Sydney Catchment Authority Answers to Questions on Notice

Inquiry into the Adequacy of Water Storages

Questions from the Public hearing

1. Shoalhaven pumping costs

The Hon. PAUL GREEN: *Coming from the Shoalhaven you come over the mountain there, what sort of dollars are you talking about pumping there in terms of dollars equating to megalitres per day—electricity costs versus water.*

Mr TANNER *I could have told you when the drought was on in 2007 because we pumped—*

Ms DINNING: *Can we take that on notice?*

The Hon. PAUL GREEN: *Yes. It would be really helpful for the Committee to know that.*

Answer

Between April 2003 and March 2009, 837,674 ML was transferred from the Shoalhaven Scheme to Wingecarribee Reservoir (27% of the amount of water SCA supplied to Sydney Water over this time). The energy cost (excluding GST) was $47,730,442 with an average cost per ML (excl GST) of $57.

2. SCA supply to Goulburn

The Hon. Dr PETER PHELPS: *Ms Dinning, did you say something about doing something in Goulburn in the near future?*

Ms DINNING: *Goulburn is a prescribed customer to the SCA now.*

CHAIR *How long has that been the case?*

Ms DINNING: *I would have to check the actual time.*

CHAIR *But relatively recently?*

Ms DINNING*: Yes.*

Answer

The Sydney Water Catchment Management Regulation 2008 was amended on 15 June 2012 to include Goulburn-Mulwaree Council as a prescribed local council to which the SCA is able to supply water.

3. Yield calculation without desalination or groundwater

The Hon. Dr PETER PHELPS: *It is just an issue that was raised and I wanted to put it out there. Excluding desalination and groundwater, let us say, for example, that there was no desalination plant and you were statutorily prohibited from accessing groundwater for the system. What is a worse case survival period for Sydney's drinking water, given the current infrastructure of the SCA?*

Mr TANNER: *The 610 gigalitres per annum yield includes both tranches of desalination, the 250 that has been built, with the operating rules of starting and stopping, 70 per cent, 80 per cent for the other dam storage. It also includes the second 250 part of the desalination, which would be built if the dams ever got down to around 30 per cent. So that is all included in our yield calculations. If we excluded desalination and groundwater, which is not a huge component, I would have to get back to you on what the new yield of the system would be without those two pieces of desalination plant*

Answer

Without access to either the desalination plant or groundwater the long term water supply system yield currently 610GL/a would drop to 470 GL/a. Demand in 2011/12 was 485 GL/a. If yield is less than demand, then greater Sydney would be using, on average, more water per year than can be sustainably extracted from the system over the long term.

In the short term, there is plenty of water available because the dams are full. However, the system must be managed for the long term, especially in light of uncertainty surrounding population growth and climate change.

If there was a continuing drought of the same severity as occurred in 2004 (allowing for small inflows into the system from the base flows that are always present), access to drought measures such as groundwater and additional desalination would allow storages to be maintained at about 25%. This would enable Greater Sydney to continue to access the water supply, but there would be severe water restrictions. Without the current and planned desalination and groundwater there would be about 10 years of supply from current storage levels to empty.

4. Cost of the Sydney Desalination Plant

The Hon. PAUL GREEN*: Can we get an indication of when the desalination plant is on and when it is off—the pattern over the last 18 months or whatever it is?*
Mr TANNER *It was finished and it ran for two years, a proving period of two years which finished on 30 June this year. For the last two years up to 30 June it was in its defects liability proving period. It is switched off now and it will not go back on again until our dams drop below 70 per cent.*
The Hon. Dr PETER PHELPS*: How much did it cost?*
Mr TANNER *I think it was $1.9 billion. I would have to check that.*

Answer

The cost of the desalination plant was $1.9 billion *(Source: Sydney Water Annual Report 2010).*

Supplementary Questions

1. Role of the SCA in the development of the Metropolitan Water Plan

The Government submission highlights the importance of the Metropolitan Water Plan in ensuring a supply of potable water to the Sydney region.

What role does the SCA play in the development of the Metropolitan Water Plan?

Answer

The Metropolitan Water Directorate in the Department of Finance and Services (DFS) leads a whole of government approach to coordinating future planning for Sydney's water supply through the development of the Metropolitan Water Plan. This process involves identifying and diversifying sources of water to minimise risks of water shortages, optimising existing infrastructure, increasing the efficient use of water, and using different grades of water appropriately to achieve a balance between demand for water and water availability (system yield).

The plan has adopted a portfolio approach that involves analysing different combinations of existing and new water supply and demand measures in order to identify the mix that provides water security for people and for the environment at the least cost.

The plan is reviewed by an independent panel of experts (the Independent Water Advisory Panel) from a wide range of disciplines to ensure it is robust. Significant input from the SCA and Sydney Water regarding demand projections, yield modelling and options for either reducing demand or increasing water supply are critical to the development of the plan.

The SCA's WATHNET (Water Headworks Network) Model is fundamental to planning the capacity of the entire water supply system (including those parts of the system managed by Sydney Water, the SCA and the Sydney Desalination Plant), both now and in the future, and to analysing the water supply and demand options that might contribute to a future Metropolitan Water Plan that guarantees a secure and reliable water supply.

The SCA is also responsible for delivering various components of the Metropolitan Water Plan. For example, the Deep Water Access Project arose out of the *2004 Metropolitan Water Plan*. Works to access the deep water in Warragamba and Nepean Dams were completed in 2006 at a cost of $119 million, on schedule and within budget. Previously inaccessible water (200 GL) at the bottom of the dams can now be used if required.

The SCA has also investigated the development of groundwater at Kangaloon and has implemented changes to operating rules that have increased system yield. The SCA is currently reviewing the requirements for augmentation of the Shoalhaven transfer system. The preferred option is a tunnel from Burrawang to Avon Dam. River health initiatives such as environmental flows and fish passage have also been delivered by the SCA.

The SCA investigates water supply options beyond the planning timeframe of the Metropolitan Water Plan (2025) to address significant longer term uncertainty emanating from population growth, demand management and climate change.

2. Ensuring raw water quality

The SCA is responsible for Warragamba Dam, which is the key source of greater Sydney's drinking water supply. What measures does the SCA pursue to ensure that the water in Warragamba Dam is potable?

Answer

Under the *Sydney Water Catchment Management Act 1998* the role of the SCA is to be a supplier of raw water (s.13(c)) and the SCA has the primary function of protecting the quality and quantity of water in catchment areas (s.15(2)). The SCA supplies raw water, responsibility for supplying potable (drinking) water rests with the SCA's customers who supply water directly to consumers.

The Sydney Catchment Authority has adopted the multi-barrier approach to water quality management and risk assessment recommended by the Australian Drinking Water Guidelines 2011 (ADWG). This involves addressing water quality risks at each barrier rather than relying on the effectiveness of a single barrier within the supply system. The ADWG framework applies to the whole supply chain from the source to the consumer to ensure a seamless approach to managing risks to the consumer.

The SCA is responsible for managing parts of the water supply chain catchment, lakes and the raw water delivery system) and works closely with its upstream stakeholders and downstream customers to ensure raw water supplied for treatment is of appropriate quality.

The standard for raw water (supplied by the SCA to Sydney Water, and to Shoalhaven and Wingecarribee Councils) is not the same as the drinking water standard for potable water that Sydney Water, and Shoalhaven and Wingecarribee Councils supply their customers.

Raw water supplied by the SCA to its customers is required to meet the site specific parameters in the Raw Water Supply Agreements that the SCA has with Sydney Water and the Councils. These parameters are based on both the capacity of the receiving water filtration plants to treat the raw water and on historical water quality data.

The SCA's water quality management activities are focussed on the source waters in the catchments and measures to manage pollutant risks, monitoring and modelling of limnological processes in the lakes, source supply and offtake selection and transport to customers' treatment plants via the raw water delivery system. The raw water supply network provides redundancies and interconnectivity to maximise flexibility of supply sources in order to source the best quality raw water for treatment.

Barrier 1: Catchments

The SCA has developed the Healthy Catchments Strategy (HCS) to reduce risks to water quality. The SCA has identified the most significant risks in the drinking water catchment in terms of four priority pollutants (pathogens, nitrogen and phosphorous and suspended solids). The risks are classified according to uses and management of land in a tool called the *Pollution Source Assessment Tool* (PSAT).

PSAT brings together the best science and technical information, spatial data, modelling, expert knowledge and best management practices to assist the SCA in prioritising management activities in the catchments. It analyses the relative risk of the four priority pollutants from 13 land use activities. The relative risk for each pollutant is categorised into four classes 'very high', 'high', 'medium', and 'low'. The results of PSAT are reported for

each module and pollutant at a drainage unit scale. These risk ratings are then used to prioritise intervention programs under the HCS 2012-16.

Barrier 2: Lakes

Source selection is the single strongest control the SCA can employ to manage raw water quality at the supply point. Knowledge of the raw water supply system and verification through monitoring inform the selection of optimum water quality from the available range of lakes and depths within the lakes.

Stratification

The SCA routinely monitors the water profile of each storage to identify water quality changes and determine the best depth from which to supply.

Stratification occurs in spring and summer, when the air temperature is higher than the water temperature. Water has its greatest density at 4 degrees, so the colder water sinks to the bottom and the lighter warm water stays at the surface. A stratified lake has 3 layers with different temperatures, with a warm layer of water (epilimnion) overlying a colder layer (hypolimnion) and separated by a much narrower temperature transition zone in between (thermocline). The hypolimnion can become depleted in oxygen (anoxic), while the warmer epilimnion is in danger of encouraging nutrient concentrations and algal growth.

Destratification devices such as aerators are available in some storages to prevent deoxygenation of the deeper water where there is a risk of stratification. Destratification may also assist in the control of algae.

An optimal layer is chosen for the supply which is usually within the treatment capability of the water filtration plants.

Inflow events

Inflows to major SCA storages are monitored and major inflows (which can contain poorer quality water) are tracked to identify potential water quality risks. This is to determine the level at which inflows are travelling within the water column so that offtake levels can be set to draw the best quality water for supply. Real time monitoring is supported by models (SCARMS – the Sydney Catchment Authority Reservoir Management System), which can be used to predict the likely lake behaviour in response to inflows and changing environmental conditions such as weather.

Barrier 3: Raw Water Delivery System

Flexibility and interconnectivity in the raw water supply system allows the SCA to select the best quality water to supply for treatment. This may include blending supply from multiple sources or changing sources if an issue is identified in one source. The SCA pre-chlorinates raw water travelling along the Upper Canal to provide preliminary protection from potential contamination.

Online water quality instruments located near dam walls and in supply conduits generate alarms when certain parameters exceed preset values, allowing intervention by operators to prevent poor quality raw water going to water treatment plants. Biomonitoring stations that use water quality sensitive fish to indicate water quality changes also operate.

3. Storage management practices

A number of submissions have highlighted the importance good storage management practices in maximising the amount of water available for consumers, such as minimising water losses from evaporation or leakages.

a) *What storage management practices does the SCA currently implement?*

b) *Are there any storage management practices that the SCA is examining for future use?*

Answer (a)

Storage management to supply the best quality water

Water quality within reservoirs can vary considerably, depending on the depth within the reservoir, the season, temperature, rainfall and inflows from the catchment area. The SCA manages its water storages to optimise the quality of water supplied to customers by:

- sophisticated water quality modelling, supported by an extensive monitoring network throughout the catchment and storages
- carefully selecting water, including offtake choice within reservoirs, and blending water from various sources
- actively managing storages, including artificial destratification at some locations.

Using variable offtakes to extract the best quality water

SCA dams have variable offtakes so that water can be extracted at different depths to select the best quality water available and avoid water quality problems such as algae or excessive turbidity after heavy rain. The SCA uses SCARMS (the Sydney Catchment Authority Reservoir Management System) to closely monitor and model water quality. A chain of thermistors suspended in the lake monitors water temperature and other quality characteristics. The data and modelling enables managers to determine from where to draw the best quality water for customer supply.

Case Study – June 2007 inflow event

In June 2007 the SCA experienced a major inflow into Lake Burragorang. The inflows had the potential to have an adverse impact on the water quality delivered through the variable off-takes at Warragamba Dam. SCARMS provided real time advice with descriptions of the progression of inflows and lake behaviour, and the status of the lake and the off-takes. SCARMS reduced the turnaround time for field measurement and enabled the SCA to alter the off-take levels to select the best quality water available for supply to customers. Observations during the event led to further model improvements as well as enhanced interpretation and understanding of the limitations of modelling and the capabilities of SCARMS.

Destratification

Artificial destratification can be used to mix water layers to avoid potential water quality issues that can arise in a stratified storage. When compressed air is used, the air is pumped into the lake near the bottom, forming a 'plume'. The rising air bubbles add air to the water and also serve to bring the cold water up from the bottom. As an alternative to compressed air, propellers can be used. In addition to eliminating the problems caused by anaerobic bottom water, destratification of lakes often reduces the growth of algae.

Destratification is started when the temperature differential is achieved in the lakes, nominally 4 degrees between the top and bottom of the lake. Aeration is maintained until the

temperature differential falls below 2 degrees. Aeration is used in the Blue Mountains, Prospect, Nepean, Avon, and Woronora storages to counteract the effects of stratification. Each lake reacts differently to aeration and must be monitored individually. Decisions on whether and how to use aeration are determined by continuous monitoring.

Blending water sources

The interconnectivity of SCA's supply network provides the opportunity to blend water from different storages to achieve water quality outcomes. For example if there is reduced quality of water in Warragamba Dam, water from Upper Nepean dams (supplied via the Upper Canal) and Prospect Reservoir can be mixed with Warragamba Dam water before it is supplied to Prospect water filtration plant.

Storage management to maximise water quantity and minimise spills

Dams fill and empty at different rates, depending on the size of their catchments, rainfall, inflows, storage volume, evaporation, environmental flow requirements and the demand for water. Dams with a relatively small storage volume compared to their mean annual inflow (which is dependent on catchment size and rainfall) are more likely to fill and spill. If the demand for water supplied by a particular storage is relatively high, then there is a need to balance the storages to ensure that there is sufficient water to meet demand through the next drought.

The SCA has decision tools (drawdown curves) to minimise spills from the dams. This provides the maximum system yield whilst ensuring all demands are met. As a general rule, these are used to ensure that the dams have an equal likelihood of spilling at any time and have been updated to reflect recent changes in system configuration, including the Nepean and Warragamba Deep Water Pumping and the Sydney Desalination Plant. The 2011 review of the WATHNET model reviewed the drawdown curves and found that they were close to optimal.

Storage management to balance water quality and water quantity

Each storage has its own unique water quality characteristics. Water from Warragamba Dam is generally of higher quality than the Upper Nepean dams. The SCA determines from which storage to source the highest quality water and prioritise balancing for water supply security. Changing source waters is carried out in consultation with customers to ensure water filtration plants are prepared for a change in raw water quality.

Answer (b)

The SCA uses models for catchment runoff, the behaviour of water in the storages (SCARMS), the impact of environmental flow releases in the downstream river and the water supply system network. Integrating these models is challenging. The SCA is participating in the eWater Source modelling platform, where work has commenced to integrate models under the eWater modelling framework as part of the National Hydrology Modelling Strategy.

This will improve model transparency between stakeholders. Both the NSW Office of Water (NOW) and Sydney Water have adopted the Source modelling platform, with Sydney Water using Source for the Hawkesbury Nepean downstream modelling project. Exchange of data and explanation of modelling results is more efficient if agencies have a common modelling platform.

Work is currently being undertaken to incorporate economic modelling functionality into the SCA's WATHNET model. This will enable short term and long term supply options to be

optimised. The near short term storage projections will also be able to inform demand forecasts and energy expenditure forecasts for business planning. Further development of the SCARMS model capability to predict algal blooms in storages is planned to be undertaken over the next few years.

4. Demand management, grey water and recycling

A number of submissions have highlighted the importance of demand management practices to reduce water use, such as capturing storm water runoff and installing domestic tanks.

a) *What demand management practices does the SCA currently implement?*

b) *Some submissions also highlight the importance of better capturing greywater and using recycled water, particularly for industrial use. What would be classified as greywater, and what issues are involved with using recycling water, for both domestic and industrial usage?*

Answer (a)

The SCA is not a high water user. The SCA tries to set an example in the efficient use of water. The SCA's offices in the Penrith Government Office Building (NSW government owned) and the Warragamba Visitor and Operations Centre (SCA owned) use rainwater from tanks for non-potable water use (eg toilet flushing) and uses water efficient devices (eg taps and toilets). The Campbelltown office (leased from the private sector) has water efficient devices.

The SCA has very low levels of leakage and losses from its structures and conduits because SCA assets are generally above ground and leaks are easily detected and rectified. Leakage or loss from SCA infrastructure can also be an intentional and inherent part of an asset's design. Dams are designed to seep for structural safety and to prevent excessive build up of water pressure within or beneath them. If leakage does *not* occur, the safety of the dam structure could be compromised, with the potential for failure.

Other water supply system losses are known and able to be estimated, but there are often no practical barriers for their prevention. The largest losses of this type are evaporation and groundwater surface water interactions.

The SCA plays an active role in the NSW Government's Metropolitan Water Plan *Water for Life* education program which ensures consistent messages and approaches to demand management and water conservation.

Answer (b)

Greywater is the waste water from kitchen sinks, washing machines, laundry tubs, hand basins, spas, the shower and bath. It is not waste water from toilets. Recycling water for domestic and industrial usage in Sydney is a matter for Sydney Water and NSW Health.

In the drinking water catchment the SCA requires all development to have a Neutral or Beneficial Effect on Water Quality. This includes developments with on-site wastewater systems including those that reuse greywater.

5. Shoalhaven scheme

The submission from Shoalhaven City Council notes that the '[r]elease of water from Tallowa Dam for Shoalhaven use is controlled through a series of agreed protocols' between the SCA and Shoalhaven Water (Submission 63, p 4).

a) *What are these protocols, and are similar protocols in place for any other dams that are managed by the SCA?*

b) *The Shoalhaven submission also noted that '[f]lows from the Shoalhaven can also be used to supplement Sydney's water supply during a drought'. What involvement does the SCA have in deciding when this supplementation would occur and how/when would this decision be made?*

Answer (a)

The protocols with Shoalhaven City Council are included in the *Water Sharing Plan for the Greater Metropolitan Regional Unregulated River Water Sources 2011* (Part 6).

The SCA also has agreed arrangement with each major customer. These contain details of the operations and activities that will be undertaken by the SCA and the customer in the delivery of raw water by the SCA. This includes communications between the SCA and the customer, regulators and stakeholders as well as guidelines with regards to water quality and quantity in addition to plans covering the management of incidents and operation and maintenance of assets.

Releases from all SCA dams and weirs are made in accordance with the System Operation Rules in the *Water Sharing Plan for the Greater Metropolitan Regional Unregulated River Water Sources 2011* (Part 6) and the requirements of the Water Supply Work and Water Use Approvals granted under the *Water Management Act 2000*. This includes releases for environmental purposes, riparian uses, urban water supply and water transfers.

Answer (b)

Transfers from Tallowa Dam through to Wingecarribee Reservoir and then to Nepean and/ or Warragamba Dams are governed by the System Operation Rules in the *Water Sharing Plan for the Greater Metropolitan Regional Unregulated River Water Sources 2011* (Part 6) and the requirements of the Water Supply Work and Water Use Approvals granted under the *Water Management Act 2000*.

The operating rules state that water transfers will commence when total system storage is at 75 percent and will continue until total dam storage rises above 80 percent. The rules also state that water will not be drawn down further than one metre below Tallowa Dam's Full Supply Level (FSL). In emergency circumstances (extreme drought), Tallowa Dam can be drawn down three metres below FSL.

The operating rules were incorporated into the SCA's Water Management Licence in July 2009 and they became part of the Water Sharing Plan for the Greater Metropolitan Regional Unregulated River Water Sources 2011 (Part 6) and the SCA water supply work and water use approvals under the *Water Management Act 2000* (May 2012).

The Metropolitan Water Plan 2010 identified augmentation of the Shoalhaven Transfers Scheme as the next most likely measure to increase the yield from the water supply system. This augmentation would affect the triggers for commencing pumping and associated operating rules.