Review of the Performance Criteria in Sydney Catchment Authority's Operating Licence

Final Report

Prepared for IPART by
SKM

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OF NEW SOUTH WALES

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Abbreviations

EPA	Environment Protection Authority of NSW
DIPNR	Department of Infrastructure, Planning and Natural Resources
IPART	Independent Pricing and Regulatory Tribunal of NSW
MWD	Metropolitan Water District of Southern California
SEPP	State Environmental Planning Policy
SCA	Sydney Catchment Authority
SWC	Sydney Water Corporation
WFP	Water Filtration Plant

Glossary

Hawkesbury Nepean River Management Forum
The body established to make recommendations to the NSW government on environmental flow provisions for inclusion in the Sydney Catchment Authority's Water Management licence.

Pump mark
The "pump mark" is the level of overall system storage at which pumping commences from the Shoalhaven system in order to increase water availability to Sydney. Currently the pump mark is set at 60 % of overall storage.

95th Percentile Flow
The 95th percentile flow is the flow which occurs or is exceeded 95% of the time. It is a relatively low flow.

Translucent flow releases
Releases whereby a percentage of inflows to a dam must be released. This involves passing a fixed percentage of the actual inflow to the dam and aims to mimic natural flow patterns.

Transparent flow releases
Releases from water storages that are matched to inflows to the storage.

Executive Summary

Background to the Review of the Performance Criteria

The Independent Pricing and Regulatory Tribunal of New South Wales (IPART) is the Operating Licence Regulator for the Sydney Catchment Authority (SCA). A number of issues were identified relating to the Performance Criteria contained in Schedule 2 of the Operating Licence during the Mid Term Operating Licence Review and the 2001/2002 Operational Audit. Those issues related to:

- The applicability of one of the criteria, the "security" criterion which, strictly, was found to be non-compliant for the purposes of the audit, although by an insignificant margin;
- The difficulty of understanding and interpreting the criteria;
- Framing of the criteria in terms of the *forecast* rather than the *actual* demand of Sydney Water Corporation; and
- Assessment of compliance based on probabilistic modelling which means there is inherent uncertainty in assessing performance.

Study Objectives

The study objectives are to review the expression and form of the performance criteria and assess whether they are:

- Clear, concise and appropriate; and
- Whether alternative expressions and/or forms of the criteria are more suitable.

The review of the criteria was undertaken with particular reference to:

- Criteria adopted by comparable bulk suppliers;
- The appropriateness of the criteria in the context of SCA's operating environment;
- Comments by operating licence auditors and, in particular, the 2001 audit;
- Comments made in submissions to the Mid-term licence review and by participants at the associated Tribunal workshop; and
- Ease of application and clarity.

Methodology

The methodology used for this study involved a survey of the major Australian (and some overseas) urban bulk water suppliers to ascertain current practice for performance criteria and the objectives underlying those criteria. This was followed by consultation with key stakeholders to the SCA water supply system to determine the range of objectives that they would wish the performance criteria to satisfy. The stakeholders consulted were:

- Sydney Catchment Authority (SCA);
- Sydney Water Corporation (SWC);
- Environment Protection Authority of NSW (EPA);

- NSW Ministry for Energy and Utilities;
- The Hawkesbury-Nepean River Management Forum and its Independent Expert Panel;
- Shoalhaven Water and Wingecarribee Shire Council;
- NSW Health; and
- The NSW Department of Infrastructure, Planning and Natural Resources (DIPNR).

The outcomes of the survey of water supply authorities and discussions with stakeholders were then used as a basis for reviewing and assessing the performance criteria.

Practice elsewhere and performance criteria objectives

The survey of other water authorities revealed that practice varied according to whether or not the water resource was constrained in being able to provide continuous supply to system demands without restriction. In areas where the water resource was abundant, and the reliability perceived to be 100 percent, the approach using explicit performance criteria (other than 100% reliability) was not used. In resource constrained areas, similar to Sydney, a similar approach to that of Sydney's was adopted using water restrictions to protect a buffer storage by applying water restrictions in time of drought. The performance criteria used generally dealt with the acceptable frequency, severity and duration of restrictions.

Discussions with the key stakeholders provided clarity regarding the performance criteria's major objectives, which are summarised as:

- The **Primary Objective** is to ensure the system does not run out of water;
- The secondary, supporting, objectives are to ensure that the frequency, duration and severity of water restrictions that may be anticipated in ensuring the primary objective is achieved are acceptable to the community being served.

The discussions indicated that the revised environmental flow requirements (currently being addressed by the Hawkesbury-Nepean Management Forum) would be contained in the Water Management Licence issued by DIPNR, and hence would not need to be explicitly addressed by the Performance Criteria. The concept of stating the sustainable yield of the system as part of the Performance Criteria was suggested in order to provide a focus for demand management initiatives, and promote the sustainable yield of the resource. There was also agreement that the anticipated demand reductions for various levels of water restrictions, as currently stated in Schedule 2 of the Operating Licence, were overly optimistic and should be reviewed. Current modelling practice by the SCA does not allow for the demand fluctuations induced by climate variability (eg that in dry years the demand would be greater than average) and it was considered that this practice by the SCA should be revised.

Sydney's system may be regarded as supply limited – for example, the area designated for the Welcome Reef Dam, which previously had been the preferred next major augmentation scheme, has been proclaimed as a nature reserve. There is a clear community expectation that the water supply should be managed within current resources. This sentiment should be reflected in the Operating Licence by not

including criteria expressed in a way that drive the SCA to increase the available supply in order to comply.

Appropriate Performance Criteria

Revised criteria should be *clear, measurable, achievable, controllable* and *relevant.*

The proposed form for the criteria is that they comprise:

1) An introduction including a statement of the Performance Criteria Objectives
2) The Performance Criteria; and
3) A statement regarding the system yield.

The following is an example of the suggested form and content of the criteria.

"**Catchment Infrastructure Works Performance Criteria**

1) Introduction and Objectives of the Performance Criteria

These performance criteria, together with the Drought Response Plan:

(a) Have the primary objective of ensuring that the water supply system should not run out of water - that is that the supply can continue to meet the restricted demand requirements with water of acceptable quality, and sufficient pressure, to all parts of the system;

(b) Achieve this objective without imposing water restrictions too frequently, too severely, or for excessively long periods, based on the preferences of the community;

(c) Describe the standard of service to be provided to customers in terms of the frequency, severity and duration of water restrictions which may be anticipated; and

(d) Are intended to promote the sustainable use of the available water resources.

The performance criteria are used in a computer model of the water supply system that can estimate the likelihood of certain events occurring. The model uses the projected average water demands, adjusted to reflect climatic conditions. Because of the uncertainty around future climatic conditions, and other factors, there is a degree of modelling uncertainty, which is allowed for in the performance criteria.

2) Performance Criteria

(a) *Supply Continuity*. A minimum operating storage equivalent to x months of total restricted demand (or y % of storage) shall be maintained as a buffer to assure supply continuity. The probability of the system storage levels falling to the buffer storage level shall not exceed 1 occasion in 1,000 years (for example). A Drought Response Plan, drawn up in collaboration with Sydney Water Corporation, shall include a contingency plan, triggered by impingement of the storage buffer, to ensure that basic supplies can continue to be met for an indefinite period.

(b) *Water restrictions frequency*. Restrictions will not need to be applied, on average, more often than once every ten years (for example).

(c) *Water restrictions duration;* Restrictions for continuous periods exceeding 24 months (for example) shall not be required, on average, more than once in 200 years (for example).

(d) *Water restrictions severity:* Water restrictions requiring a demand reduction of 50% (for example, or whatever demand reduction is anticipated by the highest level of restrictions) shall not be required more often, on average, than once in 200 years (for example).

The system shall be operated, based on the above criteria, the current pattern of demands and restriction rules stated in the Drought Response Plan, to provide an average yield of 600 GL/year (or such other figure as may be determined, from time to time, by the system modelling)."

Recommendations

The following recommendations are made:

- That the Performance Criteria as drafted for the example provided above be taken forward for further consideration as part of the End of Term Review of the SCA's Operating Licence.
- That the implications of the proposed Performance Criteria be investigated to ensure they are achievable within the context of current policy, for example as stated by the NSW Premier in March 2003 (Premier of New South Wales, 2003).
- That consideration be given as to whether the Operating Licence should be amended to clearly reflect the following obligations on the SCA (potentially included as sub-clauses under the current Clause 8.1):
  - To ensure that the system is operated consistent with maintaining the yield stated in Schedule 2;
  - In addition to operating the supply system consistent with providing the yield as specified in Schedule 2, to meet the requirements of the Water Management Licence, specifically for the release of environmental and riparian flows;
  - That the modelling procedure used to assess performance of the system against the Performance Criteria specified in Schedule 2 must be consistent with appropriate and acceptable industry practice; and
  - To actively work with other Authorities/bodies to ensure that appropriate water demand management, and water recycling and reuse strategies are in place.
- That the water demand projections, currently included with the Performance Criteria, no be longer included in the SCA's Operating Licence, but be transferred to an alternative, relevant and publicly accessible document.
- That the table of water restriction levels, showing anticipated savings and average occurrence probability, be omitted from Schedule 2 of the Operating Licence and carried over to the SCA's Drought Response Plan.
- That the modelling procedure used to assess performance of the system against these criteria must be consistent with acceptable industry practice, for example it should incorporate the impact of climate variability on the system demands.

- That the anticipated demand reductions following the implementation of water restrictions should be reviewed in the light of the introduction of water conservation measures and other factors.

1. Introduction

1.1 Background to the review of the performance criteria

The Independent Pricing and Regulatory Tribunal of New South Wales (IPART) is the Operating Licence Regulator for the Sydney Catchment Authority (SCA). The SCA's Operating Licence was issued in April 2000 under the *Sydney Water Catchment Management Act 1998*, requiring that a Mid-term Review be undertaken in about January 2002 to determine whether the Licence is fulfilling its objectives.

In addition, the operations of the Sydney Catchment Authority are reviewed by IPART, through Operational Audits, for conformity to the performance requirements contained within their Operating Licence.

The following issues were noted in relation to the performance criteria during the 2001/02 Operational Audit and during a Mid-term Operating Licence Review.

2001/02 Audit

- *Review the applicability of the "security" criterion as part of the mid-term review of the Operating Licence. The review should consider whether adopting extreme monthly event criterion is deliverable, to an acceptable degree of accuracy by the model process.*
- *If the "security" criterion is deemed technically feasible, the review should consider whether the level and likelihood set by the criterion is appropriate (the level of the operating storage should not fall below 5 % more often than one month in 100,000 months).*

Mid-term Review

- *The criteria are expressed in an unnecessarily complicated way that makes them difficult to interpret;*
- *The assessment of compliance with the criteria is based on probabilistic modelling, which means there is inherent uncertainty in assessing performance;*
- *The criteria and assessment of compliance is framed in terms of the Catchment Authority's capacity to meet Sydney Water Corporation's forecast demand, rather than Sydney Water Corporation's actual demand.*

The Mid-term Review recommended that there was "insufficient information to recommend changes to the criteria at this time" but that "these criteria be reconsidered at the end of term review".

The current study was designed to provide further information to enable the criteria to be reconsidered during the end of term review. Specifically, it makes recommendations regarding the most suitable expression and form that these criteria should take.

1.2 Study objectives

The study objective were to review the expression and form of the performance criteria and to assess whether they are:

- Clear, concise and appropriate; and
- Whether alternative expressions and/or forms of the criteria are more suitable.

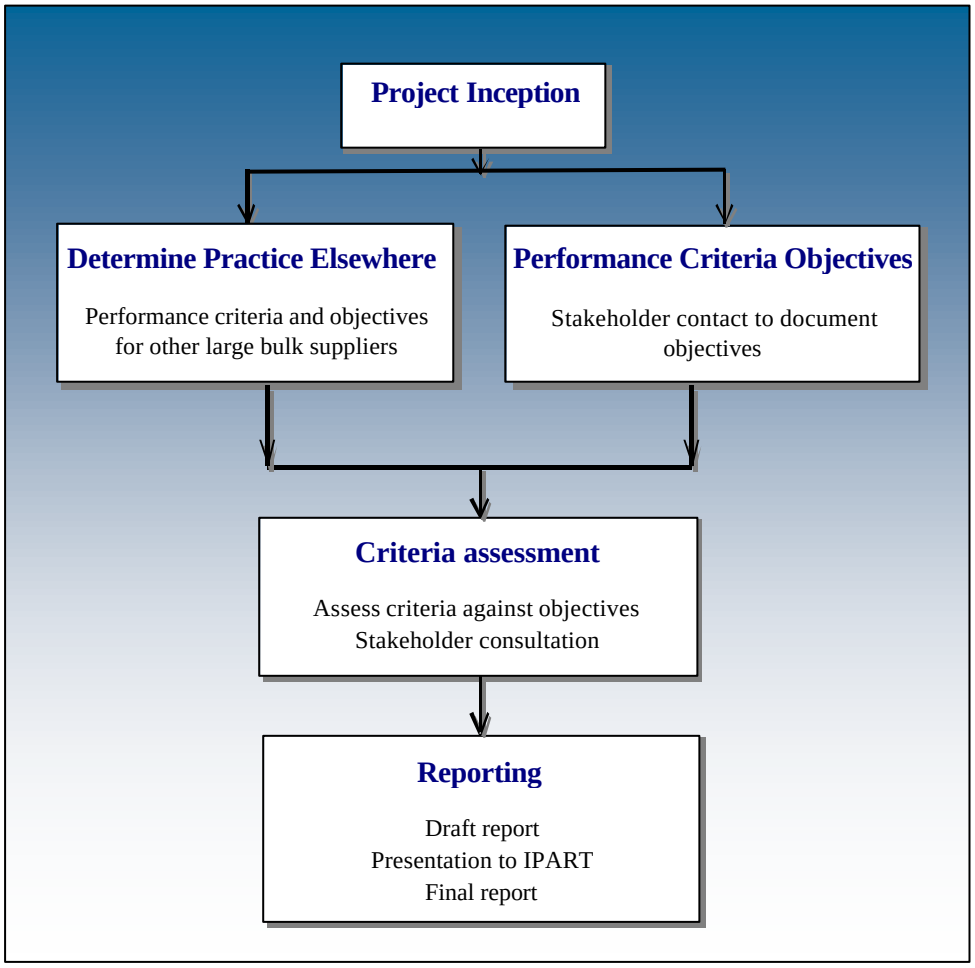
The review of the criteria was undertaken with particular reference to:

- Criteria adopted by comparable bulk suppliers;
- The appropriateness of the criteria in the context of SCA's operating environment;
- Comments by operating licence auditors and, in particular, the 2001 audit;
- Comments made in submissions to the Mid-term licence review and by participants at the associated Tribunal workshop; and
- Ease of application and clarity.

1.3 Methodology

The methodology used for this study is shown schematically in Figure 1-1.

Figure 1-1 Project Methodology



The main tasks involved the following:

- *Determination of Practice Elsewhere:* Major urban bulk water suppliers throughout Australia were requested to provide information regarding the performance criteria that they used. These organisations were also asked to provide, as far as possible, the background rationale for adopting those criteria. In particular, what were the specific objectives in relation to supply security that needed to be satisfied and how did these relate to the criteria against which performance in achieving them is measured?

  Two overseas organisations that manage large urban water supply systems with similar characteristics to Sydney's were also requested to provide similar information. A list of the organisations contacted can be found in Section 4.

- *Determination of Performance Criteria Objectives:* The key stakeholder organisations associated with Sydney's water supply and with management of its water supply catchments were also consulted to obtain their input to the review, in particular regarding the objectives that should underlie the performance criteria. The following organisations were consulted through interviews with members of the project team or for review of documents:
  - *Sydney Water Corporation;*
  - *The Environment Protection Authority of New South Wales;*
  - *The Hawkesbury-Nepean River Management Forum and its Independent Expert Panel;*
  - *Shoalhaven Water and Wingecarribee Shire Council;*
  - *Ministry for Energy and Utilities;*
  - *Sydney Catchment Authority;*
  - *NSW Health; and*
  - *DIPNR.*

- *Assessment of the Performance Criteria:* An assessment of the SCA's existing performance criteria was undertaken, considering both the criteria employed by the other large urban bulk water suppliers consulted and the relevant objectives identified in the preceding tasks. This assessment involved consideration of the appropriateness of the existing criteria and whether any alternative forms of criteria could be used to better satisfy the objectives. The assessment also considered the appropriateness of the criteria in relation to practical assessment capabilities, clarity of interpretation and ease and effectiveness of application.

1.4 Layout of this report

This report has adopted the following layout and logic:

- **Section 1** introduces the subject and provides background information;
- **Section 2** briefly describes the physical water supply infrastructure concerned to provide the context for the performance criteria;

- **Section 3** presents the current Performance Criteria and the objectives underlying those criteria as perceived by SCA;
- **Section 4** discusses the results of a survey of the performance criteria used by other water supply authorities both within Australia and overseas;
- **Section 5** presents the feedback received from discussions held with the key stakeholders involved with Sydney's water supply, particularly concerning the objectives they see the performance criteria should satisfy.
- **Section 6** identifies the various options for adopting appropriate performance criteria for Sydney in terms of the desirable attributes of those criteria, and the means of addressing the various issues raised by the key stakeholders, and the regulatory framework within which SCA operates. It also assesses the relative merits of the options and recommends, in conceptual terms, the key criteria for consideration in relation to the SCA's supply system.
- **Section 7** addresses the appropriate form and expression to be adopted to define the key criteria, and presents an example of the performance criteria for consideration.
- **Section 8** summarises the principal conclusions and recommendations from this investigation.

2. Water Supply System Yield and Performance Criteria

This section of the report briefly describes the key characteristics of the bulk water supply system for Sydney, as operated by the Sydney Catchment Authority (SCA), and notes some of the relevant performance constraints on the system.

It also describes how the system yield of water supply systems, such as the Sydney system, is determined and provides important definitions for the terms commonly used.

It concludes by providing a short review of the performance criteria that can be applied to water supply systems in general.

2.1 The SCA Supply System

The SCA supplies bulk water to the Sydney Water Corporation (SWC) for treatment and supply to the Sydney metropolitan area, as well as to local government areas outside the Sydney distribution system. Overall, the system supplies, on average, over 600,000 million litres of bulk water per year for over 4 million people.

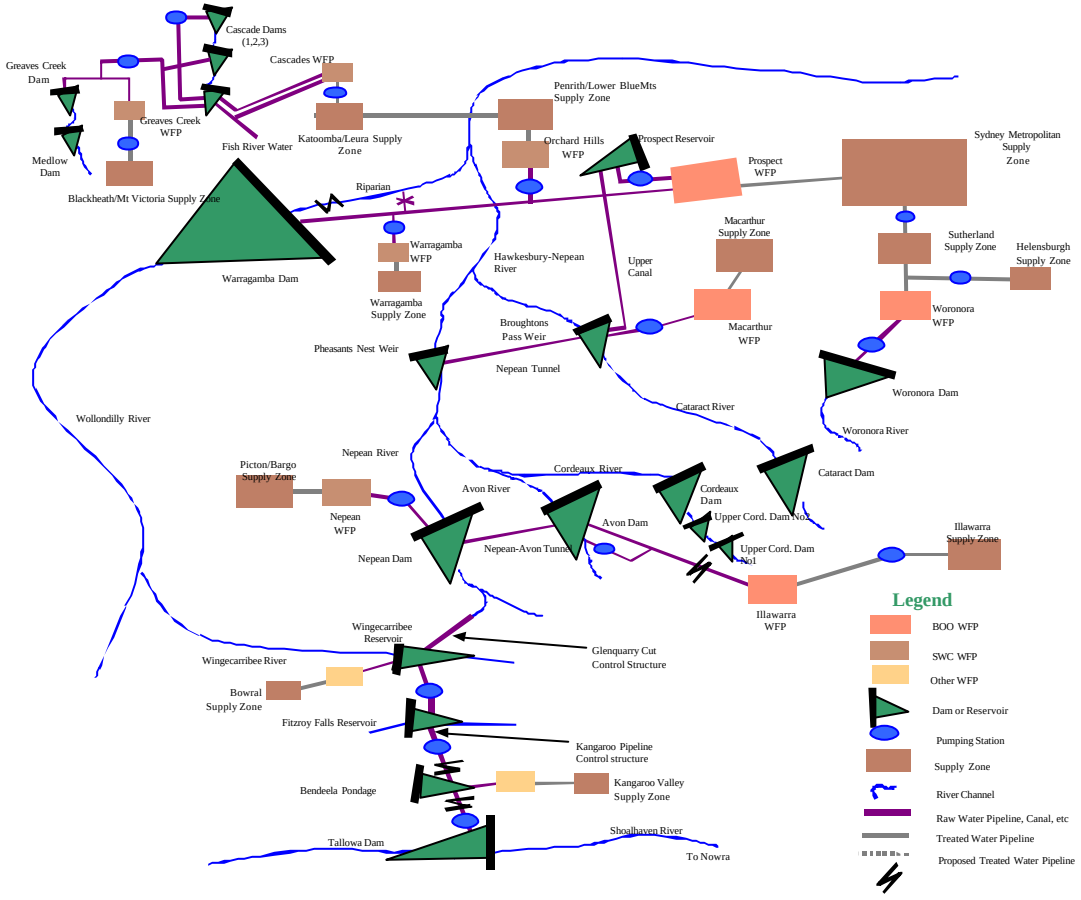
The supply system incorporates infrastructure including the Shoalhaven System, the Warragamba and Blue Mountains Dams, the Upper Nepean Dams and the Woronora Dam. Bulk water is supplied from the SCA's system of 18 major dams and 2 diversion weirs, through a network of pipelines and canals, to 11 water filtration plants. Small volumes of raw water are also supplied to a small number of minor customers directly from the storages, pipelines or the Upper Canal. The SCA system does not include the water filtration plants - SWC owns and operates five of these, four are privately built, owned and operated (under agreement with SWC) plants, one is owned and operated by the Wingecarribee Shire Council and the remaining one by the Shoalhaven City Council.

The supply system, shown schematically in Figure 2-1, comprises six main components:

- The Prospect Reservoir System;
- The Upper Nepean Dams and Upper Canal System;
- The Woronora Dam System;
- The Warragamba Dam and Warragamba Pipeline System;
- The Shoalhaven System; and
- The Blue Mountains System.

The system is operated to supply demands drawn through the water filtration plants, which effectively define the points of demand on the SCA bulk water supply system.

■ **Figure 2-1 Schematic Outline of SCA's Bulk Water Supply System (source: SCA)**



In the early 1960's the Blue Mountain System was connected to the Fish River water supply scheme. This connection has provided increased flexibility to source the best quality water, and provides a supplement to the Blue Mountains supply sources, as required, during dry periods or whilst maintenance work is carried out. In addition, SWC draws water from the Hawkesbury-Nepean River at North Richmond for supply to customers in that region. This water is treated at the North Richmond Water Filtration Plant. The SCA is not required to make specific bulk supplies for North Richmond. Flows from local catchments and environmental releases from the SCA's storages sustain supply to that plant. This is also the case for agricultural demands drawn from the river below the SCA's storages. As such, these agricultural demands and the demand at the North Richmond WFP are not explicitly included as part of the demand for bulk water upon which the yield of the SCA's supply system is based.

2.1.1 Water Management Licence Requirements

In addition to providing water for urban use, SCA's Water Management Licence, which is issued and regulated by DIPNR, currently specifies provisional environmental flow releases required for each of its water management works. These release requirements are being reviewed through the Hawkesbury-Nepean River Management Forum and it is envisaged that a more rigorous environmental flow regime, consistent with sustaining the long term health of the Hawkesbury–Nepean system, will be recommended to Government. The releases currently specified correspond to passing the 95th percentile flows (shown and explained in Table 2-1, and the glossary) while inflows are equal to or greater than those flows, and passing the natural inflow when this is less than the 95th percentile flow. No environmental flow releases are required when the works are spilling naturally.

■ **Table 2-1 Environmental flow release requirements specified in SCA's Water Management Licence – 95th percentile flows**

Water Management Works	95th Percentile Flows [1]
Warragamba Dam	33.3 ML/day
Cataract Dam	1.3 ML/day
Nepean Dam	4.4 ML/day
Pheasants Nest Weir	10.5 ML/day
Broughtons Pass Weir	1.7 ML/day
Cordeaux Dam	1.9 ML/day
Wingecarribee Dam	3 ML/day
Avon Dam	1.8 ML/day [2]

Notes:

1) The 95th percentile flow is the flow, which occurs or is exceeded 95% of the time, in this case the daily flow equalled or exceeded on at least 95 days out of 100. It is a relatively low flow.

2) Currently, due to the physical configuration of the outlet works, a flow of only 1.8 ML/day cannot be released from Avon Dam. With the existing dam infrastructure, the minimum possible downstream release is 25 ML/day (original construction of the outlet infrastructure in the 1920s did not envisage, nor cater for, a smaller release rate).

A release of 90 ML/day or natural inflow (whichever is less) must also be maintained from Tallowa Dam until environmental flow provisions recommended by the Shoalhaven-Illawarra Water Management Committee have been endorsed in a Water Management Plan.

Releases from Woronora Dam are required under an adaptive environmental flow management regime. This comprises transparent flow releases (for which the entire flow entering the water storage must be released) where inflow is less than or equal to 5 ML/day; and translucent releases (for which a specified percentage of the incoming flow to the water storage must be released) when inflow is greater than 5 ML/day but less than 30 ML/day. In addition annual high flow releases (800 ML/day for at least 3 days per year) from January 2003 are required.

The Water Management Licence also has rules governing releases and transfers between the Shoalhaven and Hawkesbury-Nepean catchments and from Wingecarribee Reservoir to the Wollondilly River and to the Nepean Reservoir (Schedule 3 of the licence).

In addition, the Water Management Licence specifies riparian release requirements. The SCA must release a minimum flow of 10 ML/day from Warragamba Dam in addition to the environmental flow releases. When inflow to the Dam is less than 40 ML/day, the SCA must ensure that a minimum flow of 50 ML/day is maintained over Penrith Weir.

Where natural inflow to Tallowa Dam is between 90 ML/day and 180 ML/day (inclusive), the SCA must release Shoalhaven City Council's supply requirements (up to a maximum of 90 ML/day) in addition to the environmental flow releases.

A riparian flow release equivalent to 1 ML/day must also be made from Wingecarribee Dam, and the SCA must ensure a flow equivalent to five thirds of the inflow of Wildes Meadow Creek into Fitzroy Falls Reservoir is maintained over the Fitzroy Falls. This amount was designed to mimic the pre-dam inflow volume and is subject to review during the course of the licence.

The Hawkesbury-Nepean River Management Forum is currently reviewing the environmental flow provisions and is investigating options that could potentially reduce the yield for consumptive purposes below the current estimate of 600 GL/year.

2.1.2 Operational Considerations

Generally the SCA supply system can be operated so that the points of demand (ie. the water filtration plants) can be supplied with water from several different sources. This ensures that consumers in different supply areas experience equal water supply assurance, or likelihood of water restrictions. There are however some exceptions to this as follows:

- The Raw water from Nepean Reservoir is the only supply source for the Nepean Water Filtration Plant (WFP) through a pumped rising main. This plant supplies the towns of Picton, Oakdale, Thirlmere, Buxton and Green Hills.
- The Illawarra WFP has its own supply by both a gravity pipeline and a pumped rising main from the Avon Reservoir. Water can be transferred from Nepean Reservoir to Avon Reservoir through the Nepean-Avon Tunnel, and this key link in the system is used to ensure supply can be maintained to the Illawarra Supply Zone, with diversions from the Nepean and Shoalhaven catchments.

  Although water is not typically released for supply to Prospect WFP from the Nepean and Avon Reservoirs due to the need to maintain water:

  - in Avon Reservoir to supply the Illawarra; and
  - in Nepean Reservoir to ensure there is sufficient head to enable transfers to Avon Reservoir through the Nepean-Avon Tunnel.

  such releases from Nepean Reservoir are important in balancing overall storage levels during periods of drought.

- Parts of the Blue Mountains system cannot be supplied from the main part of the SCA system.

The Shoalhaven system is a combined pumped storage hydropower and water supply facility. Transfers from the Shoalhaven system into Wingecarribee Reservoir are important during periods of drought to augment supplies to Sydney, the Illawarra and to Wingecarribee supply systems. Raw water can be released from Wingecarribee Reservoir to flow into the Warragamba Reservoir. Supply via this route would not normally be provided due to the expected high level of losses (including river diversions) between Wingecarribee Reservoir and Warragamba Reservoir and to the need to transfer water into the Nepean and Avon reservoirs to maintain supplies to the Illawarra. However, during periods of drought, transfers of water from Wingecarribee Reservoir to Warragamba Reservoir are made based on the balance of requirements in the different parts of the supply system. Current operating rules dictate that pumping from the Shoalhaven system into Wingecarribee Reservoir would start when the total SCA system storage level falls to 60% (known as the “pump mark”).

2.1.3 Supply Constraints

In previous planning, the Welcome Reef Dam, on the Shoalhaven River, had been identified as the preferred option for next major augmentation of the SCA supply system. In September 2001, however, the New South Wales Minister for the Environment announced that plans for construction of this dam would be deferred indefinitely. In March 2003 the Premier issued a news release which confirmed that plans for the dam had been scrapped, and that the Nadgigomar Nature Reserve would be established on land previously purchased for future construction of the dam (Premier of New South Wales, 2003). These announcements have increased the emphasis placed on management of the demand for water, and water recycling and reuse, in contrast to accessing further supply sources and building additional dams, which would have significant associated environmental, social and economic costs.

Although there are potentially other supply side options available for investigation that could increase yield without full scale augmentation, no large, new supply source schemes are envisaged (Pers Comm, SCA). Full scale augmentation options would involve significant costs, both financial and environmental. The SCA system is therefore, to some extent, supply limited.

2.2 Yield estimation

The capacity of a water supply system to supply water is assessed by estimating the system's yield. Yield can be defined as the annual volume of water that can be supplied, on average, by the system subject to:

- The system configuration and operational rules;
- The variability of water inflows (typically streamflows) to the system and of any other climatic factors affecting the system;
- The seasonal pattern of water supply from the system and any associated impacts of climatic variability; and
- The level of service (water resource security performance) criteria adopted for the system.

The yield therefore defines a characteristic of the supply system (its ability to supply water under a specified set of operating conditions), and not the demand that may be placed on the system. Where the demand is less than the yield, the system performance will, in the long term, be better than the performance criteria requirements and there will be some excess capacity for the system to supply demand.

On the other hand, where the demand is equal to or greater than the yield, the system performance will only just satisfy the criteria or will fail against some or all of the criteria. This indicates that the system has no capacity to supply any additional demand, or to supply the existing demand without violating the level of service.

By comparing the estimated yield with forecast levels of demand on the system, an assessment of any potential lack of supply capacity in the system can be made. This flags the need to either investigate options for increasing the yield, or to decrease the demand through demand management in order to ensure that the system demands can continue to be satisfied within the constraints of the required performance criteria.

2.3 Performance measures used for water supply systems

The typical range of measures used for water supply systems are discussed below. These measures, and the limits set on them, provide the basis for the performance criteria adopted for water supply systems.

Figure 2-2 provides a simple illustration of the typical behaviour over time for the volume of water stored in the storage(s) of a (hypothetical) urban water supply system. The diagram provides a simplified representation of two possible states for the system. These two states are shown as two zones – water restrictions applied, and water restrictions not applied, depending on whether the total storage volume is below or above (respectively) the drought restriction trigger shown. This figure can be used to illustrate the fundamental concepts underlying the main types of drought security performance criteria.

It should be noted that Figure 2-2 has been simplified and that there are at least three respects in which the line representing the boundary between "no restrictions" and "restrictions" may be more complex in practice:

(a) The trigger line(s) for entering and ceasing restrictions may be separated (ie. shown as two or more lines instead of one);

(b) The trigger may vary on a monthly basis, especially in areas which experience most of their rainfall at a particular time of the year; and

(c) The trigger will vary according to the predicted average annual demand - that is, restrictions will be triggered earlier for higher average demands.

In general, there are six basic types of system performance measures related to representing water resource security for the operation and planning of urban supply systems. These are outlined as follows.

1) The *Frequency* of restrictions.

This is a measure of the number of occasions in a given period on which restrictions are applied. This can be based on the number of drought events experienced over a defined period that result in periods of restriction being imposed. For example, for the supply system represented in Figure 2-2, around 10 drought events can be identified where the total storage level dropped below the drought restriction trigger over the 50 year period depicted (the number of 10 drought events is approximate and assumes, for the purposes of illustrating the basic concepts, that short durations of restrictions have been lumped together with other periods of restriction). This equates to restrictions being imposed about once every five years, on average, for the hypothetical system.

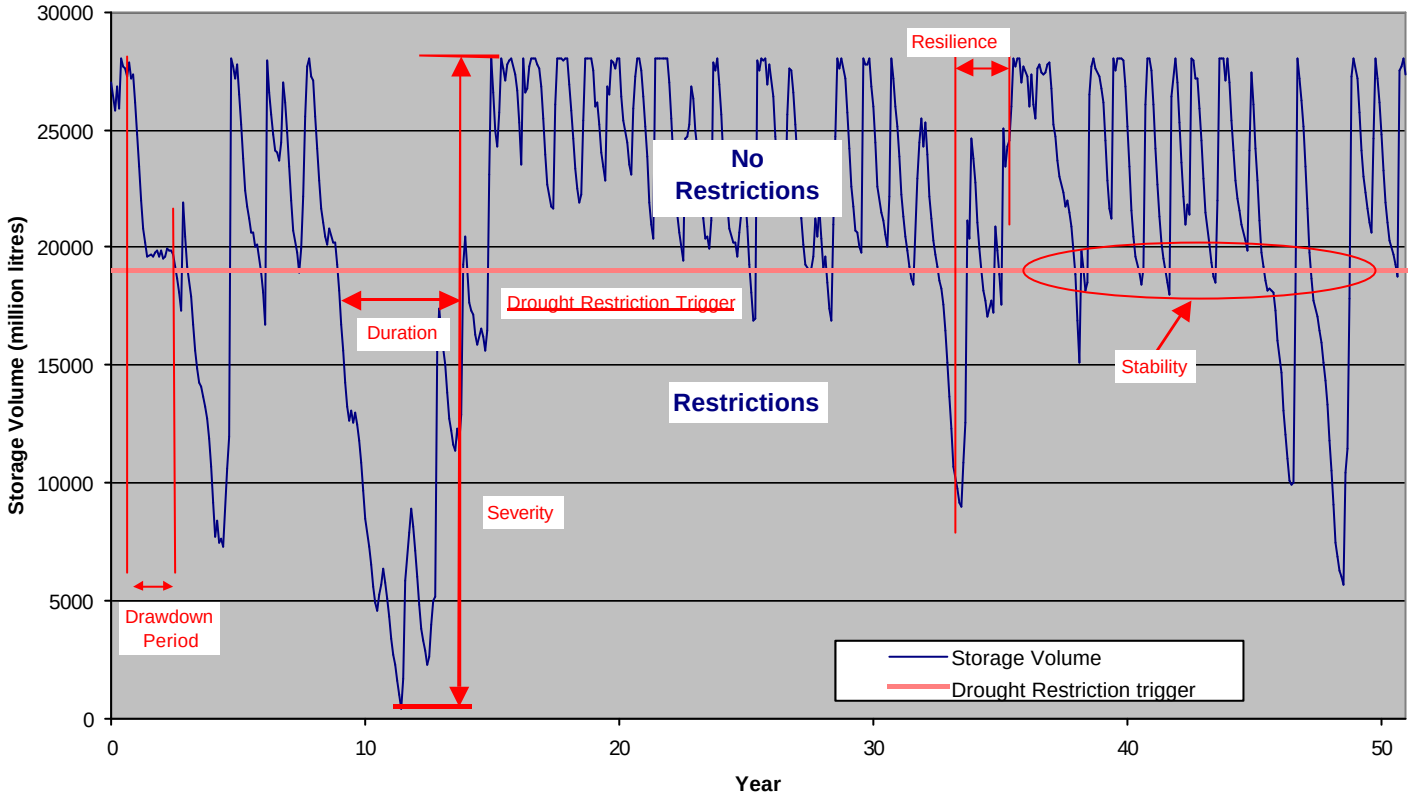
Alternatively, the frequency of restrictions could be based on the number of years over the period in which restrictions applied. In most cases this would be expected to provide an estimate of frequency similar to the event based measure. However, in cases where single restriction events last for more than one year this will not be the case, with the measure based on years in restrictions also incorporating the impacts of the longer duration of the restriction events. For example a single continuous period of restrictions lasting for three years out of ten would be measured as a frequency of 30% if based on the number of years, and only 10% if based on the number of events. In this sense, a measure based on the number of years in which restrictions are applied is not a pure measure of restriction frequency.

2) The *Duration* of restrictions.

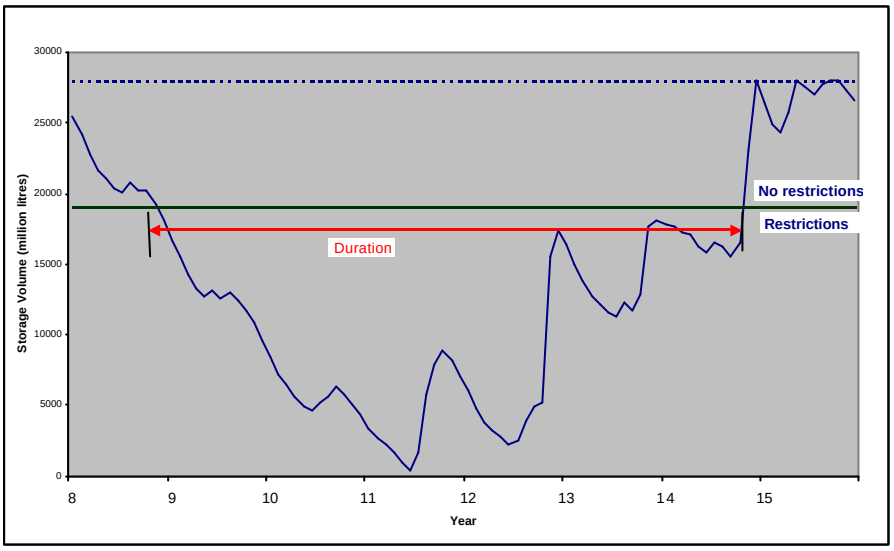
In its simplest form, this is a measure of how long restriction events are likely to be. This can be expressed, for example, as the longest period over which a particular restriction event occurred. For example, such a measure is shown (labelled as "duration") in Figure 2-2 and Figure 2-3, and would typically be expressed as the number of months for which restrictions are applied in that event.

The duration of restrictions can also be expressed as the total amount of time over a defined period for which restrictions are applied. In practice, this is often taken as the number of months in restriction over the entire period considered. For example, in reference to Figure 2-2, a total of 169 months were affected by restrictions over the entire 50 year period. This equates to 169 months out of a total of 600 months (ie. 12 months times 50 years), or about 28% of months overall. The main problem with this as a measure of the duration of restrictions is that, as for measuring the number of years in which restrictions are applied, it tends to incorporate both the number of restriction events and the duration of those events. This effectively gives an estimate of the proportion of time over a long period in which we could expect restrictions to apply, rather than a direct measure of how long restrictions would be expected to apply. For this reason it is a more difficult concept to grasp than the more direct measure outlined in the previous paragraph.

■ **Figure 2-2 Hypothetical Water Supply System Behaviour**



■ **Figure 2-3 Duration of Restrictions**



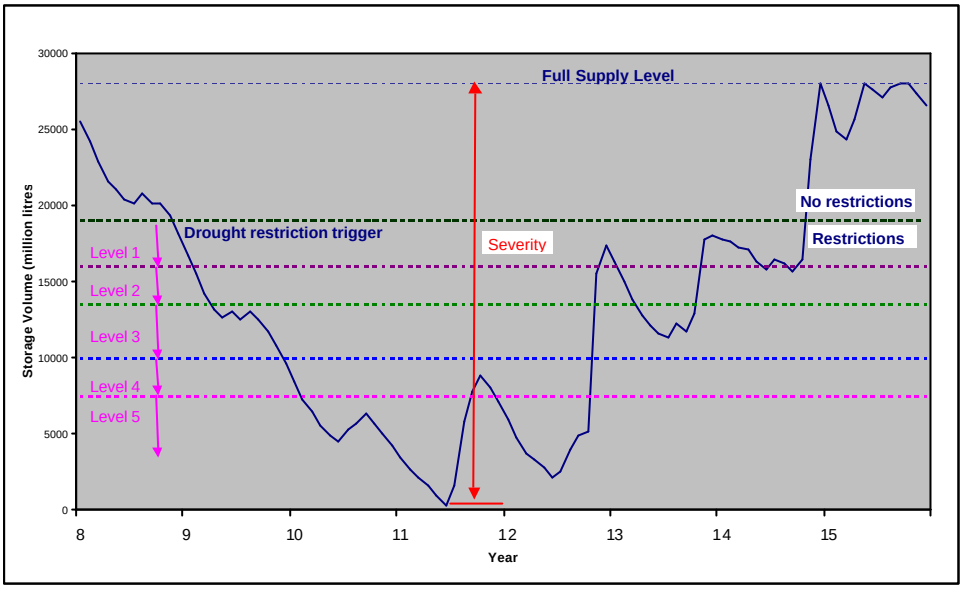
The difference between the two types of measures discussed for duration may be illustrated by using an example of a system that for ten years experiences 3 months of restrictions for each of those years. The duration of restrictions is 30 months out of 120 or 25%. Alternatively it may experience restrictions only once in that time but for 30 months. The percentage would also be 25% but the impact felt by consumers quite different given the length of time spent in one restriction period.

3) The *Severity* of the restrictions.

This provides a measure of the extent to which the system storages may be drawn down during a period of drought. The further the storage level is drawn down, the more severe the level of restrictions that would apply and, importantly, the closer the system gets to running out of water. A severity measure therefore provides insight into the degree to which the community will be affected by the restrictions imposed (inconvenience, hardship, etc.) and of the potential for the continuity of supply for basic needs to be threatened as a result of extreme drought.

Severity can be measured simply as the most severe level of restrictions that would be applied – this relates directly to the inconvenience and/or hardship resulting from the imposition of restrictions. The degree of inconvenience increases with the level of restrictions. For example level 1 restrictions may only limit times of garden watering, level 2 may, in addition, prohibit watering of lawns, and level 3 prohibit all watering except by hand-held hose, and so on. Alternatively, severity can be measured by the extent to which the storage volume has been reduced during a drought event – this can be related more directly to the risk of running out of water. An example of the latter measure is shown in Figure 2-4, labelled "severity". Figure 2-4 also illustrates how increasing levels of water restrictions would be triggered as the water storage level progressively decreases.

■ **Figure 2-4 Restrictions Severity**

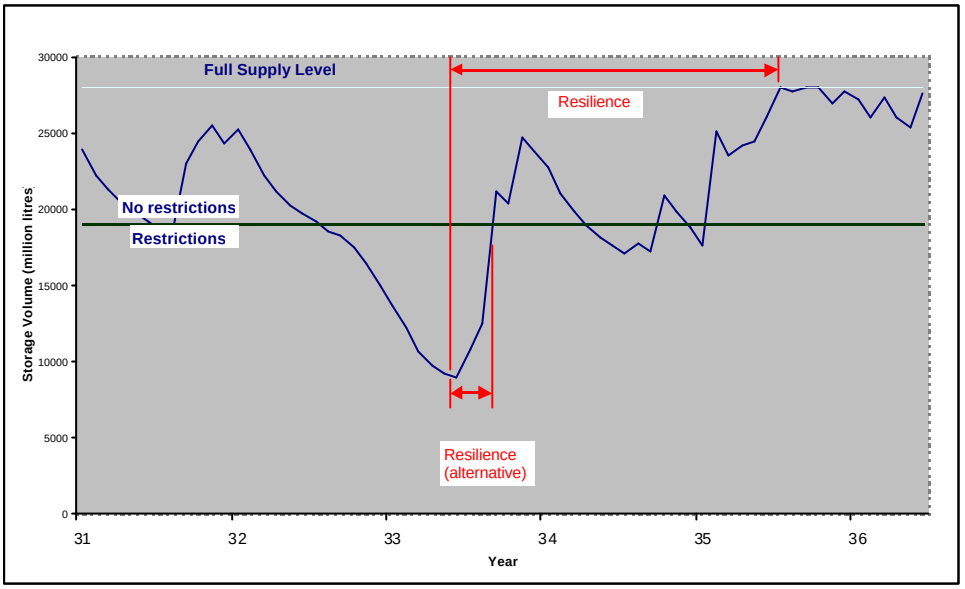


The above measures would typically be those in which the general community, as a consumer of water, is most interested. They are therefore typically the main focus for defining standards of service for water resource security. There are also system performance measures that relate more to the planning and operational aspects of maintaining supply such that the level of service provided to the community meets the community's expectations. As would be expected, these measures tend to be of greater interest to water supply authorities than to the general community. These types of measures are outlined as follows.

4) The *Resilience* of the system.

This provides a measure of the ability of the supply system to recover to a satisfactory condition after the end of a drought period. As an example, this could be defined as the length of time taken for the storage level to recover to full supply volume, as shown in 5 (labelled as "resilience). Alternatively, the time taken for the storage level to recover to a state where restrictions are lifted, could be used. The determination of what a "satisfactory" condition might be for a particular system will depend, to a large extent, on the characteristics of the system.

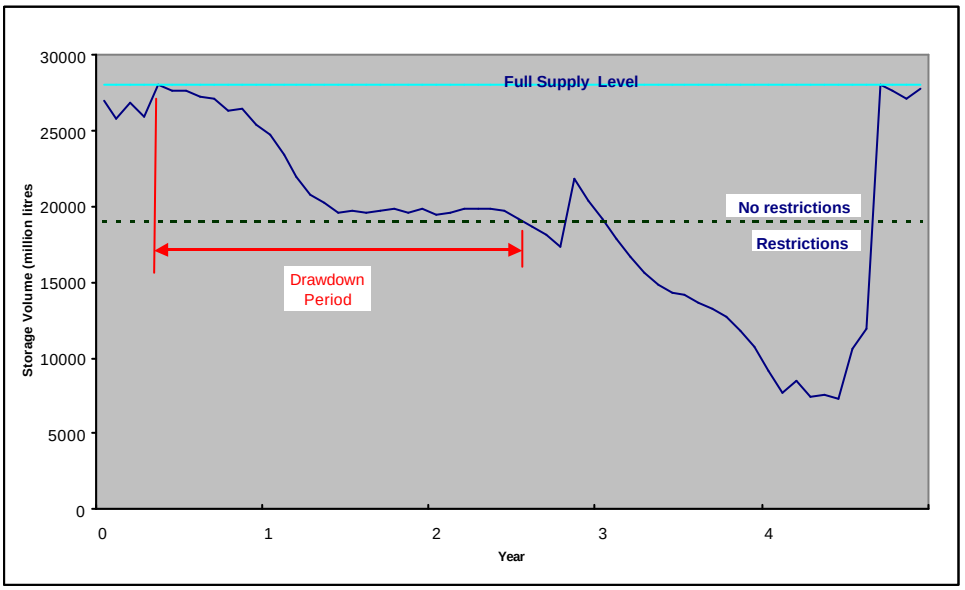
■ **Figure 2-5 System Resilience**



5) The *Drawdown Period*,

This provides a measure of the time taken for the supply system to move from the full supply volume condition to a level where restrictions will be imposed. Such a measure is illustrated in Figure 2-2 (labelled as "drawdown period") and in Figure 2-6.

■ **Figure 2-6 Drawdown Period**

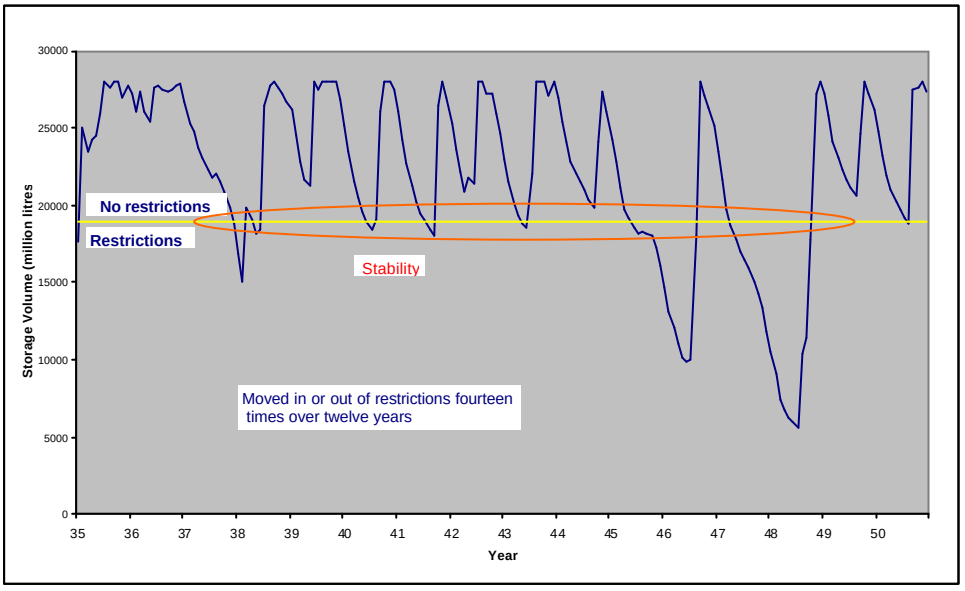


From a technical perspective the term *critical drawdown* refers to the period from the reservoir being full to the lowest point of drawdown during the critical drought. The critical drought is the worst drought on record.

6) The system *Stability*.

This provides a measure of the degree of fluctuation between periods of restrictions and period of no restrictions within a specified (short) period of time. The period of time considered would be chosen based on the characteristics of the supply system and on the expectations of the community (nuisance effect of restrictions being repeatedly lifted and reimposed within relatively short periods of time). Typically, this may be of the order of six months, but for large urban systems is likely to be longer. The area outlined in Figure 2-7 labelled as "stability" illustrates an extended period for the hypothetical supply system over which there is relatively frequent oscillation between restricted and non-restricted periods. Although a measure of the stability of the system could be of interest to the community, in practice it may be used by a water supply authority more as an indicator for internal operational purposes to ensure that explicit standards of service (eg. frequency, duration and severity of restrictions) can be maintained over a range of climatic and operational conditions.

■ **Figure 2-7 System Stability**



Overall, no single performance measure will generally be sufficient to adequately represent the desired standards of service. A combination of measures is required to ensure that all aspects of interest to the community are dealt with. Typically, this may involve the use of a number of performance measures, including measures relating to the frequency, duration and severity of restrictions.

2.3.1 The context of performance criteria

Water resource security performance criteria express the community expectations about the reliability of their water supply. Because improving this reliability costs money (and in addition has social and environmental implications) these criteria also

reflect a trade-off between the social and economic costs of disruption to, or shortfalls in, water supplies and the social and economic cost of taking measures to ensure those shortfalls do not occur. Those measures may comprise providing new water sources or reducing demands (demand management). Because the supply is dependent on rainfall and associated catchment runoff to storage reservoirs, which varies every year, the water supply availability needs to be expressed in terms of a probability, or risk, of not being able to continue supply without imposing water restrictions. The level of risk of water supply shortfall that societies are prepared to tolerate varies and may depend on:

- The cost of supply augmentation; and
- Memories of the cost, inconvenience and disruption caused by water restrictions in preceding droughts.

Recently there has been a growing awareness of the importance of considering the environmental cost of large water supply schemes, which historically has been less important. As such, the pendulum has now swung away from developing new supply sources towards demand management and, in some cases, the acceptance of higher levels of risk of supply shortfalls.

Demand management implicitly incorporates higher levels of risk tolerance in water resource management, as it leads to “demand hardening” and an associated reduction in the efficacy of water restrictions.

3. SCA's Current Operating Licence and Performance Criteria Objectives

3.1 Performance Criteria

Sydney Catchment Authority was established in 1998 to separate the responsibility for Bulk water supply from those for water treatment and distribution which, historically, had all been undertaken by Sydney Water Corporation. The *Sydney Water Catchment Management Act, 1998* was passed which established the Authority in its role as catchment manager and bulk water supplier to the Sydney Water Corporation, and set out its' responsibilities. These were defined in the *Sydney Catchment Authority Operating Licence* which was issued under the Act and amended in April 2000 and are, in summary, as follows:

- Compliance with the Operating Licence and all applicable laws; and
- Management and protection of the Catchment Area and Catchment Infrastructure Works to promote water quality et al;
- To conduct its operations in an ecologically sustainable manner;
- To manage the Catchment Infrastructure Works efficiently and economically and in accordance with sound commercial principles.

Clause 5.1 of the Operating Licence refers to the Bulk Water Supply Agreement between Sydney Catchment Authority and Sydney Water Corporation. The terms of the Agreement include stipulations concerning

(a) The standard of the quality of the water supplied;

(b) The continuity of the water supply;

(c) The maintenance of adequate reserves of water by the Authority; and

(d) The cost to be paid by Sydney Water Corporation for the supply of water to it.

To satisfy items (b) and (c) above Sydney Catchment Authority (SCA) has an obligation under Clause 8.1.2 of its Operating Licence to:

"….ensure that Catchment Infrastructure Works are designed, operated and managed to provide Sydney Water Corporation with a long-term standard of services which accords with the performance criteria set out in Schedule 2."

Schedule 2 of the Operating Licence specifies three performance criteria relating to long-term standards of service. These are set out as follows:

Reliability

Reliability is defined in Schedule 2 as *"….the percentage of months, on average, that the Authority* [SCA] *will meet in full Sydney Water Corporation's Forecast Average Annual Demand requirements referred to in paragraph (f)…."*.

The performance criterion specified for reliability is that it *"….. is to be not less than 97% ...."*, meaning that *"…. it is estimated that, on average, restrictions will not need to be applied more often than 30 months in 1,000 months."* This means that restrictions would not be in force for more than 3% of the time overall and is therefore, technically, a measure of the *frequency* of restrictions with time measured on a monthly scale. However, given that a monthly timescale is very small compared to the overall period over which the performance is conceptually being assessed (ie. over the long term), this measure also includes mixes characteristics of a duration measure with the frequency measure (see discussion in Section 2.3).

Robustness

Robustness is defined in Schedule 2 as:

"…. The percentage of years, on average, that the Authority [SCA] *will not require a reduction in Sydney Water Corporation's Forecast Average Annual Demand for Bulk Raw Water referred to in paragraph (f) …."*.

A "year" is further defined in the relevant clause as *"…. each period of 12 months commencing on 1 July …."* and a year will have been affected by restrictions *"…. if in any day of that year a restriction has been applied."*

The performance criterion specified for robustness is that it *"….. is to be not less than 90% ...."*, meaning that *"…. it is estimated that, on average, not more than 10 years in 100 years will be affected by restrictions."*

This measure is another form of *frequency* measurement limiting the number of years, on average, that water restrictions may be applied.

Security

Security is defined in Schedule 2 as:

"…. The level of the Authority's [SCA's] *operating storage below which actual storage is not to fall, on average, more often than 0.001% of the time."*

The performance criterion specified for security is that it *"…. is to be not less than 5% …."*. This means that *"…. On average, the level of operating storage will not fall below 5% more often than one month in 100,000 months."* Effectively this means that for only one month in 8,333 years is it permissible for the modelled trajectory of the storage levels to be less than 5%. This criterion is intended to ensure that the system would not run out of water.

Paragraph (f) in Schedule 2 of the Operating Licence specifies Sydney Water Corporation's Forecast Average Annual Demand for the five years from 2000 to 2004 as shown in Table 3-1.

- **Table 3-1 Sydney Water Corporation's Forecast Average Annual Demand as set out in paragraph (f), Schedule 2 of SCA's Operating Licence**

Year	Forecast Average Annual Demand (ML/year)
2000	595,000
2001	588,000
2002	586,000
2003	584,000
2004	583,000

Paragraph (d) of Schedule 2 of the Operating Licence states that these performance criteria assume *"…. That, contingent upon the Authority* [SCA] *giving Sydney Water Corporation reasonable prior written notice of the need to do so, Sydney Water Corporation will reduce its demand for water from the Authority in accordance with the following restriction levels:*

Level I	*at least a 7% demand reduction,*	*not more than 3% of time;*
Level II	*at least a 12% demand reduction,*	*not more than 1% of time;*
Level III	*at least a 20% demand reduction,*	*not more than 0.5% of time;*
Level IV	*at least a 30% demand reduction,*	*not more than 0.3% of time;*
Level V	*at least a 50% demand reduction,*	*not more than 0.05% of time."*

3.2 Performance Criteria Objectives

Discussions held with Sydney Catchment Authority indicated that the objectives for the performance criteria within their Operating Licence were as follows:

- The fundamental objective was to ensure that the system would not run out of water. In this respect the performance criteria should be interpreted in a context that includes the Drought Response Plan.
- In achieving this primary objective, the water restrictions to be imposed should not be excessively frequent, severe, or last too long from the perspective of the community.
- Clear documentation of the service standard to be provided to the community.
- Provision of an important tool for long term planning that indicates the need to bring available supplies and demand into balance.

The performance criteria were originally an engineering device to assist planning which recently had also been adopted as a customer service standard. The criteria that govern the frequency, duration and severity of restrictions must be seen as a package in which the individual criteria can be traded off against each other to guard a minimum volume of storage and maintain supply continuity.

3.3 Compliance with Performance Criteria

IPART carries out an annual audit of SCA's compliance with the Operating Licence obligations for which SCA must demonstrate compliance with these performance criteria. This also raises the question as to what SCA can actually do to ensure that the criteria are met and hence what its obligations are. This issue is discussed in Section 5.3. The following deals with how compliance may be determined.

3.3.1 Determining compliance

In order to determine whether or not the SCA supply system complies with the long-term standards of service defined by the licence performance criteria, an assessment must be made of the levels of service provided for the forecast average annual demands shown in Table 3-1. From a practical perspective, such an assessment cannot be based on observed system performance. The very nature of the performance criteria, in particular that they relate to performance, on average, over the long-term, means that some form of model must be used to represent the response of the system in supplying the required demands. Actual observations of system behaviour will typically be limited to only short periods of record over which system operation (including the level of demand supplied) is representative of the conditions relevant to the assessment. These observations will also only give a "snapshot" of how the system has performed over a relatively short period, and will not provide a reliable guide of long-term performance.

The SCA utilises a monthly water supply system simulation model developed to represent the behaviour of its supply system. This model has been developed using the WATHNET simulation modelling software.

The WATHNET model of the SCA's supply system therefore provides the means by which compliance with the long-term standard of service criteria can be assessed. To assess this compliance, the model is run setting the annual demands on the system equal to the Sydney Water Corporation's Forecast Average Annual Demand (Table 3-1) and the performance measures outlined above (for reliability, robustness and security) are calculated from the model output. These are then compared to the standard of service criteria to determine whether or not the system (as represented by the model) complies.

3.3.2 Yield estimation

The yield of the SCA supply system is estimated by running the WATHNET model for different levels of average annual demand and determining that level of demand for which the system is just able to meet all the performance criteria. This gives the annual volume of water that could be supplied from the system, on average, whilst satisfying the supply security criteria. Based on the currently available information, the SCA WATHNET modelling provides a yield estimate of 600,000 million litres (ML) per annum for the SCA bulk water supply system in its current configuration and under current operating practices.

The present performance criteria do not specify whether the projected demands to be used in the model should be the average demands as stated in Table 3-1 or whether those demands should be adjusted to include climate induced variability. Current practice is to use the former. The inclusion of variable demands according to climatic conditions is considered more realistic, and will tend to prevent over estimation of the system yield. Similarly other factors influencing demand such as population change and climate change should be included in the projections to ensure they are as realistic as possible. It has been recommended (SKM 2003) that this practice be adopted in preference to current practice and this recommendation is endorsed here.

4. Security of Supply Performance Criteria Elsewhere

4.1 Performance Criteria used by the Bulk Water Suppliers

A selection of the major bulk water supply agencies within Australia were contacted to provide the performance criteria that they use to manage and operate their water supply systems. They were also requested to provide the underlying objectives of the performance criteria.

In addition, two overseas organisations, which were considered to have similar conditions to Sydney (ie multi year storage, high rainfall variability, and exposure to multi year droughts) were contacted.

The organisations contacted are listed in Table 4-1.

■ **Table 4-1 Organisations contacted for survey of performance criteria**

Water Supply Agency	Supply area
Australia	
ACTEW	Canberra
Barwon Water	Geelong
Brisbane Water/	Brisbane
Gold Coast Water	Gold Coast
Hobart Water	Hobart
Hunter Water	Newcastle
Melbourne Water	Melbourne
Power and Water	Darwin
SA Water	Adelaide
Water Corporation of Western Australia	Perth
Overseas	
Department of Water Affairs	South Africa
Metropolitan Water District of Southern California	Los Angeles

Respondents generally provided their performance criteria in terms of the specific criteria that they utilised to protect minimum storage levels and the maximum frequency, duration and severity of restrictions. Very little information was provided on the objectives underlying those criteria and it appears likely that the criteria have been adopted on the basis of acceptance of conventional practice.

The performance criteria used by these organisations varied principally in relation to the rainfall variability and exposure to multi-year droughts of their region. Those with highly dependable supply systems that have the capacity to reliably supply all demands without restrictions did not utilise criteria similar to those for Sydney. These areas may be described as “non- resource constrained”. This is in contrast to most areas in Australia which are “resource constrained”, and where the supply systems do not have the capacity to supply all demands without restrictions in times of drought.

4.1.1 Non-resource constrained areas

The focus in these areas was generally on the water delivery system, which tended to be the limiting constraint rather than the dams, as commonly river flows are sufficiently large and reliable to require minimal storage requirements.

The Metropolitan Water District of Southern California (MWD) supplies water to a service area supporting over 16.5 million people and a US$500 billion economy. That authority adopts a policy objective as follows:

> *Through the implementation of the Integrated Resources Plan, Metropolitan and its member agencies will have the full capability to meet full-service demands at the retail level at all times.*

This policy is considered by the MWD to provide a solid foundation for a strong economy. The region's water supply is estimated to be 100 percent reliable during the next ten years. (Pers Comm, MWD). This means that, according to MWD (MWD 1996) there is an assurance that all demands for Southern California retail customers can be satisfied for all foreseeable climatic conditions over the next ten years. MWD's current practice for implementing this is "to develop supplies that are available at least ten years in advance of need to ensure water supply reliability". Furthermore, to provide a "margin of safety", MWD estimates the demands on its system to be 6 to 16 percent higher than the projections presented in the member agencies' urban water management plans (MWD, 2003). This additional allowance on top of the demand projections provides a further layer of supply assurance.

Some Australian water authorities also have, effectively, non-resource constrained systems, and assume a 100 percent reliability of their water supplies with a "no failure" approach. This approach is not suitable for resource constrained areas such as SCA's, and hence is not appropriate to adopt for Sydney.

4.1.2 Resource constrained areas

The performance criteria used by authorities in areas where the water resource was more constrained, requiring significant storage capacity, were generally similar to those currently used for Sydney. They included criteria for:

- Planning to ensure a minimum buffer storage would be maintained within the system as a contingency against a drought sequence more severe than could be foreseen based on the historic record;
- Not imposing restrictions too frequently;
- Not imposing restrictions for excessively long periods; and
- Not imposing restrictions that are excessively severe.

Not all authorities used all of the above criteria, and some specified additional aspects:

- A minimum duration for restrictions (of two weeks) to prevent customer confusion;
- Fairly detailed specification of the level of curtailment and differentiation between the different types of customer - for example, between domestic and industrial consumers. This model also recognised "strategic" water consumers, such as power stations, for which water should be provided at a very high level of assurance.
- In one instance the minimum storage to be protected was stated as a proportion of the average annual demand rather than as a proportion of total storage.

4.2 Relevance to Sydney's water supply system

Sydney's system is resource constrained rather than non-resource constrained. The form of criteria discussed in Section 4.1.2 are therefore relevant. It is considered that the performance criteria in the SCA's Operating Licence generally cover the requisite areas conventionally used by bulk water suppliers for such systems.

The concept of linking the planned minimum storage to a proportion of average annual demand that is closely related to the time required to implement a drought contingency plan may be beneficial for (and worth further consideration in relation to) the Sydney system.

5. Objectives Underlying Performance Criteria

In order to ascertain the key objectives underlying the performance criteria, a series of discussions were held with the organisations listed in Section 1.3. These discussions, combined with the responses from the survey of urban bulk water suppliers, are summarised in this section.

5.1 Objectives of Supply Authorities within Australia and Overseas

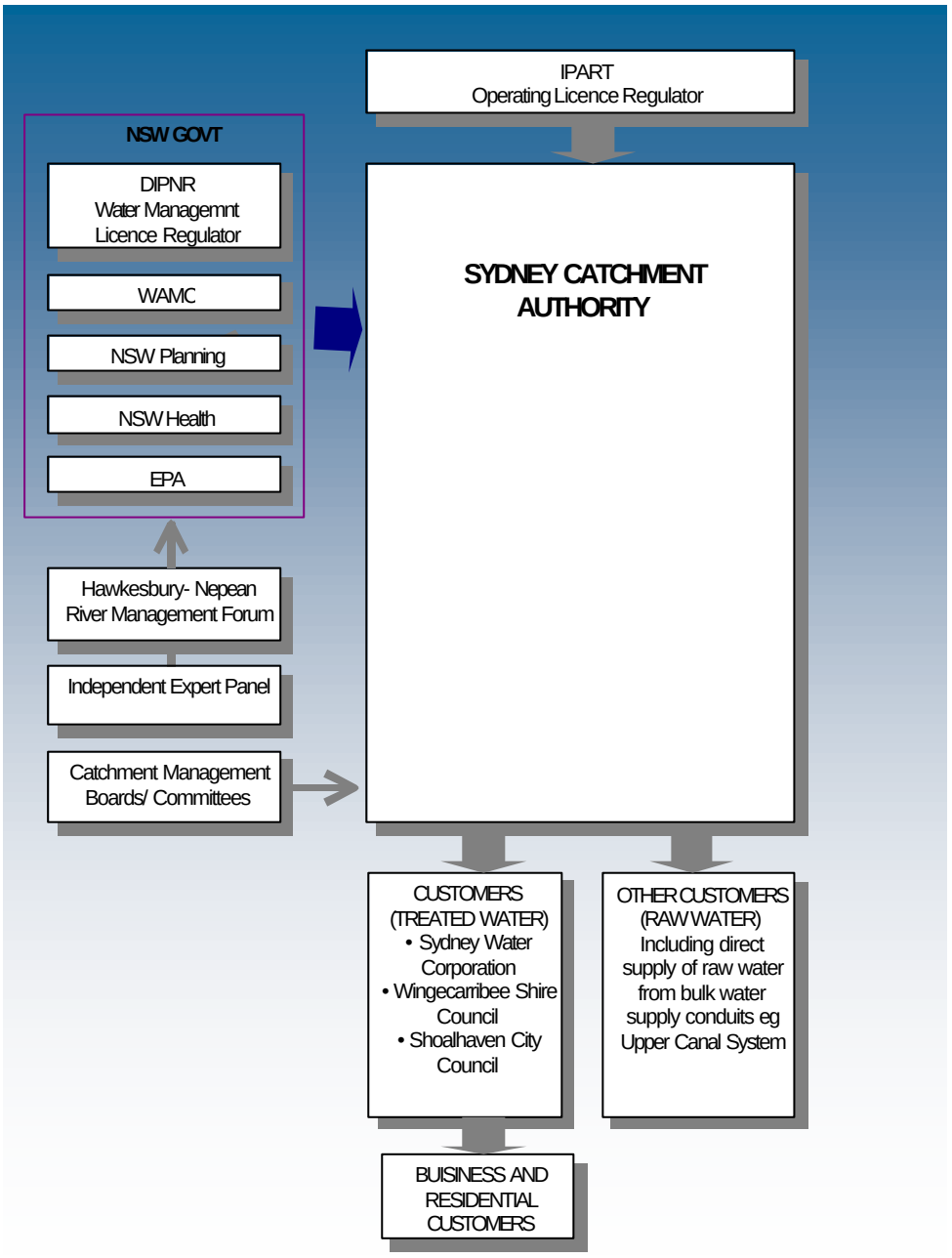
The feedback received from the survey of urban bulk water suppliers is summarised as follows:

- The community would consider it unacceptable for a large city to run out of water. The economic, environmental and social/health consequences of such an occurrence would not be tolerated by a modern society. This objective is fundamental to all stakeholders.
- Ensuring a continuous water supply requires that the supply authority has a robust Drought Response Plan. It would need to be robust in, at least, the following senses:
  - Realism of lead times for the implementation of emergency supply augmentation, including allowance for environmental and other approval processes that may be required;
  - Allowance for possible water quality problems associated with low flow and low storage levels in the usual sources;
  - Realism of the expected reduction in demand in response to restrictions – especially in the light of demand hardening following the introduction of water conservation measures;
  - Allowance for the differing water security requirements of different types of consumers; and
  - Allowance for modelling uncertainty.
- To ensure the key primary objective (not to run out of water) is met would require, for resource constrained system such as the SCA's (see Section 4.1.2), that the water supply be curtailed in times of drought. A set of secondary objectives would then be required to focus on the level of disruption this may cause. These secondary objectives aim at ensuring that the *frequency*, *duration* and *severity* of those curtailments are not excessive for the consumers.

5.2 Objectives Relevant to Sydney's system

Figure 5-1 illustrates the relationships between the Sydney Catchment Authority and other key stakeholder organisations that are relevant in relation to its bulk water supply operations and in relation to the performance criteria.

■ **Figure 5-1 Inter-Organisational Structure: Sydney Catchment Authority**



Discussions were held with the key stakeholder organisations during the period from 7th to 9th May 2003. There was general acceptance of the objectives for the performance criteria as outlined in Section 5.1 above and restated below.

- The primary objective is to ensure that the system does not run out of water;

- The secondary objectives are to ensure that the frequency, duration and severity of water restrictions that may be anticipated in ensuring the primary objective is achieved are acceptable to the community being served.

In addition some of the added perspectives were:

- Sydney Water Corporation (SWC)
  - The fundamental issue was "never" running out of water. The use of the word "never" needed to be understood in the context of the Drought Response Plan which included a Contingency Plan;
  - It was unclear whether the system performance criteria belong in an Operating Licence given that the criteria relate to planning as opposed to operations. There was concern that the inclusion of the criteria may unduly limit operational flexibility.
  - It was unclear whether the inclusion of forecast water consumption was appropriate, for example because of the difficulties it introduced if consumption in a given year exceeded the forecast consumption.
  - It was necessary to review the assumed water savings in response to restrictions. These had not been tested and would have been affected by demand hardening following the introduction of water conservation measures. Although the projected savings are not directly comparable, Table 5-1 is an indication that the anticipated savings may be over optimistic. Furthermore one of the objectives set for the Melbourne supply is that restrictions should never exceed Stage 3 restrictions.

Table 5-1 Anticipated savings from water restrictions

Metropolis	Savings as percentage of average annual demand Level of Drought					
	Voluntary restrictions	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Melbourne	0	6%	11%	18%	22%	N/A
Sydney	0	7%	12%	20%	30%	50%

Note: N/A means not applicable.

  - SWC/SCA were conducting a survey on customer preferences on water conservation versus water restrictions. Results were expected in October 2003;
  - SWC and the SCA endeavour to maintain equal security throughout all parts of the system. This is not an explicit requirement of the Operating Licence. Ongoing review (particularly during drought operations) of the Drought response Plan and associated actions may result in different trigger levels for operational measures and actions for different parts of the supply system in order to maintain equal security of supply; and
  - SWC is not wholly responsible for the demand for water. Managing of the demand, in order to moderate it, required a "whole of government" approach to achieve maximum success.
- Environment Protection Authority (EPA)
  - EPA's concern related to the environmental outcome of the performance criteria. As such they wished the criteria to be expressed in a manner that promoted the sustainable use of the resource;

- The way the performance criteria are currently expressed is undesirable, as they appear to be *demand driven* rather than *supply limited*;
- EPA would prefer the sustainable yield to be explicitly stated (eg. 600 GL/year) so that it reflected the limited nature of the resource and provided a focus for demand management;
- EPA would prefer a whole of catchment approach that stated the whole yield of the system and apportionment to the environment and to all other users;
- Transparency and simplicity of the criteria to be adopted would be a key issue;
- The criteria must adequately address competing uses for the water; and
- Before any changes were implemented to the criteria the cost implications would need to be assessed.

- Hawkesbury-Nepean River Management Forum and Independent Expert Panel
  - The curtailment of environmental flows in times of drought is already addressed outside the SCA's performance criteria, as these flows will be specified (in the Water management Licence) in terms of "transparent" and "translucent" flows which reflect inflows (see glossary for explanation of these terms). Calculations to determine the environmental flow requirements are based on over 100 years of the flow regime. As such, periods of drought are already taken into consideration. Separate criteria are not required for the environmental flows.
  - There is a potential equity issue regarding water transferred from the Shoalhaven system. Setting the pump mark (see glossary) to 60%, before the introduction of restrictions (stage 1) at 55% of overall system storage, means that the water resources in the Shoalhaven system may become stressed before restrictions are commenced in the Sydney Metropolitan supply system.
  - The security criteria are currently too generic – different water supply securities were suggested for different types of water use. Potentially, this could be supported by cost differentiation between different levels of security;
  - Demand management cannot be carried out by Sydney Water alone. It requires a "whole of government" approach;
  - Security criteria should apply to all parts of the system equally;
  - The Hawkesbury-Nepean River Management Forum Expert Panel is looking at the potential impacts of environmental flow requirements on yield. The environmental flow options currently under investigation may, upon implementation, substantially reduce the system yield below the current estimate of 600 GL/year (Hawkesbury-Nepean Management Forum (2003). Changes in the environmental flow requirements would most likely be accompanied by more stringent flow measurement and monitoring requirements;
  - The Forum is also interested in the issue of whether some areas may not (due to the more isolated nature of their connection to the system) currently meet the supply performance criteria;

- The performance criteria need to be considered more broadly in terms of all users of water across the catchment. It is anticipated that the broader water allocation requirements for the catchment would be accounted for in the Water Management Licence specifications.

- Shoalhaven Water and Wingecarribee Shire Council
  - Although these two organisations source a significant amount of their bulk water supply from the SCA's system, they do not consider it appropriate to incorporate security of supply for their systems in the SCA Operating Licence. This is because they also have alternative sources that have different characteristics to the SCA sources, and should not have constraints that may not be relevant governing the operation of their systems.

- Ministry for Energy and Utilities
  - It is appropriate for the performance criteria to remain within the Operating Licence to reassure customers that their water supply is safe. This also provides an enforceable vehicle that is regularly monitored;
  - The performance criteria should be matched to the performance criteria for Sydney Water, and be complementary to them so that the two organisations are not driven in opposite directions. The SCA's performance criteria should focus on supply management and Sydney Water's on demand management.

- Sydney Catchment Authority
  - Sydney Catchment Authority consider that it is appropriate for the performance criteria to remain within the Operating Licence, as they provide an important indicator of the standard of service to be provided to customers;
  - Sydney Catchment Authority echoed many of the issues raised by Sydney Water. These included:
    - The need to review water savings that could be achieved by imposing water restrictions in the light of demand hardening and other issues;
    - Their joint operational endeavours to maintain equal security across the entire system;
    - The joint survey to establish customer preferences on water restrictions;
    - The need to simplify the criteria to make them easier to understand; and
    - Sydney Water, by itself, could not control the demand for water. A "whole of government" approach is required for this;
  - Sydney Catchment Authority advises against reducing the level of reliability from 97% to 95%, as this reduces the contingency for modelling uncertainty and the likely overoptimistic estimates for water savings from restrictions; and
  - It is considered that it may be useful to include the yield estimate together with the criteria in order to provide a focus for demand management. This would provide a clear and transparent statement of the yield and establish the SCA's accountability to operate the system consistent with providing that yield. This is in contrast to the specifications in the current Licence, which seem to relate more to an obligation to ensure that supply can meet (potentially increased) levels of demand into the future.

5.3 How Should These Objectives be Achieved?

The key objectives outlined relate to not running out of water, whilst maintaining a certain desired level of service (in terms of frequency, duration and severity of restrictions) to the community. These can be achieved by ensuring there is sufficient water available to meet demand or, alternatively, by ensuring that the level of demand does not exceed available supply. Traditionally the focus was on increasing supply to match demand. Community expectations have now changed – there is a shift to managing within the available developed resources – that is, from demand driven to supply limited management.

Whereas currently the Licence obligations on the SCA appear to reflect the need to adjust (increase) supplies to meet (increasing) demand, the perceived community expectations regarding the behaviour that the Licence should promote are:

- Not to increase yield by developing new sources;
- Management of the system in a manner that is consistent with maintaining the existing yield and ensuring that appropriate practices for assessing system performance and estimating yield are used;
- That environmental flows be released in accordance with the requirements of the Water Management Licence; and
- Working with other Authorities/bodies to ensure that water demand management, and water recycling and reuse strategies are in place.

5.4 Summary

The discussions with key stakeholder organisations provided a clear consensus regarding the nature of the objectives for the performance criteria. These are summarised as follows:

- There should be the following primary and secondary objectives:
  - The primary objective is to ensure that the system does not run out water; and
  - The secondary objectives would be to ensure that the frequency, duration and severity of water restrictions that may be anticipated in ensuring the primary objective is achieved are acceptable to the community being served.
- That the performance criteria need to be simplified in order that they can be more easily understood.

There were also a number of issues of which (as they were not addressed in each of the discussions) it cannot be said that there is clear consensus. However, these issues are unlikely to be contentious and are outlined as follows:

- The anticipated water savings that may be achieved by introducing water restrictions are overly optimistic and should be reviewed.
- The environmental water requirements are being addressed by the Hawkesbury-Nepean Management Forum. They are being formulated in a manner that will implicitly address the management of the release of the environmental water

requirements in times of drought. They therefore do not need to be explicitly covered by the Performance Criteria.

- It would be desirable to state the sustainable yield of the system together with the performance criteria in order to promote the sustainable use of the resource.
- That the performance criteria should be complementary to those applicable to Sydney Water.

There was not agreement over the following issues:

- Sydney Water Corporation expressed reservations about inclusion of the performance criteria within the Operating Licence, given that the criteria relate to planning as opposed to operations. All other organisations interviewed expressed the opinion that it was appropriate for the performance criteria to remain within the Operating Licence as it documented important customer service standards within an audited vehicle.

  Although it is not possible to assess the performance criteria directly in an operational sense (ie. based on observed performance over previous periods, as is the case for most operating performance criteria), they can be assessed using the supply system modelling techniques discussed in Section 3.3.1.
- The desirability of, and the need to, maintain equal supply assurance across the whole system. In practice, this issue is pertinent to the supplies to the Nepean and Illawarra WFPs and some centres supplied from the Blue Mountain Reservoirs. Whereas the SCA and SWC endeavour to ensure, operationally, that equal assurance is maintained to all consumers, at times this may not be totally achieved. Shoalhaven Water and Wingecarribee Shire Council, which receive supplies from Tallowa and Wingecarribee Reservoirs respectively, have indicated their preference not to be included within the Operating Licence arrangements. It is recommended that these issues may be more appropriately addressed in the Drought Response Plan and/or in specific bulk water supply agreements between the SCA and its direct customers (retail water suppliers).
- The inclusion of the estimated yield (currently 600 GL/year) together with the performance criteria.

6. Options for Adopting Appropriate Security of Supply Criteria for Sydney

6.1 Desirable Attributes of Performance Criteria

The performance criteria to be adopted for use in an auditable vehicle should have the following attributes:

- *Clarity*: The criteria should be easy to understand and unambiguous;
- *Measurable*: The degree of performance should be capable of being measured in a consistent manner;
- *Achievable:* The criteria should be realistic to the extent that they are achievable;
- *Controllable:* the targets set by the criteria should measure parameters that are within the control of the Authority; and
- *Relevant:* the criteria should be relevant and important to the Authority and its customers.

6.2 Interactions with Other Relevant Regulatory and Legislative Instruments

The role and responsibilities of the SCA are established by the provisions of the S*ydney Water Catchment Management Act 1998* and Regulations. The Act establishes a number of sub-ordinate instruments – the Operating Licence, Memoranda of Understanding (MoUs), Regional Environment Plan and plans of management – to assist in the operation of the SCA (IPART, 2003). There are a number of regulatory and legislative instruments, and management plans, which govern the operation, planning and management of the bulk water supply infrastructure. The list below refers specifically to the supply to Sydney Water Corporation, which accounts for more than 99% of the water supplied to customers from SCA's system.

- Operating Licence;

The SCA must conduct its activities in accordance with the Operating Licence. The SCA's compliance with the obligations under the Licence is audited annually by IPART. The current Licence has effect until 31 December 2004, and its terms are subject to review. The annual operational audit checks performance compliance for:

  - Maintenance of the various Memoranda of Understanding;
  - Customer and consumer relations;
  - Management of bulk water quality;
  - Management and protection of the catchments;
  - Management of catchment infrastructure and demand management; and
  - Environmental management.

- The Water Management Licence;

The SCA's Water Management Licence was issued by the former Department of Land and Water Conservation (now the Department of Infrastructure, Planning and Natural

Resources - DIPNR). It outlines objectives for the SCA in relation to access to water resources within its area of operations and establishes the platform for environmental flows to be released from SCA infrastructure.

- The Bulk Water Supply Agreement;

This is an agreement between the SCA and Sydney Water Corporation (SWC), which covers the conditions under which water is supplied by the SCA to SWC.

- The Drought Response Plan;

This plan describes the planned actions in the event of prolonged below average inflows to water storages, with the objective of maintaining adequate water supply security. It is a requirement of the Bulk Water Supply Agreement and was developed by the SCA in consultation with SWC.

- The SCA's Bulk Water Supply Network Plan;

This plan documents the configuration and operation of the SCA's bulk water supply system, including its function and infrastructure arrangements. It focuses on operations to deliver the required volumes of raw bulk water for metropolitan Sydney, the Illawarra, the Southern Tablelands and the Blue Mountains, and outlines options and an action plan for maintaining system operation to meet the required levels of service over the medium term.

In addition to Sydney Water Corporation, the SCA also serves more than 50 additional customers, with separate agreements for these customers regulating those relationships. Memoranda of Understanding have been drawn up between the SCA and the NSW Environment Protection Authority (EPA), the Water Administration Ministerial Corporation (WAMC) and NSW Health. These provide the structure and processes for cooperative interaction with those bodies. Furthermore, there are important instruments, aimed primarily at protecting water quality, such as the SEPP 58 – Protecting Sydney's Water Supply, which further regulate the SCA's operations.

6.3 Appropriate Combinations of Criteria

There is a range of options for the revised performance criteria that may be adopted for inclusion in Sydney Catchment Authority's Operating Licence. The options listed below encompasses the main issues identified in the review:

1) Option 1: Retain the existing criteria;
2) Option 2: Rephrase the existing criteria, with basically similar content, by developing a set of Primary and Secondary criteria relating directly to the key objectives identified in this review;
3) Option 3: Develop a set of Primary and Secondary criteria that includes distinction between the different levels of security that may be required by different users;
4) Option 4: Develop a set of Primary and Secondary criteria that explicitly states the system yield;
5) Option 5: Use the system yield itself as the principal criterion; and

6) Option 6: Develop a set of Primary and Secondary criteria, and include a criterion regarding maintenance of equal supply assurance throughout the system.

These options and their associated issues are discussed in the following sections of the report.

6.3.1 Option 1: Status Quo

Option 1 is not acceptable as the present wording is unclear, ambiguous in some respects, and not easy to understand. There is also a concern that the existing criteria and the framework in which they are presented are not consistent with providing a mechanism encouraging the SCA to operate its bulk water harvesting and delivery system as a supply limited, rather than as a demand driven, system (see Section 5.3).

6.3.2 Option 2: A Set of Primary and Secondary Criteria

The existing criteria do address the principal issues of maintaining supply continuity whilst using water restrictions that are not excessively frequent, long or severe. They suffer, however, from lack of clarity. Under this option, the basic content of the performance criteria would be retained whilst eliminating the lack of clarity and ambiguity. The criteria would be expressed in the following form:

- The primary (maintaining supply continuity) and secondary (minimising societal disruption caused by water restrictions) objectives;
- A set of criteria, comprising primary (protecting a buffer supply) and secondary criteria (the frequency, duration and severity of water restrictions).

6.3.3 Option 3: With Distinction of Security Specifications for Different Types of Use

Option 3 would provide for explicit specification of the probability of restrictions being applied for different categories of water use. For example, domestic outdoor use may be restricted more often or more severely than industrial use, or than use by strategic and essential service consumers such as hospitals.

Currently, this information underlies the anticipated percentage demand reductions for each level of water restrictions, which are stated in Schedule 2 of the Licence along with the performance criteria. This type of information is relevant to consumers and could potentially be included as specific performance criteria, effectively defining different standards of service to apply to different categories of water use.

Difficulties may arise with this approach, however, where the need to amend the restriction rules occurs. In practice, the planned restrictions may not achieve the desired savings and may therefore need to be amended. This scenario is highly likely during periods of severe drought, as experience with severe restrictions is limited especially in an environment where extensive measures for demand management have been instituted, and "demand hardening" has occurred.

Overall, this option is not recommended, as it will impinge undesirably on operational flexibility - for example restriction measures may need to be amended if found to be less effective than anticipated. Specification of different standards of service to apply

to different categories of water use may be more effectively included in specific bulk water supply agreements or in the SCA's Drought Response Plan.

6.3.4 Option 4: Stating the System Yield

The objective of stating the system yield along with the performance criteria (with the criteria specified as outlined above for Option 2) would be to emphasise the limited nature of the available resource. This could then be used to provide a direct link to setting meaningful demand management targets, which would be relevant for Sydney Water Corporation's Operating Licence and other "whole of government" initiatives. This would explicitly recognise the imperative to manage system demands within the available resource, and would provide a clear focus for demand management needs.

The inclusion of the system yield as part of the performance criteria could further be used as a mechanism for more clearly focusing the SCA's obligations in relation to community expectations that:

- new supply sources should not be developed to increase system yield; and that
- the supply system should be managed so as to maintain the existing system yield. the performance criteria

This would provide an explicit basis for the SCA to manage and operate its bulk water harvesting and delivery system as a supply limited, rather than as a demand driven, system.

This approach is considered beneficial and is recommended for further consideration.

6.3.5 Option 5: System Yield Only

It could be argued that the performance criteria are the rules for determining the system yield, and that it is sufficient to state the system yield by itself without also referring to the criteria. The criteria, however do represent an important standard of service and conceivably the same yield could be achieved with a different combination of criteria.

Given that this option provides no transparency in terms of the actual level of service the community can expect to receive, it is not recommended for further consideration.

6.3.6 Option 6: Maintaining Equal Supply Assurance Across the Entire System

Performance criteria reflect community expectations about the desired reliability of their water supply system and the trade off between the cost of water restrictions and the cost (including social, environmental and economic) of matching supply with demand. It is conceivable that the cost trade off relationship differs in different parts of the SCA water supply system, and therefore that maintenance of equal supply assurances across the entire system may not necessarily be beneficial overall.

From an equity perspective, it could be argued that all consumers should be treated equally and that if equal service levels cannot be maintained then differential tariffs should be introduced. In practice however this is likely to be impractical, and would

be likely to increase infrastructure and operating costs relative to other potentially more efficient options for managing this equity issue.

Imposing an equal supply security criterion in the Operating Licence is likely to reduce the existing operational flexibility that the SCA and Sydney Water currently rely upon to manage this issue equitably across the entire supply system. It would also be likely to result in committing the community to potentially costly system augmentation needs for very little marginal benefit. It is therefore recommended that an equal supply security criterion should not be included in the SCA's Operating Licence. Rather, this issue should be addressed as an operational consideration within the SCA's Drought Response Plan, or in specific bulk water supply agreements.

6.4 What is appropriate for SCA's Operating Licence?

Based on the discussion above, the preferred option recommended for further consideration is Option 4, which incorporates the criteria specified for Option 2 along with an explicit statement of the system yield. This would allow for the basic content of the existing criteria to be retained, with clarification, and supplemented by addition of the system yield with the objective of promoting sustainable use of the available water resources.

6.4.1 What is Appropriate as the Buffer Storage Level

Three alternatives were considered for defining the minimum storage level to serve as a buffer to ensure supply continuity. These alternatives are:

(a) The storage level defining the trigger for implementation of the contingency plan. This level would include allowances for modelling and other uncertainties. It would provide sufficient time for implementation of the contingency plan, whilst maintaining supply continuity with level 5 restricted demands. It would include allowances for water quality and all hydraulic considerations given the significant storage depletion that would prevail. It would ensure that adequate supply (ie. that which, as a minimum would meet basic public health needs) could be maintained at least until the contingency plan has been implemented.

(b) The storage level to provide allowance for modelling and other (eg climate change) uncertainties, and water quality and hydraulic considerations.

(c) The storage level below which SCA can no longer guarantee demands can be met by the supply (ie effectively run out of water).

The preferred option recommended for further consideration is option (a), as this represents an extremely meaningful point at which a decision would need to be made to proceed with (and commit funds for) implementing the steps outlined in the (emergency) drought contingency plan.

7. Expressing the Criteria

7.1 Proposed Form and Content

The criteria should be expressed in every day language, avoiding technical jargon. It is proposed that the general form of the criteria should cover three important areas, as follows:

1) Introduction and Statement of the Performance Criteria Objectives;
2) Statement of the Performance Criteria with associated relevant information; and
3) Statement of system yield.

In summary, it is recommended for further consideration that the criteria be categorised as satisfying primary and secondary objectives, based on the outcomes of the review and on feedback from the key stakeholders.

The primary objective relates to providing the community with the reassurance that they will not run out of water. There are three main components to this:

- The supply system itself has the capacity to maintain a level of supply, over most periods, that is adequate;
- Where longer duration drought periods occur, a Drought Response Plan (and associated demand restriction rules) provides for further protection of the storage levels in the supply system; and
- In cases of extreme, prolonged drought, a workable Contingency/Emergency Plan exists that ensures that measures can be introduced such that the basic water needs of Sydney will continue to be met indefinitely (ie. the city will not run out of water).

The secondary objective relates to minimising (to the extent required by the community) the inconvenience and cost to the community associated with implementing drought response and/or emergency measures. These relate, in particular, to setting standards of service for the expected:

- Frequency;
- Duration; and
- Severity

of restrictions.

Inclusion of an explicit statement of the estimated system yield satisfying these criteria could also be included in the Licence, so as to clearly communicate the supply limited nature of the supply system managed by the SCA. The specific obligations of the SCA, given its constraints in terms of expanding the available supply, would be to:

- Ensure that the system is operated consistent with maintaining the stated yield; and to

- Be actively involved, as required, with other organisations, in relation to any demand management initiatives that may be required to ensure that overall system demands do not exceed the available system yield.

The statement of the available yield figure in the SCA's Operating Licence could therefore serve to establish meaningful demand management targets for the overall Sydney water supply system.

7.2 Example

The current referral clause in the main text of the Operating Licence is as follows:

8.1.2 The Authority must ensure that Catchment Infrastructure Works are designed, operated and maintained to provide Sydney Water Corporation with a long-term standard of services which accords with the performance Criteria set out in Schedule 2.

This clause could be maintained as it is, with the key revisions focusing on the content of Schedule 2. In addition, consideration should be given to the overall framework surrounding the criteria and to the obligations of the SCA under the Licence. These issues are discussed in Section 5.3. As such, consideration should be given as to whether the Operating Licence should be amended to reflect the following obligations (relating to the Performance Criteria) on the SCA:

- To ensure that the system is operated consistent with maintaining the yield stated in Schedule 2;
- In addition to operating the supply system consistent with providing the yield as specified in Schedule 2, to meet the requirements of the Water Management Licence, specifically for the release of environmental and riparian flows;
- That the modelling procedure used to assess performance of the system against the Performance Criteria specified in Schedule 2 must be consistent with appropriate and acceptable industry practice; and
- To actively work with other Authorities/bodies to ensure that appropriate water demand management, and water recycling and reuse strategies are in place.

If included in the operating Licence, these obligations would most appropriately be included as sub-clauses under the current Clause 8.1, Management of Catchment Infrastructure Works.

Suggested revised text for Schedule 2 is as follows:

Catchment Infrastructure Works Performance Criteria

1) Introduction and Objectives of the Performance Criteria

These performance criteria, together with the SCA's Drought Response Plan:

(a) Have the primary objective of ensuring that the water supply system should not run out of water; that is, that the supply can continue to meet the restricted demand requirements catering for basic water needs, with water of acceptable quality, and sufficient pressure, to all parts of the supply system.

(b) Achieve this objective without imposing water restrictions too frequently, too severely, or for excessively long periods, based on the preferences of the customers;

(c) Describe the standard of service to be provided to customers in terms of the frequency, severity and duration of water restrictions that may be anticipated; and

(d) Are intended to promote the sustainable use of the available water resources.

The performance of the supply system against the criteria is assessed using a computer model of the water supply system that can estimate the likelihood of certain events occurring. The model uses the projected average water demands, adjusted to reflect climatic conditions. Because of the uncertainty around future climatic conditions, and other factors, there is a degree of modelling uncertainty which is allowed for in the performance criteria.

2) Performance Criteria

(a) *Supply Continuity*. A minimum operating storage equivalent to x months of total restricted demand (or y % of storage) shall be maintained as a buffer to assure supply continuity. The probability of the system storage levels falling to the buffer storage level shall not exceed 1 occasion in 1,000 years (for example). A Drought Response Plan, drawn up in collaboration with Sydney Water Corporation, shall include a contingency plan, triggered by impingement of the storage buffer, to ensure that basic supplies can continue to be met for an indefinite period.

The size of the buffer storage to be maintained could be expressed either as a number of months ("x") of restricted demand, or more directly as a percentage of total system storage ("y%"). The latter approach is more straightforward and more easily understood, particularly given that the community can easily make direct comparisons with publicised storage levels at any time. The size of the buffer storage could be determined as recommended in Section 6.4.1, with "x" being defined based on the length of time taken to implement the contingency plan responses. The restricted level of demand to be supplied during that period ("x" months) could be defined based on expected demands at the highest level of restrictions, or based on a specified minimum requirement for basic health needs ("z" litres/capita/day for "x" months).

(b) *Water restrictions frequency.* Restrictions will not need to be applied, on average, more often than once every ten years (for example).

(c) *Water restrictions duration;* Restrictions for continuous periods exceeding 24 months (for example) shall not be required, on average, more than once in 200 years (for example).

(d) *Water restrictions severity:* Level V (for example) water restrictions shall not be required more often, on average, than once in 200 years (for example).

The system shall be operated, based on the above criteria, the current pattern of demands and the restriction rules stated in the Drought Response Plan, to provide an average yield of 600 GL/year (or such other figure as may be determined as required, from time to time, by the system modelling).

7.3 Information Recommended for Removal From Schedule 2 of the Operating Licence

It is recommended for further consideration as part of the End of Term Licence Review, that the detailed information regarding the levels of water restrictions illustrated below be removed from the operating Licence and transferred to the Drought Response Plan. It is considered that this information is too detailed for incorporation within the Operating Licence. It also should be updated regularly as water demand patterns and levels change, and as further information becomes available regarding the realistic demand reductions that can be achieved under restrictions. Removing these from the Operating Licence and including them in the Drought Response Plan (referred to by the Licence) provides greater flexibility for ongoing review of restriction rules to ensure appropriate operational management can be maintained during periods of drought.

In addition to specifying the anticipated demand savings for each water restriction level, and the maximum percentage of time for which each level may be applied, consideration should be given to adding a maximum percentage of time that infringement of the safety buffer storage zone may occur.

Restriction Level	**Expected Demand Reduction**	**Likelihood**
Level I	at least a 7% demand reduction,	not more than 3% of time;
Level II	at least a 12% demand reduction,	not more than 1% of time;
Level III	at least a 20% demand reduction,	not more than 0.5% of time;
Level IV	at least a 30% demand reduction,	not more than 0.3% of time;
Level V	at least a 50% demand reduction,	not more than 0.05% of time.

It is also recommended that information on the projected system demands be removed from Schedule 2 of the operating Licence. It is considered that the emphasis should be placed more on the sustainable yield the system can supply (as a means of setting meaningful and practical objectives and targets for demand management initiatives), rather than on ensuring the supply can meet the demands into the future. This would explicitly acknowledge the supply side limitations and the importance of appropriate and sustainable management of the overall supply system by clearly setting out the demand management needs.

It is further emphasised, however, that the projected system demands should be clearly specified in some other relevant, publicly accessible document. This would ensure that transparency is maintained for the public in relation to the current levels of demand the system is subjected to and on the likely future levels of demand, and how these compare to the demand management targets and the system yield stated in the SCA's Operating Licence.

8. Conclusions and Recommendations

The following conclusions and recommendations are made following the discussions and investigations that have taken place during the course of this study.

8.1 Conclusions

- The current set of performance criteria should be modified to increase their clarity, remove ambiguity and emphasise the requirement to manage the available water resources in a sustainable manner.
- The demand reductions postulated for the various levels of water restrictions are considered to be overly optimistic.
- The investigations conducted for this report have identified community expectations about the management of the water supply system that do not fall specifically within the ambit of the performance criteria themselves, but rather relate to the framework surrounding the criteria and to the obligations of the SCA under the Licence. These issues are discussed in Section 5.3. There is potential to include a more specific statement of the SCA's obligations under the Operating Licence, reflecting management of a supply limited rather than a demand driven system. This would provide clear and unambiguous drivers encouraging the SCA to operate its bulk water harvesting and delivery system in a manner consistent with current community expectations.

8.2 Recommendations

The following recommendations are made:

- That the revised Performance Criteria as drafted in Section 7.2 of this report be taken forward for further consideration as part of the End of Term Review of the SCA's Operating Licence.
- That the implications of the proposed Performance Criteria be investigated to ensure they are achievable within the context of current policy, for example as stated by the NSW Premier in March 2003 (Premier of New South Wales, 2003).
- That consideration be given as to whether the Operating Licence should be amended to clearly reflect the following obligations on the SCA (potentially included as sub-clauses under the current Clause 8.1):
  - To ensure that the system is operated consistent with maintaining the yield stated in Schedule 2;
  - In addition to operating the supply system consistent with providing the yield as specified in Schedule 2, to meet the requirements of the Water Management Licence, specifically for the release of environmental and riparian flows;
  - That the modelling procedure used to assess performance of the system against the Performance Criteria specified in Schedule 2 must be consistent with appropriate and acceptable industry practice; and
  - To actively work with other Authorities/bodies to ensure that appropriate water demand management, and water recycling and reuse strategies are in place.

- That the water demand projections, currently included with the Performance Criteria, no be longer included in the SCA's Operating Licence, but be transferred to an alternative, relevant and publicly accessible document.
- That the table of water restriction levels, showing anticipated savings and average occurrence probability, be omitted from Schedule 2 of the Operating Licence and carried over to the SCA's Drought Response Plan.
- That the modelling procedure used to assess performance of the system against these criteria must be consistent with acceptable industry practice, for example it should incorporate the impact of climate variability on the system demands.
- That the anticipated demand reductions following the implementation of water restrictions should be reviewed in the light of the introduction of water conservation measures and other factors.

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