is capable of supplying around 50 ML/d, for a two year period during severe drought periods. A reduced total daily flow would be available from the bores if pumping continued into a third year. "The modelling suggested that recovery of the aquifer is relatively rapid and is on a similar timeframe to the pumping phase. Full aquifer recharge/recovery is dependant on the rainfall patterns at that time.</p> <p>This is another way of saying that the borefield is incapable of sustaining 50 ML/d for three years and that, if' drought continues, the aquifer recovery could be very slow, despite cessation of pumping. In effect, use of the borefield is predicated upon the assumption that drought will be limited to periods of two years and interspersed with periods of at least similar length to allow recovery. 'these findings are insufficiently convincing to justify proceeding with the borefield.</p>	The recent numerical modelling explores several rainfall scenarios (including worse drought and successive worse drought rainfall patterns) and this work concludes that around 10000 ML (and possibly up to 13000 ML) per year is sustainable during a succession of severe drought years.

96	In addition, other users in the area can be impacted by the increased extraction from the aquifer and its impact on the overall sustainability of the resource. If, as it appears likely, the Robertson Basalt provides leakage to the underlying sandstone, then the existing groundwater entitlements will need to be factored into the analysis by SCA. One potential impact on existing users of extraction from the proposed borefield will be to reduce the security of supply due to the aquifer system becoming over allocated.	Leakage between basalt and sandstone is not proven, and in fact is most unlikely across the catchment. The only area where there may be a connection is the vicinity of the basalt intrusion in the Mt Butler area. Existing groundwater entitlements have been factored into the allocations that DWE has authorised for the area (and this includes a substantial allocation to SCA for the Kangaloon borefield)
96	The groundwater in the proposed borefield is currently administered by the Water Act 1912. Under the Act, a number of parishes have been subject to groundwater embargoes that restrict future commercial access to groundwater. Groundwater embargoes are applied by the NSW Department of Water and Energy (DWE) when the density of bores and/or the volumetric allocations attaching to renewable licences reach the maximum allowable under the management plan rules for a particular area. Across the Southern Highlands and in other areas of the Sydney Basin there are pockets of intensive groundwater use that the former Department of Natural Resources (DNR) (now DWE) considered (in 2004, 2005 and 2001) may have led to water level estimates were derived from two primary sources - Coffey Geosciences (2006) and McLean and others (2008). The estimates only relate to the potential to cause induced recharge and do not relate to captured discharge.	The baseflow estimates provided in the water balance tables generated from the numerical modelling reflect (under non-pumping conditions) the natural groundwater discharges to the different stream segments. Under pumping conditions, the baseflow estimates represent continuing baseflow (ie. original baseflow less any captured discharge) and any induced recharge from the permanent streams
128	the net benefit to the catchment-of the borefield is likely to be substantially less than the headline range of 30 to 45 GL of water.	The recent research studies and numerical modelling results suggest otherwise with most of the water pumped sourced from groundwater (and indirectly rainfall recharge) and there being less than 5-20 percent sourced from surface water

96	<p>Related to the issue of sustainability and over allocation, the Director Generals Requirements explicitly state that the proposal should address: Derivation of sustainable yield information for the affected groundwater systems, including comment on the assumptions and uncertainties inherent in these calculations, and making reference to predicted depletion and recovery cycles, rainfall, and drought intensity. The EA must also include a general water balance for the project, noting any expected losses through evaporation or infiltration, particularly as a result of run of river transfers.</p> <p>64. The EA does not meet this requirement and as such needs amendment</p>	<p>Sustainable yield isn't the correct term to use to describe borefield capacity - it is a term that DWE uses to assess the capacity of large aquifers over very large areas taking into account socio-economic and environmental requirements (and in this instance the source is known as the Nepean Sandstones). Borefield "safe yield" or capacity is a more appropriate term. The sustainable use of the borefield is based on a calculation of safe yield that recognises the baseflow contribution to the Nepean River. Substantial information in this regard is provided in the different modelling studies, specifically water balances, drawdown patterns, recovery cycles, and various drought pumping cycles have been presented. The river interaction issue has been presented in substantial detail in the latest transient modelling study.</p>
96	<p>Of importance in the process will be how the new WSP will manage the currently embargoed areas within the context of purportedly granting a draft allocation to SCA for the operation of the proposed borefield. It is understood that the current embargoed entitlements in the parishes immediately adjacent to the borefield are low in comparison with the likely allocation required by SCA. If DWE believes it is warranted to embargo current use at such low rates due to issues with sustainability, how can it allocated very large additional resources in the area without compromising sustainable yield? Equally, how will the WSP propose to manage over allocation with existing users?</p>	<p>The prospect of an SCA borefield was factored into DWE's decision to embargo the parishes surrounding Kangaloon in late 2005, and does not compromise the sustainability of the sandstone resource. The large SCA allocation is factored into the sustainable yield calculations already and the purpose of the new WSP is to ensure that allocations are within sustainable limits.</p>
96	<p>The recharge volumes estimated in Paragraphs 18, 20 & 21 do not equate to a sustainable yield for this section of the proposed borefield as the latter needs to allow for allocation to the environment, which under State legislation is set to a default of 30% of total recharge unless otherwise specified.</p>	<p>The 30 percent to environment value is a default value if no specific studies are available. It is also only meant to apply on a groundwater source basis and has little relevance on a smaller borefield basis. To this end, SCA has commissioned specific studies to assess groundwater dependence and this is now known to be low. Probably less than 20 percent of average annual recharge. The 30 percent default value applied by DWE has no legislative basis.</p>
96	<p>A number of private production bores also occur within the area of recharge identified above. The entitlement for these bores would need to be accounted for in any evaluation of sustainable yield for the Kangaloon area.</p>	<p>DWE has accounted for other licensed groundwater users in their management approaches.</p>

140	The key to estimating the sustainability of this, essentially, unconfined to semi-unconfined aquifer is to calculate its drainable volume. In order to do this the 3-D volume of the aquifer mass is required multiplied by its specific yield (simplistically the drainable percentage of free pore space).	Long term sustainability is based on recharge (not storage) and hence actual recovery rates and cycles are the most important aquifer attributes. Storage is important in the context that it must be large to provide the necessary buffer during droughts. The Kangaloon aquifer satisfies all these requirements.
140	The sustainable yield of the Hawkesbury Sandstone aquifer is not estimated or quoted in any of the reports that have been reviewed. Only 'simplistic' estimates of aquifer storage volume without calculation of throughflow are presented for a range of recharge rates and speculative specific yields over a specified drawdown 'capture area' or 'zone of pumping influence'.	The sustainable yield of the Hawkesbury Sandstone aquifers in the Nepean Sandstones source area has been determined by DWE. It is of the order of 100,000 ML per year. SCA is proposing a large drought water supply borefield with an assessed "safe yield" (or borefield capacity) in the range 10000 to 15000 ML per year. Recent numerical modelling provides a good understanding of aquifer parameters, borefield capacity, drawdown patterns and transient behaviour.
140	Given these predictions, extraction of groundwater from a poorly understood system should be undertaken with caution, especially given the current drought dominated / regime. Periods of frequent and extended droughts may not allow sufficient time for recharge before groundwater extraction is required again due to low dam levels i.e. may need to operate for periods longer than three years.	The SCA's last three and a half years of investigations has yielded a substantial understanding of the aquifer. Combined with production based over much longer time frames, the SCA is confident of the capacity and performance of the aquifer to provide additional water during droughts. Extractions will be regulated by DWE and comprehensive monitoring of water levels will be part of the monitoring program if the borefield is constructed and becomes operational.
140	In analysing future test pumping trials there is a need to account for potential production well losses (well efficiencies) and separate these out from well interference impacts on drawdown.	It is recognised there is high well loss at some production bore sites.
96	There are fundamental flaws in the conceptual model of the hydrogeology of the area. When considered, these flaws lead to the conclusion that there is a much smaller volume of water available for use than described in the EA.	The conceptual model for the hydrogeology of the area has been reviewed by independent peer reviewers and DWE, and is supported by these experts. The model is not considered flawed. The pumping trials and modelling studies indicate the storage is large and all the studies completed to date suggest that when the borefield is operational water levels will fall, and longer term the storage will refill and water levels will recover to pre-usage levels.
140	Undertake petrophysical analyses from core drilling to determine specific yield and estimate aquifer volume and sustainability	Laboratory testing to determine permeability and specific yield maybe a useful check but cannot be upscaled to reflect aquifer storage on a regional borefield basis because of the substantial aquifer heterogeneity present.

140	sustainability of the water source. Specifically, it is understood that there is a concern that insufficient field testing of the aquifer has been undertaken to assess its regional behaviour to long-term pumping including the determination of its 'safe yield'1. This concern is accentuated by technical assessments that indicate that the aquifer behaves hydraulically as a 'fractured rock aquifer	The amount of testing on this fractured rock aquifer system has been substantial and involves 25 pumping tests as well as two extended pumping trials. The volume of work completed is beyond what would normally be completed for a large groundwater development but given the complexity of this fractured rock aquifer, additional study has been completed for this area. The pumping trials were initiated to provide additional certainty about bore capacity and extent of drawdowns after discussions with peer reviewers
140	In the case of Bore 2M, a revised analysis doubles the T value to about 14 m ² /d, which is still very low but more consistent with the SC. Indeed, most of the Cooper-Jacob plots behave akin to those characteristic of dual- porosity aquifers. The changes in drawdown ('delta s' on Figure 4-1) might also be explained by barrier ("impermeable") fault boundary effects combined with dual porosity. All the Theis curve ('log-log plots') graphical matches look odd. They should have been matched with more complex type curves e.g. Stretslova's method which would treat the late time data as "delayed yield" (drainage from interstitial matrix following initial dewatering of fractures).	The permeability and transmissivity distribution has been further refined by the latest numerical modelling. The sandstone is dual porosity and delayed yield is evident as upper fracture zones drain under pumping. Three layers have been included in the model to better replicate the aquifer characteristics
140	This 'Cooper-Jacob plot' manifests as a dual-porosity aquifer (i.e. exhibits both primary porosity in the matrix and secondary porosity from fracturing) and should have been analysed as such, say, using the Moench (1984) method to get more reliable transmissivity estimates. Table 4-1 presents a rough estimate of well specific capacity (SC) (drawdown at 1000 mins) compared with transmissivity (T) values derived by URS (2007a & c) from a selected sample of wells. This table indicates that transmissivities have tended to be underestimated by using the Cooper-Jacob analytical method.	The permeability and transmissivity distribution has been further refined by the numerical modelling. The sandstone is dual porosity and delayed yield is evident as upper fracture zones drain under pumping
The following submissions also made comment on this issue - the content was similar to the selected issues above – 5, 18, 20, 28, 30, 40, 41, 84, 85, 89, 98, 101, 122, 133		

2.07.03 Aquifer water age/dating/origin (27 comments recorded)		
46, 99, 103, 104, 105, 107, 110, 111, 112, 113, 117	Exact recharge figures following vague but estimated between 5-10 years. Radiocarbon dating indicates that recharge may be primarily from other parts of the aquifer and not a rainfall event.	The age and origin of recharge water has been described by some as uncertain. There was significant rainfall recharge reporting to the fractured aquifers but there was also water migrating laterally in the deeper aquifers (as the signature of the water sampled at each of the pumping sites after the recovery period indicated that the groundwater had not changed in quality or age). Simply stated this means the aquifer storage is large and that rainfall recharge (although substantial) is still a relatively small volume in comparison to the aquifer storage - hence while water levels fully recover, and recharge is quick, the age of the water does not change quickly because of the large aquifer storage volume.
91	Recent work has shown that where trial pumping was carried out the aquifer did not refill just from the subsequent rain event. Most of the water was 'old water which had flowed in from elsewhere This questions the earlier conclusions	The age and origin of recharge water has been described by some as uncertain. There was significant rainfall recharge reporting to the fractured aquifers but there was also water migrating laterally in the deeper aquifers (as the signature of the water sampled at each of the pumping sites after the recovery period indicated that the groundwater had not changed in quality or age). Simply stated this means the aquifer storage is large and that rainfall recharge (although substantial) is still a relatively small volume in comparison to the aquifer storage - hence while water levels fully recover, and recharge is quick, the age of the water does not change quickly because of the large aquifer storage volume.

84, 96	<p>There is a vast mixture of ages of water that came from three bores in the trial. A comparison of groundwater ages at the start of pumping with groundwater ages after recovery for three bores showed age ranges of 320 years to 5754 years and ages varied between before and after pumping. The radiocarbon data showed that inflow from the aquifers primarily recharged the water level. This is of concern as the SCA continues to make the dubious assertion that recharge of the aquifer comes from direct rainfall on the sandstone area. This indicates that the area of effect may be far greater than anticipated and that rainfall may have only a very minor influence on aquifer recovery.</p> <p>The latter contradicts the URS Water Level and Drawdown Assessment which stated "These recovery rates are no doubt associated with the June rainfall recharge events. The speed of the recovery provides additional evidence that the aquifer system will recover quickly after substantial rainfall recharge events" (URS 2007).</p>	<p>The age and origin of recharge water has been described by some as uncertain. There was significant rainfall recharge reporting to the fractured aquifers but there was also water migrating laterally in the deeper aquifers (as the signature of the water sampled at each of the pumping sites after the recovery period indicated that the groundwater had not changed in quality or age). Simply stated this means the aquifer storage is large and that rainfall recharge (although substantial) is still a relatively small volume in comparison to the aquifer storage - hence while water levels fully recover, and recharge is quick, the age of the water does not change quickly because of the large aquifer storage volume.</p>
84, 96	<p>That the SCA investigate the extraction of only the water within the basal aquifers of the Hawkesbury Sandstone. Our interpretation of their data is that it is the oldest and the most pure and may not require any treatment for iron.</p>	<p>The fractured aquifers within the sandstone strata are naturally linked and it is not possible to take just "low iron" groundwater or groundwater from the basal aquifers.</p>
84, 96	<p>That would be less likely to have consequences for existing users. There could be a separation of old, "iron-free" water in the lower aquifers from the younger, "iron-rich" water in the upper aquifers. However, the SCA have failed to prove the total variation of water quality or age within separate aquifers as the bores have taken mixed water, due to the design of the bores themselves. The assessment of water quality was based on cumulative water samples down the boreholes and iron content, for example, was determined only for the total cumulative sample from the completed bore.</p>	<p>Iron concentrations in groundwater relate to the geology and the amount of iron cement in the sandstone rock mass - it is not related to the age or depth of the groundwater in the sandstone. It is true that the water samples analysed were cumulative and integrated samples across all aquifer zones. This was done purposely as this is how the borefield would operate in practice. A research and development (R&D) study nearing completion provides additional insight into the water quality in individual fracture zones - while the chemistries are similar the age of waters is quite variable.</p>
84	<p>It is possible that the groundwater is not mixing in a vertical plane, because the rock fractures are not as prevalent or as open as reported. If the fractures do not allow vertical mixing of water from the various aquifers, water could be extracted only from the lower or from other selected aquifers.</p>	<p>Vertical mixing does occur although it is less dominant at some sites where lateral groundwater flow is apparent.</p>

127	<p>This new report (PB 2008) investigated water quality and recharge. By comparing groundwater ages before and after pumping it found that the contribution of new recharge water (e.g. rainfall) was minor and that the water level recovery was primarily due to the inflow of water from aquifer zones unaffected by pumping into the zones affected by pumping. This is of great concern as we have been told by the SCA that recharge comes from direct rainfall on the sandstone area. It shows that the area of effect is greater than the anticipated drawdown area and that rainfall may have a minor influence with aquifer recovery. It also questions the validity of earlier assumptions which led to this proposal being considered in the first place.</p>	<p>The age and origin of recharge water has been described by some as uncertain. There was significant rainfall recharge reporting to the fractured aquifers but there was also water migrating laterally in the deeper aquifers (as the signature of the water sampled at each of the pumping sites after the recovery period indicated that the groundwater had not changed in quality or age). Simply stated this means the aquifer storage is large and that rainfall recharge (although substantial) is still a relatively small volume in comparison to the aquifer storage - hence while water levels fully recover, and recharge is quick, the age of the water does not change quickly because of the large aquifer storage volume.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 87, 98</p>		
<p>2.07.04 Aquifer flow rate direction (14 comments recorded)</p>		
96	<p>Groundwater flow directions Despite the predicted drawdown of 60-80 meters in the immediate vicinity of pumping bores, and a 10 meters drawdown at 2 km from the borefield, "... changes to groundwater flow directions will be limited to the area within the zone of influence from the borefield pumping, and some throughflow to downgradient areas is still anticipated." If 75 bores are pumping at the rates and inter-bore distances proposed, the three- dimensional zone of influence will at least comprise the region of drawdown in Figure 9.1, down to a depth varying up to 80 m.</p>	<p>The local complexity of fracturing, aquifer permeabilities and the zones of influence when bores are pumping strongly influences drawdown patterns and groundwater flow directions. As an example, when the Tourist Rd pumping trial was on, the water level in the downgradient Bore 2H rose by around 2m even though there was intensive pumping from three production bores immediately upgradient. The only explanation for this trend is the there was throughflow to the downgradient area that was not captured by the production bores.</p>
115	<p>Some say 'they think! it may only drain to the North West.</p>	<p>Water level trends follow the topography and are primarily to the north and north east, with trends in the west, being more north westerly.</p>
140	<p>There is also the question of groundwater discharge to the Illawarra scarp re Fig.7, Coffey, 2006 and Figure 4.11, KBR, 2008 which appears to indicate that there is gradient towards the scarp from the high country at Robertson to the north. Baseline groundwater gradients in the aquifer are steep from the south (of the order of 15 m per km); this highlights a zone of limited permeability that may limit capture and / result in greater capture down-gradient to intercept available streamflows.</p>	<p>There is no known groundwater gradient towards the Illawarra escarpment within the borefield area (or within the area of influence of the borefield). Groundwater gradients are to the north and are steep because of the topography. There are some areas of lower permeability and these areas may be responsible for local steepening of gradients.</p>

140	Aquifer throughflow has not been discussed in addressing borefield safe yield.	Aquifer permeability, flow and velocities are part of the substantial numerical modeling studies have been completed for the borefield area. Water balances have been prepared in assessing borefield capacity and "safe yield".
The following submissions also made comment on this issue - the content was similar to the selected issues above – 78, 84, 87, 101, 108, 119, 120, 128		
2.07.05 Recharge and Discharge - areas and rates (338 comments recorded)		
46, 48, 49, 50, 51, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 68, 69, 71, 72, 74, 76, 77, 87, 98, 99, 103, 104, 105, 107, 110, 111, 112, 113, 117, 132, 138, 139, 141, 142, 143, 144, 145	The Kangaloon aquifer already naturally supplies the Nepean Dam via discharge near the dam and nearby wetlands which feed the creeks that supply the dams, By bringing the water to the surface and transporting over an 80-100km distance, the water is subject to evaporation and pollution	Baseflow occurs from the groundwater systems to the major creek and rivers (especially those in the incised gorge areas to the north) - the groundwater however is old water that is discharging from groundwater storage after many thousands of years. Velocities are slow and residence times are long so much of the groundwater in storage is not available during drought. Pumping and run-of-river transport of treated groundwater will not increase the current rate of evaporation from the water supply or increase any pollution risk to the supply. The transport distance in the Nepean River from discharge locations to the Nepean dam storage is between 5 and 10 km. Instream the water is subject to minimal evaporation and no pollution as it is all within vegetated and protected catchments.
96	A water budget that questionably relies on high rainfall events to ensure rapid recovery of the aquifers after 2-3 years of pumping.	The sustainability of the borefield that taps the sandstone aquifers is based on rainfall recharge and recovery of water levels. Pumping trials suggest this recharge is relatively rapid even with small rainfall events.
84, 96	There is a vast mixture of ages of water that came from three bores in the trial. A comparison of groundwater ages at the start of pumping with groundwater ages after recovery for three bores showed age ranges of 320 years to 5754 years and ages varied between before and after pumping. The radiocarbon data showed that inflow from the aquifers primarily recharged the water level. This is of concern as the SCA continues to make the dubious assertion that recharge of the aquifer comes from direct rainfall on the sandstone area. This indicates that the area of effect may be far greater than anticipated and that rainfall may have only a very minor influence on aquifer recovery. The latter contradicts the URS Water Level and Drawdown Assessment which stated "These recovery rates .. are no doubt associated with the June rainfall recharge events. The speed of the recovery provides additional evidence that the aquifer system will recover quickly after substantial rainfall recharge events" (URS 2007).	The age and origin of recharge water has been described by some as uncertain. There was significant rainfall recharge reporting to the fractured aquifers but there was also water migrating laterally in the deeper aquifers (as the signature of the water sampled at each of the pumping sites after the recovery period indicated that the groundwater had not changed in quality or age). Simply stated this means the aquifer storage is large and that rainfall recharge (although substantial) is still a relatively small volume in comparison to the aquifer storage hence while water levels fully recover, and recharge is quick, the age of the water does not change quickly because of the large aquifer storage volume. SCA does not believe the information is contradictory

96	Figure 1 (below) shows the watertable contours for the Hawkesbury Sandstone as interpreted by Coffey Geoscience (2006) (their Figure 6). The contours clearly show the higher groundwater levels under the much wider area of Wianamatta Group outcrop, further confirming the leaky nature of these sediments.	The groundwater contours do not confirm that the shales are leaky and that there is recharge from basalt higher in the catchment. A more likely explanation is that in the area of sandstone outcrop there is substantial rainfall recharge due to direct infiltration and infiltration of runoff water from the low permeability shales and basalt springs that flow for many months after rain.
96	Based on the published approach to recharge estimation from SCA (5% of average rainfall over the area of the aquifer), the likely recharge to the Western Block is about 2 GL/yr. This assumes that there is no recharge via the Robertson Basalt. If fracturing occurs in the Wianamatta Group, then recharge from the Robertson Basalt is possible, and the recharge estimate would be higher.	Recharge from the basalt and shales is an unlikely scenario given that shales are not known to fracture vertically and remain open for extended periods. Water quality studies suggest there is no leakage from the shales to the sandstone aquifers in the higher catchment areas. If the recharge rates are higher, that would provide further improvement in the certainty and sustainability of the borefield without compromising the basalt springs areas that would continue to operate as normal.
96	Similarly, the area to the east of the Eastern Block, that is, around Stockyard Swamp, covers an area of about 20 km ² . Using the same approach as above, the recharge rate to this area of the borefield is about 1 GL/yr.	Noted
96	The total estimated recharge to the borefield using the methods reported by SCA is therefore about 4 GL/yr.	This estimate (which doesn't cover the north western area) is in reasonable agreement with SCA's initial estimates of recharge and using the resource as a drought supply. Allowing for long recovery periods it confirms the borefield would operate sustainably.
44	Stream-flow depletion will result if over-extraction occurs and the current natural feeding system of the dam will be adversely affected.	The important issue here is the timescale at which water flows through the sandstone strata to discharge as baseflow lower in the catchment. This residence and flow time is of the order of thousands to tens of thousands of years. The sandstone groundwater is water that would not be available during any drought period hence the borefield strategy is to take part of the storage volume during drought (maximum 30 percent) close to the recharge area, and allow the depleted storage to recharge and recover at the conclusion of each drought period.

78	<p>There is a significant lack of knowledge relating to aquifer recharge areas. Aquifer recharge areas have not been identified and/or mapped. There has been some anecdotal references to the recharge areas being to the south of the proposed borefield however this has not been substantiated. Whilst the documentation addresses to some extent recharge volumes it does not identify where recharge areas exist in the landscape therefore references to volumes and rates are considered tentative at best. A project of this magnitude should not be allowed to proceed until the recharge areas are defined. There may be significant land use/land management issues relating to the location of the recharge areas hence its critical their extent and characteristics are fully understood prior to the borefield project progressing.</p>	<p>Recharge to the sandstone aquifer system occurs everywhere where the Hawkesbury Sandstone is exposed at surface. Some areas display fast recharge and large rises in water levels, other areas display time lags before maximum recharge occurs, while others only show small increases in water levels. Recharge rates and volumes are variable but it occurs everywhere in the landscape. Chemistry and water level studies support this process and have identified the primary recharge areas. It would be inaccurate to assume there are recharge and non recharge areas that can be mapped on a localised scale.</p>
96	<p>There are two types of impacts from groundwater extraction on streamflow. Firstly, when a drawdown cone from groundwater pumping intercepts a stream or river, water can be induced out of the stream into the groundwater system. This water then becomes additional recharge to groundwater and is termed induced recharge. Secondly, when water is extracted from a borehole, it changes the water balance in the aquifer such that an equivalent volume of water must be lost from discharge somewhere else in the aquifer. This holds due to the requirement to conserve the mass of water in the overall system — that is, one can't create additional water just by pumping. This change in the discharge characteristics usually relates in lower groundwater discharge rates to streamflow at some stage in the future after pumping. This volume is termed captured discharge. The impact of this latter process is felt at the site where the groundwater would have discharged had pumping not occurred. This can be many kilometers away from the pumping site and is determined by the nature of the discharge processes in the aquifer. 47. The EA provides estimates of the impact of groundwater extraction from the proposed borefield on the areas surface water. These estimates were derived from two primary sources — Coffey Geosciences (2006) and McLean and others (2008). The estimates only relate to the potential to cause induced recharge and do not relate to captured discharge.</p>	<p>The EA discusses the processes and effects of borefield pumping on the local streams. In this catchment the connectivity is poor and the impacts to streams are relatively minor. Testing and research to date indicates that induced recharge is less than 5-10 percent of the water pumped at Doudles Folly Creek (unlikely to be more than 3 or 4 bores that would influence the creek so the sum total of effects would be less than 0.5-1 ML per day) and less at other sites. Similarly the captured discharge component (based on modelling studies is low and is expected to be of the same order of magnitude). Ongoing monitoring of baseflows will assist in quantifying and managing any impacts.</p>

96	<p>Coffey Geosciences (2006) provided some estimates of connectivity between the surface water streams and creeks and the underlying groundwater as part of their modelling exercises. They assumed three different values for the hydraulic conductivity of the sediments comprising the bed materials of the surface water systems, and then allowed the model to simulate the impacts of pumping on surface water flows, The three estimates of hydraulic conductivity resulted in three levels of impact. SCA then adopted one of these estimates, the lowest, as the likely impact on the streams. The three levels of impact ranged between 18% and 50% of extracted water coming from stream leakage.</p> <p>49. There is no basis for SCA to adopt the lowest leakage rate as analysed in the model. The streams of the area are underlain by either sandstone or by sandy sediments. The hydraulic conductivity adopted by SCA of the bed sub-strate is too low for these types of sediments. A more realistic value would be much higher. The SCA placed great emphasis on their field observations of fracture density in the bed of the streams and the mapping of discharge features.</p> <p>This type of work is highly subjective and not a rigorous base upon which to base such an important conclusion.</p>	<p>Research and development (R&D) studies, pumping trial and transient modelling studies now suggest that stream connectivity is even lower and losses are only around 5-20 percent across the area. The induced recharge from streams is very low in comparison to actual stream flow and the volumes of groundwater that are expected to be pumped.</p>
65	<p>An honest assessment of a drought situation would show that reliance on the aquifers is delusory. The aquifer water table would be lower, and even natural flows would be reduced or nonexistent. Some upstream natural flows will also be diverted (naturally) away from filling the reservoir to help fill the aquifer ('losing stream'). A percentage of rainfall will also go to into the aquifer and not the reservoir,</p>	<p>Groundwater is commonly used as a drought water supply across Australia and this sandstone resource area, with large storage and high rainfall (and recharge rates) characteristics, fits the criteria as a suitable prospect. The natural variations in water levels in this sandstone aquifer (from wet to drought seasons) appear to be less than 5m across the proposed borefield area and consequently the variation in storage is relatively small.</p> <p>Research and development (R&D) studies, pumping trial and transient modelling studies suggest that stream connectivity is low and losses are around 5-20 percent across the area. The induced recharge from streams is very low in comparison to actual stream flow and the volumes of groundwater that are expected to be pumped.</p>
128	<p>Claims made in the EA about fast recharge of the borefield are not valid if the Southern Highlands experiences a drought concurrently with other areas of the catchment.</p>	<p>Recharge is an outcome of local rainfall events and is not influenced by rainfall events or trends in broader areas of the SCA's hydrological catchment.</p>

128	<p>The EA contains conflicting interpretations of the pumping test results</p> <ul style="list-style-type: none"> • The URS report on the pumping trial reported fast recovery of groundwater levels at the production bore sites on cessation of pumping. This was interpreted as a factor supporting the sustainability of the borefield. • However the peer review attributes an entirely different reason to the rapid recovery of groundwater levels - the rapid recovery arises from water in the casing flowing into the bore on cessation of pumping <p>The EA relies on borefield analysis which has been found to be flawed. The reliability of the conclusions reached in the URS report is questionable.</p>	<p>The URS report and Woolley peer review reports are consistent in their conclusions. The peer reviewer did however make the point that recovery and recharge are different and that both processes are evident in the pumping trial recovery data. Fast recovery of water levels is expected as the aquifer heads try to equilibrate across the aquifer zone/s, then the rate of recovery will flatten out. Water levels will only recovery to pre-existing water levels with recharge and what was in evidence at both the pumping trial sites was that water levels rose to above pre-start water levels within a few months of the cessation of pumping, confirming that there had also been substantial recharge to the sandstone aquifers.</p>
140	<p>However, neither the recharge mechanism has been well researched nor the location of recharge (intake beds or area) has been well-defined, mapped and represented a plan or a drawing. The recharge area is simply defined as being in the "south-central part of the project area'.</p>	<p>Recharge to the sandstone aquifer system occurs everywhere where the Hawkesbury Sandstone is exposed at surface. Some areas display fast recharge and large rises in water levels, other areas display time lags before maximum recharge occurs, while others still only show small increases in water levels. Recharge rates and volumes are variable but it occurs everywhere in the landscape. Chemistry, pumping trial and water level monitoring studies support this process and have identified the primary recharge areas. Recharge and non recharge areas cannot be mapped on a local scale.</p>
140	<p>The notion of active recharge of the aquifer by rainfall is supported. It has been established by multidisciplinary hydrogeological studies, including:</p> <ul style="list-style-type: none"> • dynamic response seen in SWL hydrographs; • hydrochemical data including elevated levels of dissolved oxygen in the groundwater and very low salinity; • supposed higher temperature of recharged water (but the scale of Fig. 4.18 does not allow this to be ascertained); • presence of stygofauna indicating oxygenated water (although limited information on the distribution of stygofauna is currently available for the Hawkesbury Sandstone aquifer); and, • dating of groundwater by tritium showing 'Modern' groundwater. 	<p>There are now many technical studies that confirm the conceptual model that local rainfall recharge is the dominant recharge source.</p>

140	In terms of duration, transfers have operated for up three months continuously, although more typical durations are in the order of several weeks at a time. This begs a question — has this additional water enabled enhanced recharge to the aquifer to take place since the start of the Shoalhaven transfer? Without historical surface and groundwater flow data this is problematic to answer.	There is no evidence to suggest that there has been enhanced groundwater recharge in the area of Doudles Folly Creek and downstream along the Nepean River. Groundwater levels are much higher than stream water levels, and groundwater monitoring shows that in the vicinity of the creek, water levels go up slightly when transfers occur then drain back to background levels when transfers cease. This is a bank storage effect and additional water cannot permanently enter the sandstone aquifers because they are full and overflowing.
133	The EA does not consider for one moment the impact of gross disruption of the Kangaloon Aquifer upon the Illawarra Escarpment, which itself is a high profile environment, much valued by the people of the Illawarra region. The Escarpment contains numerous threatened species on both the relevant State and Federal Endangered Species legislation. As the SCA's own published documents are now known to show that after trial pumping ceased, other groundwater from outside the borefield came into the Kangaloon Aquifer (from outside the borefield) that means that the SCAs narrowly defined area of impact from the pumping is inadequate. That casts into doubt their operational disclaimers of impacts outside the area of the immediate borefield (2Km from the nearest bore). That statistical definition of the restriction of the area of impact is now known to be worthless, and must be abandoned.	Pumping trials show no impact at distance and certainly none as far away as the Illawarra escarpment. Drawdowns were only within 1-2km and groundwater recharge after each of the pumping trials was localised and was not from areas "outside the borefield". The numerical modelling predicts impacts at greater distances with drawdowns only reaching the escarpment under extreme drought conditions and a decade of pumping. This is an extremely unlikely scenario and monitoring systems would be in place to ensure that sensitive areas are protected.
140	If this is the case, and accepting reported widespread direct recharge to the aquifer occurs through outcrop I sub-crop fractures, then one would anticipate large streambed conductance and 'point sources connectivity' to be dense [especially given that creeks tend to be associated with structural hiatus (faults and fractures)].	SCA surveys of the streambeds in the area do not support the case that these features are associated with large scale areas of deformation, faulting and fracturing. Stream gauging, water balance estimates and modelling studies support the conclusion that bed conductance is low.
133	Principles 5 and 5.1 state: i. Planning, approval and management of developments and land use activities should aim to minimise adverse impacts on groundwater systems by: 1. maintaining natural patterns of recharge and minimising disruption to groundwater levels that are critical for ecosystems;	No areas have been identified where sandstone aquifer drawdowns are likely to be critical for ecosystem health. Natural patterns of rainfall recharge are expected to continue. Disruption of groundwater levels in the sandstone aquifer will be closely monitored.

140	During low rainfall (i.e. drought) periods, groundwater extraction can result in the lowering of groundwater table and capillary fringe, resulting in change in head differential which can result in accelerated rates of leakage/percolation (i.e. induced recharge) from the unsaturated zone/fractures.	The nature of groundwater is such that pumping from deeper aquifers cannot induce or dry out soil moisture in the unsaturated zone or influence shallow perched water zones in any way.
140	Studies into aquifer recharge in northern NSW showed that recharge events were driven by large but sporadic rainfall events compared to small but frequent rain events providing limited recharge to shallow aquifers (Brodie et al. 2008). It is expected that recharge following small but frequent rain events is limited by surface runoff, evaporation and transpiration	It is agreed that some variability in recharge rates is expected with different rainfall events.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 2, 3, 5, 6, 7, 8, 11, 13, 15, 16, 17, 18, 20, 22, 23, 24, 25, 28, 29, 30, 33, 34, 35, 36, 37, 38, 39, 40, 41, 53, 55, 66, 70, 82, 83, 85, 86, 89, 91, 101, 108, 114, 118, 119, 120, 122, 124, 127, 129, 131		
2.07.06 Artificial recharge (3 comments recorded)		
140	further investigations into managed aquifer recharge.	No further investigations are proposed into managed aquifer recharge (MAR) at this time.
140	Managed Aquifer Recharge (MAR) via Aquifer Storage and Recovery (ASR) wells should be considered. This would enable additional recharge and banking to the aquifer storage and lessen the impacts of evaporation arising from pumping discharge transfers and surface reservoir storage. The Shoalhaven transfer via Doudles Folly Creek seems an ideal source of recharge water that the comprehensive geochemical studies have indicated compatible with the groundwater. ASR could solve the insidious problem of dewatering of the upper fractures that test pumping has indicated may occur in certain bores.	A desktop feasibility study has been completed and deep well injection is one method that has been identified as suitable if managed aquifer recharge is ever contemplated for this aquifer. SCA believe that in this high rainfall area, there will be sufficient natural recharge to recover and maintain groundwater levels and achieve full storage levels for periodic operation. Managed aquifer recharge is not contemplated at this time.
140	Incipient aquifer dewatering could lead to aquifer deformation that, when combined with drawing water from the deeper, inherently less permeable (macro-scale) part of the aquifer, could lead to a reduced hydraulic conductivity and inevitable consequences such 'accelerated' well dewatering. This might be combated by considering managed aquifer recharge (via well injection).	Drilling and groundwater extraction from a consolidated rock such as sandstone will not create subsidence or deformation. Managed aquifer recharge is possible in this type of aquifer system but is not contemplated as part of this borefield development

2.07.07 Drawdown rates and time lag (63 comments recorded)		
6, 8, 11, 13, 15, 16, 22, 23, 33, 34, 36, 38, 39, 83, 86, 114, 118, 127, 131	Monitoring of the natural environment is a good idea but some of the effects of sustained lowering of the water table may take many years to be visible and then it may be too late.	The proposed monitoring network will provide a good assessment of expected water levels and drawdowns and provide early warning of any ecosystem issues. Ecosystem monitoring will also be part of the monitoring program if the borefield is constructed and operational.
124	To counter this uncertainty, the documentation must better describe the situation, clarify the reasoning behind the adoption of particular values and provide greater commitment to responding to abrupt, unpredicted increases in drawdowns from individual sites during pumping operation, together with greater emphasis placed on the mitigation of impacts detected during the systematic monitoring of groundwater levels. The development of trigger levels, alluded to in the EA, must be progressed so that there can be a clearly defined linkage between drawdown in specific locations and the responsive management actions that will ensue.	The outline of the proposed monitoring plan, and associated network and frequency, is provided in the EA and is further expanded in the preferred project report. The development of trigger levels and on/off cycles will be developed in consultation with DWE as part of the final water licensing arrangements.
84	There is a lack of temporal data on effects of long-term drawdown on the important ecology of the area.	There is no deep sandstone groundwater use in the immediate area of the borefield, so the effects of long term drawdown (apart from those observed during SCA's pumping trials) cannot be monitored. SCA does not plan any additional pumping trials prior to staged borefield construction.
133	With regard to the remaining EPBC Act "endangered species" identified within the Borefield area, we ask the following question. 18. Will the establishment of a huge borefield, which will lower the entire water-table of the Kangaloon Aquifer be likely to have a significant impact on "Temperate Highland Peat Swamps on Sandstone and all the Listed Endangered Species and Listed Vulnerable Species, and the Listed Migratory Species?"	The EA (particularly Chapter 10) has comprehensively documented the hydrological and environmental settings, and any adverse impacts will be managed to minimise their effect. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and become operational. Pumping trials have indicated no impact to perched water tables and upland swamps.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 18, 44, 48, 49, 50, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 68, 69, 71, 72, 74, 76, 77, 78, 79, 87, 91, 96, 97, 101, 122, 132, 138, 139, 141, 142, 143, 144, 145		

2.07.08 Zone of influence/Area of drawdown (20 comments recorded)		
122	It has also been argued that the impact from this proposal extends beyond the project area in relation to drawdown as well as potential impacts to vegetation along the Illawarra escarpment.	<p>Pumping trials show no impact at distance and certainly none as far away as the Illawarra escarpment. Drawdowns were only within 1-2km and groundwater recharge after each of the pumping trials was localised and was not from areas "outside the borefield".</p> <p>The numerical modelling predicts impacts at greater distances with drawdowns only reaching the escarpment under extreme drought conditions and a decade of pumping. This is an extremely unlikely scenario and monitoring systems would be in place to ensure that sensitive areas are protected. Vegetation impacts along the Illawarra escarpment are not expected.</p>
96	The EA defines the area of impact of the proposed borefield as the area where drawdowns are greater than 10 m. Obviously, there will be impacts on current users outside of this area even if only through increased pumping costs due to greater drawdowns.	The EA and modelling studies recognise there will be some drawdown at distance. Preliminary modelling in 2006 suggested this would be less than 10m at distances greater than 2kms. The latest transient modelling suggests similar drawdown patterns with the 10m drawdown contour located at distances of 2 to 2.5km at the end of extended pumping periods associated with severe drought. The impacts to users are expected to be minimal as water level variations are likely to be within the normal range of fluctuations.
44	The SCA listed supply security for Illawarra as a "certain" project outcome. However the Illawarra is vulnerable because it is unable to tap the Warragamba Dam and the project increases potential for the degradation of the Illawarra Catchment area. If the borefield pumps for 2-3 years the water table will be greatly depleted and take an estimated, yet not certain, 5-10 years to recover. During this recovery, less water will naturally be supplied to the reservoir via the aquifer and upstream flows may naturally divert to recharge the aquifer. Under drought conditions a decrease in security and stability of Illawarra's water supply will ensue, especially when accounting for precipitation variability due to climate change.	<p>Potable water to the Illawarra is solely supplied from a pumping station at Avon dam. The project will actually improve the security of the Illawarra water supply and there are no significant impacts to surface supplies.</p> <p>Groundwater level recovery after pumping cycles is dependent on the length of pumping and rainfall patterns and transient modelling suggests this is likely to be of the order of years. Pumping trials however indicated recharge and recovery could be of the order of months after significant rainfall events.</p>
97	The level of the water table will be reduced significantly causing water further down the aquifer to replenish the table impacting an area far exceeding the Governments prediction. This may impact rivers and agriculture far from the area covered by the proposal.	The expected drawdowns are all within the local area of the borefield. Water is sourced from local aquifer storage and groundwater is recharged locally in the Upper Nepean catchment. The pumping trial and modelling studies indicate there is no impact at distance in the more intensively developed agricultural areas of the region.

108	Despite the predicted drawdown of 60—80 m in the immediate vicinity of pumping bores, and a 10 m drawdown at 2 km from the borefield, changes' to groundwater flow directions will be limited to the area within the zone of influence from the borefield pumping and some throughflow to downgradient areas is still anticipated. If 75 bores are pumping at the rates and inter-bore distances proposed (section 1.1 above), the three- dimensional zone of influence will at least comprise the region of drawdown in Figure 9.1, down 40 a depth Varying up to 80 m. Throughflow will continue beneath and around the 3d—zone, but will be disrupted within it. The rate of recovery will reflect the time for thoughflow to re—establish in the zone of influence after pumping ceases,	Groundwater pumping will intercept a large proportion of the flow but not all flow moving from south to north because of the complexity of the fracturing, aquifer permeabilities and the zones of influence when bores are pumping. As an example, when the Tourist Rd pumping trial was on, the water level in the downgradient Bore 2H rose by around 2m even though there was intensive pumping from three production bores immediately upgradient. The only explanation for this trend is that there was throughflow to the downgradient area that was not captured by the production bores.
2	No assessment has been made regarding the effects on the Kangaloon Aquifer or on associated water storages including groundwater in the Southern Highlands of the proposed pipeline to Goulburn	It is understood the proposed pipeline to Goulburn will rely on surface water. The expected drawdowns are all within the local area of the borefield and are well away from the water supply storages. Water is sourced from local aquifer storage and groundwater is recharged locally in the Upper Nepean catchment. The pumping trial and modelling studies indicate there is no impact at distance in the more intensively developed agricultural areas of the region (including the Goulburn pipeline offtake area)
78	The extent to which groundwater extraction may impact on the Wingecarribee Reservoir and the vegetation and ecosystems that support the Wingecarribee Swamp does not appear to have been investigated.	The expected drawdowns are all within the local area of the borefield. Water is sourced from local aquifer storage and groundwater is recharged locally in the Upper Nepean catchment - the pumping trial and modelling studies indicate there is negligible impact at distance, including the Wingecarribee Reservoir area
82	No environmental / scientific monitoring facilities outside the 2km bore site. Why?	Groundwater investigations to the south of the main borefield spine require investigations and monitoring bores on private property. Investigations in these areas have been proposed but have not been able to be completed at this time. There is sufficient information from the few bores on SCA land (at around 2km) to confirm water levels and water quality in the main recharge area. To the north, there are sufficient bores located on SCA land to monitor downgradient conditions. More monitoring bores will be established as part of the larger monitoring network proposed when the borefield proposal is reactivated
133	It is therefore incumbent upon the Dept of Planning to satisfy itself that these wider impacts will not be damaging to other sensitive environments outside the immediate area of the “borefield” as defined by the SCA.	Pumping trial data and modelling results confirm that most drawdown will be within 2 to 2.5km of production bores. Impacts on the environment in the wider regional context are unlikely.

140	Furthermore seepage is indicated from Wingecarribee reservoir indicating that it may not be hydraulically isolated by the groundwater divide between itself and the Nepean catchment.	The initial modelling was conceptualised to include the sandstone aquifers in the Wingecarribee catchment and results suggested a slight impact on the sandstone water levels and a very small loss from the reservoir under extended borefield pumping conditions. There was limited data in this southerly direction and the pumping trial indications were that water level drawdowns are unlikely to extend this far. Later modelling suggests similar drawdown patterns (all within the Upper Nepean catchment) with the 10m drawdown contour located at distances of 2 to 2.5km at the end of extended pumping periods associated with severe drought
The following submissions also made comment on this issue - the content was similar to the selected issues above – 82, 84, 101, 124		
2.07.09 Ecosystem dependence (88 comments recorded)		
6, 8, 11, 13, 16, 22, 33, 34, 36, 38, 39, 83, 84, 86, 96, 114, 118, 127, 131	The flora and fauna surveys, carried out in Spring and Autumn have been very useful in highlighting the large number of endangered species and communities in this area. This is an ecological hot spot and should be left undisturbed.	The project's minor impact on the ecology of the area is described in the EA. The borefield development is low impact and construction will be in already disturbed areas. The area disturbed is small within the disturbed areas and areas impacted by trenching are expected to quickly re-establish. The biodiversity of the area will not be affected.
124	It is recommended that further investigation is conducted in relation to potential access to groundwater and that rigorous monitoring of the woodland communities (particularly EECs) is conducted. This should include both monitoring of water levels in the vicinity of the vegetation and also floristic monitoring.	Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible. Water level monitoring will be one of the primary indicators of aquifer variability. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.
133	The EA fails to properly account for the integration of Butler's Swamp and Stockyard Swamp and all other "Temperate Highland Peat Swamps on Sandstone" (known in NSW DECC terminology as "Upland Swamps") into the hydrology of the region. These are "Groundwater Dependent Ecosystems", albeit of varying "sensitivity". None-the-less the EA fails to adequately assess their vulnerability to gross interference with the groundwater, as is proposed by the SCA. Thus the EA also fails to account for the numerous endangered species (flora and fauna, including stygofauna) which are known to reside within these precious habitats. In that regard the EA fails to comply with the DG's Requirements and the DG's Supplementary Requirements.	Habitats have been subject to detailed investigation and assessment. Pumping trials have shown that upland swamps are perched and disconnected and not impacted by pumping. As there is an unsaturated zone beneath these perched systems they cannot be influenced by pumping. The only processes at work within perched water tables (whether they are associated with upland swamps or terrestrial vegetation) are evaporation, transpiration and natural drainage. None of these processes are influenced in any way by pumping from the disconnected sandstone aquifers. Substantial assessment has been undertaken as part of the baseline studies for the EA on the biodiversity of upland swamps and the threatened species in the vicinity of these features. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.

91	<p>The flora and fauna surveys carried out have highlighted the existence of endangered species and ecological communities. There has not been enough work done to ensure all species have been identified or ecological relationships studied. The effects of a sustained lowering the water table may take many years to become visible, but then it may be too late.</p>	<p>Pumping trials have shown that upland swamps are perched and disconnected and not impacted by pumping. As there is an unsaturated zone beneath these perched systems they cannot be influenced by pumping. The only processes at work within perched water tables (whether they are associated with upland swamps or terrestrial vegetation) are evaporation, transpiration and natural drainage - none of these processes are influenced pumping from the disconnected sandstone aquifers.</p> <p>Water level monitoring will be one of the primary indicators of aquifer variability. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.</p>
133	<p>The report by LesryK (Attachment K to the EA) purports to assess this issue. It is quite inadequate. Just because those consultant did not see a particular species along the pipeline corridor does not mean that species is not present. The “desktop survey” they apparently conducted (to supplement their brief field trip) is inadequate as it failed to produce a full list of the species involved.</p>	<p>Intensive effort over many years and seasons, using established survey methods, including targeted survey has been undertaken. The LesryK flora and fauna survey assesses the borefield construction and operation with the proposed borefield corridor. The numerous SMEC ecosystem studies since 2006 provide the baseline studies of the different ecosystems within and adjacent to the borefield. Collectively the list of species identified is substantial and comprehensive.</p>
84, 96	<p>There is a lack of temporal data on effects of long-term drawdown on the important ecology of the area.</p>	<p>Extensive investigations, modelling and trials have provided detailed information regarding anticipated drawdowns. These efforts have been analysed and results presented in the EA together with anticipated impacts on the ecology. Seasonal SMEC studies were completed before and after the four month Tourist Rd pumping trial in 2007.</p> <p>Water level monitoring will be one of the primary indicators of aquifer variability. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.</p>
1	<p>Despite the fact that more than 60 studies have been done we do not believe that the environmental impact can be predicted with any certainty.</p>	<p>The number of studies completed in advance of the EA is substantial and there is now an excellent understanding of the hydrology, hydrogeology and ecosystems within the borefield area. Water level monitoring will be one of the primary indicators of aquifer variability and resource behaviour. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.</p>

44	Although the Sydney Catchment Authority (SCA) claims there will be no significant impact on ecosystems based on their initial research, it could be several years before effects of a sustained lowering of the water are visible and at this point the damage will be irreversible. Similarly, there is no way to predict what the effects of ecosystems downstream of the borefield will be.	<p>The number of studies completed in advance of the EA is substantial and there is now an excellent understanding of the hydrology, hydrogeology and ecosystems within the borefield area. This has contributed to robust prediction about potential impacts. No irreversible impacts are anticipated and the proposed management and monitoring program will ensure that no irreversible impacts occur.</p> <p>Water level monitoring will be one of the primary indicators of aquifer variability and resource behaviour. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p>
79	further investigations, under a range of climatic conditions, should be undertaken to determine whether upland swamps and riparian woodlands in the area are dependent on groundwater;	<p>Pumping trials (across wet and dry months) have shown that upland swamps are perched and disconnected and not impacted by pumping. As there is an unsaturated zone beneath these perched systems they cannot be influenced by pumping. The only process at work within perched water tables (whether they are associated with upland swamps or terrestrial vegetation) are evaporation, transpiration and natural drainage - none of these processes are influenced in any way by pumping from the disconnected sandstone aquifers.</p> <p>Water level monitoring will be one of the primary indicators of aquifer variability and resource behaviour. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p>
44	The SCA's Environmental Assessment (EA) lists "improved monitoring of the natural environment (groundwater, surface water, and nearby ecosystems" ³) indicating that the SCA is still unsure of presence of threatened and endangered species as well as the interconnectedness of the aquifer, groundwater, and surface ecosystems.	The proposed monitoring will gauge the predicted impacts of the project and contribute to the adaptive management of the borefield. Management of the borefield will respond to impacts beyond those predicted and address the presence of threatened or endangered species not currently identified.
118	Similar to the last comment, but it is interesting that the SCA appears to have drawn mainly from their research over the last few years showing a lack of research in this area over the last 100 years or so. The flora and fauna surveys, carried out in Spring and Autumn have been very useful in highlighting the large number of endangered species and communities in this area. This is an ecological hot spot and should be left undisturbed.	<p>Recent work commissioned by SCA was important in providing baseline information on the ecosystems in the vicinity of the borefield, and provided a sound basis for assessing potential impacts of the project..</p> <p>The borefield development is low impact and construction will be in already disturbed areas. The area disturbed is small within the disturbed areas and areas impacted by trenching are expected to quickly re-establish. The biodiversity of the area will not be affected.</p>

133	<p>In the SMEC Report “Baseline Groundwater Dependent Ecosystems Evaluation Study” (September 2006) there is a Peer Review conducted by Professor Derek Eamus, Dr Hose and Assoc Prof Dangerfield, their concluding remarks are as follows:</p> <p>i) “There is much work to be done, however, before the following key question can be answered: what level of groundwater extraction is sustainable and what level does not pose an unacceptable threat to groundwater dependent ecosystems? This is the core question that must be addressed by the SCA prior to groundwater abstraction.” Peer Review: Eamus, Hose and Dangerfield. p14 of Appendix 9 of the SMEC report.</p> <p>b) That single most profound question by Eamus et al remains unanswered by the SCA to this date.</p>	<p>This peer review attaches to the original SMEC baseline study from Spring 2006 prior to any of the later studies being concluded. Much more work has been completed since that time. Subsequent studies have indicated that there is no dependence associated with upland swamps, only minor connectivity with stream baseflows, and no known connectivity with terrestrial vegetation. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p> <p>There is sufficient certainty about groundwater dependence (or the lack thereof) to proceed with borefield development.</p>
140	<p>the studies have focused on wetlands within the vicinity of the borefield and have not considered all wetlands within the region. As groundwater extraction will affect the water table level over a broader area, especially during extended dry periods (compounded by being in a drought dominated regime and global warming), impacts to other wetlands, in particular Wingecarribee Swamp should be considered.</p>	<p>The numerous SMEC ecosystem studies have focused on the upland swamps located adjacent to the borefield development. The PB, 2007 study focused on all other upland swamps within the likely area of influence of the borefield. Modelling has shown that drawdown impacts do not extend to the Wingecarribee Swamp/Reservoir area (and other studies have shown that this swamp is quite different in its morphology and character, and is supported by the basalt springs that emanate on the southern flank of the Mittagong Ranges.</p>
140	<p>Ecosystems dependent on the surface expression of groundwater eg base-flow rivers and streams, and wetlands: Considerable investment has been undertaken by SCA to assess the potential for groundwater extraction to impact such ecosystems in the vicinity of the borefield, including Butlers and Stockyard Swamps. While the various studies indicate (and a conclusion that we agree with) that wetlands located within the basalt are unlikely to be affected by groundwater extraction from the Hawkesbury Sandstone aquifer (including Butlers Swamp), the studies do not conclusively show that wetlands such as Stockyard Swamp are disconnected. In addition, the studies have focused on wetlands within the vicinity of the borefield and have not considered all wetlands within the region. As groundwater extraction will affect the water table level over a broader area, especially during extended dry periods (compounded by being in a drought dominated regime and global warming), impacts to other wetlands, in particular Wingecarribee Swamp should be considered.</p>	<p>Both pumping trials for the Tourist Rd pumping trial and the Stockyard Swamp pumping trial (together with the peer reviewer reports) conclude that the perched water associated with the swamps is disconnected from the regional sandstone aquifers. These two swamps are the closest swamps to the proposed borefield and therefore the most sensitive to operations.</p> <p>PB, 2007 (in the EA Appendix) considered the other swamps in the area of influence of the borefield and assessed the likely risks to these ecosystems.</p> <p>Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p> <p>Wingecarribee Swamp will not be impacted.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 5, 15, 18, 21, 23, 53, 78, 85, 89, 119, 120, 122, 128</p>		

2.07.10 Aquifer connectivity (30 comments recorded)		
108	BMCS accepts that.. water level declines in the sandstone will not impact the rate of vertical seepage from the base of the basalt, due to the presence of a thick shale/clay layer.. ' Nevertheless, there are areas where the basalt overlaps the shale and is in direct contact with the sandstone aquifer and the unsaturated zone (Fig. 9.1). This would promote leakage and should not be regarded as a negligible factor.	The only known area of contact between the basalt and the sandstone is the intrusion in the vicinity of Mt Butler. The springs in the Mt Butler area that appear to be in direct contact with the sandstone strata will be monitored more closely.
124	Transmissivity estimates are provided for each of the piezometers. There is no documentation of the analysis or the method used. However the estimates are significantly different to those obtained by RES (2006) or Woolley (2008). There is no commentary on the implications of the free drainage of the shallow 'major inflow' zones. For instance piezometer 2C in Table 4 has 4 zones of which Table 6 indicates only one was not free draining at the end of the pumping trial.	There is substantial explanation in the RES, 2006 analysis and SCA agrees that there are some differences in estimates from later (longer term) testing. The most conservative permeability and transmissivity distribution has been adopted and further refined by the numerical modelling. The sandstone is dual porosity and delayed yield is evident as upper fracture zones drain under pumping. The latest numerical modelling (adopted three layers and the potential for upper zones to be dewatered) has been taken into account.
124	The document refers to springs sourced from basalt aquifers and states that there is unlikely to be any connectivity between the basalt and sandstone aquifers. Is it possible that springs could be sourced from the sandstone aquifer? The report has not identified ecosystems that may rely on springs in the area yet it refers to potential loss of water from springs and compensation.	Springs cannot be sourced by water from the sandstone aquifer where the basalt rocks occur high in the catchment and tens of metres above the top of the sandstone strata. Sandstone groundwater does not flow uphill but rather flows to the north following the topography and the dip of the strata. SCA studies show no connectivity between the sandstone and the basalt aquifer systems along the Mittagong Ranges and this disconnection is expected to be maintained even if a borefield was constructed and operational for a long period. Monitoring will be in place to monitor spring levels and flow at key sites. The comment regarding compensation if springs were affected is a precautionary measure and does not imply there is connectivity between the two aquifers.
96	These water quality results may indicate that the upstream water is sourced from groundwater (with similar elements and may be connected). There is no shale layer at Butlers Swamp, so although the results suggest that the Swamp is protected from drawdown during pumping, the long-term effect is unknown, and the risks from these impacts may be substantial.	Pumping trials have shown that upland swamps are disconnected. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.

<p>108</p>	<p>'for the elevated perched water zones at several upland swamp sires, the variations in water levels suggest that the perched water storage is entirely rainfall dependant, there is 'no linkage with the regional sandstone aquifer, and these zones' go dry when lower rainfall periods occur. The significant points to be made here are:</p> <p>(i) all watertables, perched or otherwise, are rainfall—dependent -- it is the amount of water beneath the perched watertable that influences drying out and rainfall-response times;</p> <p>(ii) a low level of vertical hydraulic conductivity between the perched and main watertables is not necessarily precluded by any of the observations, despite the pumping trial having no apparent impact on the disconnected upland swamps... (p9-6). This point is made irrespective of the graphs in Figures 4.16 and 4.17 (p4.32), which clearly demonstrate the differing rates of response to rainfall events however, Figure 4.17 on the scale of the pumping trial, suggests that the perched watertable was gradually falling until replenished by the rain fall event.</p> <p>Whilst it can be argued that the fall purely reflects lack of precipitation, a case can be made for exacerbated slow bleeding from the perched watertable during the progression of the pumping test. The possibility of very slow bleeding of a perched swamp, during prolonged pumping (2-3 years) of the borefield, has not been precluded. This matter is critical because the swamps are at their most vulnerable when severely stressed by prolonged drought. The small component of bleeding could be the tipping factor between ultimate recovery' and total collapse.</p>	<p>(i) the maintenance of perched water tables is dependent on rainfall and evapo-transpiration not the unsaturated conditions immediately below swamps or the depth to the regional water table</p> <p>(ii) there may be some minor vertical leakage through weathered rock and fracture zones to the regional water table, however if this process was dominant in the vicinity of the swamps then perched water would never accumulate in the swamps. Where this process does occur, the leakage is controlled by the permeability of the fractures not any pumping stresses in the area. Stockyard Swamp was used as a control during the Tourist Rd pumping trial and the rates of water level decline were similar at both sites further indicating that the pumping trial had no impact on perched water tables</p>
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96	<p>“... the groundwater is drawn from aquifer storage... there is no apparent impact on the disconnected upland swamps or the adjacent permanent streams... On a regional basis... there was continued regional flow through the line of production bores from south to north,”</p> <p>I am of the view that the statement regarding ‘no apparent impact’ is unsatisfactory. What criteria were used to gauge impacts on swamps and adjacent streams? In view of the significant rainfall events during the period, and bearing in mind that the swamps are rainfall dependent and supposedly related to perched watertables, how can any impact attributable to pumping be discounted? Is it reasonable to extrapolate continuous regional flow of groundwater in relation to a 7-bore pumping test during a period of significant rainfall, to 75-bore production under conditions of prolonged drought? The cumulative flow disruption must be far more extensive.</p>	<p>Groundwater pumping will intercept a large proportion of the flow but not all flow moving from south to north because of the complexity of the fracturing, aquifer permeabilities and the zones of influence when bores are pumping. As an example, when the Tourist Rd pumping trial was on, the water level in the downgradient Bore 2H rose by around 2m even though there was intensive pumping from three production bores immediately upgradient. The only explanation for this trend is that there was throughflow to the downgradient area that was not captured by the production bores.</p>
82	<p>Ref KBR Environmental Assessment – S.4.5 Aquifer is extensive and fractured areas are interconnected. The project may impact on ecosystems lowering the regional water table. Pumping might dry the uppermost sections and some permeable parts of the sandstone aquifer.</p>	<p>Water levels do fall and the uppermost part of the regional sandstone aquifer becomes dewatered. Perched water levels are unaffected and impacts on surficial ecosystems are considered negligible.</p>
78	<p>the relationship between the shallow aquifers and the deep aquifers in this area appear not to be known</p>	<p>There is substantial monitoring bore information obtained during both the Tourist Rd and Stockyard Swamp pumping trials that indicate that the upper most sandstone aquifers are affected by pumping at production bores. The rates of water level declines vary from site to site but generally there is slightly less drawdown in the shallowest zone compared to deeper zones.</p>
44	<p>The water discharged from the Butlers Swamp trial contains a similar chemical composition to the upstream water, apart from the iron and manganese, which could indicate that the upstream water is also from a groundwater source that may be linked to the groundwater used for the borefields. Given this, there is a risk of upstream Nepean River drawdown which can hinder the water naturally entering the reservoir.</p>	<p>Hydrochemical studies clearly indicate that all the groundwater in the sandstone aquifers is rainfall derived. While there are slight variations in salinity and iron/manganese concentrations, these reflect residence times and the nature of the geological strata. There is no data to suggest any surface water influence from the Nepean River.</p>
79	<p>Prior to pumping, further data should be gathered as suggested by Woolley (2008) to refine water level contour maps and identify groundwater discharge areas and swamps maintained by groundwater discharges.</p>	<p>This comment refers to water level contours in the vicinity of Stockyard Swamp. Additional data was collected at the conclusion of this pumping trial. All data confirms earlier conclusions that the Stockad Swamp and adjacent swamps are perched and disconnected from the regional sandstone aquifer.</p>

133	The SCA appears to present the case that the key wetland communities in the Aquifer area are not hydrologically connected with the Aquifer. This is a self-serving argument, which they have attempted to maintain, without satisfactorily responding to the professional advice of their professional Peer Reviewer, Prof Derek Eamus In his Peer review to the SMEC Report, Professor Eamus listed 3 alternative ways of establishing beyond doubt the groundwater dependence of these Swamps. Personal communications with Mr. Graham Head and Mr. John Ross confirm that these recommendations have not been followed up- "because we do not need to". (Discussions with Messrs Wilson and Eddy and Messrs Ross and Head (then Chief Executive, SCA — 1 February 2007).	The Eamus peer review attaches to the original SMEC baseline study from Spring 2006 prior to any of the later studies being concluded. Subsequent studies have indicated that there is no dependence associated with upland swamps, only minor connectivity with stream baseflows, and no known connectivity with terrestrial vegetation. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational. There is sufficient certainty about groundwater dependence (or the lack thereof) to proceed with borefield development.
140	It would be interesting to see a test on an open-hole well completion as the casing to observe this dual porosity effect (and to gain an idea of well loss). respect, in constructing the production bores it may be better to regard the zones of the aquifer as semi-confined and cement the upper casing that eliminate any partial de-watering effects.	R&D studies have focused on individual fracture zones and undisturbed sandstone as part of the trials at Doudles Folly Creek. Fracture flow is the dominant process in this dual porosity aquifer. It is not possible to isolate upper sandstone aquifers that may be dewatered at each production bore as this process will occur naturally in the adjacent formation
The following submissions also made comment on this issue - the content was similar to the selected issues above – 68, 84, 115, 128		
2.07.11 Surface water connectivity (58 comments recorded)		
84	A pool downstream of Molly Morgans Crossing displayed a 10 cm drop in water level from the commencement of the pumping trial until approximately day 10. After this time drawdown was masked by significant local rainfall from early November until the end of the one month trial. Iron floc was also around this pool indicating a connection between the groundwater and Dudewaugh Creek.	This comment was made in the month 1 report of the Stockyard Swamp pumping trial. Results from the remaining 60 days of the pumping trial do not indicate connectivity with this pond given the three bores that were operational.
124	A discussion of potential impacts on both low and zero flow periods in relation to the NSW River Flow Objectives is required. It is often assumed that if streams are ephemeral that no impact will occur (refer to section 4.5.1 2nd paragraph). The ecology of these streams is adapted to periods of drying but may not be adapted to extended periods of drying which may be caused by production pumping	Water in ephemeral streams is derived from the basalt springs higher in the catchment and there is no hydraulic connection with the sandstone aquifers when they flow across the Hawkesbury Sandstone terrain. As the aquifer and water in ephemeral streams are hydraulically disconnected, pumping the sandstone aquifers cannot influence or dry out the streams in any way.

108	<p>“...water supplied by aquifer storage... is around 65 to 80%, with the remainder supplied by rainfall and river leakage. More recent information ... suggests that a larger proportion is likely to be derived from, aquifer storage and rainfall recharge, and a lesser amount from river leakage.”</p> <p>Again this is not good enough - There is an implication that, at times of drought, will cause an unspecified impact on watercourses due to vertical connectivity. ‘There is a need for better quantification of this matter.</p>	<p>R&D studies, pumping trial and transient modelling studies suggest that stream connectivity is low and losses are around 5-20 percent across the area. The induced recharge from streams is very low in comparison to actual stream flow and the volumes of groundwater that are expected to be pumped. Impacts to unregulated streams by inducing recharge are minor because of low connectivity along the Nepean River and expected similar conditions along other unregulated streams - impacts on ecosystems are not expected however baseflow and ecosystem monitoring is proposed on important unregulated streams.</p>
18, 20, 30, 35, 40, 41	<p>No consideration has been given to the creeks that would dry up due to draw down</p>	<p>No creeks have been identified that would be this severely impacted. The modelling study in the EA and the preferred project report addresses this issue. Baseflow reductions are predicted for permanent streams in the vicinity of the borefield but not in the wider area. Only part of the Nepean River is predicted to become a losing stream and it would not dry up as the river is the carrier of the treated groundwater from the water treatment plant.</p>
96	<p>The conclusion from McLean and others was based on the observation that during a pumping trial only 5% of the groundwater pumped originated from streamflow as measured by tracers. 52. However, the measure of 5% was for the full time of the trial.</p>	<p>Latest tritium results support surface water losses (induced recharge) less than 5-10 percent of the pumped volumes. There is no evidence to support losses of 10 percent or higher, although the latest transient modelling suggests that losses (combined induced recharge and captured discharge) may be as high as 20 percent. Once the stream becomes disconnected from the underlying fractured sandstone (and this happened at Doudles Folly Creek within 48 hours of the commencement of the pumping tests), the leakage from the stream is limited and is determined by the vertical hydraulic gradient and the permeability of the fracture zones. Conversely once regional groundwater levels recover to the base of the stream then no further losses will occur to groundwater.</p>
96	<p>These conclusions about the volume of induced recharge caused by groundwater extraction from the proposed borefield will result in two types of impacts. Firstly, water will be induced from the regulated systems of Doudles Folly Creek. This will result losses of surface water flow and a misrepresentation of the amount of water that can be added to the overall water supply for Sydney. Secondly, induced recharge from unregulated streams will cause changes to the flow duration characteristics of these streams and possible impacts on in-stream ecosystems.</p>	<p>The EA discusses the processes and effects of borefield pumping on the local streams. In this catchment the connectivity is poor and the impacts to streams are relatively minor. Testing and research to date indicates that induced recharge is less than 5-10 percent of the water pumped at Doudles Folly Creek (unlikely to be more than 3 or 4 bores that would influence the creek so the sum total of effects would be less than 0.5-1 ML per day) and less at other sites. Similarly the captured discharge component (based on modelling studies is low and is expected to of the same order of magnitude). Ongoing monitoring of baseflows will assist in quantifying and managing any impacts.</p>

96	<p>Coffey Geosciences (2006) provided some estimates of connectivity between the surface water streams and creeks and the underlying groundwater as part of their modelling exercises. They assumed three different values for the hydraulic conductivity of the sediments comprising the bed materials of the surface water systems, and then allowed the model to simulate the impacts of pumping on surface water flows, The three estimates of hydraulic conductivity resulted in three levels of impact. SCA then adopted one of these estimates, the lowest, as the likely impact on the streams. The three levels of impact ranged between 18% and 50% of extracted water coming from stream leakage. 49. There is no basis for SCA to adopt the lowest leakage rate as analysed in the model. The streams of the area are underlain by either sandstone or by sandy sediments. The hydraulic conductivity adopted by SCA of the bed sub-strate is too low for these types of sediments. A more realistic value would be much higher. The SCA placed great emphasis on their field observations of fracture density in the bed of the streams and the mapping of discharge features. This type of work is highly subjective and not a rigorous base upon which to base such an important conclusion.</p>	<p>The field observations of low connectivity have proven to be correct. R&D studies, pumping trial and transient modelling studies now suggest that stream connectivity is even lower than predicted in earlier modelling studies with losses only around 5-20 percent across the area. The induced recharge from streams is very low in comparison to actual stream flow and the volumes of groundwater that are expected to be pumped.</p>
96	<p>I am concerned about the hydrologic regime comprising the groundwater and surface water, and the extent to which any changes to the regime may impact on farmers abilities to continue to farm in the area as well as the effects upon flora and fauna within the swamp and riparian habitats. I emphasise that it is the responsibility of SCA to prove there will be no adverse impacts.</p>	<p>The EA has comprehensively documented the hydrological and environmental settings, and any adverse impacts will be managed to minimise their effect. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and become operational.</p>
140	<p>Whilst the potentiometric surface indicates a regional gradient to the north (that is supported by increasing age of the groundwater down-gradient), the contours do not indicate that the river and creek system is necessarily gaining (i.e. drainage of groundwater to Nepean River system). There are also quite rapid changes in gradient that remain unexplained (that could relate to discharge and/or geological structural control viz. 'compartmentalisation' of the aquifer).</p>	<p>The only strong evidence for "gaining" stream conditions is the Nepean River downstream of the confluence with Doudles Folly Creek (in this area the Nepean River becomes more incised). In other areas, the permanent streams are thought to skim water from the top of the sandstone aquifer and discharge minor amounts of baseflow to the Nepean River where cracks and fractures are evident (relatively few sites as indicated in the SCA "run-of-river" inspection reports). Other changes in gradient are related to topography, recharge areas and possibly low permeability areas associated with the geology.</p>

140	<p>There is also the question of groundwater discharge to the Illawarra scarp re Fig.7, Coffey, 2006 and Figure 4.11, KBR, 2008 which appears to indicate that there is gradient towards the scarp from the high country at Robertson to the north. Baseline groundwater gradients in the aquifer are steep from the south (of the order of 15 m per km); this highlights a zone of limited permeability that may limit capture and / result in greater capture down-gradient to intercept available streamflows.</p>	<p>Pumping trials show no impact at distance and certainly none as far away as the Illawarra escarpment. Drawdowns were only within 1-2km and groundwater recharge after each of the pumping trials was localised and was not from areas "outside the borefield". The numerical modelling predicts impacts at greater distances with drawdowns only reaching the escarpment under extreme drought conditions and a decade of pumping. This is an extremely unlikely scenario and monitoring systems would be in place to ensure that sensitive areas are protected.</p> <p>The steep groundwater gradients are related to topography, recharge areas and possible low permeability areas associated with the geology.</p>
140	<p>Under Sub-section 4.5.1 'Surface watercourses' (KBR, 2008) re. connectivity with groundwater the following statement is made:- "Based on more recent focused studies relating to the observed linkage between surface water and groundwater (from inspections and the recent pumping trial studies), the long-term leakage from perennial streams is expected to be much less than the original lower bound of 18 %". The reviewers can find no supporting evidence for this statement</p> <p>Of interest is the further surface water — groundwater interaction research studies that / are under way. These are intended to assess the connectivity and allow a better understanding of leakage locations, leakage processes and model parameters (such as the permeability of individual aquifers and river bed conductance). Preliminary data to date suggests point source connectivity only and even lower contributions from streamflow (McLean et al, 2008) with limited available conduits and pathways through infrequent fracture zones.</p>	<p>The relevant references are the two SCA "run-of-river" references, the Tourist Rd pumping trial studies by URS in 2007, and most recently, the Coffey, 2008 transient modelling study and current results from the PB R&D study on Doudles Folly Creek.</p>
140	<p>Recharge is independent of borefield pumping, and there are no changes expected to occur to the surface environment and up-gradient landscape within the Kangaloon area. This statement is not necessarily true. It has been demonstrated that large gradients are induced by pumping; such gradients may induce large head differentials that would tend to induce recharge that may impact on stream baseflow.</p>	<p>There is the potential to induce recharge from the permanent streams where hydraulic gradients are reversed but leakage is limited by the bed profile and the lack of fractures and connectivity. This conclusion is reinforced by the results of the Tourist Rd pumping trial and the in progress R&D study.</p>

140	Whilst it is agreed that the creek and river system is a gaining system even during the 2006. early 2007, there is a possibility that the production pumping zone of influence might extend to reverse gradients and cause some creeks to lose especially down-gradient of the proposed borefield. Should such reversal of groundwater gradients capture streamflow then streams become losing', the most realistic scenario quoted in Coffey (2006) states 18 % of pumped water is sourced from leakage of rivers and Stockyard Swamp; in other scenarios this percentage increases considerably. In such a case, will there be permanent water in the losing streams and, if not, is there an overestimation of borefield yield and an underestimation of environmental impact?	The EA discusses the processes and effects of borefield pumping on the local streams. In this catchment the connectivity is poor and the impacts to streams are relatively minor. Testing and research to date indicates that induced recharge is less than 5-10 percent of the water pumped at Doudles Folly Creek (unlikely to be more than 3 or 4 bores that would influence the creek so the sum total of effects would be less than 0.5-1 ML per day) and less at other sites. Similarly the captured discharge component (based on modelling studies is low and is expected to be of the same order of magnitude). Ongoing monitoring of baseflows will assist in verifying and managing any impacts.
140	If this is the case, and accepting reported widespread direct recharge to the aquifer occurs through outcrop or sub-crop fractures, then one would anticipate large streambed conductance and 'point sources connectivity' to be dense [especially given that creeks tend to be associated with structural hiatus (faults and fractures)].	Surveys of the streambeds in the area (as reported in the EA) do not support the case that these features are associated with large scale areas of deformation, faulting and fracturing. Gauging and modelling studies support the conclusion that bed conductance is low.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 28, 32, 44, 85, 86, 89, 97, 128, 133		
2.07.12 Technical expertise and research adequacy (165 comments recorded)		
84, 96	The monitoring of the natural environment (groundwater, surface water and nearby ecosystems) has occurred only relatively recently and should be considered as preliminary findings. This reveals a lack of research in this area during decades of management of the Special Areas.	The SCA has commissioned and completed substantial technical, scientific and environmental investigations (more than 90 studies) on the groundwater source at Kangaloon and the local environment of the proposed borefield area. The investigation programs began in the Upper Nepean (Kangaloon) in March 2005 and monitoring programs have been under way for more than three years.
126	The Rivers SOS Alliance of 37 groups around NSW liaises with the Save Water Alliance and we have access to a report commissioned by them from Ray Evans, consultant hydrogeologist. Mr Evans's report confirms beyond doubt our fears for the headwaters of Sydney's iconic river if this project goes ahead	The SCA has commissioned and completed substantial technical, scientific and environmental investigations (more than 90 studies) on the groundwater source at Kangaloon and the local environment of the proposed borefield area. The Evans report does not introduce any new information to that already presented by SCA.

97	The absence of scientific study to determine the impact on the environment horrifies me and conflicts with government policy that “sharing of water from a water source must protect the water source and its dependent ecosystems and... must protect basis landholder rights”.	The SCA has commissioned and completed substantial technical, scientific and environmental investigations (more than 90 studies) on the groundwater source at Kangaloon and the local environment of the proposed borefield area. The investigation programs began in the Upper Nepean (Kangaloon) in March 2005 and monitoring programs have been under way for more than three years.
2	The scientific logic employed is questionable	The scientific method and logic that has been used for these reports is rigorous and is considered best practice. Investigations have been staged, conclusions reviewed and the important recommendations acted upon. The approach endorsed by all peer reviewers. No flaws have been identified.
96	Other risks to sustainable management of the resource have not been resolved, and therefore if, contrary to this submission, the proposal is permitted to proceed, further studies over a range of seasons should be conducted.	Water level monitoring programs will be ongoing to assess river and groundwater levels over a succession of seasons. This will allow further refinements to the model in the event that borefield construction and operation does occur in the future. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.
101	The long term consequences are largely unknown as acknowledged by the proponent’s consultants. The Environmental Assessment Summary contains the following disclaimer by Kellogg Brown & Root Pty Limited: Future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.”	The EA has been based on best available information and modelling predictions. The statement recognizes that the EA was compiled and written by KBR on the basis of other technical, environmental and engineering information supplied to them. While the assessment and mitigation measures have been fully assessed by KBR, the original source documentation has been accepted but not verified, hence the limitations statement at the strat of the EA. The limitations statement is consistent with industry practice of differentiating information supplied by SCA as part of the project from new information collected and analysed by KBR. SCA also audited and inspected field work programs when in progress and believes that all the information provided is accurate and reliable.
6, 8, 11, 13, 15, 16, 22, 23, 33, 34, 36, 38, 39, 83, 86, 118, 127, 131	“improved information for catchment and water supply management (surface water/groundwater interaction, research benefits)” • This point only shows the lack of definitive knowledge that the SCA apparently has with this proposal but they are asking the state government for the go ahead and development of the borefield which will possibly cost around 100M dollars with the development being irreversible.	The SCA does not accept this point. The extensive studies are an enhancement to the knowledge of the area.

47	<p>KBR Pty Ltd state on the second page of their Environment Assessment Summary that the scope of their assessment is limited by the request of their client's (unseen) contract between themselves and the SCA.</p> <p>For this reason alone, the assessment is limited and does not include all the environmental facts surrounding this issue and therefore it should not be sole reference considered when deciding if this borefield project should go ahead.</p>	<p>The EA has been based on best available information and modelling predictions. The statement recognises that the EA was compiled and written by KBR on the basis of other technical, environmental and engineering information supplied to them. While the assessment and mitigation measures have been fully assessed by KBR, the original source documentation has been accepted but not verified, hence the limitations statement at the strat of the EA. The limitations statement is consistent with industry practice of differentiating information supplied by SCA as part of the project from new information collected and analysed by KBR.</p> <p>SCA audited and inspected field work programs when in progress and believes that all the information provided is accurate and reliable.</p>
128	<p>Key studies on the impact of the borefield development on the Kangaloon region, and Moresby Hill Road in particular, are inadequate in their scope, and incomplete.</p>	<p>The key hydrogeological and environmental studies are substantial and cover the whole of the borefield area. The LesryK report studies the impact of the borefield (from flora and fauna perspective) on the Moresby Hill Rd area and fullfills all requirements of an environmental assessment under Part 3A.</p>
97	<p>I strongly request this Government conduct an extensive environmental study before continuing with this Upper Nepean (Kangaloon) borefield project. Please listen to the scientific facts already undertaken by Conservation groups and consider the native fauna, flora and residents of the Southern Highlands</p>	<p>The SCA is not aware of any scientific reports by conservation groups, but can assure all respondants that extensive and thorough scientific reports have been completed and are attached or referenced as part of the environmental assessment.</p>
127	<p>Our society would also like to thank the Sydney Catchment Authority for their open and frank discussions as well as their presentations and thanks to the SCA and the NSW Government for the availability of reports.</p>	<p>Noted</p>
3	<p>The information so far acquired should be carefully recorded for the future</p>	<p>Agreed.</p>

4	The environmental input statement is flawed and needs reassessment by independent experts, such as Hydro Tasmania Consulting a well credentialed organisation, more than capable of undertaking an assessment of the adequateness of the robustness of the scientific data	<p>The EA has been based on best available information and modelling predictions. The statement recognizes that the EA was compiled and written by KBR on the basis of other technical, environmental and engineering information supplied to them. While the assessment and mitigation measures have been fully assessed by KBR, the original source documentation has been accepted but not verified, hence the limitations statement at the strat of the EA. The limitations statement is consistent with industry practice of differentiating information supplied by SCA as part of the project from new information collected and analysed by KBR. Some of the studies were independently peer reviewed when they were compiled and submitted to SCA.</p> <p>SCA also audited and inspected field work programs when in progress and believes that all the information provided is accurate and reliable. The SCA has accepted and responded to the submission from Hydro Tasmania but does not accept that that organisation is better credentialed to compile an EA on a borefield in the Sydney Basin. Many of the studies that Hydro Tasmania refer to were already in train or have recently been completed by SCA.</p>
65	The only knowledge gained so far is that water can be pumped from the aquifers at a required volume. The consequences are not known and no attempt has been made to address these.	The SCA has commissioned and completed substantial technical, scientific and environmental investigations (more than 90 studies) on the groundwater source at Kangaloon and the local environment of the proposed borefield area. The investigation programs began in the Upper Nepean (Kangaloon) in March 2005 and monitoring programs have been under way for more than three years. The EA and recent technical reports provide a thorough analysis of potential impacts and how they will be managed and mitigated. The EA's statement of commitments includes a commitment to what measures the SCA will implement should impacts occur.
3	This is in spite of the mountains of information that have been prepared to overwhelm anyone with common sense.	The studies were completed in order to provide a comprehensive EA of all aspects of the project.
52	Pay attention to the people who know, not the hired consultants who are dependant on sycophancy for their pay and future profit. This is a project which affects the world, directly in some instances, indirectly in others.	The specialists who prepared these reports were appointment based on their significant capabilities and relevant experience. They are independent consultants and are not employees of the SCA.
16	Given the current fortunate state of Sydney's dams, at minimum this proposal should be put on hold while proper (un-biased) analysis is carried out,	The specialists who prepared these reports were appointed based on their significant capabilities and relevant experience. They are independent consultants and are not employees of the SCA.

128	<p>Proposed Area 2 borefield has insufficient data for a project of this scale The EA envisages that the borefield could produce 10-15 GL of water per annum for two years. This equates to 10-15 million tonnes of water per annum — a substantial project.</p> <ul style="list-style-type: none"> • Some 23 production bores will be located in Area 2. • The expected production from Area 2 is not specified in the report- rather, production yield is based on average rates for the entire field, recognising that production rates will vary from bore to bore. <p>There is insufficient data to specify where the water for this “critical infrastructure” will come from</p>	<p>Proposed production bore locations were provided on the figures in Chapter 7 with more detail on the individual area plans in Appendix S. The approximate (average) production rates for each of the four areas are Area 1 - 6.5 ML/d; Area 2 - 11.8 ML/d; Area 3 - 16.8 ML/d and Area 4 - 6 ML/d, to provide an average 41 ML/d or 15000 ML per year. Rates are based on either the known (after drilling and pump testing), expected (after drilling) or likely (extrapolated from nearby sites) rates at each bore site. Rates used are less than the total safe yield of individual bores. The recently cancelled infill drilling program was to confirm sites in Area 2 and to increase the certainty of bore yield estimates from "likely" to "expected". The recent numerical modelling is based on these estimates - the maximum pumping rate for the whole borefield would not exceed 50 ML/d.</p>
84	<p>Some excellent studies have been conducted in the area and worthwhile science into the groundwater system has been achieved, which will contribute to our understanding of these systems, so they can be better managed and protected into the future.</p>	<p>Agreed.</p>
114	<p>As an English teacher I am disturbed by the vagueness of the document the SCA has produced. For example: P19 Summary: “As the aquifer is extensive and fractured areas are interconnected, it is not anticipated that there would be a perceived threat to the aquifer ecosystem.” This type of language smacks of the ‘suck and see approach of the current government in this state, it is certainly too vague to be real science</p>	<p>The SCA has commissioned and completed substantial technical, scientific and environmental investigations (more than 90 studies) on the groundwater source at Kangaloon and the local environment of the proposed borefield area. The investigation programs began in the Upper Nepean (Kangaloon) in March 2005 and monitoring programs have been under way for three years.</p> <p>The staged approach to investigations and the borefield concept is a credible scientific approach.</p>
133	<p>I would point out that the major report conducted by SMEC on the Groundwater Dependent Ecosystems (GDEs) in the Kangaloon Aquifer has not been included in the Environment Assessment. “Baseline Groundwater Dependent Ecosystems Evaluation Study” (September 2006). Thus, the Dept of Planning has been denied the opportunity to review the thorough research conducted by those consultants, and the damning critique of the SCA’s failures in regard to identifying the extent of the “dependence” of these precious habitats upon the groundwater, by Eamus et al. That is why I have referred to just a few of these comments, to at least alert you to the existence of such devastating critiques, by one of Australia’s leading experts in the subject of GDEs.</p>	<p>The Eamus peer review attaches to the original SMEC baseline study from Spring 2006 prior to any of the later studies being concluded (it was released as part of the public exhibition of studies in July 2006 but is now superceded). Subsequent studies have indicated that there is no dependence associated with upland swamps, only minor connectivity with stream baseflows, and no known connectivity with terrestrial vegetation. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.</p> <p>There is sufficient certainty about groundwater dependence (or the lack thereof) to proceed with borefield development.</p>

133	In regard to the overall Borefield proposal, we contend that the Peer Reviewers, especially Professor Derek Eamus et al (in the SMEC report), D.R. Woolley, and Dr Noel Merrick (in regard to the Coffey Report) all identify serious shortcomings in the scientific data on which the SCA's borefield proposal is based. These shortcomings are sufficiently serious as to warrant rejection of the SCA's Environment Assessment.	The peer reviews supported the methodology and work completed by SCA (at the time of the reviews) and identified additional work that would assist in confirming the resource occurrence, resource behaviour, ecosystem linkages and impacts, and the sustainability of development. Most of this work has now been completed with subsequent studies, pumping trials, additional testing and numerical modelling studies now available (included in either the EA or reported in the preferred project report).
140	Major weakness is presentation of diagrams and information (apart from Coffey 2006) provided in them, making it difficult to interpret results — requires a DTM to 'drape' areal data (e.g. potentiometric surface) over. Clearly define study area and boundaries of proposed borefield are required.	The information (text and maps) have been thoroughly reviewed and describe the material sufficiently well for most readers and respondents
140	the additional research and testing work that HTC recommends be undertaken should be undertaken and completed prior to any further action being taken	Most of the studies that were mentioned or recommended by Hydro Tasmania were already in train or have recently been completed by SCA
140	1. Investigations to date have been conducted in a logical manner, and have been successful in identifying an important groundwater resource within the Hawkesbury Sandstone aquifer in the Upper Nepean Catchment area. Noted Agree; but appear to have been fast-tracked that has made scientific appraisal (through possible lack of integration of data /studies) at times problematic.	Studies were fast-tracked between 2005 to early 2008 but there are no omissions. Studies have been integrated in the EA and again in this preferred project report. Breadth of technical studies should be reassessed when the project is reactivated but SCA considers that the studies and their conclusions are reasonably well integrated
133	The EA does not address the numerous criticisms of poor methodology, limited analysis, and numerous calls for "further studies" which were made by numerous Peer Reviewers, employed by the SCA as consultants to review the numerous studies conducted by professional consultants, (engineering, technical and environmental).	Most of the important further studies recommended in reports and by peer reviewers have been followed up in subsequent studies in 2007 and 2008. This issue is discussed further in the preferred project report.

140	5. Further work is necessary to provide information about long-term pumping rates, spacing and positioning of bores before resources are committed to a full-scale borefield. Borefield pumping trial (February - June 2007 and October - January 2008) — see Section 4.4.4 and URS, 2007a, 2007c, 2007e and 2008. Agree & partially addressed; note that test pump analyses need to be reexamined to fit different analytical models.	The recent transient groundwater modelling study has integrated much of this data and relevant conclusions are based on bore locations and long term expected pumping rates
140	Table 11.1 of KBR (2008) documents additional studies being undertaken in parallel with planning approvals. These are important research components of the overall study and the reviewers would be interested in reviewing the results of these studies prior to any planning approvals	Technical reports will be progressively made available when completed
The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 7, 15, 18, 21, 25, 28, 29, 30, 32, 35, 37, 41, 44, 53, 66, 78, 80, 81, 85, 91, 108, 115, 122, 124, 125, 132, 134, 137		
2.07.13 Modeling methodology/approach/predictions (36 comments recorded)		
96	There are fundamental flaws in the conceptual model of the hydrogeology of the area. When considered, these flaws lead to the conclusion that the volume of water described in the EA as being available for use is, in reality, much less.. If the proposal proceeds at the extraction rates suggested, then the aquifer will be placed in major deficit. Further, if the aquifer cannot support the levels of extraction suggested, then the SCA will have wasted public funds.	The conceptual model has been tabled and reviewed by independent peer reviewers and DWE, and is supported by these experts. The model is not considered flawed but SCA agrees that there will be short term deficits when the borefield is operational (and hence water levels will fall) but longer term it will be in surplus and water levels will recover to pre-usage levels.
124	The EA describes the hydrogeology of the Hawkesbury Sandstone (the target aquifer) in terms of primary and secondary permeability (porosity), which is consistent with current understanding of that consolidated rock mass within the Sydney Basin generally. The discussion then proceeds to identify the fracture (secondary) permeability as being the dominant factor in the development of high bore yields in the study area, and reaches the conclusion that the sandstone behaves as a leaky confined aquifer (section 4.4.2, page 4-18). This is not in agreement with the numerical modelling carried out for the project, which constructed the sandstone as an unconfined aquifer for the steady-state simulations.	For the initial steady state modelling, a single layer was conceptualised and modelled for the Hawkesbury Sandstone aquifer system. With much more information, the most recent transient modelling involves three layers in the Hawkesbury Sandstone to simulate the variability in permeability and observed responses to rainfall, recharge, and pumping. The dual porosity has been replicated by the current permeability distribution.

124	<p>The drawdown recorded in the piezometers associated with each test when analysed using the appropriate earth model (which is clearly stated in the main report) provide estimates hydraulic conductivity, storage aquifer and leakage. This information is not currently available.</p> <p>When compiled for each production bore site the degree of heterogeneity around each site is clear. It is this information that will guide the impact of individual production sites rather than the distributed parameter model.</p> <p>Many of the piezometers are unsuitable for analysis as do not appear to tap the aquifer tested.</p> <p>For later times many of the bores indicate free draining shallow aquifer zones (i.e. when the recorded drawdown falls below these zone). This would change the aquifer parameter estimates derived for early times.</p>	<p>The numerical model is a tool to predict the impact of the borefield on a regional scale. It will not necessarily replicate the all the drawdowns and all the recovery cycles at all bore sites. Individual pumping tests will define the "safe yield" at each production bore site and extensive monitoring within the borefield when operational and during recovery is the key to long term performance. The current monitoring bore network adequately addresses and obtains data on both the full sequence of sandstone aquifer water levels and individual aquifer water level responses. Additional monitoring bores and wells are to be installed when the borefield is constructed and becomes operational.</p>
124	<p>The current groundwater flow model (Coffey, 2006): Is a steady state model. This calibrates on hydraulic parameters only, leaving the storage parameters used in the later predictions as uncalibrated estimates only. The assessed aquifer transmissivities for each bore site given in Table 1 are different from both RES (2006) and Woolley (2006). The basis of this assessment is discussed but is in part not relevant and the statistical validity of the relationship developed in Figure 4 is questionable. • Conceptualises the Hawkesbury Sandstone as a single aquifer. The model has been developed so that an unconfined pumping response is simulated using an estimated specific yield (as distinct matrix porosity that is estimated in URS 2007 b). • The water levels used in the calibration appear to be composites from both the confined and water table portions of the aquifer system. • The model provides regional estimates</p>	<p>Specific comments are:</p> <ul style="list-style-type: none"> (i) For the initial steady state modelling, a single layer was conceptualised and modelled for the Hawkesbury Sandstone aquifer system. With much more information, the most recent transient modelling involves three layers in the Hawkesbury Sandstone to simulate the variability in permeability and observed responses to pumping. The dual porosity has been replicated by the current permeability distribution. (ii) Water levels were mostly composites for the earlier calibration, whereas composites have been avoided for the latest three - layer transient modelling calibration (iii) The modelling does provide regional estimates
124	<p>The model provides regional estimates on the impacts of the water table, not of the pumping pressure levels.</p>	<p>The latest transient modelling provides water level elevations for different sites and different layers within the Hawkesbury Sandstone</p>

124	<p>Peer review, The review is on the modelling process not the predictive capacity. The study area has large water level gradients. Thus while the model fit' meets the guideline the absolute error in the water level height is large.</p> <p>Due to the above issues, the model presented in the EA is considered unsuitable to predict the impact of the proposed borefield, However the model is being superseded by a transient flow model that was due for completion in early 2008 (see Section 9.2.2 page 9-13 main Report — Revision G). It is probably more appropriate to comment on that model (when available) in terms of the predicted borefield impacts, as many of the concerns with the Coffey (2006) model may have been addressed.</p>	<p>Noted. The initial numerical model was an initial model to assess likely drawdowns and the extent of drawdowns based on an extraction rate of 50ML/day</p>
124	<p>Whilst the Tourist Road pumping trial continued for four months without any hydraulic limits (eg. barrier boundaries typical of fractured rock behaviour under pumping stresses) becoming evident, it is entirely possible that under longer durations significant declines in pumping water levels could eventuate due to the fracture systems being progressively dewatered. Should the calculated groundwater storage volumes be affected by equivalence between the adopted parameter values as indicated above, then little confidence can be placed on the resulting values, and this will have implications for the perceived sustainability of the pumping based on this generic approach.</p>	<p>The modelling tool is the best available method to predict likely regional drawdowns given different borefield pumping scenarios. Unknown boundaries cannot be modelled and accounted for at this time</p> <p>More data, analysis and model reviews will enable constant improvement in model predictions.</p>
96	<p>This data does not support the original conceptual model of disconnected basalt and sandstone aquifers where there is intervening Wianamatta Group sediments. There is now reasonable evidence to conclude that the SCA model is incorrect.</p>	<p>The conceptual model has been tabled and reviewed by independent peer reviewers and DWE, and is supported by these experts. The model is not considered flawed.</p>
96	<p>The alternative conceptual model for groundwater flow in the vicinity of Mt Butler would allow groundwater to recharge through the Basalt to the underlying sandstone aquifer, either by direct downward flow or by flow down the Basalt intrusion and then laterally out into the sandstone. As pumping in the sandstone aquifer causes water levels to fall, this would create a drawdown in the Basalt itself. This drawdown would affect the volume of flow from the springs associated with the basalt, and therefore be implicated in causing possible reductions in the flow of spring water to the swamp during dry times.</p>	<p>There are springs in the Mt Butler area that appear to be direct contact with the sandstone strata so these sites will be monitored more closely. The comprehensive investigations completed at Butlers Swamp (which is north of Mt Butler) indicate that it is entirely supported by rainfall recharge. There is no spring flow to the swamp and there is no deep groundwater linkage supporting the swamp. This disconnection ensures that the swamp will not be impacted by the proposal. Monitoring will ensure that Butlers Swamp will not be impacted by the borefield proposal.</p>

128	<p>The geological model is insufficiently detailed to support the EA recommendations • The geological model for the borefield is based on regional mapping and a generalised stratigraphic column. • The model depicts the basalt zones to be stratigraphically and physically high above the extraction and recharge zones, and contends that the groundwater in the basalt zones is not linked to the sandstone aquifers to be accessed by the borefield. • However, the regional mapping, the magnetic survey and the geological descriptions identify numerous faults and describe a complex horst — graben structure • For example, Bore 2J intersected 27 metres of basalt, near surface. This was not expected. Further, the implications for the borefield and the surface within the borefield and recharge area are not assessed The geological model, which is central to the EA conclusions, does not reflect the complexity of the geology. As a result, the EA conclusions are flawed.</p>	<p>Some comments:</p> <ul style="list-style-type: none"> (i) the geological model is based on regional and local mapping, and results from individual test bores within the borefield area (ii) basalt linkage with sandstone aquifers is poor as described above (iii) yes there has been substantial intrusions and structural movements over geological time (iv) the geological model in the vicinity of the Mt Butler intrusion is reasonably clear (v) the complex geology of the area will never be fully appreciated but on a regional scale the important features are mapped and included in the hydrogeological understanding of the area
96	<p>One major flaw in the conceptual model is that there is no consideration of impacts from groundwater extraction on the streams and creeks of the area. This conclusion has been shown by the SCA's own work to be erroneous. Once impacts from pumping reach a steady state, a large percentage of the groundwater extracted at some sites will be sourced directly from stream flow. Further, as the aquifer recovers from periods of extraction, streamflow in the area will be diminished due to deficit introduced into the water balance</p>	<p>Surface water - groundwater interaction is included - and site studies and numerical modelling have shown that the connectivity is poor</p>

133	<p>I would draw your attention to the attached detailed Report from Mr. Ray Evans of Salient Solutions” (Attachment A) “Comment on Upper Nepean (Kangaloon) Borefield Project Environmental Assessment”</p> <p>That document further explores both the regulatory shortcomings in the operation of the Dept Of Water and Energy (to date), as well as thoroughly analysing the short-comings in the Hydrological model used by the SCA, on which it bases its conclusions that pumping of the Kangaloon Aquifer (as proposed) is ‘sustainable”. As with any modelling, the validity of the premises (assumptions) on which the model is based affects the conclusions arrived at. As Mr. Evans points out, the SCA’s modelling is based upon faulty or inadequate information.</p> <p>b) False or poorly constructed “theoretical models” which inaccurately present the geology of the region. False assumptions will lead inevitably to unanticipated results, with likely adverse impacts on the natural environment and the rural residents of the adjacent areas, and particularly other users of the groundwater. Over-allocation of groundwater water resources are inevitable if this project is approved by the Dept of Planning. That would be contrary to the D-G’s Requirements.</p>	<p>The original steady state model constructed in 2006 has been updated substantially with the latest transient modelling results.</p> <p>The regional geology is well known and not in dispute. These features have been included in the latest numerical model</p>
96	<p>These serious flaws require that the EA be withdrawn and further developed, based on more detailed work assessing the various aspects outlined above, Further, it is recommended that the NSW DWE develop a groundwater management plan for the Southern Highlands Management Zone that takes account of the sustainable yield of the entire aquifer system and explicitly develops a detailed and robust conceptual model that will lead to the full impacts being documented and accounted for.</p>	<p>SCA understands that Department of Water and Energy (DWE) has a draft Water Sharing Plan for the Sydney Basin area and that the sandstones of this area are referred to as the "Nepean Sandstones". This borefield has been factored into the DWE estimates and the Nepean Sandstone source area is not considered to be "over-allocated".</p>
96	<p>The work by Coffey Geoscience (2006) also allowed leakage to occur from the Robertson Basalt through the Wianamatta Shale to the underlying Sandstone. This is contrary to what has been adopted by SCA.</p>	<p>There is very low leakage (and rainfall recharge) in areas covered by basalt and shale. This is not contrary to the SCA model that advocates the dominant recharge to the sandstone aquifers is in the upper catchment areas where there is exposed sandstone.</p>

96	<p>Modelled water budgets “Rainfall recharge is the main contribution to the natural sandstone system, with an average of more than 36 ML/d recharging wider low rainfall conditions. When there is no pumping, all the permanent streams are connected gaining streams... receiving more than 23 ML/d from groundwater discharge... Under pumping conditions, rainfall recharge remains the same... however the baseflows in permanent streams in the vicinity of the borefield are slightly lower., some 37 ML/d out of the 45 ML/d that is pumped from the bores is sourced from aquifer storage... The surface water groundwater interaction research studies... allow a better understanding of leakage locations, leakage processes and model parameters...” The implications of these data need clarification: (i) how was 36 ML/d under low rainfall conditions arrived at? Was it derived from recovery rates or from actual rainfall data and, if the latter, what is the implied infiltration rate? [4-6% infiltration is indicated in the next section of the report]. (ii) Lowering base flows over 2-3 years with no certainty of recovery if drought persists may have adverse riparian impacts. (iii) As additional investigations are referred to, a decision on the borefield should not precede them.</p>	<p>Comments are:</p> <ul style="list-style-type: none"> (i) this is a result from the steady state modelling (ii) original modelling was suggesting more than 18 percent of pumped groundwater may have been sourced from the permanent streams - this is now expected to be less than 10 percent and certainly not greater than 20 percent so the proposed baseflow impacts are less than originally proposed (iii) the additional investigations have largely been completed (pumping trials and now the transient modelling)
133	<p>There are fundamental flaws in the conceptual model of the hydrogeology of the area. When considered, these flaws lead to the conclusion that there is a much smaller volume of water available for use than described in the EA.</p>	<p>The conceptual model has been tabled and reviewed by independent peer reviewers and the Department of Water and Energy, and is supported by these experts. The model is not considered flawed.</p>
140	<p>Need to refine hydrogeological conceptual model - reconcile geology of the area with hydrogeology groundwater hydrology</p>	<p>The conceptual model has been tabled and reviewed by independent peer reviewers and DWE, and is supported by these experts. The model is not considered flawed - the regional geological features have been included in the most recent numerical modelling.</p>
140	<p>Recharge is said to range between 3 and 10% of rainfall. The initial groundwater model was calibrated on a rainfall recharge rate of 4 to 6 %. The range of recharge coefficients input to the model is considered to be realistic.</p>	<p>Noted</p>

140	<p>A water budget was output by the numerical groundwater model (Coffey, 2006). Rainfall recharge and surface water-groundwater interaction were the key issues assessed by the modelling and water balance studies. The model assumes all the permanent streams are connected to the aquifer and that Stockyard Swamp is also connected.</p> <p>In KBR (2008) the lowest river bed connectivity scenario (riverbed vertical hydraulic conductivity of 0.001 m/d with ML/d from each of 50 bores²) was presented from this modelling to show the sensitivity of the groundwater system to river leakage and its impact on pumped groundwater flow. KBR (2008) states that the low connectivity case is now considered to best represent catchment conditions if the bore field was operational. Table 9.1 (KBR, 2008) presented the water budget for the conditions of no pumping (steady state) and at the end of pumping duration (2 years) for this scenario.</p> <p>The water budget presented and summarised in Tables 10 and 11, Coffey (2006) appears to be sound; however the reporting of this mode) under environmental compliance statements in KBR (2008) is questioned; see below.</p> <p>Under no pumping, inflow (recharge 36 ML/d under 'low rainfall conditions³) balances outflow via stream baseflow.</p> <p>With no groundwater pumping, there is no groundwater storage depletion. The decile 4 rainfall was taken for modelling recharge coefficients. This is just below average rainfall and not necessarily a 'low rainfall' scenario. It is untrue to state that there is no storage depletion under quiescent conditions; as there is a natural gradient under semi-unconfined conditions there must be some storage depletion.</p>	<p>Decile one rainfall was used for the steady state modelling predictions.</p> <p>Steady state modelling is unable to take into account transient variations in aquifer storage. This has been captured in the latest transient groundwater modelling results.</p>
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140	The crucial aspect to estimating the sustainable yield of the Hawkesbury Sandstone aquifer is having a good conceptual knowledge of the aquifer (and representing the geometry of this explicitly). Of the reports reviewed, Coffey (2006) is to be commended in attempting to amalgamate the numerous (often concomitant) and disparate studies and datasets in an attempt to create a conceptual model as a basis for numerical modelling. The model and its iterations form a key tool for understanding the sustainability of the aquifer. It is evident from the conceptual model that the structural geology is not well known (only really controlled in the modelling report alone in the proposed borefield area, in terms of anisotropy, by displaying corridors of elevated hydraulic conductivity values). Hence it is considered that the hydrogeological conceptual model needs refining.	The original steady state model constructed in 2006 has been updated substantially with the latest transient modelling results. The regional geology is well known and not in dispute. These features have been included in the latest numerical model
140	The safe yield of the proposed borefield has been modelled. It is concerning that some of the simulated bores dewatered in the model. Test pumping analytical techniques has not necessarily examined this but dewatering is indicated (including by incomplete recoveries after pumping).	The borefield safe yield was not modelled in the original steady state model, rather a borefield yield of 50ML/day was applied across 50 production bores and this resulted in some bores in low permeability cells to be dewatered. The Hawkesbury Sandstone is now conceptualised as three layers and the fracture zones have been recast based on more site specific information. Dewatering of upper layers does occur and SCA agrees that dewatering of some strata (ie depletion of aquifer storage) will occur during operational periods.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 101, 108		
2.07.14 System yield (10 comments recorded)		
128	the net benefit to the catchment-of the borefield is likely to be substantially less than the headline range of 30 to 45 GL of water.	The water balances from the latest transient modelling indicate that the pumped volumes averaged over an extended drought pumping cycle are likely to be in the range 10 to 13 GL of water per annum. Volumes are unlikely to reach 15 GL per annum without production bores being located on new high permeability features or unless additional bores are added to the borefield. Allowing for 10-20 percent loss of baseflow from streams, the net gain from groundwater storage is likely to be around 10 GL per annum and 30 GL in any one extended pumping cycle.
122	The groundwater will be distributed to the Nepean River for storage into the Nepean and Avon Dams. It is a concern that the Sydney metropolitan water supply will be dependent on the Illawarra water supply.	The Metropolitan dams have been, and will continue to be, an important component of both the Greater Sydney and Illawarra supply systems. Illawarra is supplied solely from Avon Dam (although this dam is connected to Nepean Dam which also receives supplies via Shoalhaven transfers. Having a borefield in the upper Nepean provides greater security of supply to the Illawarra during extreme drought periods.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 101, 109, 116, 125		

2.07.15 Pumping trial (64 comments recorded)		
96	The pumping trial is far removed from operational reality in the context of significant and prolonged drought, The Association is concerned over the duration of pumping (2 years versus 4 months), the daily volumes being pumped (30-50 ML/d versus 4 ML/d, and the spacing of the bores ('average' for 75 bores is 500-750 m, but what was the spacing in the pumping test?),	Water levels, water quality and the use of control sites was the approach used to assess the swamp impacts (or the lack of impact). For the respective areas around Butlers Swamp and Stockyard Swamp, the drawdowns and impacts will be the same irrespective of whether there are seven or 75 bores pumping. The seven bores in the vicinity of Butlers Swamp (and the 3 at Stockyard Swamp) will be pumped at the same or at lesser rates than was undertaken during the pumping trial. There will be no new or additional pumping bores or stresses on the sandstone aquifers within these areas.
101	There remains considerable uncertainty about the long term effects of sustained pumping. The test pumping for 6 months was overtaken by above average rainfall in 2007 of the type that had not been experienced in the preceding 6 or 7 years of drought. In fact, annual rainfall in calendar 2007 at 68 inches, on my property, in the centre of the borefield area, was the highest recorded there in at least the preceding 20 years. Recent reports suggest there is considerable uncertainty as to whether bores were replenished after test pumping as a consequence of rainfall or as a consequence of water flows within the aquifer'. I understand that it has not been (and probably cannot be) conclusively demonstrated that it was the latter, because water was extracted from differing levels in the aquifer. However the information contradicts earlier reports by the proponents consultants that the rapid recharge was the result of rainfall.	<p>Water levels were high at the commencement of both pumping trials (after rain) but drier conditions prevailed during each of the trials. Irrespective of the starting water levels, it is the performance of the pumping bores, interference drawdowns, impacts on shallow perched systems and the extent of drawdowns that were key data obtained from the trials. This information is equally valid from a wetter period as well as a drought period, as it relates to the physical attributes of the sandstone - primarily the permeability and connectivity attributes of the aquifer.</p> <p>There was significant rainfall recharge reporting to the fractured aquifers but there was also water migrating laterally in the deeper aquifers (as the signature of the water sampled at each of the pumping sites after the recovery period indicated that the groundwater had not changed in quality or age). This means the aquifer storage is large and that rainfall recharge (although substantial) is still a relatively small volume in comparison to the aquifer storage. Hence while water levels fully recover, and recharge is quick, the age of the water does not change quickly because of the large aquifer storage volume.</p>

124	<p>The pump testing for which results were presented in the EA (refer to Figure 4.16 page 4-32) was conducted after the summer period and after significant rainfall and therefore not representative of conditions during which the bore field is proposed to be used i.e. during a severe drought. The document refers to a second pump test that was completed in January 2008 but the results are not presented. It is likely that significant rainfall also occurred during the period of the second pump test.</p>	<p>Early results for the second pumping trial at Stockyard Swamp were reported in the EA. The trial was completed across the dry summer period during December 2007 and January 2008</p>
124	<p>Whilst the Tourist Road pumping trial continued for four months without any hydraulic limits (eg. barrier boundaries typical of fractured rock behaviour under pumping stresses) becoming evident, it is entirely possible that under longer durations significant declines in pumping water levels could eventuate due to the fracture systems being progressively dewatered. Should the calculated groundwater storage volumes be affected by equivalence between the adopted parameter values as indicated above, then little confidence can be placed on the resulting values, and this will have implications for the perceived sustainability of the pumping based on this generic approach.</p>	<p>The modelling tool is the best available method to predict likely regional drawdowns given different borefield pumping scenarios. Unknown boundaries cannot be modelled and accounted for at this time. More data, analysis and model reviews will enable constant improvement in model predictions.</p>
128	<p>The EA contains conflicting interpretations of the pumping test results</p> <ul style="list-style-type: none"> • The URS report on the pumping trial reported fast recovery of groundwater levels at the production bore sites on cessation of pumping. This was interpreted as a factor supporting the sustainability of the borefield. • However the peer review attributes an entirely different reason to the rapid recovery of groundwater levels - the rapid recovery arises from water in the casing flowing into the bore on cessation of pumping <p>The EA relies on borefield analysis which has been found to be flawed. The reliability of the conclusions reached in the URS report is questionable.</p>	<p>The URS report and Woolley peer review reports are consistent in their conclusions. The peer reviewer did however make the point that recovery and recharge are different and that both processes are evident in the pumping trial recovery data. Fast recovery of water levels is expected as the aquifer levels try to equilibrate across the aquifer zone/s, then the rate of recovery will flatten out. Water levels will only recover to pre-existing water levels with recharge. What was in evidence at both the pumping trial sites was that water levels rose to above pre-start water levels within a few months of the cessation of pumping, confirming that there had also been substantial recharge to the sandstone aquifers.</p>

96	<p>The final reports from the pumping trial showed that there was no connectivity with the surficial aquifer and the regional aquifer at Butlers and Stockyard swamps. However, the pumping trial in 2007 was impacted by the rainfall event in February 2007 which led to the cessation of the pumping trial. This in turn allowed the aquifer to recharge and the impact of the pumping has thus been difficult to ascertain. The premature conclusion of the six-month pumping test at just less than 4 months is of concern. The operational borefield trial was compromised by the unseasonal break in the drought patterns, therefore the impacts of continuous pumping could not be established with any certainty. The report that analysed the trial clearly states that the rapid recharge of the bores that had been pumped in the trial period was 90 per cent from the aquifers and only 10 per cent from the heavy rainfall event. The implications from this result is that pumping from a fully operational borefield will have a much more widespread impact on the aquifer than the modelling suggested and it cannot be expected that rainfall recharge will refill (lie aquifer with (lie speed that has been predicted.</p>	<p>The impact (or rather the lack of impact) of continuous pumping on the perched water systems is definitive and not in question (all reviewers). The pumping trial could have continued for the proposed six months, however SCA took the decision to take final water samples then monitor the recovery/recharge event as this would provide more important data and be the best indication of how the borefield and aquifer water levels would react when a drought ending rainfall recharge event occurred.</p> <p>The trends and results from these pumping trials have been included in the latest transient modelling calibration.</p>
96	<p>Stockyard Swamp Trial "The second pumping trial.., commenced in late October 2007.. involving three production bores pumping 2 ML/d for a period of three months.' This is 3 months versus operational conditions of 2-3years and 2 ML/d versus 30-50 ML/d. Fu</p>	<p>Water levels, water quality and the use of control sites was the approach used to assess the swamp impacts (or the lack of impact). For the respective areas around Butlers Swamp and Stockyard Swamp, the drawdowns and impacts will be the same irrespective of whether there are seven or 75 bores pumping. The seven bores in the vicinity of Butlers Swamp (and the 3 at Stockyard Swamp) will be pumped at the same or lesser rates than was undertaken during the pumping trial. There will be no new or additional pumping bores or stresses on the sandstone aquifers in these areas.</p>
91	<p>Recent work has shown that where trial pumping was carried out the aquifer did not refill just from the subsequent rain event. Most of the water was 'old water which had flowed in from elsewhere This questions the earlier conclusions</p>	<p>There was significant rainfall recharge reporting to the fractured aquifers but there was also water migrating laterally in the deeper aquifers (as the signature of the water sampled at each of the pumping sites after the recovery period indicated that the groundwater had not changed in quality or age). This means the aquifer storage is large and that rainfall recharge (although substantial) is still a relatively small volume in comparison to the aquifer storage. Hence while water levels fully recover, and recharge is quick, the age of the water does not change quickly because of the large aquifer storage volume.</p>

2	It covered effects of pumping on a limited area ie. Bakers Swamp and not wider groundwater reserves	Pumping trials were completed on two areas (10 bores in total) and pumping tests have been completed at more than 20 other locations - this is considered a reasonable representation of sandstone aquifer conditions across the borefield area.
73	When your pump testing was carried out in 2007, the testing dried up our bore and natural springs, this was brought to the attention of Sydney Water but they didn't want to know about it. Not once during the test pumping did anyone come and check our natural springs or bore to see the dramatic drop in water and to say there has been no affect is a complete lie	The SCA maintains a comprehensive data base of all contacts with the community. There was no report of springs or bores drying up in relation to the pumping trials. Two residents rang with concerns about their bores which the SCA investigated and both proved to be maintenance and pump issues. One resident reported springs drying up, and this was at a time when the SCA had not commenced pumping, so this was therefore due to other factors. If the resident contacted Sydney Water they would be unable to assist as they are not responsible for this project. Further, the SCA was monitoring a large number of bores and selected springs during the pumping trials and no drawdowns or drying of springs were recorded.
133	Furthermore, did you realize that even the 3 month pumping trials at Stockyard Swamp have not been fully analysed yet, (by the technical hydrological consultants) and the results not included in this EA? How can the SCA claim everything is OK, when they have not even "finished crunching the numbers"?	The trial was completed late January 2008 and reports written on the water level impacts at the conclusion of the trial and after several months of recovery. Trends were exactly the same as observed at the Tourist Rd trial.
140	that test pumping is done over at least one full weather cycle (i.e. drought, complete recharge and drought) there is a significant risk the long-term availability of the resources be will depleted	Testing was completed over one complete drought (worst historical) and now the start of a wet cycle. This is sufficient data and analysis to input into a numerical model to obtain reasonable conclusions from the predictive modelling.
108	"...the western arm of the trial borefield fully recovered within a month.., while three of four bores in the eastern arm' took four to six months The question unanswered by this is what percentage of the field takes the longer recovery times?	The numerical model provides broader indications of likely recovery cycles, and ongoing monitoring will provide more explicit information on the variability across the borefield
140	Undertake long-term test pumping of open hole, and flow-meter logging to avoid well loss (head) component	Individual bore holes, when converted to production bores, will be pumping tested to determine their safe yield.
140	5. Further work is necessary to provide information about long-term pumping rates, spacing and positioning of bores before resources are committed to a full-scale borefield. Borefield pumping trial (February - June 2007 and October - January 2008) — see Section 4.4.4 and URS, 2007a, 2007c, 2007e and 2008. Agree & partially addressed; note that test pump analyses need to be reexamined to fit different analytical models.	The recent transient groundwater modelling study has integrated much of this data and relevant conclusions are based on bore locations and long term expected pumping rates

140	<p>The Trial Pumping conducted by the SCA was inadequate. The original proposal was that the SCA pump the borefield for 6 months, in order to “test the limits of the Aquifer”. The SCA stopped pumping in June 2007, after a significant rainfall event (flooding of the Nepean River occurred after two separate rainfall events in the month) a) 318 mm of rain fell (in Robertson) over the long weekend of 9-11 June 2007. Subsequently, a further 55 mm fell in several hours on 16 June. That rainfall caused the Nepean River to flood. b) The SCA then stopped pumping, after local residents reported the flooding of the Nepean River (verified by the Bureau of Meteorology Flood Warning site) Source: http://peonyden.blogspot.com/2007/06/sea-pumping-into-flooded-river.html c) After the stopping of pumping, and the return of river flows to normal, the SCA advised that they would not resume pumping. d) Mr. Ross (Project Manager) was questioned by myself and Mr. Eddy about why they were not resuming pumping, to complete the trial. His answer was “We don’t need to - we know enough already”. (pers corm. Ross - Wilson, and Eddy) e) Sure enough, the SCA abandoned the 7 bore Trial Pumping. 1) That means they failed to complete the full trial. It is acknowledged that a consultant “Peer Reviewer” Mr. Woolley agreed with the proposal not to resume pumping “because the system being tested would not be in a steady state at the commencement of pumping (D Woolley, Peer Review of URS report for SCA “End of Trial Pumping Test — Water level and Drawdown Assessment”. None—the—less, the fact remains that the SCA failed to complete their original pumping trial. Thus they have failed to “test the limits of the Aquifer”. g) Consequently, all the supposed “findings” from the “Trial Pumping” are of dubious statistical validity, for they tell the SCA little about the true limits of the Aquifer. h) The EA itself does not address this failure (and numerous others). As such it fails to meet basic standards of scientific credibility. It is inadequate, and ought to be rejected. i) It would be unsound practice for the Dept of Planning to accept the EA, as it stands, as a basis on which to approve this proposal under Part 3A of the EPA Act 1999.</p>	<p>The impact (or rather the lack of impact) of continuous pumping on the perched water systems is definitive after four months of pumping and is not in question (all reviewers). Also to restart a pumping test or trial while the aquifer system is in recovery mode is poor practice, and no useful information would have been obtained from a recommencement of this trial for the extra two months. SCA took the decision to take final water samples then monitor the recovery/recharge event as this would provide more important data and be the best indication of how the borefield and aquifer water levels would react when a drought ending rainfall recharge event occurred. Data has been analysed and determined to be scientifically credible and extremely useful in understanding the hydrological processes in the area. The trends and results from these pumping trials have been included in the latest transient modelling calibration.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 3, 5, 21, 44, 54, 78, 84, 114, 119, 120, 122, 127</p>		

2.07.16 Climate Change (47 comments recorded)		
78	Recent extreme fluctuations in climatic conditions of prolonged drought and short term intense rainfall events means the investigation period has been during a period of great climatic variation. It is erroneous for the SCA to claim that their testing and trials have been exhaustive. This is simply not true. An exhaustive trial period would be for a much longer period when average conditions and seasonal variability are more likely to be achieved and therefore assessed.	As per the EA main report pp 2-3 - Groundwater storage is less dependent than surface water storage on rainfall regimes or climate change, and has minimal evaporation losses, although the longer term sustainability of groundwater is dependent on rainfall recharge. Supply from desalination is totally independent of rainfall. As per the EA main report pp 6-4 - The NSW Government has commissioned research from CSIRO into the impacts of climate change on the variability of our climate; in particular, the complex cycles of El Nino and La Nina. Through understanding the cycles that affect our weather patterns, and by predicting likely changes due to greenhouse gas emission, it is possible to derive more accurate information about the long-term availability of rainfall so that necessary planning measures can be implemented. Climate change impacts on water availability in Sydney may include higher temperatures, changed rainfall patterns, increased evaporation and longer, more intense droughts.
96	Although the three years' hydrographic data are available, it is disappointing that more consideration has not been given to changing weather patterns in view of the groundwater being a supplementary water source during severe drought. '1J dam levels drop to 40% capacity or below, groundwater' from multiple sources will be used to supply 30 to 45 billion litres (GL) of water each year during severe drought periods."	The original steady state modelling was based on Decile 10 rainfall (worse than any known drought), and periods during each of the pumping trials were similar to the severe drought conditions experienced from 2003 to 2006. A range of severe climatic cycles has been used for the recent transient groundwater modelling
65	To suggest that either project could be greenhouse gas neutral is fallacious as it would consume the negligible 'green' electricity currently produced in NSW. This a deceptive pea and shells argument about the use of 'green power'. This argument would only be valid if there were a net zero growth in State power demand as consequence of these projects, As it stands, we need to meet significant reductions in power consumption and avoid capital projects that do not aid that objective.	The borefield power consumption is low at only 1 to 2 MW per day if all components of the borefield were fully functional and there was some cycling of pumping. Green power options to run the borefield will be explored again if/when it is constructed and becomes operational. However its occasional use is not compatible with its operation as a green power scheme.
65	It would also place further power demands on the State grid and contribute its own part to one of the main underlying causes for present and future droughts — climate change.	Borefield power demands are very low and its occasional use will not create issues for the state or local power grids.

140	Global warming indications are that temperatures and evapotranspiration will increase and precipitation will decrease in the Hawkesbury-Nepean Catchment (Warner 2002). In the Hawkesbury-Nepean, temperatures are expected to rise by 0.4 — 2C by 2030, while precipitation trends for the same periods is +5 to -15% (Warner 2002), which would result in reduced runoff and groundwater recharge, and decreased water resources. Higher temperatures reduce the effectiveness of precipitation by promoting evaporation and transpiration, thus reducing runoff, percolation and discharge to rivers and groundwater aquifers.	These global warming indications are out of date. New climate change modelling for SE Australia and SCA's catchments is currently under way and will be progressively reported in 2008 and 2009 by CSIRO. Earlier studies suggesting much lower rainfall patterns have been updated for coastal SE Australia. Similar rainfall with increases in the extremes of rainfall patterns with perhaps less runoff due to drier profiles and higher temperatures is currently one of most likely outcomes. If this outcome is correct, then a new groundwater resource and drought borefield could be most useful as it would be protected from evaporation, and recharged by extreme rainfall events.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 6, 8, 11, 13, 15,, 16, 22, 23, 25, 33, 34, 36, 38, 39, 44, 65, 78, 82, 83, 86, 108, 114, 116, 118, 122, 127, 131		
2.08.00 Geology and Geological structure (26 comments recorded)		
96	The conceptual model of the region has been described by a number of authors and includes a two layer aquifer system, with the upper aquifer comprising the Robertson Basalt, and the lower layer the Hawkesbury Sandstone. SCA commissioned work had developed a conceptual model where these two aquifers were considered to be isolated from each other by the intervening fine grained units of the Wianamatta Group. My conceptual model is essentially similar, but provides more local detail based on published geological maps in the SCA report and includes the influence of major faulting and fracturing. Essentially, the model was similar to that of the SCA but includes a fault bounded block lying north of Robertson. This block appears to have no Wianamatta Group sediments between the Robertson Basalt and the Hawkesbury Sandstone, thus potentially allowing connection between the two aquifers.	This small area where basalt is in contact with sandstone is recognised and has been included in the later project descriptions and latest numerical modelling.
124	Chapter 4 of the EA (and particularly section 4.3, page 4-4 and section 4.4, page 4-15) is intended to provide the appreciation of the geological and hydrogeological setting of the proposed borefield area. The description of the geology is generally sound; however, because the proposal relies heavily on fracture-controlled enhanced permeability, the use of a structural diagram (Figure 4.3, page 4-7) that was developed in May 2006 is not adequate to illustrate the situation. It is clear from other information provided (Appendix F) that information on several additional fault structures is available and this must be used to further the understanding of the geology of the area if there is to be any confidence in the sustainability of the proposed borefield,	Noted. Some of the additional displacements suggested by later studies are relatively minor. The latest numerical modelling has revisited the most significant geological structures and the conceptualisation has been adapted to agree with the most prominent of these known features.

<p>124</p>	<p>It is apparent from the diagrams provided that greater consideration of the hydrogeological setting must be incorporated into the contouring of water (pressure) levels for the proposed borefield area. The contour maps presented for the Tourist Road pumping trial do not appear to account for the presence of identified structural features despite these being clearly identified on a sectional diagram within the same report.</p> <p>Various monitoring points within the contour maps provided appear to not have been considered in the contouring process (eg. EA Volume 1, Main Report: Figure 4.12 — bore 6A, 2M2d, 2B, BAT9, BAT10, BAT14, 2K, 11B, BAT7, 5B; EA Volume 2, Appendix F, Tourist Road pumping trial report: Figure 9 - bore 2B, Figure 10 — bores 2 B, 2M2d, 2J, 2N, Figure 11 — bores 2A/D, 2 B, 2M2d; EA Volume 2, Appendix G, Stockyard Swamp pumping trial report: Figure 4 — bore 3G. Figure 5 — bores BAT14, 3C, 3P). The presence of these anomalies does not provide any confidence that the contouring adequately depicts the situation at the times indicated.</p> <p>Although subtle, the variation in contour pattern that would be derived from better application of the contouring software package using control points (including structural features) more effectively would provide greater surety in the understanding of processes occurring during borefield operation. Certainly, the removal of the anomalous parts of the contouring diagrams would clarify and inform the understanding of the likely groundwater flow behaviour and may even provide unforeseen insight into the aquifer response to pumping stresses.</p> <p>Similarly the adoption of even approximate structural orientations in the contouring will engender significantly greater confidence in the proposal as a whole, rather than it appearing to be a disjointed set of consultant reports with little common understanding between them. The documentation must incorporate a more considered degree of professional judgment in the contouring of water (pressure) levels in order for a more realistic assessment of the sustainability of the proposed borefield to be made.</p>	<p>Groundwater contours are based on the factual data obtained from each of the monitored sites. It is the best interpretation of the available data but it is recognised that other interpretations are possible. Structural geology may have an influence on the contour patterns but this is not always the case.</p> <p>SCA does not believe that a substantial revision of the water level contours based on structural geology features is warranted at the present time, however future interpretations will be mindful of the possible influence of these features (as more information becomes available).</p> <p>Contours plans are not important to assess safe yield or sustainability aspects however they are important tools to reconfirm the conceptual model and to understand the influence of pumping during drawdown cycles and recovery during recharge/recovery cycles.</p>
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96	The EA acknowledges that the Robertson Basalt outcrop at Mt Butler lies directly on the Hawkesbury Sandstone, and that in all probability, it intrudes through the sandstone, The EA does not provide any further analysis of how this might affect the hydrogeology of the area, and specifically how important this is to the hydrology of Butlers Swamp.	There are springs in the Mt Butler area that appear to be in direct contact with the sandstone strata so these sites will be monitored more closely. The comprehensive investigations completed at Butlers Swamp (which is the north of Mt Butler) indicate that it is entirely supported by rainfall recharge. There is no spring flow to the swamp and there is no deep groundwater linkage supporting the swamp. This disconnection ensures that the swamp will not be impacted by the proposal. Monitoring will ensure that Butlers Swamp will not be impacted by the borefield proposal.
96	water level declines in the sandstone will not impact the rate of vertical seepage from the base of the basalt due to the presence of a thick shale/clay layer... Nevertheless, there are areas where the basalt overlaps the shale and is in direct contact with the sandstone aquifer and the unsaturated zone (Fig. 9,1). This would promote leakage and should not be regarded as a negligible factor.	This small area where basalt is in contact with sandstone is recognised and has been included in the later project descriptions and latest numerical modelling.

<p>96</p>	<p>All workers have commented on the dual porosity nature of the aquifer and the influence on bore yield of the Mt Murray structure, which is now thought to be a fault of some kind.</p> <p>16. The fault block mentioned above includes Trial production bores 2C, 2F, 2G and 2L. The block will be referred to as the Eastern Block. Trial production bores 2D, 2E and 2M are located west of the fault block, in an area that will be referred to as the Western Block.</p> <p>17. As mentioned above, the Eastern Block is fault bounded and uplifted. The area of the Eastern Block up-hydraulic gradient from (that is, to the south of) the four Trial production bores is about 20 km² (about 2 km wide and 10 km long). Groundwater level data (including Site 12 and tunnel observation bores from previous studies by SCA) indicates that flow in the Eastern Block is to the north from the Robertson Basalt area. There is a marked step down in groundwater levels adjacent to the inferred eastern faulted boundary of the Block (as seen in the tunnel observation bores). Similarly, there is a marked step up in groundwater levels between the Eastern and Western Blocks (as seen in the groundwater level difference between sites 12 and Whatman bore).</p> <p>18. Based on the published approach to recharge estimation from SCA (5% of average rainfall over the area of the aquifer), the likely recharge to the Eastern Block is about 1 GL/yr. This assumes that there is recharge via the Robertson Basalt. If the model of SCA is correct and there is no recharge from the Robertson Basalt, then the recharge to this area is substantially less.</p> <p>19. The area of the Western Block is difficult to determine as there is no detailed geological mapping further to the west of Site 5. However¹ if it is assumed that the Western Block is bounded by a northerly trending groundwater flow line coincident with western boundary of the proposed borefield, then the area can be estimated as about 40 km². This area is derived based on a width of about 4 km and a length of 10 km between the production bores and the edge of the outcropping Wianamatta Group (consistent with the conceptual model of SCA).</p> <p>20. Based on the published approach to recharge estimation from SCA (5% of average rainfall over the area of the aquifer), the likely recharge to the Western Block is about 2 GL/yr. This assumes that there is no recharge via the Robertson Basalt. If fracturing occurs in the Wianamatta Group, then recharge from the Robertson</p>	<p>18 and 20. Recharge rates noted. Recharge from the basalt and shales is an unlikely scenario given that shales are not known to fracture vertically and remain open for extended periods. Water quality studies suggest there is no leakage from the shales to the sandstone aquifers in the higher catchment areas. If the recharge rates are higher, that would provide further improvement in the certainty and sustainability of the borefield without compromising the basalt springs areas that would continue to operate as normal.</p>
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	Basalt is possible, and the recharge estimate would be higher. 21. Similarly, the area to the east of the Eastern Block, that is, around Stockyard Swamp, covers an area of about 20 km ² . Using the same approach as above, the recharge rate to this area of the borefield is about 1 GL/yr. 22. The total estimated recharge to the borefield using the methods reported by SCA is therefore about 4 GL/yr.	22. This estimate (which doesn't cover the north western area) is in reasonable agreement with SCA's initial estimates of recharge and using the resource as a drought supply and being able to operate sustainably.
140	Undertake petrophysical analyses from core drilling to determine specific yield and estimate aquifer volume and sustainability	Laboratory testing to determine permeability and specific yield maybe a useful check but cannot be upscaled to reflect aquifer storage on a regional borefield basis because of the substantial aquifer heterogeneity present
140	Re-examine airborne geophysics	Reviewed as part of transient modelling and conceptualisation of the geological structure
140	Consider surface geophysics to map fault zones	Resistivity imaging (and other ground techniques) have recently been completed to prove the usefulness of this technique in identifying major fracture and fault zones
The following submissions also made comment on this issue - the content was similar to the selected issues above – 29, 78, 82, 92, 128, 135, 140		
3.00.00 Socio-Economic Impact/Issues 2 comments recorded)		
123	Above all, please reconsider the potentially irreversible effects of the Kangaloon Aquifers and how it will affect my family's viability in this area.	The borefield will not diminish the agricultural productivity of the area, as it is mostly constructed on SCA lands in the Special Areas. The borefield taps only the sandstone aquifers of the mid catchment, and there are relatively few users of the sandstone aquifer in the vicinity of the borefield. . Substantial monitoring will be in place and adaptive management applied to ensure there are no irreversible impacts.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 81		
3.01.00 Beneficial Uses and Water as a Resource (5 comments recorded)		
96	The EA defines the area of impact of the proposed borefield as the area where drawdowns are greater than 10 m. Obviously, there will be impacts on current users outside of this area even if only through increased pumping costs due to greater drawdowns.	The EA and modelling studies recognise there will be some drawdown at distance. Preliminary modelling in 2006 suggested this would be less than 10m at distances greater than 2kms. The latest transient modelling suggests similar drawdown patterns with the 10m drawdown contour located at distances of 2 to 2.5km at the end of extended pumping periods associated with severe drought. The impacts to users are expected to be minimal as water level variations are likely to be within the normal range of fluctuations.

133	By allowing a huge allocation for the new SCA borefield the DWE will be endangering rather than protecting the environment and probably existing groundwater users.	<p>Groundwater entitlements and allocations are dealt with by the Department of Water and Energy who is the State's groundwater manager and regulator. The Kangaloon borefield proposal has been factored into the Greater Metropolitan Water Sharing Plan for the Nepean Sandstone source area and water is available under that plan.</p> <p>The large SCA allocation is factored into the sustainable yield calculations already (this includes both environmental, basic rights and all consumptive uses) and the purpose of the new water sharing plan is to ensure that over-allocation never occurs.</p>
The following submissions also made comment on this issue - the content was similar to the selected issues above – 65, 86, 134		
3.01.01 Drinking Water use (7 comments recorded)		
90, 94, 93, 95	We have many endangered species in this area and many farms that rely completely on natural springs and creeks that flow from these water sources that the SCA want to tap into.	<p>Basalt rocks and springs occur high in the catchment and tens of metres above the top of the sandstone strata. Sandstone groundwater does not flow uphill but rather flows to the north following the topography and the dip of the strata. SCA studies show no connectivity between the sandstone and the basalt aquifer systems and this disconnection is expected to be maintained even if a borefield was constructed and operational for a long period.</p> <p>Hence there is a negligible risk of impact to springs and creeks in the uppermost part of the catchment. Monitoring will be in place to monitor spring levels and flow at key sites.</p>
The following submissions also made comment on this issue - the content was similar to the selected issues above – 21, 96, 122		
3.01.02 Agricultural use (30 comments recorded)		
96	A secure water supply is more likely to be retained by farmers and landholders in Kangaloon if there is no development of the borefield.	The allocation, monitoring and management of all water resources is the responsibility of the Department of Water and Energy (DWE) (the State's groundwater manager and regulator). The importance of this borefield for drought will ensure there are effective management plans and DWE/SCA monitoring networks that maintain sustainability and security of supply. This area will always be viewed as a primary water supply area and will be afforded appropriate protection.

96	I am concerned about the hydrologic regime comprising the groundwater and surface water, and the extent to which any changes to the regime may impact on farmers abilities to continue to farm in the area as well as the effects upon flora and fauna within the swamp and riparian habitats. I emphasise that it is the responsibility of SCA to prove there will be no adverse impacts.	There are numerous studies that the SCA has completed that critically look at the linkages between surface water, springs and groundwater. Most water used on farms is derived from rainfall, dams, springs or spring-fed creeks/rivers. Springs occur higher in the catchment and are associated with the basalt terrain, and are mostly disconnected from the sandstone aquifers (except in the Mt Butler area) Groundwater in the sandstone aquifers is derived from rainfall recharge. This is the largest aquifer system in the area and the least used by farmers. The modelling results demonstrate the impacts of a large borefield and the largest water level declines are close to the borefield and at distance are considered manageable. There is a negligible risk of impact to springs and creeks in the uppermost part of the catchment, and the declines in private sandstone bores are considered manageable. Monitoring will be in place to monitor spring levels and flow at key sites, and water levels in representative bores. The borefield will not diminish productivity or the viability of farming.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 7, 9, 21, 43, 44, 46, 66, 73, 75, 82, 84, 90, 93, 94, 95, 101, 114, 122, 128, 133, 140		
3.01.03 Livestock use (37 comments recorded)		
2	No full and complete assessment of compensation to landowners is included to cover affected water flow from bores for stock and domestic purposes or for any commensurate reduction in capital value of a landowners property	When the borefield is operational, there will be a substantial network of observation bores between the borefield and existing bores on agricultural lands. Water levels variations beyond the normal range of fluctuations are only expected to occur within 2 to 2.5km of operational production bores. If impacts are evident and are attributable to borefield pumping, the SCA will have a range of remedial measures in place to re-establish, augment or replace existing supplies. There is no evidence to suggest that property values will be affected by the proposal.

42	Six generations of my family has been in the Kangaloon and East Kangaloon area. We have operated dairy farms and general farming operations The supply of water is an essential part of our operations	<p>The borefield will not diminish the agricultural productivity of the area, as it is mostly constructed on SCA lands in the Special Areas, the borefield taps only the sandstone aquifers of the mid catchment, and there are relatively few users of the sandstone aquifer in the vicinity of the borefield.</p> <p>Substantial monitoring will be place and adaptive management applied to ensure there are no irreversible impacts. If impacts are evident and are attributable to borefield pumping the SCA will have a range of remedial measures in place to re-establish, augment or replace existing supplies.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 7, 9, 10, 18, 20, 21, 28, 40, 41, 44, 46, 55, 66, 73, 82, 84, 90, 92, 93, 94, 95, 96, 101, 114, 122, 133, 140</p>		
<p>3.01.04 Rural residential/domestic use (17 comments recorded)</p>		
92	As already stated to you before, our family rely completely on our natural springs and our creek to water not only ourselves but our stock (cattle, horses and sheep) If anything happens to our creek or springs, then like the SCA, we rely completely on rainfall	<p>SCA studies show no connectivity between the sandstone and the basalt aquifer systems and this disconnection is expected to be maintained even if a borefield was constructed and operational for a long period.</p> <p>Hence there is a negligible risk of impact to springs and creeks in the uppermost part of the catchment. Monitoring will be in place to monitor spring levels and flow at key sites.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 2, 7, 9, 21, 46, 66, 75, 86, 93, 94, 95, 96, 101, 123</p>		
<p>3.02.00 Infrastructure layout/placement (4 comments recorded)</p>		
122	The proposal includes piping under roads and private property. This is a concern for affected interests.	<p>If the decision is made to construct the borefield, then one of the first tasks will be to revisit the borefield design and determine the location of required easements. Most easements will relate to power connections from existing or upgraded lines. There are relatively few pipeline easements as most of the route not located on SCA land will be located in the verge of public roads. There will be extensive consultation and valuation of easements prior to the final design and construction programs commencing in these areas.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 128, 140</p>		

3.02.01 Easements (2 comments recorded)		
130	There may be a requirement for an easement to our property for the power supply to bores on Diamond Fields Road. We have received no correspondence in relation to an easement requirement.	While the routes for power and pipelines are shown in the EA and preferred project report, there has been no approach to landowners at this time because of the Government's decision to defer the construction of the borefield at this time.
88	We object to any easements being created on our property.	Noted. The current borefield design maximises the use of SCA and public land, and minimises any infrastructure across private lands. If there are to be easements on private land this will be subject to extensive consultation and valuation of easements prior to the final design and construction programs
3.02.02 Property acquisitions (8 comments recorded)		
75	and the SCA are contemplating forced property purchases is new and deeply concerning	There have not been any compulsory acquisitions. The SCA has purchased two properties by agreement with the owners
96	Of recent concern is the offer by the SCA to buy some of this highly productive fanning land to create settling ponds. These will accumulate high level of minerals found in the extracted groundwater, effectively reducing land productivity and visual amenity as well as increasing truck movements for waste removal.	The water treatment facilities along Tourist Road and Fire Trail Number Three will be located, designed and landscaped to minimise visual impact. Disturbed areas will be rehabilitated quickly with native local species, and for this reason there will be minimal visual impact and changes to the landscape.
101	These issues are relevant to the Requirements under the heading "Land Use Planning and Resources Conflicts". As the acquisition of the ***** land has apparently not been disclosed in the proponent's EA, the proponent has not presented measures to minimise the conflicts identified in paragraphs 20 and 21 above, and therefore is not in a position to satisfy the Requirements in this regard.	The SCA detailed in section 9.5 of the EA that there would be property acquisitions, further the SCA has produced a map detailing the proposed route of the borefield. This is considered sufficient for the purpose of identifying infrastructure impacts.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 84, 123		

3.02.04 Property values (14 comments recorded)		
100	We are horrified by the potential impact the proposed borefield project will have on our lifestyle, quality of living and the value of our property.	This borefield development is low impact as most of the associated infrastructure is on SCA land and is buried. The proposed development will not affect the use or enjoyment of the rural lands and natural bush. There is no evidence to suggest that property values will be affected or the quality of living will be compromised by the proposal.
140	Also in discussions we have had with senior executives of the SCA and from the documents to which we have had access, there is no proposal for financial compensation to landowners or the Council in the event of – • loss of available water, or • a drop in land value (which will adversely impact on landowners individually and the Council were rating on a u.c.v. basis is capped).	When the borefield is operational, there will be a substantial network of observation bores between the borefield and existing bores on agricultural lands. Water level variations beyond the normal range of fluctuations are only expected to occur within 2 to 2.5km of operational production bores. If impacts are evident and are attributable to borefield pumping then SCA will have a range of remedial measures in place to re-establish, augment or replace existing supplies. Financial compensation measures are not required if there is no loss of supply. There is no evidence to suggest that property values will be affected by the proposal.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 36, 88, 101, 123		
3.02.05 Visual impacts (41 comments recorded)		
88	(Refer 5.1.3 Power Supplies) Explain how your design option is minimising impact through private properties?	As per the EA main report pp 7-27 - The SCA assessed each part of the network in relation to environmental impacts and visual amenity. The SCA weighed up visual amenity with particular reference to residents and the environmental impacts of trenching for underground power. The preferred option (of upgrading existing power lines) is designed to reduce impacts on visual amenity, while substantially augmenting the existing power network. This will benefit all residents.
53	Local vegetation provides a major part of the scenic value which attracts so many tourists to this area. Many local people rely on this tourist industry and also value their magnificent natural surroundings.	Minimal vegetation clearance is proposed, and the bulk of the infrastructure will be underground, or screened from public roads and private lands. The water treatment facilities along Tourist Road and Fire Trail Number Three will be located, designed and landscaped to minimise visual impact. Disturbed areas will be rehabilitated quickly with native local species, and for this reason there will be minimal visual impact and changes to the landscape.

88	I note that you are using underground power on SCA tenured land as you have deemed it visually sensitive. Our private property is visually sensitive to us so why aren't the powerlines over our property planned to be underground?	The SCA assessed each part of the network in relation to environmental impacts and visual amenity. The SCA weighed up visual amenity with particular reference to residents and the environmental impacts of trenching for underground power. The preferred option is designed to reduce impacts on visual amenity, while augmenting the existing power network. Only selected underground segments were able to be negotiated for this rural network. The final power designs have been prepared in accordance with Integral Energy guidelines and their master plan for the area.
54	The method to separate the iron out is in large scale settling ponds, proposed for construction on the edge of Tourist Road (a high visibility visually appealing site will be replaced with a red/brown pit of sludge). This will have impacts upon the visual amenity of the area and reduce its appeal for tourists travelling to the district, causing a loss of tourist driven economic support.	Minimal vegetation clearance is proposed, and the bulk of the infrastructure will be underground, or screened from public roads and private lands. The water treatment facilities along Tourist Road and Fire Trail Number Three will be located, designed and landscaped to minimise visual impact. Disturbed areas will be rehabilitated quickly with native local species, and for this reason there will be minimal visual impact and changes to the landscape.
100	INCREASED POWER SUPPLY. Any upgrade to the power supply should not impact the appearance, enjoyment or value of our property. Therefore we would request that the proposed upgrade to 3 phase power on our property does not include replacing the aesthetically appropriate timber poles with ugly concrete or metal poles. If our timber poles are not capable of the increased power supply, it is unreasonable to impact our property and we would therefore request that the power be installed underground.	Comments noted. The current power design is to use timber poles across agricultural land and steel or concrete poles in all other areas. This design will need to be reviewed again as part of the design review if the borefield proceeds in the future.
130	We request residents of Diamond Fields Road be offered the same consideration with regard visual pollution as those offered to Kangaloon Road residents.	Current powerlines along Diamond Fields Rd will be upgraded in the same manner that existing lines along Tourist Rd will be upgraded. There is no differentiation between the two areas. Underground power is only being contemplated along Tourist Rd where there are no existing power lines.
130	We are extremely concerned with the visual pollution of the security lighting to McGuires Creek River Discharge point and the impact this may have on our residence.	No full time security lighting is now being proposed for either water treatment plant and discharge location.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 18, 21, 32, 36, 73, 78, 84, 92, 96, 97, 100, 101, 114, 119, 120, 123, 128, 129		

3.03.00 Tourism (7 comments recorded)		
81	The potential impact to the local EEC's, areas of national significance and the potential economic impacts upon our local tourist economy do not seem to be either cost effective, nor do they provide any significant or substantial benefits to the end user	Impacts are expected to be minimal and will be mitigated. Impacts on tourism would be during construction only. Ongoing visual impacts would be minimal based on the design of the proposal
78	Aesthetic impact on high tourist areas e.g. Tourist Road.	Minimal vegetation clearance is proposed, and the bulk of the infrastructure will be underground, or screened from public roads and private lands. The water treatment facilities along Tourist Road and Fire Trail Number Three will be located, designed and landscaped to minimise visual impact. Disturbed areas will be rehabilitated quickly with native local species, and for this reason there will be minimal visual impact and changes to the landscape.
101	It is difficult to convey in words the experience of driving along Tourist Road. The northern side is largely undisturbed and contains extensive stands of various types of eucalypts which provide a changing scene, while farmlands on the other side provide contrast. On a sunny day, or a moonlit night it is quite striking in its beauty. There are other scenic drives that are more memorable or spectacular, but Tourist Drive offers something distinctive, if not unique. It is difficult to imagine how it will be affected by 35 kilometres of pipelines and overhead or underground power lines, let alone the other structures. Pipes require excavation, removal of trees and disturbance of undergrowth and topsoil which takes years to restore.	Minimal vegetation clearance is proposed, and the bulk of the infrastructure will be underground, or screened from public roads and private lands. The water treatment facilities along Tourist Road and Fire Trail Number Three will be located, designed and landscaped to minimise visual impact. Disturbed areas will be rehabilitated quickly with native local species, and for this reason there will be minimal visual impact and changes to the landscape.
92	We also feel that the visual effect along all of Tourist Road and Kirkland Road needs to be discussed more and a better conclusion met. This is a tourist area; hence the name, and overhead powerlines of any sort are just not acceptable. This is a natural bush area and overhead powerlines are a shocking suggestion by SCA or Integral Energy and if this development should be approved then this needs to be addressed further. All underground powerlines are the only answer.	Underground power is proposed in publicly visible areas where there are no existing power lines. Upgrading of overhead power is proposed in the agricultural landscape where there is existing overhead power. The current routes will not change with the only extensions being from existing poles to new poles beside each production bore.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 96, 100		

3.05.00 Land Use Restrictions/Infrastrure (13 comments recorded)		
96	Whereas the desalination plant has the potential to affect only the area of construction as well as any necessary additional pipeline corridor, the borefield proposal will affect, directly and indirectly, in a variety of ways, as outlined below, many hectares of both public and private land. The private land is productive and quite intensively developed and populated; the public land is largely in a pristine state and has been, for many decades until now, dedicated to the protection of the environment in the widest sense.	This borefield development is low impact as most of the associated infrastructure is on disturbed fire trails within the SCA lands – pipelines are buried, and power lines will be overhead but Aerial Bundled Cable (ABC) cabling. Impacts to private land will be negligible (works mostly involve the upgrade of power lines to provide more reliable supply, and a few bores and pipelines crossings in the Kangaloon Rd area) – there will be no impact to the productivity of private agricultural land.
82	Damage to roads and infrastructure would occur.	Road dilapidation studies would be completed in advance of any borefield construction, and public roads (and road verges) would be restored to their former condition where trenches and crossings occurred
135	<ul style="list-style-type: none"> The report does not acknowledge that the eastern extent of the proposed borefield overlies the south western corner of the NRE Avondale Colliery and Mining Lease No. 1565. 	The existence of this lease is acknowledged and the location and boundaries of leases is shown in Section 4.10 of the EA.
135	<ul style="list-style-type: none"> The report fails to acknowledge the potential for coal sterilisation with related impacts upon mine viability, revenue from coal sales and potential lost royalties. 	There is no mention of coal sterilisation in the EA because it is envisaged that provided there is no major disturbance and drainage of groundwater from the Hawkesbury Sandstone, the two land uses can co-exist.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 84, 97		
3.06.00 Layout and Design (16 comments recorded)		
79	appropriate measures be taken to limit impacts on upland swamp habitats during construction of bores and the pipeline	All sensitive areas and known threatened species will be protected - if special trenching and construction methods are required near sensitive areas, then these will be identified and included in the CEMP requirements
44	The strategic location of this project is questionable due to the distance from the Nepean Dam (approximately 80-100km). The bores would bring water to the surface and transport it over a long distance where it will be subject to evaporation pollution	The transport distance in the Nepean River from discharge locations to Nepean dam storage is between 5 and 10 km (not 80 to 100km). Instream the water is subject to minimal evaporation and no pollution as it is all within protected catchments.
101	Fitting 5 hectares of equipment into this environment together with associated traffic and maintenance and monitoring activities will result in significant and ongoing disturbance.	The Tourist Rd water treatment plant layout is mostly collection ponds - all infrastructure will be on cleared agricultural land so there will be no additional environmental impacts. The operational aspects are believed to be adequately covered in the EA and the preferred project report where additional information is presented on layout and site functionality.
3	There is also the uncertain requirements for the Asset Protection Zones surrounding the infrastructure and power supply	The maximum cleared area around any infrastructure will be 8m (mostly transformer locations near individual bores). Various distances apply to the overhead power layout depending on the type of overhead wiring proposed.

88	How is the Fibre Optic network to be routed (what path will it take and will it be above or below ground)?	The proposed fibre optic communications network will be located underground in the same trench as the pipeline where possible
78	All creek crossings need to be assessed individually by Councils Asset Engineer. Some of our bridge and culvert assets are new where as others are due for replacement. Attaching SCA assets to our bridges and culverts will not be ruled out however in some instances this may not be accommodated.	Noted. This aspect to be discussed further with Wingecarribee Shire Council when final tender designs are prepared.
78	The road bridge and culvert dilapidation study must be prepared in consultation with WSC Roads and traffic staff to remove any potential ambiguities.	Noted. This aspect to be discussed further with Wingecarribee Shire Council prior to final tender designs and the construction program.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 85, 89, 114, 127		
3.06.02 Bores (39 comments recorded)		
20	I am also informed that there is a danger of contamination for Sydney's water from the highly toxic iron sludge through seepage at the sites and the added Aluminum Sulphate used to aid the settling of the concentrated solids; the acids used to clean the bores are also a contaminant.	The amount of alum to be added to the collection ponds to accelerate flocculation is minimal. Also all ponds are bunded and lined so there is no potential for chemicals to escape to the Nepean River. The acids to be used to clean scale and iron oxides from bores are biodegradable organic acids that are non-toxic
122	Infrastructure Not finalised? The project identifies an unknown production bore figure inside an outside the specified project zone, It only states the majority of which [75] will be located within the identified corridor' (pg. 4). The report actually states that 'the final number and location of production bores have not been finalised and depend on further testing' (pg. 4), yet the community is asked to comment on the proposal now.	The proposed production bore locations have been identified for each area with the proviso that the actual location may change slightly depending on the results of geophysical surveys, infill test drilling, site access, and connection to the borefield infrastructure. Most bore sites are confirmed for Areas 2 and 3. Final bore sites are likely to be within 50-100m of the proposed locations however for a long linear piece of infrastructure such as this, it is not possible to confirm every bore location until all the infill drilling is completed for all areas.
124	The EA identifies typical bore construction for production bores within the proposed borefield as having screens placed from around 25 metres below ground level (mbgl). It is understood that the upcoming Sydney Metropolitan Groundwater Plan will require as standard pressure cementing to 30 mbgl of any borehole in close proximity to groundwater dependent ecosystems (that have a buffer distance rule applied). This requirement may be modified where minimal impact on the base flow in streams and GDEs can be demonstrated; however, this will require detailed scrutiny on a case-by-case basis. Consideration of these requirements must be reflected more clearly within the Statement of Commitments.	Substantial information on stream baseflow and GDEs and the negligible connectivity with the regional sandstone aquifer is presented in the EA. Perched groundwater and shallow alluvial groundwater will be cased and cemented off in constructing each production bore (typically 10 to 15m below ground level).

20	I understand that there may have been problems with fouling at the test bore sites.	No iron-fouling problems have been encountered that reduce the production bore efficiencies.
44	The boreholes would also vastly increase the potential for pollution and degradation of the catchment area.	There is no evidence or reason why production bores would pollute or degrade the catchment area. Two water treatment plants will be in place to remove dissolved iron
3	This, plus the expectation of the need to redrill the bores due to deposits of iron building up inside them and the concomitant engineering intrusion required at future intervals will lead to on-going disruption and damage.	There is no expectation to redrill production bores because of iron scale and fouling. These stainless steel bores should have a life of 30 to 50 years if properly maintained.
18, 28, 30, 35, 40, 41	There is also a danger of contamination for Sydney's water from the highly toxic iron sludge through seepage at the sites and the added Aluminum Sulphate used to aid the settling of the concentrated solids; the acids used to clean the bores are also a contaminant	The amount of alum to be added to the collection ponds to accelerate flocculation is minimal. Also all ponds are bunded and lined so there is no potential for chemicals to escape to the Nepean River. The acids to be used to clean scale and iron oxides from bores are biodegradable organic acids that are non-toxic
84, 96	The introduction of powerlines and pumps in the catchment increases the risk of bushfires in the area.	Appropriate areas will be maintained around the different types of powerlines. There is no increased risk of fire due to borehole pumps left submerged in the water column.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 24, 119, 120, 128, 135, 140, 146		
3.06.03 Pipes (23 comments recorded)		
130	We request that all services (water, power & communications) that are laid underground do not disturb creek beds and therefore should be installed within road crossings.	Pipelines and communications are entirely underground (except at some bridge and culvert crossings) so as not to disturb creek beds - where these cannot be accommodated on SCA land, the infrastructure will be within the verges of the road reserves. Power will be a mixture of overhead and underground sections according to the current network and the sensitivity of each area.
135	This would require an undertaking that future underground mining would be permitted, that supporting infrastructure (such as pipelines and power lines) will be constructed in such a manner to accommodate subsidence.	If borefield infrastructure was in place, the onus would be on the mining company to ensure that the infrastructure was not compromised. If the borefield development occurred later after mining, then the borefield would have to be designed to deal with more fractured Hawkesbury Sandstone and possibly undulating ground
78	Council's road opening conditions and the IPWEA specification for road restorations 306U are to be used where road crossing excavations are unavoidable. Road crossings are to be minimised and Council would like to inspect the backfilling of these works.	Noted

78	Council would prefer all pipeline infrastructure and works to be located within SCA property as a first option. Where this is not possible Council would like to be involved in the justification process for using the road reserve. Short term project savings could lead long term maintenance costs for road infrastructure.	This is SCA's preferred approach, and road crossings and use of road reserves will be minimised where possible.
122	The proposal includes piping under roads and private property. This is a concern for affected interests.	The use of road crossings and reserves will be minimised where possible. The number of easements crossing private land will also be minimised. A large portion along Kirkland Rd is now designed to be in the verge of Kirkland Rd rather than across private land.
78	Within Moresby Hill Road trenching along the southern alignment would have a lesser impact on established trees than the northern side.	The northern side is proposed so as to minimise road crossings. Minimal impact on trees is expected if the trenching is on the boundary of the road reserve and the SCA lands.
78	Within the road reserve all pipelines should be located within the shoulder of the road and not within the pavement. The effect these works will have on table drains and natural vegetation are to be minimised and the table drains are to be left in a working condition after the installation and excavation.	This is SCA's preferred approach, and road crossings and use of road reserves will be minimised where possible.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 24, 31, 44, 53, 54, 84, 96, 97, 101, 119, 120, 129, 133		
3.06.04 Water treatment (40 comments recorded)		
101	Moreover the final design of the water treatment facilities has not been completed and is proposed to be submitted at a later stage, so that the minister is, in effect, being asked to accept the environmental effect of these structures without any proper specification.	Project approval is now being sought on the two WTPs and the two river discharge locations based on the additional studies provided in the preferred project report. These designs have been discussed with adjacent residents.
96	Iron concentrations are sufficient to cause problems with production bores, pumps, and pipes. The water treatment facilities for iron removal are extensive, including aeration and sand filtration. Backwashing of the sand filter will be required every few days, and this backwash then needs treatment using Aluminium sulphate to settle the solids. The use of this chemical adjacent to the Nepean River (previously a class 'S' specially protected waterway) is of concern.	The amount of alum to be added to the collection ponds to accelerate flocculation is minimal. Also all ponds are bunded and lined so there is no potential for chemicals to escape to the Nepean River. The acids to be used to clean scale and iron oxides from bores are biodegradable organic acids that are non-toxic

129	I read with concern that extraction and treatment of the aquifer water will be required at each discharge location, particularly to remove ferrous pollutants. This may involve the washing and concentration of the iron pollutants as a sludge and their removal in tankers to “appropriate landfill sites”, in quantities of over 20 000kg month! Couldn't this iron concentrate be extracted and used elsewhere, e.g. in the ironworks, at Port Kembla?	There are no recycling opportunities for this iron sludge at this time. Twenty five tonnes per month is not a large quantity and would constitute about three tipper truck loads. This will be revisited if the borefield is constructed and operated in the future.
29	Water treatment- Page 6. Have you seen the iron oxides and other iron compounds building up in the settling ponds below the pumps to “reduce iron content rations”? I am told this material is to be carted away eventually to “an appropriate landfill location”. Do you know of one? “The main water treatment facility along Tourist Road will treat 35 to 40 million litres per day I do not believe such an operation will be whisper-quiet, and the constant movement of large trucks in and out full of wet iron salts will cause hazardous congestion on one of the area's well-used roads linking the Highlands to the Illawarra.	The collection ponds will be used to decant and recycle water from the backwashing and then to dry the iron oxide sludge so it is spadeable and can be removed using trucks. Truck movements are likely to be monthly or quarterly and are not expected to cause any traffic congestion.
65	These statements indicate potentially serious operational problems and high maintenance costs, In the case of the last statement, SCA proposes iron (24,750 kg/ month) and associated sludge water be transported by tankers and dumped at an appropriate landfill site. This waste, in its oxygenated form, has the clear potential to pollute streams, with associated bacteria forming oily looking scums in slow flowing rivers or pools. The proposed use of alum to treat the Nepean River (previously a class '5'. specially protected, waterway is equally concerning. What other chemical may also be involved is not clear	The amount of alum to be added to the collection ponds to accelerate flocculation is minimal. Also all ponds are bunded and lined so there is no potential for chemicals to escape to the Nepean River. The acids to be used to clean scale and iron oxides from bores are biodegradable organic acids that are non-toxic
84	This means that concept approval should not be granted when such components as water treatment and discharge to rivers have not been adequately addressed in the environmental assessment	Concept approval is for the approval of an engineering concept - not the final design. See Chapter 4 of the preferred project report for further information on the design of the WTP
The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 6, 8, 11, 13, 15, 16, 21, 22, 23, 36, 38, 39, 75, 83, 86, 88, 91, 114, 118, 122, 127, 130, 131, 140		

3.06.05 Power (58 comments recorded)		
88	Are overhead powerlines going to effect the value of SCA land?	The value and purpose of the SCA land is to provide safe, clean drinking water to the Greater Sydney area so there is no impact on the use of the SCA Special Area land
92	We also feel that the visual effect along all of Tourist Road and Kirkland Road needs to be discussed more and a better conclusion met. This is a tourist area; hence the name, and overhead powerlines of any sort are just not acceptable. This is a natural bush area and overhead powerlines are a shocking suggestion by SCA or Integral Energy and if this development should be approved then this needs to be addressed further. All underground powerlines are the only answer.	<p>The SCA has discussed the concept and detailed designs with Integral Energy. These discussions included the option of placing all power underground. Integral Energy did not support the underground concept because of 1. Maintenance, and 2. Ownership issues, and their policy that underground was inappropriate for a rural distribution network.</p> <p>The final adopted design was the result of maintaining visual amenity in sensitive areas along with Integral Energy's requirements. The final concept does not add any new power lines along Tourist Road (most of these sections have underground power) and the sections along Kirkland Road will be set back from the road and not be visible to residents or vbitors.</p>
100	We are also concerned about the potential noise from the power transformers to be installed. The area in which we live is totally silent at night and any minor noise can be heard from some distance. We would therefore ask that any transformers or other potentially noisy units be installed a substantial distance from our home (1 km) and not visible from Tourist Road.	Appropriate noise testing would take place prior to installation of the pad and pole-mounted transformers and if necessary, noise attenuation measures would be built into the compound designs.
135	This would require an undertaking that future underground mining would be permitted, that supporting infrastructure (such as pipelines and power lines) will be constructed in such a manner to accommodate subsidence.	If borefield infrastructure was in place, the onus would be on the mining company to ensure that the infrastructure was not compromised. If the borefield development occurred later after mining, then the borefield would have to be designed to deal with more fractured Hawkesbury Sandstone and possibly undulating ground
130	We request the position of the proposed power pole to the corner of Diamond Fields Road and Fire Road No 3 be moved 5 metres to the north to allow semi-trailer access through the corner.	Noted. This is a detailed design item that needs to be addressed as part of the final tender designs.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 6, 8, 11, 13, 15, 16, 21, 22, 23, 24, 29, 31, 33, 34, 36, 38, 39, 44, 53, 54, 65, 73, 78, 83, 84, 86, 96, 97, 101, 114, 118, 119, 120, 127, 131, 133, 146		

3.07.00 Construction Impacts/Issues (4 comments recorded)		
79	Construction phase water management A Soil and Water Management Plan (SWMP) must be prepared and implemented. The plan must describe the measures that will be employed to minimise soil erosion and the discharge of sediment and other pollutants to lands and/or waters during construction activities. The SWMP should be prepared in accordance with the requirements for such plans outlined in Managing Urban Stormwater: So//s and Construction (available from the Department of Housing).	This plan will be completed as part of the construction CEMPs.
100	DISRUPTIONS DURING CONSTRUCTION Construction will have a major impact on the daily activities and access by local residents, Whilst not ideal, a larger team of construction workers over a shorter time span would have less impact on our lives. Saturday morning construction is not appropriate and we would request that construction be kept to Monday to Friday so that we can at least have our weekends in peace.	Noted
78	Action #38 it needs to be stated that NO works are to occur on a Sunday OR public holiday.	Noted and agreed.
3.07.01 Noise (7 comments recorded)		
130	We would like to maintain the extreme quiet of the area and currently there is no industrial noise. We request you identify what low noise is in the proposal.	Minor noise would only be associated with transformers at each production bore site, and the water treatment modules at each of the WTPs. As part of the CEMP, noise testing and if required appropriate noise attenuation measures would be built into the compound designs.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 21, 84, 96, 97, 123		
3.07.02 Traffic (11 comments recorded)		
78	Traffic control plans for the construction works will need to be approved by Council's Traffic Engineer. In some instance a full road closures may be required and these will need to be addressed through the Local Traffic Committee. SCA are advised that this is process does take some time as the minutes need to be referred to full Council for endorsement.	Noted and agreed.

130	item 7.3.5 on Page 280 of 454 allows for the use of Diamond Fields Road as a construction traffic route. (Heavy Vehicle Construction Traffic Routes) This road is extremely narrow and the structure of the road and bridge would not be able to handle any additional traffic without seriously jeopardising the safety of the current users. Access to Diamonds Fields Road may be required to carry out works for Stage 4 only and accessed from Fire Road No. 3 via Kangaloon Road or Old South Road from the north. This should form part of the CEMP for contractor	Access via Diamond Fields Rd will only be required for construction of Area 4 works (except if the power needs to be supplied from the Mittagong end for areas 1, 2 and 3). Road and bridge condition will be assessed before tenders and construction, and access more rigorously assessed and determined at the time of construction.
85	The installation of pipes, settling ponds and power, and the movement of vehicles and personnel will contribute to increased risks of weed infestation, feral animal invasion and fire.	Appropriate measures will be included in the CEMPs for contractors. Very stringent conditions already apply for access to and working within the SCA Special areas. These aspects will be maintained.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 18, 28, 44, 89, 96, 97, 123, 133		
3.07.03 Dust (1 comments recorded)		
44	and decrease in air quality due to dust and air emissions	Dust will not be an issue except during initial bore construction and trench construction. Areas will be watered down to suppress dust
3.07.05 Weeds and Feral Animals (7 comments recorded)		
96	Risks to the Special Area including fire, degradation from vehicular access, and the introduction and proliferation of pests and diseases will be reduced.	Appropriate measures will be included in the CEMPs for contractors. Very stringent conditions already apply for access to and working within the SCA Special areas. These aspects will be maintained.
89	The infrastructure required for pumping and the movement of vehicles and personnel will contribute to increased risks of weed infestation, feral animal invasion and fire in the area.	Appropriate measures will be included in the CEMPs for contractors. Very stringent conditions already apply for access to and working within the SCA Special areas. These aspects will be maintained.
84, 96	During construction (and destruction of trees) there is likely to be considerable soil and vegetation disturbance, and there is a greater risk of introduced weed species becoming established in the pristine environment from workers and vehicles.	Minimal trees will be removed and trenching will be in small sections then backfilled so as to minimise soil disturbance. Appropriate measures will be included in the CEMPs for contractors. Very stringent conditions already apply for access to and working within the SCA Special areas. These aspects will be maintained.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 85, 101		

3.08.00 Impacts to Bores/Springs (19 comments recorded)		
140	<p>Also in discussions we have had with senior executives of the SCA and from the documents to which we have had access, there is no proposal for financial compensation to landowners or the Council in the event of –</p> <ul style="list-style-type: none"> • loss of available water, or • a drop in land value (which will adversely impact on landowners individually and the Council were rating on a u.c.v. basis is capped). 	<p>When the borefield is operational, there will be a substantial network of observation bores between the borefield and existing bores and springs on agricultural lands. Impacts on springs (if any) are expected to be negligible. Groundwater level variations beyond the normal range of fluctuations are only expected to occur within 2 to 2.5km of operational production bores. If impacts are evident and are attributable to borefield pumping then SCA will have a range of remedial measures in place to re-establish, augment or replace existing supplies. Financial compensation measures are not required if there is no loss of supply.</p> <p>There is no evidence to suggest that property values will be affected by the proposal.</p>
78	<p>Action #34 raises a significant issue and relates to one of the broader concerns regarding the entire project. The commitment that should private landowners experience reductions in their bore's then some form, of compensatory measure will be offered including for example alternative water supplies or modification's to existing bores (lowering) is inadequate. Loss of or a reduction in bore volumes could potentially have huge socio economic impacts such that livelihoods and a community are jeopardised. To lower a bore would appear to be an unsustainable alternative to an already sustainable practice as would sourcing water from an alternative location. The potential social and economic implications are far more significant than perhaps they are being considered.</p> <p>This point is a principal cause of much of the concern with the entire project and has not been adequately considered by the SCA or the Government more broadly.</p>	<p>There is minimal groundwater use from bores in the catchment because of the numerous other water sources (rainwater tanks, springs, permanent creeks etc) and hence the socio-economic impacts (if any) are limited. When the borefield is operational, there will be a substantial network of observation bores between the borefield and existing bores and springs on agricultural lands. Impacts on springs (if any) are expected to be negligible. Groundwater level variations beyond the normal range of fluctuations are only expected to occur within 2 to 2.5km of operational production bores. If impacts are evident and are attributable to borefield pumping the SCA will have a range of remedial measures in place to re-establish, augment or replace existing supplies. Financial compensation measures are not required if there is no loss of supply.</p> <p>There is no evidence to suggest that property values will be affected by the proposal.</p>
96	<p>The EA defines the area of impact of the proposed borefield as the area where drawdowns are greater than 10 m. Obviously, there will be impacts on current users outside of this area even if only through increased pumping costs due to greater drawdowns.</p>	<p>The EA and modelling studies recognise there will be some drawdown at distance. Preliminary modelling in 2006 suggested this would be less than 10m at distances greater than 2kms. The latest transient modelling suggests similar drawdown patterns with the 10m drawdown contour located at distances of 2 to 2.5km at the end of extended pumping periods associated with severe drought. The impacts to users are expected to be minimal as water level variations are likely to be within the normal range of fluctuations.</p>

130	has a registered bore and this is not identified as a bore in your documentation Page 454. This bore is within the 2km radius of the borefield.	Noted. SCA will do a final check of all registered bores so that a complete database of information is available prior to construction and operation.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 70, 92, 101, 114, 122		
3.08.01 Compensation (15 comments recorded)		
18, 30, 35, 41	No satisfactory answers have been given by the SCA to the farmer's pleas, to where they would get their water from for their stock, when their creeks, bores and springs run dry.	There will be no impact on ephemeral creeks and most springs as they are disconnected from the sandstone aquifers. When the borefield is operational, there will be a substantial network of observation bores between the borefield and existing bores and springs on agricultural lands. Groundwater level variations beyond the normal range of fluctuations are only expected to occur within 2 to 2.5km of operational production bores. If impacts are evident and are attributable to borefield pumping then SCA will have a range of remedial measures in place to re-establish, augment or replace existing supplies.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 2, 20, 21, 28, 40, 70, 73, 146		
3.08.02 Deepen/replace bore (3 comments recorded)		
26	Consideration should be given to a condition that requires the Sydney Catchment Authority to re-instate domestic stock supply to landholder bores that are impacted by drawdown for the project (e.g. by deepening bores or providing access to alternative supplies of comparable convenience).	When the borefield is operational, there will be a substantial network of observation bores between the borefield and existing bores on agricultural lands. Water level variations beyond the normal range of fluctuations are only expected to occur within 2 to 2.5km of operational production bores. If impacts are evident and are attributable to borefield pumping the SCA will have a range of remedial measures in place to re-establish, augment or replace existing supplies.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 73, 146		

3.09.01 MWP (157 comments recorded)		
6, 8, 11, 13, 15, 16, 22, 23, 33, 34, 36, 38, 39, 83, 86, 114, 118, 127, 131	One of the main reasons to investigate groundwater extraction was to put off building the desalination plant which is now being built. The desalination plant will feed water directly into water pipes in Sydney for Sydney's consumption. The Commonwealth Government (Labor) also gave an election promise to augment (expand) the states desalination plants if they wanted to. The desalination plant also takes the pressure off the creeks and rivers (and aquifers).	The NSW Government's strategy to achieve a sustainable and secure water supply for greater Sydney is outlined in the MWP. In addition to implementing demand management measures to reduce commercial, industrial and household water usage and other measures to increase recycling, this plan defines how the government will manage urban water sources in times of severe drought. Accessing groundwater is an important new drought response measure outlined in the plan. Construction of a 250 million litre per day (ML/d) desalination plant is underway and the use of this plant would be maximised during drought. In periods of extended drought both the desalination plant and groundwater borefields would operate in order to supplement the available drinking supply.
48, 49, 50, 51, 56, 57, 58, 59, 60, 61, 62, 63, 64, 68, 69, 71, 72, 74, 76, 77, 87, 99, 103, 104, 105, 107, 110, 111, 112, 113, 117, 132, 138, 139, 141, 142, 143, 144, 145	The water supplied by the project would only account for 3% of Sydney's water during times of drought. Other options outlined in the MWP 2006, including water saving and water recycling programs, offer more long term sustainability and a much greater volume of water.	The Metropolitan Water Plan (MWP) incorporates all of these measures and groundwater. While this Kangaloon scheme may only produce 3 percent of supply during severe drought - the total volume of all groundwater sources could be 8-10 percent which is significant during periods of severe drought.

3	How can this project proceed when the dam level is above 60% AND construction of the desalination plant is underway?	<p>The construction of the borefield was shelved by the Minister in June 2008 and will now not proceed until severe drought conditions return and dam supply levels are such that construction of the scheme is justified. The MWP strategy is about the diversification of water supply sources particularly during droughts - the strategy is not just groundwater or the desalination plant but instead the appropriate use of both sources.</p> <p>The NSW Government's strategy to achieve a sustainable and secure water supply for greater Sydney is outlined in the MWP. In addition to implementing demand management measures to reduce commercial, industrial and household water usage and other measures to increase recycling, this plan defines how the government will manage urban water sources in times of severe drought. Accessing groundwater is an important new drought response measure outlined in the plan. Construction of a 250 million litre per day (ML/d) desalination plant is underway and the use of this plant would be maximised during drought. In periods of extended drought both the desalination plant and groundwater borefields would operate in order to supplement the available drinking supply.</p>
78	Possible impact on supply of emergency water to Goulburn.	There is no link or impact on the separate pipeline proposal from Wingecarribee Dam to Goulburn.
78	Relationship to Shoalhaven transfer project.	The proposed Shoalhaven Transfers project is another (separate) aspect of the MWP.
1	Our concern at the time of the project's inception was that it was a reactive hastily conceived proposal inspired by the water shortage that was gripping Sydney residents from the drought.	The SCA has commissioned and completed substantial technical, scientific and environmental investigations (numbering more than 90 studies) on the groundwater source at Kangaloon and the local environment of the proposed borefield area. The investigation programs began in the Upper Nepean (Kangaloon) in March 2005 and monitoring programs have been under way for three years.
96	The potential deferral of an increase in capacity of the desalination plant seems an invalid argument, considering that the plant is now being constructed and it has a much greater capacity to deliver water than the groundwater option. With estimates of \$2 billion for the desalination plant, such capital expenditure should warrant maximum capacity. The desalination plant will feed water directly into Sydney Water pipes for consumption. It will also buy wind power and will promote this as an alternative energy. The Commonwealth Government gave an election promise to augment the state desalination plants if requested. The desalination plant should take the pressure off creeks, rivers aquifers.	Noted. The desalination plant is being constructed in 125 ML/day modules. The current commitment is for a 250 ML/day plant but there is potential to for a 500 ML/day plant at this site. The advice provided in the EA was that the groundwater option (all borefields which would deliver 100 to 150 ML/day) is equivalent to an extra module for the desalination plant if further augmentation is proposed/required during drought

122	It is unclear how it can be said from this that the proposal complies with the NSW State Plan dealing with 'securing supply of water and energy for NSW.' It is also unclear how this connects to the Metropolitan Water Plan and the priority (EI) 'a secure and sustainable water supply for all users'. It is arguable that the project is designed to be consistent with the plan and that it meets the objectives noted by the report.	<p>The NSW Government's strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan (MWP). The plan documents the NSW Government's response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought. The MWP was first gazetted in 2004 and since that time there have been two reviews of the plan.</p> <p>Groundwater would add to the diversity of Sydney's water supply in times of extreme drought as detailed in the EA and as part the NSW Government's MWP.</p>
122	It doesn't make sense to continue to affect potential water management with the continuation of long wall mining THAN build a desalination plant THAN dry up further possible ground water supplies. There needs to be a long term vision at a time in which it is so desperately needed.	<p>The NSW Government's strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan (MWP). The plan documents the NSW Government's response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought. The MWP was first gazetted in 2004 and since that time there have been two reviews of the plan.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 5, 9, 18, 20, 21, 25, 30, 35, 40, 44, 46, 54, 65, 70, 81, 85, 90, 93, 94, 95, 101, 109, 115, 116, 125, 126, 134, 138, 140</p>		
<p>3.09.02 NSW Planning Approvals (63 comments recorded)</p>		
101	Clearly no conditions could be imposed which would ameliorate the impact of this development.	The SCA disagrees and contends that impacts of this project are manageable.
133	How can the Dept of Planning consider itself satisfied with incomplete data? Specifically, this has implications for the Dept's responsibilities under the Bilateral Agreement, in relation to the EPBC Act declaration of the Borefield project as a "Control Action"	The Australian Government will review the EA and associated reports as part of the approval process.

3	I think the process has completely destroyed the clear and overall picture for the decision makers by creating so many facets that no one is able to look at the fundamental disaster potential of the whole project	The SCA has made every attempt to describe the attributes of the groundwater resource and to thoroughly examine and report on potential impacts of the project. As hydrogeology is a complex science - the information is comprehensive and thorough, but the SCA considers this appropriate for due consideration of the project.
79	The construction and operation of infrastructure for the project is not a scheduled activity under the Protection of the Environment Operations Act 1997 (the POEO Act), and will not require an environment protection licence. However, the project proponent and its contractors must ensure that the facilities are constructed and operated in accordance with the general environment protection provisions of the environment protection legislation, including the POEO Act, the National Parks and Wildlife Act 1974 and the Threatened Species Conservation Act 1995.	Noted
84, 96	It is incumbent on the approving authority to weigh against these impacts, and the uncertainty surrounding them, the arguments advanced in justification of such an extreme proposal, given the existence of alternatives, such as the desalination plant, which is now being constructed.	This project is proposed as part of the MWP which includes other measure such as the desalination plant. The SCA emphasises that based on the extensive studies contained in the EA
78	However, Council supports the general premise of a Statement of Commitments as contained in the EA Summary and trusts they will form part of the approvals for the project.	Noted
122	The Illawarra consists of both Wollongong and Shellharbour Councils. It is unclear what consultation actually took place with Wollongong Council while no consultation appears to have existed with Shellharbour Council, even though Director General requirement's include consulting with local council. In response to the above concerns ICEC requests an independent hearing for this project.	The project is mostly within the Wingecarribee Shire local government area and with a very small part (SCA Special Area around Stockyard Swamp) falling within the Wollongong City local government area. The project does not fall within the Shellharbour Council area. Extensive consultation has taken place with Wingecarribee Shire Council, as befits the layout of the proposed borefield. Consultation has also occurred with Wollongong Council. The SCA also convenes a Local Government Reference Panel which received regular updates on the project and includes members of all three councils.
122	Due to deficiencies in consultation and time constraints this submission is based on executive summary information. For this reason an independent hearing is requested as long as this doesn't interfere with any community group wishing to appeal on the merits of the project.	The SCA does not accept that there were deficiencies in consultation and reiterates that the project has no impact on the Shellharbour Council area hence consultation in this area was not considered necessary.

132	I urge you to consider advising the minister to set up an Advisory Panel similar to the one recently directed to oversee the DoP determination concerning the Hill Top Shooting Range. Since the minister has declared Kangaloon a 'project of state significance' under Part 3A, an advisory panel would obviate any inference of conflict of interest.	A matter for Department of Plannings consideration
2	The planning and approval process as proposed, is flawed and thereby denies natural justice to people and organisations opposed to the above application.	The proposal is being dealt with in accordance with the law and the specifics of the EP&A Act.
1	Since this project was first announced there has been a community perception that the decision to proceed was already made	This perception is incorrect. This project is being assessed under part 3A of the EP& A Act.
133	I would point out that the Federal Environment Department established (with the concurrence of the SCA) that this classification applies to all the "Upland Swamps" in the Kangaloon Borefield. That is in direct contradiction of advice to the Dept of Planning, within the EA, that the EPBC Act listing for Temperate Peat Swamps on Sandstone applies only to Butler's Swamp. That information is wrong. Its inclusion in the EA is mischievous, and might, if not corrected, lead astray the Dept of Planning in its assessment of the EA in regard to the EPBC Act. That would have implications for the Dept of Planning's responsibilities under the Federal/NSW Bilateral Agreement.	All upland swamps within the borefield area are being considered sensitive ecosystems by both the NSW Department of Planning (and other agencies) and the Commonwealth Department of Environment, Heritage and the Arts
130	We disagree with your interpretations that the Wingecarribee Shire Council Zoning for the land as Water Catchment encompasses water extraction. We believe that water extraction does not form part of this zoning and therefore rezoning is required.	The proposed land use is consistent with the zoning
96	The EA has not demonstrated adherence to the National Water Initiative (NWI). The summary treatment of the NWI in the EA has not considered the central issue of sustainable levels of extraction and the avoidance of over allocation of resources. Further, the lack of consideration of the broader groundwater budget and documentation of the impacts of the groundwater budget due to the proposal within the context of sustainable yield for the Southern Highlands is contrary to the Director General's Requirements (DGRs).	<p>The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons.</p> <p>The latest numerical modelling study describes the sustainability of the proposed development and provides water balances for the proposed scenarios.</p>

96	Unfortunately, the time extended for public comment has not been sufficient for NSW Farmers Association and The Sydney Water Catchment Taskforce of that Association, of which I am Chairman, to assimilate the huge amount of highly technical material comprising this BA process, form a corporate view on the matter and make a formal submission to the Department with respect thereto. It is to be regretted that the views of such an important and affected body as NSW Farmers Association are not before your Department with respect to this critically important matter.	Substantial information was made available to members of the Upper Nepean CRG in advance of the release and public exhibition of the Kangaloon borefield EA documentation. Even though the studies were substantial, sufficient time is considered to have been made available for submissions. The NSW Department of Planning extended the submission period for an additional two weeks beyond the statutory 30 days exhibition period to cater for the more detailed analysis and submissions
78	However, it is disappointing that Council and all other stakeholders were provided with a very short timeframe to comment on the Environmental Assessment documentation. Notwithstanding an extension was granted to Council, the volume and complexity of the documentation should have resulted in a considerably longer timeframe for submission preparation. The borefield proposal is a particularly significant issue and to provide the statutory minimum timeframe for the bulk of interested parties to read and digest over 2000 pages of scientifically dense information and then provide constructive submissions is considered problematic and a poor reflection of the Government's commitment to public participation and consultation.	Substantial information was made available to members of the Upper Nepean community reference group (CRG) in advance of the release and public exhibition of the Kangaloon borefield EA documentation. Even though the studies were substantial, sufficient time is considered to have been made available for submissions. The NSW Department of Planning extended the submission period for an additional two weeks beyond the statutory 30 days exhibition period to cater for the more detailed analysis and submissions.
44	This project conflicts with government policy under the Water Management Act of 2000, that sharing of water from a water source must protect the source of water and its dependent ecosystems and protect basic landholder's rights. The NSW Threatened Species Conservation Act 1995, Local Government Act 1993, Federal Environment Protection and Biodiversity Conservation Act 1999 stipulate	The project is consistent with relevant State and Commonwealth legislation.
133	We conclude that for the NSW Minister for Planning to approve the MP 06_0331 (Upper Nepean (Kangaloon Aquifer) Borefield Proposal would pose an unacceptable threat of a "Significant Impact" to a federally protected Endangered Ecological Community, "Temperate Highland Peat Swamps on Sandstone".	Noted.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 16, 21, 25, 26, 27, 37, 86, 116, 121, 126, 128, 147		
3.09.03 Australian Govt planning approvals (19 comments recorded)		
132	The Save Water Alliance assisted by other concerned organizations and expert consultants successfully argued for the project to be declared a 'controlled action' last year.	The SCA referred the project to the Department of Environment, Water, Heritage and the Arts in order for it to be assessed under the Environmental Protection and Biodiversity Conservation Act and to determine whether it was considered to be a controlled action.

122	Bilateral agreements should not exist with projects such as this where the Federal government is reliant on processes through the State Government that are a concern.	The Australia Government has agreed that the project will be assessed in this manner.
133	<p>With regard to the federal Minister for the Environment's declaration of the Project "Upper Nepean (Kangaloon Aquifer) Borefield proposal to be a Controlled Action under Sections 18 and 1 8A of the EPBC Act 1999 this Environmental Assessment is totally deficient. It even fails to meet the specific directions contained within the Director-General's Supplementary Requirements added specifically in order to deal with the issue of the Federal Minister's "Controlled Action" declaration Appendix B to this Submission will address this detail specifically. a) However, I would simply point to the lack of assessment of what "Drying" is meant to mean in regard to Stockyard swamp, what impact on nationally and State-level threatened species is anticipated, and what "feasible mitigation measures" are proposed. (I cannot find any mention of any such measures, despite the specific request by the Director-General that such measures be addressed.) b) The issue of migratory species is barely mentioned in the entire EA. I have found only references to the Rufous Fantail as the single example of a "Migratory Species" listed under the EPBC Act. That species is not at risk. c) However, what about the Latham's Snipe? I personally wrote about that species being found in the Kangaloon Aquifer area, over the last two years, and the "desktop research" has failed to pick up those references. Japanese (Lathams) Snipe (Capella hardwiclii,) http://peonyden.blogspot.com/2007/11/japanes-snipc-are-back-in-kanaloon.html d) Furthermore, as I specifically discussed this species IN DETAIL, in my submission to the Federal Minister, prior to him declaring the project a "Controlled Action" under the EPBC Act, and as my submission was made available to the SCA, it is appalling that the EA has missed this. e) If my personal records (as published) are not "significant" enough for the desktop researchers, I would point out that this species is listed in the EPBC Act, as a protected species, by virtue of its being covered by an Intergovernmental Treaty with Japan (Attachment C) Surely the omission of reference to an International Treaty is significant enough for the Dept of Planning to question the validity of the information which has been provided to it in the EA?</p>	<p>a) There will be no "drying" caused by groundwater pumping. No mitigation measures are therefore proposed because of there being no impact to the upland swamp. Perched water table and ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p> <p>b) Migratory species are not at risk from the borefield development as there are no linkages with their habitat to the regional groundwater in the sandstone aquifers</p> <p>c) Migratory species are not at risk from the borefield development as there are no linkages with their habitat to the regional groundwater in the sandstone aquifers</p> <p>d) Noted</p> <p>e) Noted</p>

133	<p>The Upper Nepean Borefield Proposal would threaten the hydrological integrity of this wetland. Under the Advice to the Federal Minister for Environment — relating to this Endangered Ecological Community, “Temperate Highland Peat Swamps on Sandstone” - Criterion 2— on which the listing was recommended — states:</p> <p>“Given the location of swamps in the landscape and their dependency on water, they are susceptible to changes in water flow, level of the water table, and structural damage. Several of the components of the Temperate Highland Peat Swamps on Sandstone ecological community have been degraded through alterations to water flows and a change to the level of the watertable.” and it subsequently states:</p> <p>“...alterations to the water flow and level all impact on the vegetation associations within the ecological community, as well as impacting on the peat substrate on which the ecological community is based.”</p> <p>Source: http://www.deh.gov.au/biodiversity/threatened/communities/temperate-highland-peat-swamps.html#judged</p>	<p>Pumping trials have shown that upland swamps are perched and disconnected and not impacted by pumping. As there is an unsaturated zone beneath these perched systems they cannot be influenced by pumping. The only process at work within perched water tables (whether they are associated with upland swamps or terrestrial vegetation is evaporation, transpiration and natural drainage) - none of these processes are influenced in any way by pumping from the disconnected sandstone aquifers.</p> <p>Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 44, 84, 101</p>		
<p>3.09.04 Timing of the project (43 comments recorded)</p>		
44	<p>The project was approved to go forward as an emergency option when dam levels reach 40%, however current levels are above 65%.</p>	<p>Approval for this project would not contradict the current triggers outlined in the Metropolitan Water Plan (MWP).</p>
122	<p>is the proposal for times of drought or outside times of drought since the proposal does not appear to be sustainable during times of severe drought.</p>	<p>Under the MWP, borefield pumping is only proposed in times of severe drought. Production bores would be operational during drought years then allowed to recover during non-drought years. Based on the plethora of scientific studies, it is considered sustainable within the defined parameters.</p>
6, 8, 11, 13, 15, 16, 17, 22, 23, 33, 34, 36, 38, 39, 83, 86, 118, 131	<p>In an age of concern about global terrorism, an uncontaminated water source is of incalculable value. Leave it alone.</p>	<p>SCA agrees that the groundwater resource is uncontaminated and it is of great value. The development decision is based on this being a drought resource only (ie one that would only be used in an emergency situation). For most years there would be no groundwater usage – the borefield development (or knowing there is a groundwater resource that can be developed) is a readiness strategy under the MWP.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 21, 65, 114, 127, 131</p>		

3.09.05 Continue pumping the aquifer (7 comments recorded)		
29	hiding in the words “develop the bore field’ and “strategic and progressive development of groundwater sources (expansion)”. It would appear to me that this is only the beginning of future control of our precious environment and the natural ecosystems that support a balance of flora and fauna	That is not the intention of these words.
3	The assessment offers no guarantees to the community that pumping will be only carried out in times of drought, will stop at a certain limit and the bore field will not be expanded, or that the community will be truthfully informed about activities.	The borefield, if constructed in the future, would be compliant with the conditions of approval developed under the joint bilateral approach by the NSW and Commonwealth Governments. The scheme is proposed as a new water supply scheme during periods of severe drought.
65	There is also no guarantee that that future demands in the Sydney metropolitan area will not force political pressure to ‘open the tap’ further beyond the stated ideal of restraint.	There are physical and practical limitations to the amount of water that can be extracted from the proposed borefield. It is certainly not "unlimited" and a sustainable scheme is dependent on appropriate recharge and recovery cycles. As part of the approval process, the SCA will apply for a licence with Department of Water and Energy under the current Water Act. This license will include borefield allocation, operational rules and triggers for stopping and starting all or part of the borefield.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 32, 78		
3.10.00 Other Water sources (101 comments recorded)		
48, 49, 50, 87, 99, 110, 111, 138, 139, 141, 142, 143, 144, 145	Other water supply management options outlined in the MWP 2006 should be given priority and the Kangaloon Borefield Project should not continue.	The NSW Government's strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan (MWP). The plan documents the NSW Government's response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought. The MWP incorporates all of these measures including groundwater.

78	<p>Flawed Policy — the proposal to ‘drought proof’ Sydney, whilst significant is problematic when deep aquifer water storages are accessed as a resource before other far more sustainable options are identified, developed and exhausted. Council agrees that there are significant opportunities to better manage water demand and supply such as adaptive re use, stormwater harvesting, recycling, reduced demand management, leakage detection and mitigation and non potable quality industrial use but considers these options should be better resourced, actioned and exhausted before alternatives such as borefield extractions are adopted and commissioned.</p>	<p>The NSW Government’s strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan (MWP). The plan documents the NSW Government’s response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought.</p> <p>The MWP incorporates all of these measures including groundwater.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 21, 44, 46, 51, 52, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 68, 69, 71, 72, 74, 76, 77, 84, 96, 101, 103, 104, 105, 107, 110, 111, 112, 113, 116, 117, 124, 129, 132, 137,</p>		
<p>3.10.01 Recycling (50 comments recorded)</p>		
90, 93, 94, 95	<p>but also it is not a long-term solution anyway. It is about time Sydney residents were made accountable for their own water usage and were made to install water tanks, as we here in rural NSW have, as part of their pledge for the environment.</p>	<p>The NSW Government’s strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan (MWP). The plan documents the NSW Government’s response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 44, 46, 48, 49, 50, 51, 54, 55, 56, 57, 58, 59, 60, 61, 62, 68, 69, 71, 72, 74, 76, 77, 91, 99, 63, 64, 103, 104, 105, 110, 111, 112, 113, 116, 117, 132, 138, 139, 141, 142, 143, 144, 145</p>		

3.10.02 Desalination (45 comments recorded)		
84, 96	<p>The potential deferral of an increase in capacity of the desalination plant seems an invalid argument, considering that the plant is now being constructed and it has a much greater capacity to deliver water than the groundwater option. With estimates of \$2 billion for the desalination plant, such capital expenditure should warrant maximum capacity. The desalination plant will feed water directly into Sydney Water pipes for consumption. It will also buy wind power and will promote this as an alternative energy. The Commonwealth Government gave an election promise to augment the state desalination plants if requested. The desalination plant should take the pressure off creeks, rivers aquifers.</p>	<p>The NSW Government's strategy to achieve a sustainable and secure water supply for greater Sydney is outlined in the Metropolitan Water Plan (MWP). In addition to implementing demand management measures to reduce commercial, industrial and household water usage and other measures to increase recycling, this plan defines how the government will manage urban water sources in times of severe drought. Accessing groundwater is an important new drought response measure outlined in the plan. Construction of a 250 million litre per day (ML/d) desalination plant is underway and the use of this plant would be maximised during drought. In periods of extended drought both the desalination plant and groundwater borefields would operate in order to supplement the available drinking supply.</p> <p>The NSW Government's strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan. The plan documents the NSW Government's response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 6, 8, 11, 13, 15, 22, 23, 33, 34, 36, 38, 39, 43, 55, 65, 70, 81, 83, 86, 91, 97, 114, 116, 118, 119, 120, 122, 125, 127, 131</p>		

3.10.04 Groundwater in other areas (1 comments recorded)		
101	In addition, as has been pointed out repeatedly, most of Sydney's substantial rainfall is not collected and goes to waste. Sydney's own aquifer, which is only partly contaminated, is not used to supply any of Sydney's needs. No detailed consideration appears to have been given to utilising the aquifer to store rainwater falling in Sydney, or to supplement its demand. The same issues about environmental effects would not apply in relation to Sydney's aquifer, since it does not support the sort of natural environment which exists undisturbed above much of the Kangaloon aquifer.	<p>The NSW Government's strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan. The plan documents the NSW Government's response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought.</p> <p>Groundwater is the primary drought water supply option under the current Metropolitan Water Plan (MWP). The three identified borefield areas are Kangaloon, Leonay and Wallacia but there are also other longer term sources that should be considered including mine water and the Botany Basin sandbeds. However there are substantially more issues to consider before using the sandbeds as there is aquifer contamination beneath and downgradient of former industrial areas, and there are definite Groundwater Dependent Ecosystems in this area (with strong links to the unconfined aquifer in the dunes)</p>
3.10.05 Stormwater harvesting and rainwater tanks (24 comments recorded)		
5	We have always taken the view that a more sensible and sustainable approach to such problems is to invest in the infrastructure necessary to improve the harvesting and conservation of the plentiful rainwater that falls on the Sydney basin every year. Instead, ill-conceived measures are dreamt up in answer to the continuing and ever-growing demand for water driven by urban population growth and housing development around the Sydney environs.	<p>The NSW Government's strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan. The plan documents the NSW Government's response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought.</p>
The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 7, 21, 25, 44, 54, 65, 66, 90, 93, 94, 95, 98, 116, 119, 120, 123, 129		

3.10.06 Improve system efficiency (8 comments recorded)		
25	<p>We know that the annual rainfall of the Sydney Region is subject to drought, however that does not justify taking more water from the dams than can be replaced by the catchment. There is no excuse for allowing users to believe management authority to educate the populace to adjust their demand to the sustainable supply; in the meantime reduce unnecessary losses.</p>	<p>The NSW Government's strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan. The plan documents the NSW Government's response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 16, 44, 82, 91</p>		
3.10.07 Demand management (65 comments recorded)		
123	<p>I have raised only a few concerns that our families feel about the potential 'water supply for Sydney using underground water in our area.</p> <p>I would like to now raise future solutions to Sydney's water problems, and in light of the astronomical quotes for Aquifers in Kangaloon district - the following should be considered.</p> <ul style="list-style-type: none"> o Enforce water tanks for suitable households in Sydney and offer attractive/irresistible subsidies. o Increase water rates o Ban top loading washing machines and offer attractive/irresistible subsidies for front loading washing machines o Reduce the volume of water to homes <p>These solutions are no less radical than the ones our own family had to face during the fires of 2005 which came within 1 km of our home when our water tanks were quite literally empty and our family was evacuated.</p>	<p>The NSW Government's strategy to achieve a sustainable and secure water supply for Sydney, the Blue Mountains and the Illawarra is outlined in the Metropolitan Water Plan. The plan documents the NSW Government's response to the current and future droughts and the potential impacts of climate change and population growth. Demand management measures have been implemented to reduce commercial, industrial and household water usage, as well as measures to increase recycling. This plan defines how government will manage and diversify urban water sources in times of severe drought.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 3, 5, 11, 16, 19, 21, 25, 44, 46, 48, 49, 50, 51, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 68, 69, 71, 72, 73, 74, 76, 77, 91, 97, 98, 99, 103, 104, 105, 107, 110, 111, 112, 113, 117, 119, 120, 132, 138, 139, 141, 142, 143, 144, 145</p>		

3.11.02 Overall project cost (124 comments recorded)		
78	How much water will actually end up with consumers and if the identified volume is transferred, for how long will this sustain Sydney and the Illawarra? Clearly the water transferred will sustain demand for no more than a few days. Therefore from a cost benefit perspective! the project does appear unsustainable. Council would appreciate a definitive response to this question.	<p>The borefield proposal is to supply up to 50 ML per day during periods of severe drought - this is equivalent to about 4 percent of the constrained demand for the Sydney supply systems during the most recent drought (equivalent to about 10-12 days supply pa). No transmission losses were observed during the pumping trial and instream transmission and evaporation losses to the Nepean Dam (8-10km from the discharge sites) are expected to be minimal. Water from this supply system would (most likely) help to secure the Illawarra and will not be lost from the Upper Canal system.</p> <p>Additional groundwater (currently up to 100 ML per day) may be available from other sources. The ACIL Tasman economic appraisal that reviewed the 2004 Metropolitan Water Plan in April 2006 critically evaluated groundwater in the context of other potable water supplies for drought supply and supported the development of groundwater sources.</p>
124	Benefits/costs analysis of using groundwater as a drought water supply against other supply options.	<p>The ACIL Tasman economic appraisal that reviewed the 2004 Metropolitan Water Plan in April 2006 critically evaluated groundwater in the context of other potable water supplies for drought supply and supported the development of groundwater sources. It concluded that "Knowing that the groundwater is available and can be brought into supply in time allows safe use of more dam water." - A more recent cost-benefit analysis comparing groundwater with other (new) drought water supply sources is also available.</p>
6, 11, 16, 83, 86, 118, 131	The extracted water must travel over 100 kilometres to Sydney via the Upper Canal to Prospect with losses from evaporation at the reservoirs and losses via the old open canal. When you also factor in the previous points and the following points this is unlikely to be a "lower cost option". • Without a cost-benefit analysis being conducted, how on earth can that claim be made, anyway?	<p>The transport distance in the Nepean River from discharge locations to the Nepean dam storage where it mixes with other waters is between 8 and 10km (and is not over 100km). Instream the water is subject to minimal evaporation and no pollution as it is all within protected catchments. From Nepean Dam water can be transported to Avon Dam (for the Illawarra) or to Broughtons Weir (to Upper Canal and Prospect WTP)</p>
2	No cost/benefit analysis has been included or carried out by SCA or NSW Treasury	<p>The ACIL Tasman economic appraisal that reviewed the 2004 Metropolitan Water Plan in April 2006 critically evaluated groundwater in the context of other potable water supplies for drought supply and supported the development of groundwater sources. It concluded that "Knowing that the groundwater is available and can be brought into supply in time allows safe use of more dam water." - A more recent cost-benefit analysis comparing groundwater with other (new) drought water supply sources is also available.</p>

45	Millions of dollars should NOT be spent pumping water downhill	<p>The important issue here is the timescale at which water flows through the sandstone strata to discharge as baseflow lower in the catchment. This residence and flow time is of the order of thousands to tens of thousands of years. The sandstone groundwater is water that would not be available during any drought period hence the borefield strategy is to take part of the storage volume during drought (maximum 30 percent) close to the recharge area, and allow the depleted storage to recharge and recover at the conclusion of each drought period.</p> <p>Pumping costs would not be millions of dollars for each operational cycle.</p>
134	The reports also reinforce the matters I raised in my letter of 17th April 2008 in particular the lack of a proper, independent and transparent cost/benefit analysis by NSW Treasury or SCA.	The ACIL Tasman economic appraisal that reviewed the 2004 Metropolitan Water Plan in April 2006 critically evaluated groundwater in the context of other potable water supplies for drought supply and supported the development of groundwater sources. It concluded that "Knowing that the groundwater is available and can be brought into supply in time allows safe use of more dam water." - A more recent cost-benefit analysis comparing groundwater with other (new) drought water supply sources is also available.
140	a full cost benefit analysis should be carried out by a credible external firm, be subject to scrutiny by the NSW Treasury and that the results should be published	The ACIL Tasman economic appraisal that reviewed the 2004 Metropolitan Water Plan in April 2006 critically evaluated groundwater in the context of other potable water supplies for drought supply and supported the development of groundwater sources. It concluded that "Knowing that the groundwater is available and can be brought into supply in time allows safe use of more dam water." - A more recent cost-benefit analysis comparing groundwater with other (new) drought water supply sources is also available.
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 3, 7, 8, 13, 15, 18, 20, 21, 22, 23, 24, 25, 28, 29, 30, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 44, 46, 53, 54, 55, 65, 81, 84, 91, 96, 101, 114, 115, 116, 119, 120, 125, 127, 129, 131, 132, 133</p>		

3.11.03 Cost of benefit vs environmental risk (148 comments recorded)		
87, 145	This project is unsustainable and unnecessary in the long term and the environmental risks are far too great to allow it to proceed	The SCA disagrees and contends that the environmental impacts of this project are manageable. Risks have been assessed and are now considered acceptable and quite manageable.
3	The cost of this project (\$100 million), the enormous impact it will have on the local environment and the few days worth of water (6-7 days) that it would supply for Sydney does not justify	The SCA disagrees and contends that the environmental impacts of this project are manageable. Risks have been assessed and are now considered acceptable and quite manageable.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 2, 6, 7, 8, 11, 13, 15, 16, 21, 22, 23, 33, 34, 36, 37, 38, 39, 44, 46, 48, 49, 50, 51, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 68, 69, 71, 72, 74, 75, 76, 77, 81, 83, 84, 85, 86, 89, 91, 96, 99, 101, 103, 104, 105, 107, 109, 110, 111, 112, 113, 114, 118, 119, 120, 122, 124, 127, 129, 131, 132, 138, 139, 140, 141, 142, 143, 144		
4.01.00 Operational strategy/approach (12 comments recorded)		
79	Operational Environmental Management Plan The proponent must prepare an Operational Environmental Management Plan (OEMP) to minimise environmental impacts during operation of OEMP shall address: a) flow rates; b) trigger levels for salinity and temperature; and c) management action should trigger levels be breached. Management Plan the scheme. The A report providing the results of the monitoring program must be submitted following 12 months of baseline monitoring and within three months following the first full drawdown use of the borefield.	There will be at least one Construction and Environmental Management Plan (CEMP) for the construction activities and an Operational Environmental Management Plan (OEMP) for the operational tasks - within each of the plans there will be a specific monitoring and management plan that describes the network, and main physical attributes of the groundwater resource (water levels and water quality), surface water (water levels and flow), and ecosystems (monitoring transects). The OEMP will include the items suggested. Reporting requirements will be in accordance with the conditions of approval.
29	concerns the term “severe drought”. This is such a sloppy definition! It is unclassifiable. What is “severe” ? Does it involve length? How long is “long”? And in what locations is it being unusually dry? Is environmental degradation part of it, or financial distress, or loss of business viability, or unusual meteorological data?	The current trigger for use of groundwater during severe drought periods is when supply storage levels reach 40 percent
140	It should be noted that with a stated overall production of 10—15 GL/a from 75 bores, the average discharge per bore needs to be only 0.37—0.55 ML/d assuming that all the bores in the borefield are continuously operated. This equates to an instantaneous yield of about 4— 6.5 L/s. It is more efficient to operate bores with these reduced rates with many I all bores operating in that it spreads borefield drawdown lessening interference between bores and reduces cascading of water in individual bores.	Pumping rates are expected to be lower than the assessed safe yields from individual bores, and the borefield is expected to be operated at the lowest rates to achieve the required production rates. The final operating strategy is yet to be determined and will partially depend on negotiations with Department of Water and Energy regarding the water management licence.

140	Should SCA proceed with the drought supply concept, then a staged borefield development should be considered. This not only means a staged construction schedule, but a staged commissioning of borefield 'Areas' whereby the second area is not commissioned until the results of, say, three years pumping from the first developed stage is reviewed; and so on.	Staging and operational strategies will depend on the demand requirements at the time. The construction of the borefield has been deferred and the current trigger is to utilise groundwater when dam supply levels reach 40 percent - such a low trigger (if the drought continued and became an extreme event) would not allow for staged construction and operation over many years.
140	Should the aquifer prove to be robust with a phased development of the borefield and in the face of prolonged extraction (viz, long-term, sustained 'stressing' of the resource) then the concept of drought use could be revisited and implemented at a later stage; say, ten years. This has the additional advantage of allowing imminent climate change prognosis to come into fruition.	Staging and operational strategies will depend on the demand requirements at the time. The construction of the borefield has been deferred and the current trigger is to utilise groundwater when dam supply levels reach 40 percent - such a low trigger (if the drought continued and became an extreme event) would not allow for staged construction and operation over many years.
140	This complex modus operandi is not supported — operationally it is not good practice to draw down bores then allow regular recoveries (i.e. cycle pumps) as it is energy inefficient; may create turbulent flow condition causing wetting / drying of bores that may encourage accelerate encrustation / corrosion. It is also introduces operational complications; in the reviewers experience operators tend to over-pump (depending on pump-rating where contractors have over-specified pump specifications) and it needs great operational clarity to review and infer drawdowns to cycle bores within large borefields.	Pumping rates are expected to be lower than the assessed safe yields from individual bores, and the borefield is expected to be operated at the lowest rates to achieve the required production rates. The final operating strategy is yet to be determined and will partially depend on negotiations with Department of Water and Energy regarding the water management licence. Some cycling within the borefield is expected to maintain or partially recover water levels.
140	The proposed fundamental modus operandi should be reviewed. The reviewers suggest that the SCA consider an operational regime that enables 'constant' topping up of dam reservoirs. The advantages of this are: <ul style="list-style-type: none"> • The borefield should not draw more than its sustainable yield; • Having regard to the water balance, rainfall recharge events are 'balanced' by withdrawals from the aquifer; • There is less likelihood of significant derogation of the aquifer due to a prolonged drought, and any associated ecosystems; • There is less chance of dewatering production bores (and indeed 'very low transmissivity compartments' of the aquifer); • Background monitoring can be more consistent (obviating the need for intense monitoring during pumping withdrawal events as would be the case of a drought-relief supply) thereby enabling (human and equipment) resource deployment to be more strategic, and more easily planned and managed; 	The borefield is to be used in times of severe drought hence the current philosophy is not to operate for extended periods but just to operate when required. The aquifer has substantial storage and hence can be overdrawn in drought periods provided bores don't exceed their safe yield and longer term extractions are within the sustainable limits. Operational philosophy to be reviewed as part of the Metropolitan Water Plan strategy and as additional information about borefield performance becomes available.
The following submissions also made comment on this issue - the content was similar to the selected issues above –		
96		

4.01.01 Operational start/operational stop points (16 comments recorded)		
124	It is proposed that the bore field will be used in periods of severe drought. During such a period it is likely that there would be little recharge and continuous pumping would continue to draw down the aquifer (refer to Peer review conclusion 15. in section 4.4.6). During such a period, ecosystems that depend either partly or entirely on groundwater are more likely to be affected e.g. base flow in streams, terrestrial vegetation. Is there sufficient storage downstream of the bore field to allow the bore field to be operated during periods of significant rainfall? If downstream storage is insufficient, could the water be piped to another storage?	<p>Pumping trials have shown that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.</p> <p>The borefield is just for use during extreme droughts. If Nepean Dam is full or rising it is unlikely that the borefield will be operational. There are no plans to pipe the groundwater to another storage for use</p>
78	Chapter 12 does not fully respond to concerns relating to a 'STOP' mechanism when anomalies are identified or when further monitoring makes it clear significant adverse impacts are occurring. This section of the EA should also identify a 'chain of command' relating to notifications (including the community) of a) when anomalies are identified h) when significant adverse impacts are identified.	More details regarding the proposed monitoring activities and operational responses to water level, water quality and ecosystem changes are provided in the preferred project report.
78	The SCA need to better articulate the response hierarchy in the event information/data suggests there are anomalies in the aquifer response once pumping has occurred (see Chapter 12 of EA). At the present this is not clear, It has been suggested that real time (water quality/quantity) and annual (biological/bio geographical) monitoring will occur however by the SCA's admission there will be a time lag between biological responses as a result of pumping anomalies. If anomalies occur it's proposed to increase the monitoring (to twice a year). Again, for such a critical project and considering the significance in surface ecosystems from a water catchment perspective alone, the Precautionary Principle should be applied more rigorously to explore immediate reasons for anomalies and the nexus to groundwater extraction, Climatic variation will occur over a significant period. Variations in floristic composition and structure for example as a result of borefield activities will be rapid, therefore the SCA should be responding more cautiously than simply increasing the monitoring.	More details regarding the proposed monitoring activities and operational responses to water level, water quality and ecosystem changes are provided in the preferred project report.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 6, 13, 15, 22, 23, 33, 34, 36, 38, 39, 79, 76, 114, 140		

4.01.02 Pumping periods (14 comments recorded)		
140	This complex modus operandi is not supported — operationally it is not good practice to draw down bores then allow regular recoveries (i.e. cycle pumps) as it is energy inefficient; may create turbulent flow condition causing wetting / drying of bores that may encourage accelerate encrustation I corrosion. It is also introduces operational complications; in the reviewers experience operators tend to over-pump (depending on pump-rating where contractors have over-specified pump specifications) and it needs great operational clarity to review and infer drawdowns to cycle bores within large borefields.	Pumping rates are expected to be lower than the assessed safe yields from individual bores, and the borefield is expected to be operated at the lowest rates to achieve the required production rates. The final operating strategy is yet to be determined and will partially depend on negotiations with Department of Water and Energy regarding the water management licence. Some cycling within the borefield is expected to maintain or partially recover water levels.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 6, 13, 15, 22, 23, 33, 34, 36, 38, 39, 86, 108, 114		
4.01.03 Extraction regime (10 comments recorded)		
84, 96	That full recovery of the regional groundwater level is obtained and left for at least 6 months with no pumping before appropriately triggered subsequent pumping cycles commence.	It is likely that if a large rainfall event occurred, and there was substantial inflow to the storages, that the borefield would be off for an extended time to allow the regional aquifer to fully recover. This time period is expected to be at least 6 months (and this is what has been modelled in the latest transient modelling). It is likely that the borefield would be off for even longer periods however the overall capacity of the dams, the status of the groundwater levels, and the DWE licence conditions will determine when the next pumping cycle can commence.
84, 96	That the SCA investigate the extraction of only the water within the basal aquifers of the Hawkesbury Sandstone. Our interpretation of their data is that it is the oldest and the most pure and may not require any treatment for iron.	The fractured aquifers within the sandstone strata are naturally linked and it is not possible to take just groundwater from the basal aquifers. Some of the highest dissolved iron concentrations are from the deeper boreholes even though water quality at some sites does improve with depth.
140	replacement of submersible pumps in some production bores to pump less water and reduce drawdowns	Pumping rates are expected to be lower than the assessed safe yields from individual bores, and the borefield is expected to be operated at the lowest rates to achieve the required production rates. The final operating strategy is yet to be determined and will partially depend on negotiations with DWE regarding the water management licence. Some cycling within the borefield is expected to maintain or partially recover water levels.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 108, 114, 125		

4.01.04 License conditions (5 comments recorded)		
84, 96	That the decommissioning requirements for the borefield are to be clearly stated in the approval to ensure that when the borefield is no longer operational, that there is minimal visual and environmental impact.	Visual impacts are low. All infrastructure is underground (except for some powerlines and connections). There will be no change in the site infrastructure layout from operational to non-operational periods.
84, 96	That limits on annual extraction of 15 GL are retained and never exceeded to avoid over-exploitation of the resource,	This will be conditioned under the Part 3A EP&A Act approval and SCA's bulk water licence with Department of Water and Energy.
140	Auditing and compliance reporting during borefield operations by SCA is of paramount importance and the borefield operational plan should clearly mandate these.	Noted and for possible inclusion in the conditions of approval
4.01.05 Policy direction/change (2 comments recorded)		
84, 96	That the duration of pumping cycles are clearly stated and effectively protected from alteration over time by shilling state policy directions and decisions.	An adaptive management approach will be applied to borefield operations because of the uncertainty of each climatic cycle, rainfall patterns, required pumping periods and individual bore performance. This approach together with on/off triggers would provide more certainty and environmental protection that sets duration and pumping rate schedules.
4.02.00 Monitoring plan (13 comments recorded)		
79	Control sites should be established in upland swamps which are located sufficiently far from the borefield so as to be outside of the area impacted by groundwater drawdown. This should enable the impacts of groundwater extraction to be discerned from those associated with fluctuating climatic/seasonal conditions.	There is a huge variability in the condition of ecosystems from season to season and the use of a control site for an upland swamp (if a suitable site can be located) may not provide any useful data. From the studies completed to date, it is known that perched water systems are disconnected from the regional sandstone aquifers so this requirement would have limited benefits, however (if conditioned), SCA would work with DECC and DEWHA to confirm a suitable site away from the main borefield.
79	To support these commitments, DECC recommends that: <ul style="list-style-type: none"> • both ecological and perched water-level monitoring continue: prior to groundwater extraction; while production bores are in operation; and post operation; 	Water level monitoring is one of the primary data sets being collected and a key sites network will continue for both perched water and regional groundwater sites for the foreseeable future. In view of the deferral of the borefield construction program, limited ecosystem monitoring is planned for the immediate future. Monitoring activities will increase in advance of construction and operational periods
79	Groundwater Dependent Ecosystems (GDEs) The SCA has committed to limiting the impact of the Kangaloon borefield project on the natural environment through ongoing monitoring, further groundwater investigations and application of the precautionary principle to the management of the project.	Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.

79	Operational Environmental Management Plan The proponent must prepare an Operational Environmental Management Plan (OEMP) to minimise environmental impacts during operation of OEMP shall address: a) flow rates; b) trigger levels for salinity and temperature; and c) management action should trigger levels be breached. Management Plan the scheme. The A report providing the results of the monitoring program must be submitted following 12 months of baseline monitoring and within three months following the first full drawdown use of the borefield.	There will be at least one Construction and Environmental Management Plan (CEMP) for the construction activities and an Operational Environmental Management Plan (OEMP) for the operational tasks. Within each of the plans there will be a specific monitoring and management plan that describes the network, and main physical attributes of the groundwater resource (water levels and water quality), surface water (water levels and flow), and ecosystems (monitoring transects). The OEMP will include the items suggested.
124	A strong emphasis on Adaptive Management will be a requirement of Sydney Catchment Authority's Water Management Licence, Consequently, a monitoring program to assess impacts of groundwater extraction on surface hydrology, drawdown and recovery rates and GDEs will be required to be developed and implemented under the licence. Licence conditions may impose additional requirements to that specified in the EA including additional monitoring/assessment.	This is to be expected. Again the OEMP will address these issues and items.
124	The use of control locations as part of the monitoring program is not discussed in the report. These locations must be located outside the area influenced by pumping. It is essential that all studies (eg groundwater level monitoring, floristic monitoring, aquatic ecological monitoring etc) include control locations so that effects of production pumping will not be confounded by climatic effects. If the bore field is to be operated during a severe drought, it is possible that climatic effects may mask the effects of pumping. Both control and test locations should be monitoring both before and after production pumping with adequate replication and a sufficient baseline data collection period.	Additional upgradient and downgradient monitoring locations for groundwater resource monitoring are proposed, will be included in the CEMPs and OEMP, and will be discussed with Department of Water and Energy prior to implementation. Similarly the location of stream gauges will be proposed in the plans and negotiated with DWE. Control sites for ecosystems are not as useful or as easily identified (from SCA's perspective) and may be more difficult to negotiate and include in the respective plans. Discussions will be held with DECC and DWE. Monitoring of ecosystems before, during and after pumping cycles is proposed. A key sites network for water level monitoring (both groundwater and surface water) will continue for the foreseeable future. More details are provided in the detailed monitoring framework in the preferred project report.

78	Action #6 the biophysical monitoring needs to be more frequent. Changes to the hydrology of the swamps and the landscape more broadly as a result of groundwater extraction (during extended dry periods) will be rapid. A monitoring regime of twice per annum and then more frequent of anomalies are detected would be a more appropriate regime than that proposed.	The baseline data sets that SCA has completed to date have been 6-monthly across two seasons (autumn and spring in 2006 and 2007) and there has been little correlation between each event - the biodiversity and the variability is high (even between upland swamps in the same area), so more frequent biophysical monitoring may not be useful. SCA's preference for ecosystem monitoring is 5 yearly until construction, then more detailed 6-monthly monitoring during the construction and operational phases. Shorter periods would only be adopted if a linkage was identified and ecosystem impacts were apparent.
96	The Precautionary Principle would surely require a less assured approach than is present in the following quotation: "Data sets mostly cover periods of below average rainfall but with several major rainfall events. Therefore, the extent of natural groundwater level fluctuation due to flood and drought cycles has been recorded and a longer period of monitoring will not necessarily provide a better understanding of the natural water level..." Surely the expectation of severe drought, with more extreme events being one of the indicators of climate change, merits a more conservative consideration of rainfall and drought patterns?	<p>The SCA has commissioned and completed substantial technical, scientific and environmental investigations (numbering more than 90 studies) on the groundwater resource at Kangaloon and the local environment of the proposed borefield area. The investigation programs began in the Upper Nepean (Kangaloon) in March 2005 and monitoring programs have been under way for more than three years.</p> <p>SCA believes that the natural ecosystems and resource behaviour are reasonably well known and there is sufficient certainty to proceed with the development. If there are any unforeseen impacts these can be managed and mitigated.</p> <p>If climate change involves more extreme events then ecosystem monitoring is expected to provide even more variable results and to display significant changes from survey to survey.</p>
79	If at any time the data analysis shows that the perched water level of the swamps is being impacted by the groundwater extraction, halt extraction immediately. Monitor water levels within the swamp sites weekly and survey the flora seasonally during this time; seek independent expert advice before continuing with extraction.	This response is appropriate if there is a definitive link between perched water table level decline and regional water level decline. Data loggers are installed at key sites that capture water level data continuously. The response time for drawdowns in shallow sandstone aquifers is much less than at production sites, therefore a quarterly data download is considered appropriate. Water table trends will be assessed at this time and compared to other sites without nearby pumping. If the rate of water level decline is greater than the natural sites then data will be checked, local extraction will be reduced or halted, and additional swamp monitoring will be undertaken (Note that perched water levels will not recover even with no pumping as this system is totally rainfall dependent).
140	For all of the proposed monitoring programs, figures detailing the location of the propose monitoring would assist in the understanding of the geographic extent of the monitoring an/i assessment of the efficacy of the proposed monitoring programs.	Further details are proposed in the CEMPs and OEMP and the respective monitoring and management plans.

140	Surface water systems may be affected by a) reduced groundwater discharge (i.e. reduced base flow) due to lowering of the water table, b) changes in water quality caused by discharge of extracted groundwater and c) increased baseflow due to run-of-river transfer of extracted water to Nepean Dam. Potential impacts to surface water systems as a result of a) — c) have been acknowledge by SCA and ongoing monitoring proposed.	Pumping trials, R&D studies and latest modelling have shown there is low connectivity with baseflow to streams in this area. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.
4.02.01 Groundwater monitoring (14 comments recorded)		
78	Action #25 as stated above if triggered, ecological monitoring should be more rigorous than that set out in Chapter 12 of the EA. The monitoring should be more frequent than that proposed, as alterations to the biota and landscape will be rapid (during periods of extended drought) if adverse outcomes arising from groundwater extraction arise.	<p>The baseline data sets that SCA has completed to date have been 6-monthly across two seasons (autumn and spring in 2006 and 2007) and there has been little correlation between each event. The biodiversity and the variability is high (even between upland swamps in the same area), so more frequent biophysical monitoring may not be useful. SCA's preference for ecosystem monitoring is 5 yearly until construction, then more detailed 6-monthly monitoring during the construction and operational phases. Shorter periods would only be adopted if a linkage was identified and ecosystem impacts were apparent.</p> <p>Given that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area, and current work on terrestrial vegetation shows no linkages with deeper sandstone aquifers, this monitoring approach is considered appropriate.</p>
82	No environmental / scientific monitoring facilities outside the 2km bore site. Why?	Groundwater investigations to the south of the main borefield spine require investigations and monitoring bores on private property - investigations in these areas have been proposed but have not been able to be completed at this time. There is sufficient information from the few bores on SCA land (at around 2km) to confirm water levels and water quality in the main recharge area. To the north, there are sufficient bores located on SCA land to monitor downgradient conditions. More monitoring bores will be established as part of the larger monitoring network proposed when the borefield proposal is reactivated

124	<p>The documentation indicates that the operational monitoring adopted for the project is “expansive”, whereas the monitoring during the recovery phases “contracts” to a basic data collection network (page 7-44). The monitoring during recovery periods will be particularly important, especially if long-term effects, such as impaired aquifer permeability, arise from the cyclic pumping operations (page 9-12). Additionally, the recovery performance of the aquifer will be critical to the operational flexibility espoused within the EA.</p> <p>The contraction of monitoring is inappropriate for a proposal which relies heavily on (as yet incomplete) numerical computer modelling and the adoption of mitigative measures linked to monitoring regimes to supposedly demonstrate that the project can be “sustainable”. At a minimum, the Statement of Commitments must be strengthened to ensure that monitoring is continued at a constant level throughout pumping and recovery cycles until such time that adequate data is available to unambiguously demonstrate a reduction in monitoring during nonpumping periods can be supported.</p>	<p>It is recognised that substantial monitoring will be necessary for the recovery period, and it is only proposed to contract the monitoring to key sites when full recovery of water levels has occurred across the borefield area. This smaller network would then apply during the longer intervening periods between borefield operation.</p> <p>Details are provided in the preferred project report and the Statement of Commitments is revised to reflect this approach.</p>
124	<p>The EA does not provide any significant consideration of the maintenance of the borefield components during the periods when the system is in standby mode. The Statement of Commitments must include detail on the maintenance and monitoring regime that will apply to the bores within the borefield and their immediate surroundings during non-pumping (recovery) periods. These bores (that may be considered “inactive works”) can pose a potential hazard if they are not maintained in good order or are allowed to deteriorate in the absence of adequate ongoing maintenance.</p>	<p>An operation and maintenance (O&M) program for the intervening periods between droughts is being prepared and will be in place later in 2008/09. This will be the basis of future O&M arrangements. There are substantial assets in place (trial production bores and a network of monitoring bores) that are critical to any future borefield development - the bores are not considered to pose any hazard or risk to the local environment.</p>
79	<p>Volume monitoring Pipes from groundwater drill sites must be fitted with flow meters to record the volume of groundwater discharged to the Nepean River.</p>	<p>Individual production bores will be fitted with flow meters.</p>
79	<p>Data from monitoring bores should be collected and assessed quarterly between groundwater extraction periods.</p>	<p>Continuous data loggers will be maintained at the most important key sites during the inactive periods - loggers will be downloaded 6-monthly, all bores visited 6-monthly (for manual measurements) and basic maintenance will be undertaken 6-monthly. Quarterly review will occur during the recovery period until full recovery of water levels has occurred across the borefield area.</p>

79	DECC recommends that the proponent monitor the concentration of 6 analytes using the sampling method, units of measure, and frequency specified in the table in their submission.	To be included in specific monitoring plans.
79	<p>Water Quality and Aquatic Ecology Monitoring Program</p> <p>The proponent must develop a Water Quality and Aquatic Ecology Monitoring Program to monitor the impacts of the project on the rivers into which the groundwater is discharged. The program must commence prior to the operation of the project. A review of the program must be undertaken after the first full drawdown use of the aquifer. The program must include but not necessarily limited to;</p> <ul style="list-style-type: none"> a) a baseline monitoring program; b) an evaluation of the discharges in term of temporal and spatial scales; c) a comparison of discharge data with baseline data; d) sampling and data collection at representative sites, both impact (downstream) and control sites (upstream) of the discharge point; e) sampling and data collection for the discharges and immediate receiving environment to quantify the changes in ecosystem health and water quality with specific reference to phytoplankton, aquatic vegetation, macroinvertebrates, fish, temperature, salinity, dissolved oxygen, iron and manganese; and f) for temperature and salinity, the monitoring and analysis of data must be in accordance with the ANZECC & ARM CANZ (2000) guidelines, Section 8.2.3.4 (p8.2-66, Volume 2) and Section 8.2.3.3 (p8.2-63, Volume 2), respectively. <p>Monitoring must be undertaken at appropriate upstream and downstream locations as determined by the monitoring program. A guidance table is provided in their submission.</p>	Water levels, water quality and ecosystem monitoring requirements will be further expanded for all aspects of the project, including the water discharge locations. Further details are proposed in the CEMPs and OEMP and the respective monitoring and management plans.

79	Specific monitoring related conditions The groundwater in all upland swamp environments in the study area should be monitored, regardless of whether the modelling suggests the swamps are in contact with the groundwater or not. As per the commitment in the EAR, establish monitoring bores (where they do not currently exist) at the 17 identified swamp sites within the project area (Fig 1-1: Parsons Brinckerhoff, 2007), prior to production bores becoming operational. Prior to pumping, further data should be gathered as suggested by Woolley (2008) to refine water level contour maps and identify groundwater discharge areas and swamps maintained by groundwater discharges.	Shallow perched water level monitoring at one key location (that can be accessed without any substantial construction impact) will be considered for each of the 17 identified upland swamps immediately prior to the commencement of any borefield construction - at the present time all bore/well sites in the Butlers Swamp and Stockyard Swamp areas will continue to be monitored. Additional data has been collected in the Stockyard Swamp area to refine the water level contours as mentioned by Woolley.
79	Data from monitoring bores within the swamp environments should be captured continuously during groundwater extraction periods and for at least 6 months after extraction has halted.	This level of detail and monitoring will be in place for the swamps adjacent to the borefield during construction and operational periods. Loggers at more remote sites (where regional water levels in the sandstone aquifers are known to be much deeper) are not considered warranted.
140	4. An appropriate monitoring program has been initiated. Noted and expanded. Agree; but need to be extended to the south of the borefield towards the Mittagong Ranges.	Additional groundwater monitoring will occur on private property to the south of the main spine of the borefield when the construction program is reactivated.
140	Consider installing additional monitoring bores remote from proposed borefield in less permeable 'country rock' distant from gauge groundwater inflow zones (lineaments') of enhanced permeability	There will be a selection of monitoring bores at distances of 2 to 3kms within the catchment when the construction program is reactivated. Monitoring at more remote sites is not warranted. If however there are significant drawdowns attributable to borefield operation at these distances, then even more distant monitoring will be discussed with Department of Water and Energy.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 79, 92		
4.02.02 Surface water monitoring (10 comments recorded)		
26	The fish populations are mostly upstream of major barrier dams and an impact is not indicated by the data provided thus far. However, ongoing monitoring of stream flow correlated with groundwater extraction and the ability to limit extractions to mitigate potential impacts, are recommended.	Stream gauging (heights and flows) will occur upstream and downstream of the two discharge locations to assess environmental impacts

79	<p>Water Quality and Aquatic Ecology Monitoring Program</p> <p>The proponent must develop a Water Quality and Aquatic Ecology Monitoring Program to monitor the impacts of the project on the rivers into which the groundwater is discharged. The program must commence prior to the operation of the project. A review of the program must be undertaken after the first full drawdown use of the aquifer. The program must include but not necessarily limited to;</p> <ul style="list-style-type: none"> a) a baseline monitoring program; b) an evaluation of the discharges in term of temporal and spatial scales; c) a comparison of discharge data with baseline data; d) sampling and data collection at representative sites, both impact (downstream) and control sites (upstream) of the discharge point; e) sampling and data collection for the discharges and immediate receiving environment to quantify the changes in ecosystem health and water quality with specific reference to phytoplankton, aquatic vegetation, macroinvertebrates, fish, temperature, salinity, dissolved oxygen, iron and manganese; and f) for temperature and salinity, the monitoring and analysis of data must be in accordance with the ANZECC & ARM CANZ (2000) guidelines, Section 8.2.3.4 (p8.2-66, Volume 2) and Section 8.2.3.3 (p8.2-63, Volume 2), respectively. <p>Monitoring must be undertaken at appropriate upstream and downstream locations as determined by the monitoring program. A guidance table is provided in their submission.</p>	<p>Water levels, water quality and ecosystem monitoring requirements will be further expanded for all aspects of the project, including the water discharge locations. Further details are proposed in the CEMPs and OEMP and the respective monitoring and management plans.</p>
82	<p>No environmental / scientific monitoring facilities outside the 2km bore site. Why?</p>	<p>Groundwater investigations to the south of the main borefield spine require investigations and monitoring bores on private property. Investigations in these areas have been proposed but have not been able to be completed at this time. There is sufficient information from the few bores on SCA land (at around 2km) to confirm water levels and water quality in the main recharge area. To the north, there are sufficient bores located on SCA land to monitor downgradient conditions. More monitoring bores will be established as part of the larger monitoring network proposed when the borefield proposal is reactivated. From a surface water perspective, there are no impacts proposed at distances greater than 2km so surface water monitoring at these greater distances is not proposed.</p>

124	Macroinvertebrate larvae (including dragonfly larvae) hatch in spring and require a certain water temperature for hatching. Particular care should be taken in relation to monitoring and control of the temperature of water inflow during this period. In addition, it is possible that a constant elevation in flow may influence egg deposition (proponent should refer to literature).	Dissolved oxygen and temperature will be adjusted at the water treatment plant to ambient conditions. The EA assessed the potential impact of groundwater discharge to surface water quality in the context of the stream hydrology and aquatic ecosystems. Different groundwater discharge volumes (and resultant flows) will not impact the aquatic habitats and water quality in stream.
124	Water quality in the discharge ponds, discharge exit points and instream was assessed on a monthly basis. It is therefore possible that certain parameters exceeded ANZECC Guidelines during interim periods. Key water quality parameters need to be measured more frequently in the discharge ponds to ensure that impact does not occur and to ascertain when treatment is required prior to discharge.	The quality of the pumped groundwater is very consistent in quality based on the results of the two pumping trials in 2007. Water quality changes are unlikely unless the WTP is not operating to its full effectiveness and there is variability in the dissolved oxygen, temperature, pH levels and dissolved iron concentrations. Additional monitoring may be required at the treated water outlet to the Nepean River. Parameters and frequency will be discussed with DECC.
124	Stream flow needs to be monitored both upstream and downstream of the bore field in all continually flowing creeks to allow detection of potential impact (refer to section 4.4.6 Peer review of groundwater studies Note 10). Note that the document states that "All permanent streams in the catchment are considered gaining streams (refer to Page 4-33 section entitled Groundwater discharge 3 paragraph).	The permanent streams in the area are Doudles Folly Creek, Nepean River, Burke River, Little River and Dudewaugh Creek. Levels and flow will be measured at upstream and downstream locations along the Nepean River, however it may be difficult (because of access) to measure upstream and downstream levels and flow on the other streams. At a minimum at least one gauge will be installed at a key location on each stream to monitor heights and flows prior to the operation of the borefield.
79	Requirement to monitor concentration of groundwater discharged Any discharge of groundwater must be monitored.	The quality of the pumped groundwater is very consistent in quality based on the results of the two pumping trials in 2007. Hence the quality of the discharge water is also expected to be consistent. The quality of the discharge water will be measured at the outlet (and confluence) to the Nepean River. The quantity of water released to the river will be monitored at the WTP.

140	<ul style="list-style-type: none"> Monitoring of aquatic ecosystems at the Nepean River discharge locations — given the current uncertainties, this should be expanded to include other locations upstream and downstream of the discharge locations. In addition, monitoring of stygofauna populations should be undertaken 	<p>Monitoring of aquatic ecosystems upstream and downstream of each discharge location will be part of the ecosystem monitoring program during operation. The frequency would be quarterly to start then annually.</p> <p>Monitoring of stygofauna populations will be undertaken in selected monitoring bores prior to and during operation (the large volumes pumped from the production bores do not allow for effective sampling) and then post operation sampling. Annual sampling is considered sufficient.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 92</p>		
<p>4.02.03 Ecosystem monitoring (22 comments recorded)</p>		
79	<p>Water Quality and Aquatic Ecology Monitoring Program The proponent must develop a Water Quality and Aquatic Ecology Monitoring Program to monitor the impacts of the project on the rivers into which the groundwater is discharged. The program must commence prior to the operation of the project. A review of the program must be undertaken after the first full drawdown use of the aquifer. The program must include but not necessarily limited to; a) a baseline monitoring program; b) an evaluation of the discharges in term of temporal and spatial scales; c) a comparison of discharge data with baseline data; d) sampling and data collection at representative sites, both impact (downstream) and control sites (upstream) of the discharge point; e) sampling and data collection for the discharges and immediate receiving environment to quantify the changes in ecosystem health and water quality with specific reference to phytoplankton, aquatic vegetation, macroinvertebrates, fish, temperature, salinity, dissolved oxygen, iron and manganese; and f) for temperature and salinity, the monitoring and analysis of data must be in accordance with the ANZECC & ARMCANZ (2000) guidelines, Section 8.2.3.4 (p8.2-66, Volume 2) and Section 8.2.3.3 (p8.2-63, Volume 2), respectively. Monitoring must be undertaken at appropriate upstream and downstream locations as determined by the monitoring program. A guidance table is provided in their submission.</p>	<p>Water levels, water quality and ecosystem monitoring requirements will be further expanded for all aspects of the project, including the water discharge locations. Further details are proposed in the CEMPs and OEMP and the respective monitoring and management plans.</p>

26	The fish populations are mostly upstream of major barrier dams and an impact is not indicated by the data provided thus far. However, ongoing monitoring of stream flow correlated with groundwater extraction and the ability to limit extractions to mitigate potential impacts, are recommended.	Stream gauging (heights and flows) will occur upstream and downstream of the two discharge locations to assess environmental impacts
124	It is recommended that groundwater levels in these streams be monitored during periods of drying to assess potential impacts of pumping on the hyperheic zone. This also applies to the reverse situation whereby low flow periods are reduced by the addition of water to the stream (refer to Section 9.3.2 under heading entitled Nepean River upstream of Doudles Folly Creek first paragraph)	<p>The permanent streams in the area are Doudles Folly Creek, Nepean River, Burke River, Little River and Dudewaugh Creek. Levels and flow will be measured at upstream and downstream locations along the Nepean River, however it may be difficult (because of access) to measure upstream and downstream levels and flow on the other streams - at a minimum at least one gauge will be installed at a key location on each stream to monitor heights and flows prior to the operation of the borefield. Hyporheic zones will be inspected if there is a change in levels and flow outside the normal range.</p> <p>Recent studies have proven that permanent streams in the borefield area have poor connectivity and visible loss of flow (and impact to the hyporheic zone) is not anticipated.</p>
124	Section 6.4.2 of the document states that it is considered likely that deep-rooted vegetation within the vicinity of Stockyard Swamp may be utilising groundwater but that the effect of pumping on this vegetation will not be assessed. The recommendations in relation to monitoring of this vegetation need to be adopted. Monitoring of this vegetation needs to occur on a long-term basis.	There is no known deep rooted vegetation in the vicinity of Stockyard Swamp. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.

124	It is recommended that further investigation is conducted in relation to potential access to groundwater and that rigorous monitoring of the woodland communities (particularly EECs) is conducted. This should include both monitoring of water levels in the vicinity of the vegetation and also floristic monitoring.	<p>The potential for terrestrial vegetation to be dependent on the regional sandstone aquifer is considered low. Monitoring of perched water tables indicated that they do not fluctuate under pumping conditions.</p> <p>Monitoring of perched water levels in the vicinity of terrestrial vegetation communities will be assessed – a staged approach will be adopted. At the present time (in representative sandstone areas) there are two locations in Area 1, one location in Area 2, two locations in Area 3, and none in Area 4.</p>
124	Other areas where deep-rooted vegetation may be utilising groundwater need to be identified and included in the monitoring program.	<p>The potential for terrestrial vegetation to be dependent on the regional sandstone aquifer is considered very low, and to prove a dependency would require specialised research over many years.</p> <p>No other sandstone outcrop areas are known where vegetation may be using this groundwater. Monitoring will be established in representative riparian areas, and continued on some of the landscape areas - monitoring vegetation on the basalt and alluvial areas is not helpful as these areas are unlikely to be affected by pumping. No additional (remote) monitoring is planned.</p>
124	Potential impacts of pumping on riparian vegetation, particularly in areas where groundwater discharge has been recorded or colluvial/alluvial sediments and associated water bearing zones occur should be assessed as part of the monitoring program.	<p>The potential for terrestrial (riparian) vegetation to be dependent on the regional sandstone aquifer is considered low in this area but higher in the downstream gorge areas where there is substantial groundwater discharge. To prove a dependency would require specialised research over many years. Monitoring will be established in representative riparian areas, and continued on some of the landscape areas.</p> <p>Monitoring of alluvial water levels in the vicinity of the Nepean River (and any area that is accessible and where there is definite groundwater discharge from the sandstone strata) and terrestrial vegetation communities will be assessed. At the present time (in suitable areas) there are no locations in Area 1, two locations in Area 2, none in Area 3, and none in Area 4.</p>

124	Potential impacts of pumping on low flows and the hyporheic zone of streams should be assessed as part of the monitoring program.	<p>The permanent streams in the area are Doudles Folly Creek, Nepean River, Burke River, Little River and Dudewaugh Creek. Levels and flow will be measured at upstream and downstream locations along the Nepean River, however it may be difficult (because of access) to measure upstream and downstream levels and flow on the other streams - at a minimum at least one gauge will be installed at a key location on each stream to monitor heights and flows prior to the operation of the borefield. Hyporheic zones will be inspected if there is a change in levels and flow outside the normal range.</p> <p>Recent studies have proven that permanent streams in the borefield area have poor connectivity and visible loss of flow (and impact to the hyperheic zone) is not anticipated.</p>
124	Aquatic stygofauna need to be assessed as part of the monitoring program.	Monitoring of stygofauna populations will be undertaken in selected monitoring bores prior to and during operation on an annual basis. The large volumes associated with the production bores do not allow for effective sampling.
124	Potential impacts of groundwater discharge to surface waters on riparian vegetation need to be assessed as part of the monitoring program.	<p>The water level rises in the Nepean River will be less than 25cm along the unregulated section of the river upstream of the Doudles Folly Creek. Discharges will be during periods of very low (natural) flow so the total flow will still be low and is not expected to affect riparian vegetation.</p> <p>Monitoring of alluvial water levels in the vicinity of the Nepean River (and any area that is accessible and where there is definite groundwater discharge from the sandstone strata) and terrestrial vegetation communities will be assessed. At the present time (in suitable areas) there are no locations in Area 1, two locations in Area 2, none in Area 3, and none in Area 4.</p>
79	Future swamp survey methodology should follow that of Wilkins et al (2003) since this method can be conducted with relatively little extra survey effort and provides a more comparable estimate of frequency changes over time. The method includes a standard 20 x 20m quadrat within a 32 x 32m nested quadrat design (see Morrison et al 1995 for calculating frequency score in nested quadrat design).	Noted
79	Annual flora surveys should be conducted between groundwater extraction periods to build on baseline data and determine natural trends and changes in vegetation. This way, any changes resulting from groundwater extraction can be more readily identified, Survey should begin immediately and at the same time of the year as has previously occurred (i.e. spring or autumn).	If there is any possibility of a linkage between regional groundwater and terrestrial vegetation then additional baseline monitoring would be considered in the monitoring and management plan.

82	No environmental / scientific monitoring facilities outside the 2km bore site. Why?	<p>Groundwater investigations to the south of the main borefield spine require investigations and monitoring bores on private property. Investigations in these areas have been proposed but have not been completed at this time. There is sufficient information from the few bores on SCA land (at around 2km) to confirm water levels and water quality in the main recharge area. To the north, there are sufficient bores located on SCA land to monitor downgradient conditions. More monitoring bores will be established as part of the larger monitoring network proposed when the borefield proposal is reactivated.</p> <p>From an environmental perspective, there are small regional groundwater level declines at greater than 2km but given the poor connectivity with ecosystems within the borefield area, limited environmental monitoring at these greater distances is proposed.</p>
78	<p>The following relates specifically to the Draft Statement of Commitments; Action #4 refers to the Construction Environmental Management Plan (CEMP) which details the practises and procedures to be implemented to mitigate environmental impacts. Whilst the CEMP is supported, site specific issues have not yet been identified. In relation specifically to flora and fauna issues the presence/absence of significant habitat trees, threatened species, endangered communities have yet to be established. Council is concerned with the sequencing of the project in terms of releasing the EA and then if approved developing a CEMP. There appears no provision in the process to manage or assess the significance of isolated features e.g. a threatened plant, a remnant EEC</p>	<p>Significant surveying has been completed within the corridor. Flora, fauna, and aboriginal and cultural; heritage issues have been identified. All sensitive areas and known threatened species will be protected. If special trenching and construction methods are required near sensitive areas, then these will be identified and included in the CEMP requirements</p>

78	Action #25 as stated above if triggered, ecological monitoring should be more rigorous than that set out in Chapter 12 of the EA. The monitoring should be more frequent than that proposed, as alterations to the biota and landscape will be rapid (during periods of extended drought) if adverse outcomes arising from groundwater extraction arise.	<p>The baseline data sets that SCA has completed to date have been 6-monthly across two seasons (autumn and spring in 2006 and 2007) and there has been little correlation between each event. The biodiversity and the variability is high (even between upland swamps in the same area), so more frequent biophysical monitoring may not be useful. SCA's preference for ecosystem monitoring is more detailed annual monitoring to start with and then to adopt 6-monthly or shorter periods as required.</p> <p>Given that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area, and current work on terrestrial vegetation shows no linkages with deeper sandstone aquifers, this monitoring approach is considered appropriate.</p>
79	Baseline flora surveys should be expanded by establishing permanent monitoring sites within each upland swamp, building on the 10 quadrat sites that have already been established by SMEC (2007). Ideally, there would be at least one permanent monitoring plot established for each of the 17 swamp sites (as identified in Parsons Brinckerhoff 2007), because the swamps are fragmented within the study area and may behave variably.	If there is any possibility of a linkage between regional groundwater and terrestrial vegetation then additional baseline monitoring would be considered in the monitoring and management plan.
79	<p>Impacts on threatened species and their habitat In order to complete and enhance the threatened species surveys and ensure they are adequate to evaluate the direct and indirect impact of both the borefield configuration and of individual bores, the following additional surveys are recommended to be required as part of any approval:</p> <ul style="list-style-type: none"> • Ongoing biannual surveys should be used to provide a sound basis from which to detect ecosystem changes due to groundwater extraction. These should continue for a minimum of five years post extraction. • The biannual surveys should be required to collect condition data (in addition to species diversity and distinctiveness data) to provide a sound basis from which to monitor changes to vegetation health as a result of groundwater extraction. • The biannual surveys should include <i>Lysimachia vulgaris</i> var. <i>daurica</i> and <i>Petalura gigantea</i>. These two species should also be targeted in future surveys I monitoring of groundwater dependent ecosystems as set out below. 	The potential for threatened species impact is mostly associated with the construction program and special protection measures will be in place. The risk during operation is considered negligible given that most of these species are small shrubs with limited roots and there is no known connectivity between the regional sandstone aquifer and perched water bearing zones. Additional biannual monitoring will be included in the plan for threatened species immediately prior to construction and during operational periods.

96	Unacceptable reliance on monitoring and remedial management in relation to substantial uncertainties in the context of aquatic ecosystems and threatened species.	The risk to aquatic ecosystems is considered low due to the proposed water treatment processes, and the small impact on flows and levels (everything will be within the current natural range). Threatened species locations are known and will be protected during the construction program through appropriate measures in the Construction Environmental Management Plans. The adopted approach is to be proactive and to actively monitor - remedial management is avoided where possible.
140	Monitoring of terrestrial ecosystems in woodland communities — this should be expanded to include reference sites beyond any potential influence of groundwater extraction, and included monitoring of the vegetation condition as well as species diversity and abundance. Vegetation condition is seen as a key indicator of potential impacts of groundwater extraction. Where possible the development of thresholds for vegetation condition should be determine and used as management triggers for reduction or cessation of extraction. These thresholds should take into account the delayed response by vegetation to water stress. While it is acknowledge that there will be a time delay before any biological response occurs and that monitoring has been designed to enable the implementation of contingencies before any adverse impacts arise, it is not clear exactly how this will be undertaken	<p>The potential for terrestrial vegetation to be dependent on the regional sandstone aquifer is considered low. Monitoring of perched water tables indicated that they do not fluctuate under pumping conditions.</p> <p>No sandstone outcrop areas are known where vegetation may be using this groundwater. Monitoring will be established in representative riparian areas, and continued on some of the landscape areas</p> <p>Monitoring of perched water levels in the vicinity of terrestrial vegetation communities will be assessed – a staged approach will be adopted. At the present time (in representative sandstone areas) there are two locations in Area 1, one location in Area 2, two locations in Area 3, and none in Area 4.</p>
140	<ul style="list-style-type: none"> Monitoring of aquatic ecosystems at the Nepean River discharge locations — given the current uncertainties, this should be expanded to include other locations upstream and downstream of the discharge locations. In addition, monitoring of stygofauna populations should be undertaken 	<p>Monitoring of aquatic ecosystems upstream and downstream of each discharge location will be part of the ecosystem monitoring program during operation - frequency would be quarterly to start then annually.</p> <p>Monitoring of stygofauna populations will be undertaken in selected monitoring bores prior to and during operation (the large volumes pumped from the production bores does not allow for effective sampling) - annual sampling is considered sufficient.</p>

140	<p>At present there has been no formal condition analysis to track changes to the health of vegetation communities (wetlands and woodland communities) as a result of climate change and the current drought dominated regime. Such a condition analysis would form an important baseline for the assessment of groundwater extraction on these communities, especially when compared to reference conditions. Over the last drought period, noticeable changes in vegetation condition were evident as a result of water stress caused by prolonged drought. It will be important over the lifetime (and beyond) of the proposed borefield to monitoring such changes to determine whether groundwater extraction is further exacerbating the impacts of water stress during drought periods. Particular as many of these communities are threatened, plus provided habitat for threatened species. Early detection of change in vegetation condition will be essential for successful mitigation of impacts.</p>	<p>Broader monitoring of the health of ecosystems to identify changes in biodiversity and condition associated with climate change is beyond the requirements of this project.</p>
140	<p>Monitoring of swamp ecosystems in key upland swamp areas — given the current uncertainties regarding the system, this monitoring should be expanded from five swamps in the immediate vicinity of the borefield to included other upland swamps in the broader region (including reference sites)</p>	<p>Shallow perched water level monitoring at one key location (that can be accessed without any substantial construction impact) will be considered for each of the 17 identified upland swamps immediately prior to the commencement of any borefield construction. At the present time all bore/well sites in the Butlers Swamp and Stockyard Swamp areas will continue to be monitored. There is a huge variability in the condition of these ecosystems from season to season and the use of a control site for an upland swamp (if a suitable site can be located) may not provide any useful data. From the studies completed to date it is known that perched water systems are disconnected from the regional sandstone aquifers so this requirement would have limited benefits. However (if conditioned), SCA would work with DECC and DEWHA to confirm a suitable site away from the main borefield.</p>
140	<p>While pumping trials suggest that groundwater extraction is unlikely to have a significant impact on vegetation communities/threatened species habitats, the trials were only for a short duration. Actual extraction will occur over a longer period when communities/habitats are already stressed by extended drought. Groundwater extraction may add an additional stress that could cause partial or complete mortality in large trees.</p>	<p>Groundwater pumping cannot add additional stress if there is no connection between perched water and regional sandstone aquifers. The trials were designed to be an effective test of the many attributes of this fractured rock aquifer (including ecosystem impacts) and were carried out to the satisfaction of the peer reviewers and DEWHA.</p> <p>Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p>

4.03.00 Adaptive management (7 comments recorded)		
78	<p>The SCA need to better articulate the response hierarchy in the event information/data suggests there are anomalies in the aquifer response once pumping has occurred (see Chapter 12 of EA). At the present this is not clear, It has been suggested that real time (water quality/quantity) and annual (biological/bio geographical) monitoring will occur however by the SCA's admission there will be a time lag between biological responses as a result of pumping anomalies. If anomalies occur it's proposed to increase the monitoring (to twice a year). Again, for such a critical project and considering the significance in surface ecosystems from a water catchment perspective alone, the Precautionary Principle should be applied more rigorously to explore immediate reasons for anomalies and the nexus to groundwater extraction, Climatic variation will occur over a significant period. Variations in floristic composition and structure for example as a result of borefield activities will be rapid, therefore the SCA should be responding more cautiously than simply increasing the monitoring.</p>	<p>Pumping trials have shown that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. There is not a high risk to any of these ecosystems so the monitoring network, content and frequency should reflect the risks and the most sensitive ecosystems that may have some connectivity or risk. Further detail are provided in the preferred project report and will be finalised with DECC and DWE as appropriate.</p> <p>Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.</p>
140	<p>To counter this uncertainty, the documentation must better describe the situation, clarify the reasoning behind the adoption of particular values and provide greater commitment to responding to abrupt, unpredicted increases in drawdowns from individual sites during pumping operation, together with greater emphasis placed on the mitigation of impacts detected during the systematic monitoring of groundwater levels. The development of trigger levels, alluded to in the EA, must be progressed so that there can be a clearly defined linkage between drawdown in specific locations and the responsive management actions that will ensue.</p>	<p>Pumping trials have shown that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. There is not a high risk to any of these ecosystems so the monitoring network, content and frequency should reflect the risks and the most sensitive ecosystems that may have some connectivity or risk. Further detail are provided in the preferred project report and will be finalised with DECC and DWE as appropriate.</p> <p>Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p>

124	<p>The documentation indicates that the operational monitoring adopted for the project is “expansive”, whereas the monitoring during the recovery phases “contracts” to a basic data collection network (page 7-44). The monitoring during recovery periods will be particularly important, especially if long-term effects, such as impaired aquifer permeability, arise from the cyclic pumping operations (page 9-12). Additionally, the recovery performance of the aquifer will be critical to the operational flexibility espoused within the EA. The contraction of monitoring is inappropriate for a proposal which relies heavily on (as yet incomplete) numerical computer modelling and the adoption of mitigative measures linked to monitoring regimes to supposedly demonstrate that the project can be “sustainable”. At a minimum, the Statement of Commitments must be strengthened to ensure that monitoring is continued at a constant level throughout pumping and recovery cycles until such time that adequate data is available to unambiguously demonstrate a reduction in monitoring during nonpumping periods can be supported.</p>	<p>It is recognised that substantial monitoring will be necessary for the recovery period, and it is only proposed to contract the monitoring to key sites when full recovery of water levels has occurred across the borefield area. This smaller network would then apply during the longer intervening periods between borefield operation. The Statement of Commitments is revised to reflect this approach.</p>
135	<p>Also it would be appropriate for the Sydney Catchment Authority to provide an undertaking that it will work with India NRE Minerals Limited (the mine operator) to develop a mining plan and extraction layout that optimises coal recovery with minimal impact upon the groundwater harvesting potential of the Stockyard Swamp area.</p>	<p>It is premature to enter into an agreement if there is no mining proposal - SCA is constantly in discussion with mining companies that operate in the Southern Coalfields and the borefield development is well known to Gudjarat Wongawilli.</p>
135	<p>These losses are predicated on the assumption that the construction of the borefield would prohibit underground coal mining. Should the borefield be constructed and operated in a fashion that does not restrict future mining operations these potential losses and impacts could be minimised.</p>	<p>SCA agrees that the mining and water supply activities could co-exist if there is no impact on the regional aquifer in the Hawkesbury Sandstone.</p>

140	<p>KBR (2008) introduces the concept of adaptive management by SCA including trigger (water) levels in the aquifer that will be implemented if any impacts are detected to the groundwater environment and swamp communities. KBR (2008) states that the adopted trigger levels will:</p> <ul style="list-style-type: none"> • help obtain more comprehensive monitoring data in order to assess whether the observed responses are real and to determine their geographical extent; and, • to generate an operational response by SCA to pumping. <p>The following management responses are proposed:</p> <ul style="list-style-type: none"> • if there are substantial water level declines (beyond the production bores), adjustment of the extraction regime by altering the proportion of water extracted from different bores or borefield areas; • if there are excessive natural or transmission losses from streamflow, adjustment of the extraction regime of bores located close to the Nepean River where these losses have been proven. <p>Realistically, as a 'contingency drought supply such an adaptive management strategy may be difficult to invoke and manage when a base-level demand may have to be satisfied.</p>	<p>There are many strategies available to pump within the borefield (eg. each of the 4 areas on/off; individual bores on/off or reduced in capacity; extended recovery periods after rain etc); and it may be that the maximum of 15000 ML per year may not be available every year depending on resource behaviour and any unusual water level or ecosystem trends. The installed capacity within the borefield will be around 18000 ML per year so there will be some flexibility in the method and timing of extractions.</p> <p>This is the adaptive approach that will be applied where possible - it is not expected that a minimum quantity would need to be supplied.</p>
4.04.01 Evaporation (7 comments recorded)		
18, 28, 30, 40, 41	<p>The 3 to 4 days of water a year the borefield would give to Sydney are questionable as evaporation has not been taken into consideration. Water will be lost from the 100 kilometers of open canals, from the reverse flow washing at each of the 75 bore sites and from the settling ponds and reservoirs.</p>	<p>The borefield proposal is to supply up to 50 ML per day during periods of severe drought - this is equivalent to about 4 percent of the constrained demand for the Sydney supply systems during the most recent drought (equivalent to about 10-12 days supply pa). No transmission losses were observed during the pumping trial and instream transmission and evaporation losses to the Nepean Dam (8-10km from the discharge sites) are expected to be minimal. Water from this supply system would (most likely) help to secure the Illawarra and will not be lost from the Upper Canal system. No water is lost from any backwashing of bores and only small quantities will be lost at each of the collection ponds at each of the WTPs.</p>
20	<p>I would have thought that as the problems associated with evaporation being recognised in the Murray-Darling irrigation system, the SCA would be more concerned about this aspect</p>	<p>This catchment area is a high rainfall and low evaporataion area and it is totally different to arid and semi-arid areas in the Murray-Darling Basin.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 120</p>		

4.04.02 Infiltration/losses (7 comments recorded)		
20	I am informed that 3 to 4 days of water a year the borefield would give to Sydney are questionable as evaporation has not been taken into consideration. Water will be lost from the 100 kilometers of open canals, from the reverse flow washing at each of the 75 bore sites and from the settling ponds and reservoirs.	The borefield proposal is to supply up to 50 ML per day during periods of severe drought - this is equivalent to about 4 percent of the constrained demand for the Sydney supply systems during the most recent drought (equivalent to about 10-12 days supply pa). No transmission losses were observed during the pumping trial and instream transmission and evaporation losses to the Nepean Dam (8-10km from the discharge sites) are expected to be minimal. Water from this supply system would (most likely) help to secure the Illawarra and will not be lost from the Upper Canal system. No water is lost from any backwashing of bores and only small quantities will be lost at each of the collection ponds at each of the WTPs.
119	I would have thought that as the problems associated with evaporation being recognised in the Murray-Darling irrigation system, the SCA would be more concerned about this aspect	This catchment area is a high rainfall and low evaporataion area and it is totally different to arid and semi-arid areas in the Murray-Darling Basin.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 18, 28, 30, 40, 41		
4.05.01 Water sharing plans/embargo/licensing (35 comments recorded)		
140	It would also appear that the KBR report does not take into account the impact of the water sharing agreement that has been entered into by the SCA in relation to water that might be moved between various parts of the Sydney basin catchment and rivers and other water resources outside that area e.g the Shoalhaven River and the proposed pipeline from the Wingecarribee swamp to Goulburn. In certain circumstances it is possible that the withdrawal of water from one area could impact on another. This should be clearly set out prior to any approval being given.	The groundwater proposal has no relevance or application to the inter-basin transfer of surface water from the Shoalhavem to Wingecarribee/Nepean or Wingecarribee to Wollondilly.
124	A strong emphasis on Adaptive Management will be a requirement of Sydney Catchment Authority's Water Management Licence, Consequently, a monitoring program to assess impacts of groundwater extraction on surface hydrology, drawdown and recovery rates and GDEs will be required to be developed and implemented under the licence. Licence conditions may impose additional requirements to that specified in the EA including additional monitoring/assessment.	Noted and agreed.

124	The EA does not provide any significant consideration of the maintenance of the borefield components during the periods when the system is in standby mode. The Statement of Commitments must include detail on the maintenance and monitoring regime that will apply to the bores within the borefield and their immediate surroundings during non-pumping (recovery) periods. These bores (that may be considered “inactive works”) can pose a potential hazard if they are not maintained in good order or are allowed to deteriorate in the absence of adequate ongoing maintenance.	An operation and maintenance (O&M) program for the intervening periods between droughts is being prepared and will be in place later in 2008/09. This will be the basis of future O&M arrangements. There are substantial assets in place (trial production bores and a network of monitoring bores) that are critical to any future borefield development - the bores are not considered to pose any hazard or risk to the local environment.
124	The Department will apply specific conditions to the SCA Corporate Licence to cover the circumstances of “inactive works” that shall commence whenever individual bores cease pumping and enter into a recovery phase. It should be noted that these conditions are required not only for the borefield proposed for the Upper Nepean area,	Noted - a matter for consideration when negotiating the bulk water licence conditions with DWE
19	Why are permits being given to build new factories Coca cola , to name one, when they are going to be tapping into an already stretched supply. Please think this through carefully before you make any decision that will haunt you forever.	Groundwater entitlements and allocations are dealt with by DWE who is the State’s groundwater manager and regulator. The Kangaloon borefield proposal has been factored into the Greater Metropolitan Water Sharing Plan for the Nepean Sandstone source area and water is available under that plan.
96	The NWI requires that all over allocated and over used water systems are returned to a sustainable level of extraction. This implies, inter al/a, that no jurisdiction should allow a WSP to over allocate a resource. The sandstone aquifer of the Kangaloon area has the potential to be over allocated if a new entitlement is given to SCA to operate the proposed borefield. The EA does not address this issue and needs amendment.	The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons. The latest numerical modelling study describes the sustainability of the proposed development.

96	<p>A new planning instrument is being developed for the groundwater resources of the area. This is called the Greater Metropolitan Area — Groundwater Sources 2008 Water Sharing Plan and is currently at the draft stage. This new WSP when enacted will manage the resources of the area via the implementation of Long Term Annual Extraction Limits. The contents of the draft plan are not yet public so it is difficult to speculate on how the WSP will affect the area, though SCA have provided their view on what will occur. 60. Of importance in the process will be how the new WSP will manage the currently embargoed areas within the context of purportedly granting a draft allocation to SCA for the operation of the proposed borefield. It is understood that the current embargoed entitlements in the parishes immediately adjacent to the borefield are low in comparison with the likely allocation required by SCA. If DWE believes it is warranted to embargo current use at such low rates due to issues with sustainability, how can it allocated very large additional resources in the area without compromising sustainable yield? Equally, how will the WSP propose to manage over allocation with existing users?</p>	<p>The prospect of an SCA borefield was factored into DWE's decision to embargo the parishes surrounding Kangaloon in late 2005, and does not compromise the sustainability of the sandstone resource.</p> <p>The large SCA allocation is factored into the sustainable yield calculations already and the purpose of the new WSP is to ensure that over-allocation never occurs.</p>
133	<p>It fails to account why the SCA and the Dept of Water and Energy are operating in breach of the current legislation controlling the allocation of groundwater.</p>	<p>Any borefield allocation that is issued for the Kangaloon borefield will be consistent with the current Water Act legislation and proposed Water Sharing Plan (Nepean Sandstones section) under the Water Management Act. A borefield allocation was factored in prior to the 2005 embargo announcement in the area.</p> <p>All construction and testing work completed as part of the site investigations has been assessed and approved under Part 5 of the EP&A Act. The test bore construction programs and the pumping tests and trials are all fully authorised under licences and notices issued under Part 5 and Part 9 of the Water Act.</p>
133	<p>The imposition of embargoes on new commercial water groundwater licences in specified areas of the Belanglo, Bundanoon, Murrimba and Wingello parishes by the DNR on 16 December 2006. And, further embargoes that increased the number of parishes embargoed to seven, certainly substantiate considerable concern in relation to overtaxed groundwater resources in the region.</p>	<p>The last embargo was December 2005. The prospect of an SCA borefield was factored into DWE's decision to embargo the parishes surrounding Kangaloon in late 2005, and does not compromise the sustainability of the sandstone resource. The large SCA allocation is factored into the sustainable yield calculations already and the purpose of the new WSP is to ensure that over-allocation never occurs.</p>

96	<p>The EA does not outline the full impacts of groundwater extraction on the existing groundwater users as required by the DGI{s. Once the NSW Government has provided an entitlement to SCA for operation of the proposed borefield, the Southern Highlands Management Zone will be substantially over allocated, Given that all parishes local to the proposed borefield are embargoed, the NSW Government will be forced by the NWI to move to reduce the level of over allocation. This will require management intervention, possibly in the form of compulsory entitlement reduction or by requiring the SCA to buy entitlement.</p>	<p>The impacts of the proposed borefield extraction are provided in the two modelling studies.</p> <p>The prospect of an SCA borefield was factored into DWE's decision to embargo the parishes surrounding Kangaloon in late 2005, and does not compromise the sustainability of the sandstone resource. The large SCA allocation is factored into the sustainable yield calculations already and the purpose of the new WSP is to ensure that over-allocation never occurs.</p>
96	<p>The EA has not demonstrated adherence to the NWI. The summary treatment of the NWI in the EA has not considered the central issue of sustainable levels of extraction and the avoidance of over allocation of resources. Further, the lack of consideration of the broader groundwater budget and documentation of the impacts of the groundwater budget due to the proposal within the context of sustainable yield for the Southern Highlands is contrary to the Director General's Requirements (DGRs).</p>	<p>The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons.</p> <p>The latest numerical modelling study describes the sustainability of the proposed development and provides water balances for the proposed scenarios.</p>
122	<p>In addition to this community members are sceptical of assurances that have been provided due to Groundwater Embargoes imposed on surrounding parishes. Concerns have also been relayed regarding a possible over-allocation of groundwater, particularly in times of drought leading to inevitable restrictions.</p>	<p>The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons. The latest numerical modelling study describes the sustainability of the proposed development and provides water balances for the proposed scenarios.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 44, 46, 80, 121, 132</p>		

4.05.02 Impacts/regulation (6 comments recorded)		
79	<p>Adaptive management</p> <p>The population of <i>Persoonia glaucescens</i> in the study area is a very significant one and should be protected from both the direct and indirect impacts of the construction and operation of the borefield. As a member of the Proteaceae family, this species is particularly vulnerable to infection by <i>Phytophthora c/nnamomi</i>. Consequently, in addition to other safeguards discussed in Lesryk 2007 and Vol 1 of the main report, any water pumped from adjacent bores should be directed away from this species to avoid creating conditions that might be conducive to infection.</p> <p>The recommendations in section 9 of Lesryk (2007), section 5 of Parsons Brinkerhoff (2007) and section 6 of SMEC (2007) should be fully incorporated with the CEMP and QEMP for the Kangaloon project.</p>	<p>The construction impacts will be minimised by using disturbed areas wherever possible and locating boreholes and pipelines such that there is only minimal removal of established vegetation. Listed threatened species and hollow trees will be avoided. It is likely that construction impacts on threatened biota will be limited to some woodland ecosystem areas. Threatened fauna and aquatic species are not likely to be disturbed to any significant degree by construction and the special requirements for <i>Persoonia glaucescens</i> are noted. No water will be discharged close to these populations. Location of species will be identified in advance of construction and protected from any disturbance in the CEMP arrangements. Construction will be rigorously managed to further limit potential impacts.</p>
79	<p>Operational phase water management</p> <p>The consent does not authorise the pollution of waters. It is up to the proponent to ensure that it complies with the environment protection legislation,</p>	<p>SCA will apply for a Protection of the Environment Operating (POEO) Licence for the river and creek discharge facilities from the two water treatment plants (WTPs).</p>
79	<p>The construction and operation of infrastructure for the project is not a scheduled activity under the Protection of the Environment Operations Act 1997 (the POEO Act), and will not require an environment protection licence. However, the project proponent and its contractors must ensure that the facilities are constructed and operated in accordance with the general environment protection provisions of the environment protection legislation, including the POEO Act, the National Parks and Wildlife Act 1974 and the Threatened Species Conservation Act 1995.</p>	<p>The facilities will be constructed and operated in accordance with the general environment protection provisions of the environment protection legislation, including the POEO Act, the National Parks and Wildlife Act 1974 and the Threatened Species Conservation Act 1995.</p>

79	<p>Currently it is not clear whether the Sydney Catchment Authority (SCA) will seek an environment protection licence for the regulation of water pollution from an unscheduled activity in relation to the proposed treatment, discharge and conveyance of the extracted groundwater. In order to minimise the duplication of approval and reporting requirements for the proponent should a licence be sought and subsequently issued, it would be appreciated if DoP would draft the conditions of consent so as to make clear that any licence issued by DECC would supersede the Ministers 3A consent requirements to the extent that the licence dealt with issues covered in the Consent</p>	<p>SCA will apply for a POEO Licence for the river and creek discharge facilities from the two WTPs.</p>
<p>The following submissions also made comment on this issue - the content was similar to the selected issues above – 44, 135</p>		
<p>4.05.03 ESD principles/precautionary principle (25 comments recorded)</p>		
96	<p>On the basis of the Precautionary Principle, the borefield development should not proceed until greater certainty exists regarding the impacts of groundwater extraction. This means that concept approval should not be granted when such components as water treatment and discharge to rivers have not been adequately addressed in the environmental assessment. Many problems Australia is now confronting in relation to its water resources result from taking water from one region to supply another, the primary example being the Murray-Darling system. This is not just an equity issue; it suggests that we should not, in light of that experience, embark on a new and untried scheme, without being absolutely certain that it will not have long-term consequences, and to the extent it does, that there is absolutely no alternative. The Precautionary Principle requires that uncertainties should be clearly stated and resolved and not be left for resolution by as yet uncompleted work. Furthermore, when uncertainty exists, the Precautionary Principle requires that the environmental concern benefit from the doubt, rather than benefit of the doubt being cast in favor of the project.</p>	<p>There is substantial certainty regarding the impacts of the development after all the investigation programs and the completion of the two pumping trials in 2007 and 2008. These and other substantial studies show that surface water - groundwater connectivity is low in this part of the catchment. Deep sandstone aquifers are poorly connected to permanent streams and terrestrial vegetation, and are not connected to upland swamps - the project is not expected to impact on the local streams or ecosystems but will be the subject of ongoing monitoring.</p>

124	<p>An assumption is made that woodland vegetation does not have access to groundwater due to the presence of massive sandstone (refer to section 4.6.1 last paragraph last sentence). Principle 4 of the NSW Groundwater Dependent Ecosystems Policy states “Where scientific knowledge is lacking, the Precautionary Principle should be applied to protect groundwater dependent ecosystems. The development of adaptive management systems and research to improve understanding of these ecosystems is essential to their management.” As stated in the document, there is little information available in the literature in relation to rooting depths of the canopy species present (refer to section 4.6.1). It is possible that the trees access groundwater through fractures during periods of low rainfall or in some other way</p>	<p>Work on terrestrial vegetation to date shows no linkages with deeper sandstone aquifers (there are 5 shallow bores constructed at various sites to monitor perched and deeper water levels). While upper parts of the sandstone aquifer may be dewatered, the ecosystems impacts are expected to be negligible. Water level monitoring will be one of the primary indicators of aquifer variability.</p> <p>The potential for terrestrial vegetation to be dependent on the regional sandstone aquifer is considered low, and to prove a dependency (especially a dependency during drought) would require specialised research over many years. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p>
124	<p>A precautionary approach should be taken in relation to connectivity between aquifers (basalt and sandstone), connectivity between upland swamps and sandstone aquifer, groundwater dependence of woodland vegetation and contribution of groundwater to base flow of streams.</p>	<p>SCA studies show no connectivity between the sandstone and the basalt aquifer systems and this disconnection is expected to be maintained even if a borefield was constructed and operational for a long period. Monitoring will be in place to monitor spring levels and flow at key sites.</p> <p>Similarly pumping trials have shown that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers.</p> <p>Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p>

108	<p>The aquatic ecosystems of the Upper Nepean Catchment could... be dependent on groundwater baseflow during... low flow periods... If groundwater pumping reduces water levels near streams because of drawdown, a decreased baseflow in permanent streams in the immediate vicinity of the borefield could occur.</p> <p>“Any reduction in base flows...for long periods...may result in changes to water quality (increased nutrients and increased temperature), build up of organic matter and evaporation of surface water which may affect instream fauna.”</p> <p>Perhaps because of the uncertainties in the above quotations, it is unsurprising that the report invokes ongoing monitoring of groundwater levels and stream flows to provide sufficient information to manage impacts on adjacent surface water environments.”</p> <p>BMCS believes that this approach involving a ‘suck-it-and—see’ philosophy, couched in terms of monitoring and reactive management, is incompatible with the Precautionary Principle.</p>	<p>Baseflow derived from groundwater aquifers does contribute to the water that is "harvested" and collects in the Nepean Dam. However the main baseflow sources are the basalt spings in the elevated portion of the catchment and drainage from sandstone strata in the gorge landscape to the north of the borefield. Studies have shown that baseflow contributions from sandstone aquifers to streamflow in the vicinity of the borefield are minimal. Most of this water is in transit to the discharge areas located lower in the catchment. The rate of groundwater flow is of the order of metres per year and therefore occassionally taking water from storage in the sandstone aquifer system in the upper parts of the catchment will not influence the primary baseflows across the catchment.</p> <p>There will be substantial groundwater, surface water and ecosystem monitoring during operational periods.</p>
96, 108	<p>The Precautionary Principle would surely require a less assured approach than is present in the following quotation: “Data sets mostly cover periods of below average rainfall, but with several major rainfall events. ‘Therefore, the extent of natural groundwater level fluctuation due to flood and drought cycles has been recorded and a longer period of monitoring will not necessarily provide a better understanding of the natural water level ...’ Surely the expectation of severe drought, with more extreme events being one of the indicators of climate change, merits a more conservative consideration of rainfall and drought patterns?”</p>	<p>New climate change modelling for SE Australia and SCA's catchments is currently under way and will be progressively reported in 2008 and 2009. Earlier studies suggesting much lower rainfall patterns have been updated for coastal SE Australia. Similar rainfall with increases in the extremes of rainfall patterns with perhaps less runoff due to drier profiles and higher temperatures is currently one of the most likely outcomes. If this outcome is correct, then a groundwater resource and drought borefield could be most useful as it would be protected from evaporation, and recharged by extreme rainfall events.</p> <p>Different rainfall patterns are addressed in the recent numerical modelling study.</p>

78	<p>The proposal fails the Precautionary Principle test .. it is difficult to reconcile claims that there is a sustainable supply of good quality potable water in the deep aquifers and that harvesting these storages is sustainable based on current information/data, given the extremely short timeframe of investigations and test pumping. Recent extreme fluctuations in climatic conditions of prolonged drought and short term intense rainfall events means the investigation period has been during a period of great climatic variation. It is erroneous for the SCA to claim that their testing and trials have been exhaustive. This is simply not true. An exhaustive trial period would be for a much longer period when average conditions and seasonal variability are more likely to be achieved and therefore assessed. The Precautionary Principle therefore should be applied more rigorously and trial periods conducted over a longer timeframe.</p>	<p>There have been numerous comprehensive studies of the groundwater resource and local ecosystems as part of the Kangaloon borefield investigations. The pumping trials completed to date are the best study to assess sustainability. The next stage (to obtain pumping response data on an even larger scale) would be to construct all or part of the borefield and to operate it for an extended period of time.</p> <p>The numerical modelling (under a variety of rainfall scenarios) suggests that there will be local depletion of groundwater in the sandstone aquifers during pumping but this recharges with a return to normal rainfall patterns</p> <p>No further testing is considered warranted and with appropriate monitoring systems in place, groundwater and ecosystem trends can be identified early and resolved.</p>
79	<p>Groundwater Dependent Ecosystems (GDEs) The SCA has committed to limiting the impact of the Kangaloon borefield project on the natural environment through ongoing monitoring, further groundwater investigations and application of the precautionary principle to the management of the project.</p>	Noted
78	<p>The SCA need to better articulate the response hierarchy in the event information/data suggests there are anomalies in the aquifer response once pumping has occurred (see Chapter 12 of EA). At the present this is not clear, It has been suggested that real time (water quality/quantity) and annual (biological/bio geographical) monitoring will occur however by the SCA's admission there will be a time lag between biological responses as a result of pumping anomalies. If anomalies occur it's proposed to increase the monitoring (to twice a year). Again, for such a critical project and considering the significance in surface ecosystems from a water catchment perspective alone, the Precautionary Principle should be applied more rigorously to explore immediate reasons for anomalies and the nexus to groundwater extraction, Climatic variation will occur over a significant period. Variations in floristic composition and structure for example as a result of borefield activities will be rapid, therefore the SCA should be responding more cautiously than simply increasing the monitoring.</p>	<p>The basis of the ongoing monitoring program is to assess the more easily measured physical parameters of water level, flow and water quality. Ecosystem monitoring will supplement this data. Key sites monitoring will continue at sites during non-operational periods and more expansive monitoring will occur during pumping and recovery cycles. Greater detail is provided in the preferred project report.</p> <p>While studies have indicated that there is no known connectivity with terrestrial vegetation and upland swamps, perched water level monitoring programs will be expanded after discussion with DECC. Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.</p>

80	Our CAP, which was prepared in consultation with key NSW Government agencies and stakeholders, recognises a number of ground water dependent ecosystems in the project area. In planning the implementation phase the HNCMA recommends that the precautionary principle be applied to ensure that all appropriate measures are taken to protect these ecosystems, and related environmental investment, from any damage that could be attributed to either the operation of the bore field or to construction and management activities.	Possible Groundwater Dependent Ecosystems within the area of the borefield have been investigated in much greater detail than that provided in the CAP. Only baseflow to streams, potentially some terrestrial vegetation and stygofauna have been identified as possibly having some groundwater dependency. Risks are low and monitoring and management during construction and operation are considered the most appropriate response
133	Principle 4 states: i. Where scientific knowledge is lacking, the precautionary principle should be applied to protect groundwater dependent ecosystems. The development of adaptive management systems and research to improve understanding of these ecosystems is essential to their management.	Possible GDEs within the area of the borefield have been investigated. Only baseflow to streams, potentially some terrestrial vegetation and stygofauna have been identified as possibly having some groundwater dependency. Risks are low and monitoring and management during construction and operation are considered the most appropriate response
140	However, as stygofauna usually exist in relatively stable conditions, the precautionary principle would suggest that any populations (if they exist) would be impacted by groundwater extraction.	An extensive baseline assessment has been completed and this indicates that stygofauna populations exist at most sites sampled - particularly prevalent in the shallower, small diameter monitoring bores and wells Ecosystem monitoring will be part of the monitoring program if the borefield is constructed and becomes operational.
140	Given these predictions, extraction of groundwater from a poorly understood system should be undertaken with caution, especially given the current drought dominated / regime. Periods of frequent and extended droughts may not allow sufficient time for recharge before groundwater extraction is required again due to low dam levels i.e. may need to operate for periods longer than three years.	Aquifer systems and the landscape hydrology and local environment are not poorly understood. As well as the baseline studies, there is now more than three years of transient data over drought and wetter seasons to assess variability. Pumping trials have shown that upland swamps are disconnected and there is low connectivity with baseflow to streams in this area. Work on terrestrial vegetation shows no linkages with deeper sandstone aquifers. Groundwater resource, surface water and ecosystem monitoring will be part of the monitoring program if the borefield is constructed and operational.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 1, 3, 81, 84, 101, 122, 137		

4.05.04 NWI (13 comments recorded)		
133	It fails to accord with the National Water Initiative.	The proposed development complies with the NWI and there is no over allocation of the sandstone groundwater resource when considering the longer planning, allocation and usage timeframe.
96	The EA has not demonstrated adherence to the NWI. The summary treatment of the NWI in the EA has not considered the central issue of sustainable levels of extraction and the avoidance of over allocation of resources. Further, the lack of consideration of the broader groundwater budget and documentation of the impacts of the groundwater budget due to the proposal within the context of sustainable yield for the Southern Highlands is contrary to the Director General's Requirements (DGRs).	<p>The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons.</p> <p>The latest numerical modelling study describes the sustainability of the proposed development and provides water balances for the proposed scenarios.</p>
96	There is a planning vacuum within which the proposal for the borefield at Kangaloon as been developed. The relevant State agency (Department of Water and Energy — DWE) has not provided the correct advice concerning the sustainable yield of the aquifer and whether granting of the allocation to operate the scheme causes the aquifer to be over allocated. Groundwater in a large number of parishes in the area has been subject to embargo for future commercial use. These embargoes have been enacted since 2004 and clearly show that DWE is concerned over the level of allocation, and possibly use, in the region. It is the responsibility of the Department to instigate a detailed groundwater management plan for the Southern Highlands Management Zone prior to the granting of the single largest allocation for the region. This responsibility not only stems from the relevant NSW legislation, but also from NSW being a signatory to the National Water Initiative.	<p>The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons.</p> <p>The latest numerical modelling study describes the sustainability of the proposed development and provides water balances for the proposed scenarios.</p>

121	Specifically, we would like your view on how this meets the requirements of the National Water Initiative concerning over allocated systems.	<p>The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons.</p> <p>The latest numerical modelling study describes the sustainability of the proposed development and provides water balances for the proposed scenarios.</p>
96	The EA does not outline the full impacts of groundwater extraction on the existing groundwater users as required by the DGRs. Once the NSW Government has provided an entitlement to SCA for operation of the proposed borefield, the Southern Highlands Management Zone will be substantially over allocated. Given that all parishes local to the proposed borefield are embargoed, the NSW Government will be forced by the NWI to move to reduce the level of over allocation. This will require management intervention, possibly in the form of compulsory entitlement reduction or by requiring the SCA to buy entitlement.	The impacts of the proposed borefield extraction are provided in the two modelling studies. The prospect of an SCA borefield was factored into DWE's decision to embargo the parishes surrounding Kangaloon in late 2005, and does not compromise the sustainability of the sandstone resource. The large SCA allocation is factored into the sustainable yield calculations already and the purpose of the new Water Sharing Plan (WSP) is to ensure that over-allocation never occurs.
96	The NWI requires that all over allocated and over used water systems are returned to a sustainable level of extraction. This implies, inter al/a, that no jurisdiction should allow a WSP to over allocate a resource. The sandstone aquifer of the Kangaloon area has the potential to be over allocated if a new entitlement is given to SCA to operate the proposed borefield. The EA does not address this issue and needs amendment.	<p>The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons.</p> <p>The latest numerical modelling study describes the sustainability of the proposed development and provides water balances for the proposed sceanarios.</p>
96	NSW is a cosignatory to the National Water Initiative (NWI), Aspects of the NWI and how it affects the proposed borefield have been reported in the EA. However, the EA does not discuss the single most important issue contained in the NWI agreement — that of over allocation. The treatment of issues related to the NWI is too simplistic and avoids the major issue	<p>The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons.</p> <p>The latest numerical modelling study describes the sustainability of the proposed development and provides water balances for the proposed scenarios.</p>

140	Although, borefield pumping over 2 - 3 years accounts for a maximum derogation from aquifer storage of 10% of total aquifer storage, extraction in quantities higher than the rainfall recharge rate during the drought period is envisaged. This seems to be contrary to National Water Initiative's (NWI) guidelines.	The Nepean Sandstone source area will not be overallocated. The SCA proposal is to take 15,000 ML/yr in years of extreme drought and this is unlikely to occur more than 2 or 3 years a decade, hence the expected volumes of recharge exceed the likely usage when compared over a longer term drought usage cycle. The substantial volumes in storage provide the required buffer in drought seasons. The latest numerical modelling study describes the sustainability of the proposed development and provides water balances for the proposed scenarios.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 46, 134		
4.06.00 Operational Issues (2 comments recorded)		
84, 96	Once this proposal is permitted to go ahead, even if it is never used for pumping, it will have had irreversible effects by virtue of the development of the infrastructure and the intrusion necessary for its ongoing maintenance and protection.	The infrastructure installation is low impact and from existing testing programs completed in recent years it is clear that the natural areas regenerate quickly after disturbance for boreholes and pipelines.
4.06.01 Noise (8 comments recorded)		
21	As you can imagine, living in rural NSW is a very quiet existence that we have been enjoying very much. Yet during the testing period the bore near our house (2G) made a low vibrating noise, that was very noticeable at night as our bedrooms face that direction. The SCA were very efficient with helping us with this as it was near driving us crazy. I know that there will be no generators if the proposed borefields are established, but I also know that there will be other noise factors that could be of concern, that we will only find out about when all is approved and built and probably too late for us to be heard.	A construction environmental management plan (CEMP) will be prepared for the construction of the project - this plan will include a commitment to the evaluation and if required mitigation of noise within the appropriate guidelines.
100	We are also concerned about the potential noise from the power transformers to be installed. The area in which we live is totally silent at night and any minor noise can be heard from some distance. We would therefore ask that any transformers or other potentially noisy units be installed a substantial distance from our home (1 km) and not visible from Tourist Road.	The SCA will consider noise in selecting the power transformers but does not expect this to be a noise issue.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 21, 29, 36, 123, 130		

4.06.02 Bushfire (52 comments recorded)		
84, 96	The introduction of powerlines and pumps in the catchment increases the risk of bushfires in the area.	An appropriate fire break will be implemented as per Integral Energy's guidelines.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 44, 46, 48, 49, 50, 51, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 68, 69, 71, 72, 74, 76, 77, 84, 87, 89, 99, 103, 104, 105, 107, 110, 111, 112, 113, 117, 130, 132, 138, 139, 141, 142, 143, 144, 145, 146,		
4.06.04 Traffic (23 comments recorded)		
125	The local roads are unsuitable for the tankers which will be needed to remove the sludge extracted from the water.	A TMP will be designed and implemented for the construction of the project. For ongoing operational management the SCA has completed road dilapidation surveys and will monitor roads for any damage caused by construction or operational activities as part of the borefield project. The SCA considers the roads appropriate for the proposed activities.
120	The alteration to the current social amenity of the area and road damage from the large number of heavy vehicles transporting sludge from filtration sites is also unwarranted.	A TMP will be designed and implemented for the construction of the project. For ongoing operational management the SCA has completed road dilapidation surveys and will monitor roads for any damage caused by construction or operational activities as part of the borefield project. The SCA considers the roads appropriate for the proposed activities.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 18, 20, 28, 29, 30, 35, 36, 40, 41, 84, 96, 100, 101, 119, 123, 129		
4.06.05 Water treatment (28 comments recorded)		
65	These statements indicate potentially serious operational problems and high maintenance costs, In the case of the last statement, SCA proposes iron (24,750 kg/ month) and associated sludge water be transported by tankers and dumped at an appropriate landfill site. This waste, in its oxygenated form, has the clear potential to pollute streams, with associated bacteria forming oily looking scums in slow flowing rivers or pools. The proposed use of alum to treat the Nepean River (previously a class '5'. specially protected, waterway is equally concerning. What other chemical may also be involved is not clear	Iron sludge will be dried before being trucked to landfill - no sludges will be released to the Nepean River and hence there is no pollution potential
The following submissions also made comment on this issue - the content was similar to the selected issues above – 6, 8, 11, 13, 15, 16, 22, 23, 29, 33, 36, 38, 39, 44, 83, 86, 101, 114, 118, 119, 120, 127, 131		
5.04.03 Alternatives/renewables (1 comments recorded)		
78	Purchase of green power to offset power consumption of project.	The borefield power consumption is low at only 1 to 2 MW per day if all components of the borefield were fully functional and there was some cycling of pumping. Green power options to run the borefield will be explored again when/if it is constructed and becomes operational, however its occasional use does not lend its operation as a green power scheme.

6.01.00 Community Consultation program (1 comments recorded)		
88	(Refer Appendix S.B Draft statement of Commitments 29) You have made a commitment to consult with Wingecarribee Shire Council about construction within road reserves. Why hasn't the same commitment been made to private landholders?	The same commitment has been made to the local community. See Statement of Commitments - No 13.
6.01.01 Community Consultation during planning (37 comments recorded)		
135	On Monday 13th February 2006, representatives of Gujarat NRE FCGL Pty Ltd met with representatives of the Sydney Catchment Authority, where a number of issues relating to future mining operations were discussed. The potential impacts of groundwater harvesting in the Stockyard Swamp area were raised and it was identified that the trial bores as constructed were within the Mining Lease and ongoing consultation and sharing of geological information would be necessary. Unfortunately there would appear to be little to no consultation as exemplified by the Environmental Assessment & associated reports.	There have been ongoing updates between parties and the offer of information if required.
127	Our society would also like to thank the Sydney Catchment Authority for their open and frank discussions as well as their presentations and thanks to the SCA and the NSW Government for the availability of reports.	Noted. Thank you.
147	Due to a number of factors including the large amount of documentation to get through to come to a balanced viewpoint on this proposal and that the proposal has been put to the public during school holidays.	Part 3A proposals are required to be exhibited for 30 days - this project was exhibited for 42 days and further extensions were granted for submissions.
84	The Upper Nepean Groundwater Community Reference Group (the group) has provided a submission to the NSW Department of Planning regarding the above development application. The group acknowledges the extensive consultation that the Sydney Catchment Authority has provided over the past two years, with 18 formal meetings and a field trip to the affected area. The consultations and information were greatly appreciated by the group and the community at large. The group has provided a much-needed avenue for the public to express their concerns regarding this proposal.	Noted.

21	As you can imagine, living in rural NSW is a very quiet existence that we have been enjoying very much. Yet during the testing period the bore near our house (2G) made a low vibrating noise, that was very noticeable at night as our bedrooms face that direction. The SCA were very efficient with helping us with this as it was near driving us crazy. I know that there will be no generators if the proposed borefields are established, but I also know that there will be other noise factors that could be of concern, that we will only find out about when all is approved and built and probably too late for us to be heard.	Noted. Thank you.
92	We feel, as many others that the SCA are working against the community with this aquifer. They have sent representatives to us to explain a great deal. Which has been done well,	Noted. Thank you.
114	No water assessment was done on my property by the SCA although requested one by phone.	The SCA does not have any outstanding requests for groundwater surveys for residents.
122	Due to deficiencies in consultation in Kiama and time constraints this submission is based on executive summary information. For this reason an independent hearing is requested as long as this doesn't interfere with any community group wishing to appeal on the merits of the project.	The proposal does not impact the Kiama area. Consultation efforts were focused on areas that the project directly impacts.
122	Consultation on the current Upper Nepean borefields proposal has been abysmal in the Illawarra.	The proposal has no impact on the Illawarra, and will in fact increase supply security to the Illawarra. Consultation has been focused on directly impacted residents and communities. However, consultation has taken place with Wollongong City Council and the EA has been available on DoP's website. Further, media releases have been sent to Illawarra newspapers and advertisements have also been placed in Illawarra newspapers.
122	The Illawarra consists of both Wollongong and Shellharbour Councils. It is unclear what consultation actually took place with Wollongong Council while no consultation appears to have existed with Shellharbour Council, even though Director General requirement's include consulting with local council. In response to the above concerns ICEC requests an independent hearing for this project.	Again, the project is mostly within the Wingecarribee Shire local government area and with a very small part (SCA special area around Stockyard Swamp) falling within the Wollongong City local government area. The project does not fall within the Shellharbour Council area. Extensive consultation has taken place with Wingecarribee Shire Council, as befits the layout of the proposed borefield. Consultation has also occurred with Wollongong Council. The SCA also convenes a Local Government Reference Panel which received regular updates on the project and includes members of all three councils.
3	I would like to thank the SCA for the opportunity to make a submission and to complement the process which has been thorough and open to everyone.	Noted. Thank you.

96	That public announcements of proposed pumping, duration of pumping, cease-to-pump, and additional studies and research are made through media outlets and peak representative groups.	More information will be publicly released on both the construction works program and the operational program if Government decides to reactivate the proposal.
96	That ongoing community consultation is undertaken by government agencies to allow ongoing impacts and other issues to be publicly debated. 'the proponent, if approval is gained, needs to inform the community of the Southern Highlands about ongoing construction and operation of the groundwater project. A peak body should be retained and informed at annual or biannual meetings to retain community input.	The SCA has made a commitment to continue to consult extensively with the community (Statement fo Committments No 13.) The ongoing consultation plan includes a focus on consultation with directly affected residents, rather than continuation or reformation of a community reference group.
78	Council appreciates the considerable effort the Sydney Catchment Authority (SCA) has made to keep Council and the community abreast and informed of the proposal. SCA staff have made themselves readily available to meet with Councillors and Council staff to provide up to date information and progress of the project. The SCA have also been responsive to issues raised.	Noted. Thank you.
12	Firstly, I wish to ask you what notification of the Public Exhibition has been made in the Illawarra region?	NSW Government Noticeboard advertisements were made in Illawarra, Southern Highlands and Sydney newspapers (2 April 2008) to announce the environmental assessment exhibition
The following submissions also made comment on this issue - the content was similar to the selected issues above – 7, 25, 32, 36, 75, 81, 88, 115, 131, 132, 133, 140, 146		
6.01.02 Community Consultation during construction (10 comments recorded)		
133	This is the difference between an "academic" consideration of the route for pipelines and powerlines, (by LesryK) and the real-life reality of how such proposals are considered by country people, who have been born and bred in the district, and who love the bush where they grew up. These people are the kind of people who would readily 'man the barricades" to oppose such large-scale clearing or precious trees.	The SCA will continue to consult extensively with the community in relation to this project and will treat residents with empathy and sincerity.
133	The Save Water Alliance has, and continues to maintain a legal and legitimate opposition to the Borefield proposal. We have always (and will continue) to respect the rights of workers, their health and safety issues. Any protests will be legitimate, and orderly. However, I cannot answer for the "hot heads" in the community who might be provoked in to disruptive behaviour is massive clearing of old trees along these roads begins.	The SCA will continue to consult extensively with the community in relation to this project and will treat residents with sincerity.
96	That public announcements of proposed pumping, duration of pumping, cease- to-pump, and additional studies and research are made through media outlets and peak representative groups.	More information will be publicly released on both the construction works program and the operational program if Government decides to reactivate the proposal.

78	The road bridge and culvert dilapidation study must be prepared in consultation with WSC Roads and traffic staff to remove any potential ambiguities.	Noted and agreed.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 32, 84		
6.01.03 Community Consultation during operation (5 comments recorded)		
84, 96	That ongoing community consultation is undertaken by government agencies to allow ongoing impacts and other issues to be publicly debated. 'the proponent, if approval is gained, needs to inform the community of the Southern Highlands about ongoing construction and operation of the groundwater project. A peak body should be retained and informed at annual or biannual meetings to retain community input.	The SCA has made a commitment to continue to consult extensively with the community (Statement fo Commmittments No 13). The ongoing consultation plan includes a focus on consultation with directly affected residents, rather than continuation or reformation of a community reference group.
84, 96	That public announcements of proposed pumping, duration of pumping, cease- to—pump, and additional studies and research are made through media outlets and peak representative groups.	More information will be publicly released on both the construction works program and the operational program if Government decides to reactivate the proposal.
The following submissions also made comment on this issue - the content was similar to the selected issues above – 78		
6.02.00 Peer reviews and audits (19 comments recorded)		
79	All monitoring data should be assessed by experts on a regular (monthly) basis to determine whether drawdown in the perched water level is occurring.	During operational cycles, water level data from production bores and monitoring bores/wells will be monitored at least quarterly to assess trends. If impacts are suspected, the monitoring frequency will be increased pending any decision to close down bores or amend the groundwater pumping strategy.
29	Full appreciation has been noted by me of the conditions in the Limitations Statement in Dcc, A. above, especially noting that all information in A. has been supplied by "the Client", the Sydney Catchment Authority Also of special note, there has apparently been no external verification of the truth and validity of such information. Paras. 1, 2, and 3 on page ii take notice of any possible future changes to information, (or lack of it), and their reliance on past and current information, with no 'arms length' validity checks.	The EA has been based on best available information and modelling predictions. The statement recognizes that the EA was compiled and written by KBR on the basis of other technical, environmental and engineering information supplied to them. While the assessment and mitigation measures have been fully assessed by KBR, the original source documentation has been accepted but not verified, hence the limitations statement at the strat of the EA. The limitations statement is consistent with industry practice of differentiating information supplied by SCA as part of the project from new information collected and analysed by KBR. Some of the studies were independently peer reviewed when they were compiled and submitted to SCA. SCA also audited and inspected field work programs when in progress and believes that all the information provided is accurate and reliable.