3. Justification for the Project

The need for Tillegra Dam arises from the stark reality that Hunter Water's current storages and emergency Drought Management Plan are unable to protect the region from the possibility of running out of water. The Lower Hunter needs security from drought now. Future growth and the uncertainty of climate change will rapidly compound this need. The need and justification for Tillegra Dam, which are explained in detail in this section, can be summarised as follows:

- The Lower Hunter is not resistant to drought. The Lower Hunter has experienced drought in the past and the current drought affecting most of the country shows that the Lower Hunter should be prepared for droughts far worse than those on record.
- If the Lower Hunter had experienced the same level of drought as the Central Coast, which saw storages drop by almost three times more than any previous drought on record, the region would have run out of water. The consequences of running out of water are so severe that Hunter Water must have measures in place to ensure this does not happen.
- The Lower Hunter's dams are small for the population they serve and they are vulnerable to evaporation. They fill quickly but they also deplete very rapidly. Pressure on the current supply systems will only increase with future population growth and climate change uncertainties.
- With existing storages depleting rapidly during drought, there would not be enough time to take action once the drought hits.
- Action is required now.
- Hunter Water has assessed all viable options such as increased demand management strategies, water restrictions, stormwater harvesting, rainwater tanks, sewer effluent recycling, expanding groundwater sources and upgrading existing dams, new dams and desalination.
- Tillegra Dam proved to be the most cost effective solution by far.
- In addition to providing drought security, as noted in the EA Report, Tillegra Dam would also be able to accommodate significant population growth and provide a buffer for the uncertainty of long term climate change.

A large majority of submissions questioned the need for Tillegra Dam both now and into the future. Most of these submissions suggested that the Hunter catchment had more than sufficient supply to provide water for residents of the area. The Wilderness Society submission included a commissioned report prepared by the Institute for Sustainable Futures (ISF) (University of Technology, Sydney) titled *An Independent Review of the Need for Tillegra Dam*. The main issues from the ISF report and other submissions received can be summarised as follows:

- The water supply estimates used by Hunter Water to justify Tillegra Dam do not reflect the water available for the Lower Hunter. Sufficient water is available from current infrastructure to service the needs of the Hunter region.
- The demand forecasts used in the assessment of the need for Tillegra Dam are overestimated and the population growth of the region will not create sufficient demand to justify building the dam.
- Alternative sources and strategies to secure the Hunter region's water supply had not been adequately considered and these options should be further investigated. Alternative options would be sufficient to provide water to Hunter Water customers, not only in a drought situation, but well into the future.

Detailed consideration of the submissions, including the ISF report, reveals that these views have generally not been predicated on appropriate system modelling or even a thorough understanding, of the specific features and characteristics of the Lower Hunter water supply system. As demonstrated in Section 3.4, failure to understand the Lower Hunter water supply system and the modelling done by Hunter Water has resulted in a number of inaccuracies in the ISF report.

It is acknowledged that the analysis required to understand the need for the Project is complex. There are many issues that require consideration and it is easy to lose sight of the multiple factors that lead to Tillegra Dam being considered justified. To overcome some of this complexity, the first part of this chapter provides a non-technical explanation of why the dam is required, expanding on the summary above. A robust response to what Hunter Water considers to be the inaccuracies in the ISF report is then provided at a more detailed technical level.

It is noted that many of the submissions received relied on the information presented within the ISF report as a foundation for their own assertions. Addressing the matters raised in the ISF report is therefore considered to effectively answers the questions on supply, demand and Project need raised within the majority of public representations received and catalogued by DoP. All submissions are however considered and responded to within this submissions report.

3.1 Need for the Project

The need for immediate action to protect the urban water supplies of the Lower Hunter region arises from the fact that those supplies drop so rapidly during drought that there is insufficient time to prevent their complete exhaustion unless action is taken now.

Drought security is therefore the primary need for the Project with other considerations such as the ability to cater for population growth, regional supply and the uncertainty of climate change being secondary, albeit still important, considerations.

The current drought that has affected most of Australia has demonstrated that water authorities must be prepared for droughts far worse than those recorded since the beginning of European settlement. Australia has very limited weather records. Less than 100 years of detailed rainfall and stream flow records are available for the vast majority of the continent including major regional centres such as the Lower Hunter. Many of these records contain data on only three or four severe droughts in each region. Over the past decade much of Australia has learnt that this data is far too limited to rely on when trying to predict what the worst case could be, with many areas experiencing droughts far deeper and longer than any that could have been imagined based on historical records.

The Central Coast of NSW is still experiencing the effects of a drought which has seen its storages drop by nearly three times more than they would under any previous drought recorded in the area. If the Hunter had experienced such a drought, an event which would deplete its storages by three times more than any previously on record, the entire region of 500,000 people would have run out of water long before the event had ended.

The Lower Hunter region has certainly experienced severe droughts in the past. Modelling shows that a repeat of the major droughts in the early 1940s, mid 1960s and early 1980s would affect Hunter Water's water storages by more than twice as much as they would affect those of the Central Coast due to a combination of small storages and high evaporation. The fact that the Hunter's storages have been relatively unaffected by the current drought experienced elsewhere merely reflects the complex and variable nature of weather patterns and does not imply that the Lower Hunter is somehow immune or protected from extreme droughts.

The occasional rainfall that does occur during a drought is often very localised and scattered. How many times in the recent drought did people in Sydney and on the Central Coast experience showers at home only to hear that it had missed the dam catchments? For the Lower Hunter, a number of these events reached the catchments topping up the Hunter's small storages. These events were largely matters of chance - the reverse is just as conceivable.

All of these factors are clearly illustrated in Figure 3.1 which graphs how the current supply systems of the NSW Central Coast and the Lower Hunter would behave now if past weather conditions were repeated. Based on data from prior to 1992, the Central Coast system appears to be far more reliable than the Hunter system, with total storages never falling much below 80% on the Central Coast while the Hunter storages would drop rapidly to around 40%. Conditions recorded after 1992 tell a dramatically different story with Central Coast storages trending down for more than 15 years to around 30% while in the Lower Hunter dry spells were interspersed with top up storms. It should be noted that in fact, the Central Coast's storages fell to 15% because they were not completely full at the start of the dry period which began in 1992. The figure presented only shows a decrease to 30% as it depicts storage behaviour for each region's water supply starting from 100% capacity.

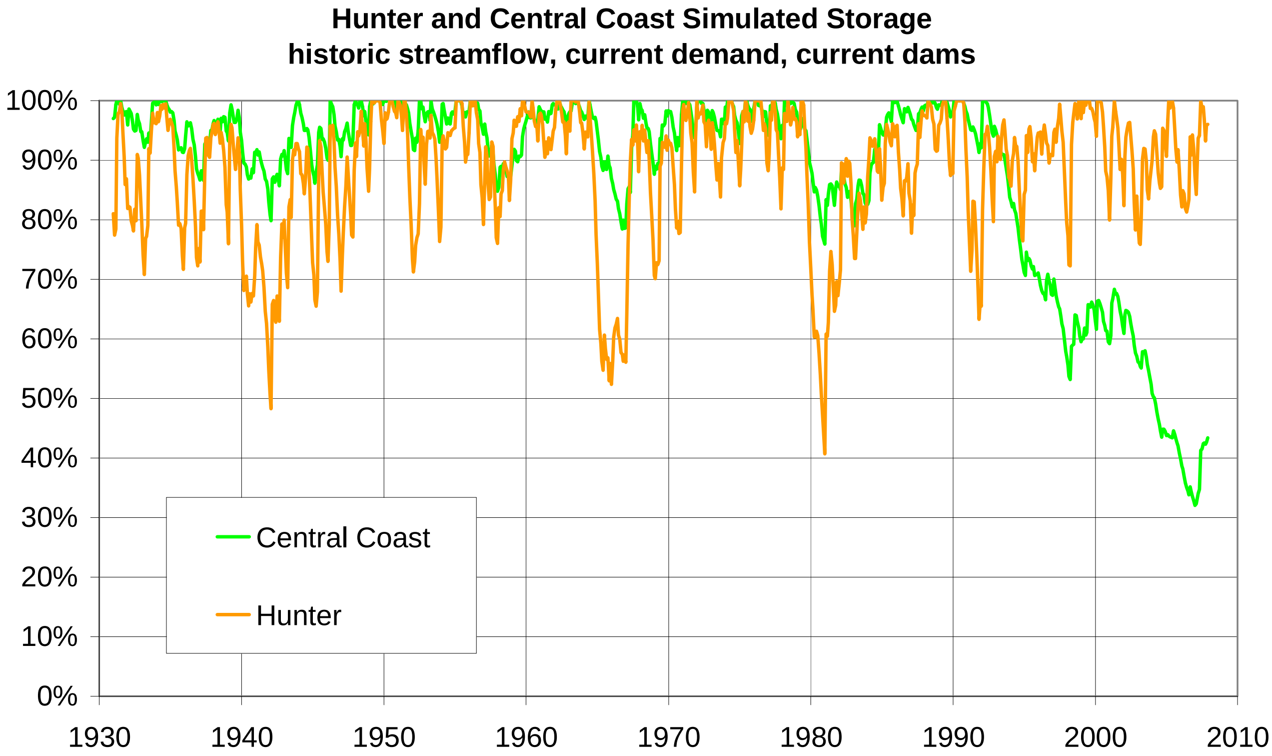


Figure 3.1 Response of storages to a repeat of past weather conditions

It is unclear whether the conditions since 1992 are attributable to climate change but in either case, one cannot assume that the conditions experienced in the last decade indicate that the Lower Hunter region is somehow immune from the effects of future droughts. To do so is to gamble with the lives and welfare of 500,000 people and a significant sector of the New South Wales economy. It would be naive and irresponsible in the extreme for those few areas of the continent not significantly affected by the current drought to ignore the lessons learnt by the rest of Australia. One cannot assume that the 80 years of weather records available in the Hunter define the limits of what will happen in the next 80 years, or even the next five years. To be responsible, Hunter Water must consider the possibility of events far worse than the handful of historical records.

The Water Services Association of Australia (WSAA) is the peak body representing major water utilities in Australia and New Zealand. Its associate membership also includes a number of universities, research facilities and relevant government departments. In 2005 WSAA published *Occasional Paper No.14-Framework for Urban Water Planning* to address the implications of the drought which was then affecting much of the Australian continent. WSAA recognised that even if the likelihood of a community running out of water is small, the consequences could be so high that water authorities should have robust measures in place to ensure that it doesn't happen under any circumstance, even under the severest regime of water restrictions.

For a small community this might involve being ready to import water by road or rail. A large centre might need to be ready to build a desalination plant or effluent treatment plant.

As the authority responsible for the provision of an urban water supply to over 500,000 people in the Lower Hunter region, Hunter Water must have in place effective measures to guarantee the supply of water under extreme conditions, potentially far worse than the handful of events experienced in the past. This is not a question of whether or not Hunter Water needs to take action. Based on the vulnerability of current supplies outlined above, the question is: what action does Hunter Water need to take and when does it need to be taken? While Hunter Water cannot change the likelihood of drought, it can change the effect of drought on the water supply system.

3.2 Identification of viable supply protection measures

3.2.1 Independence from rainfall

When choosing a course of action to address a drought of lengthy but indefinite duration, there is no choice but to look for a solution which is fundamentally independent of rainfall. Consequently, every coastal mainland capital in Australia has seen no alternative but to adopt desalination for drought security. Furthermore, desalination has not generally been adopted merely as an emergency plan to be pulled off the shelf when things get desperate. Major desalination plants are currently in operation, under construction or in preconstruction for South East Queensland, Sydney, Melbourne, Adelaide and Perth. In each case, the decision to proceed to construction was driven by an immediate need to provide security of supply and an appreciation of how much lead-time is required before a desalination plant can begin to produce water.

Hunter Water has also conducted extensive investigation of the desalination option. Hunter Water engaged consultants GHD to undertake a major study into possible desalination sites in the Lower Hunter. GHD's 2007 report demonstrates that under emergency conditions it would take 51 months from making the decision to proceed with desalination until the plant is commissioned and able to deliver treated water to households. This could be reduced to 48 months if the site is selected in advance and basic engineering briefs prepared in readiness for a quick start.

Commissioning of the recently completed Sydney desalination plant has begun, but is not completely finalised, more than five years after planning studies started. This suggests that assuming a program of 48 months may be optimistic and would provide no allowance for uncertainty or delay, although it must be assumed that in an extreme emergency, the community, Hunter Water and the NSW Government would be willing to take all necessary steps to remain on program.

Figure 3.2 shows how Hunter Water's current storages would drop under repeated years of drought equivalent to the worst 12 months on record for the Lower Hunter (1979-80). This equates to the median rate of depletion expected to occur during a drought event. Justification for using this scenario is explained in Section 3.4 in response to issues raised by ISF.

The figure shows that with no water restrictions, storages would run out within 3 years. With water restrictions in place, supplies could be extended to less than 4 years at best making the delivery of emergency desalination impossible in an extreme event if no other action is taken.

This rate of depletion is even more concerning when it is considered that the Hunter's neighbours, the Central Coast, have experienced over 15 years of drought. Figure 3.3 provides a comparison of the storage performance for the major east coast population centres if each now experienced conditions equivalent to a repeat of their worst year on record. The Lower Hunter has been extremely fortunate in recent years that it has not been exposed to conditions worse than historical records - as has been the case elsewhere. Just as the Lower Hunter's small storages fill rapidly when it rains, they deplete just as rapidly when it does not.

Despite other major population centres having storages far more resistant to severe conditions than the Lower Hunter, all are undertaking or propose major capital works to secure their supplies as shown in Table 3.1. Tillegra Dam is included for comparison, noting that the additional yield provided comes at a fraction of the capital cost per megalitre per day of the augmentations for other cities. Tillegra also avoids the major annual running and energy costs that are associated with the desalination options.

The major implication of the potential rate of depletion demonstrated by Figure 3.2 is that there is clearly insufficient lead-time to plan and construct a desalination plant once a drought has set in. Hunter Water must act now, but what action should be taken? The response of every coastal mainland capital city has been to proceed immediately with desalination. While desalination may be the only remedy completely independent of rainfall, there are options for the Lower Hunter which can remove the immediate need to construct a desalination plant and for it to remain as a last resort emergency measure.

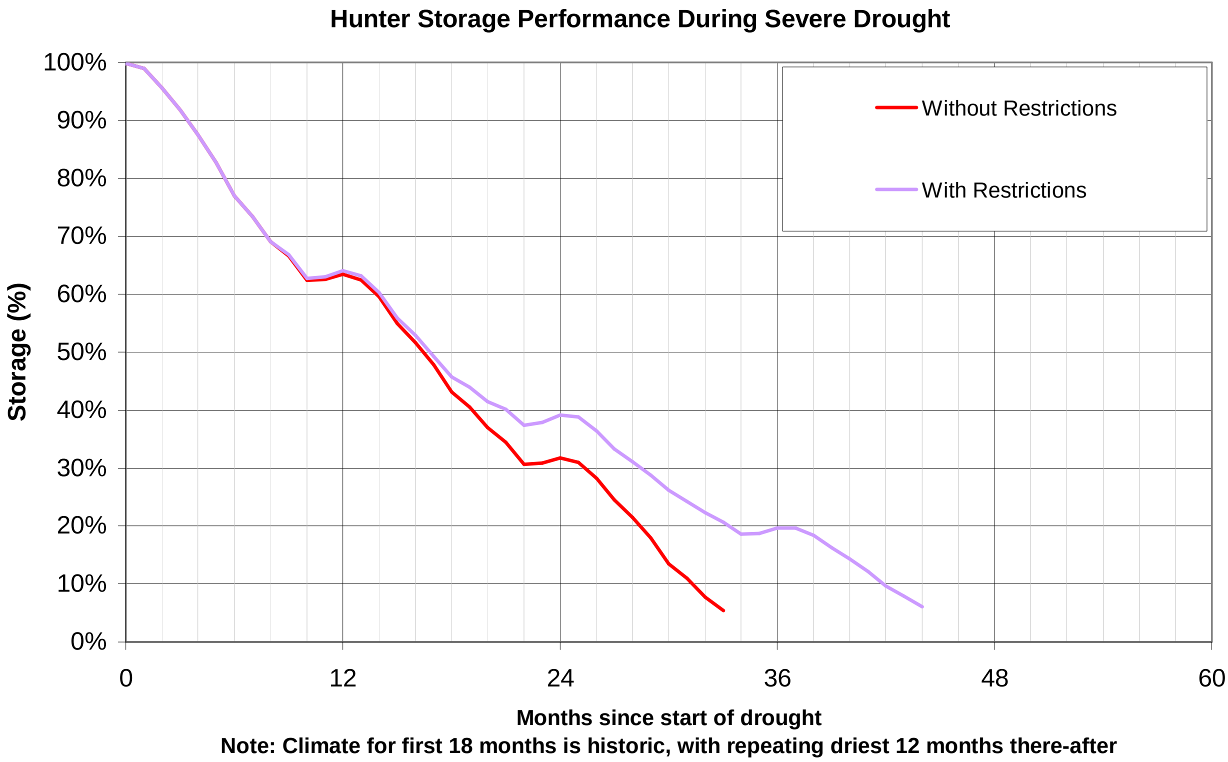


Figure 3.2 Storage performance under restriction measures

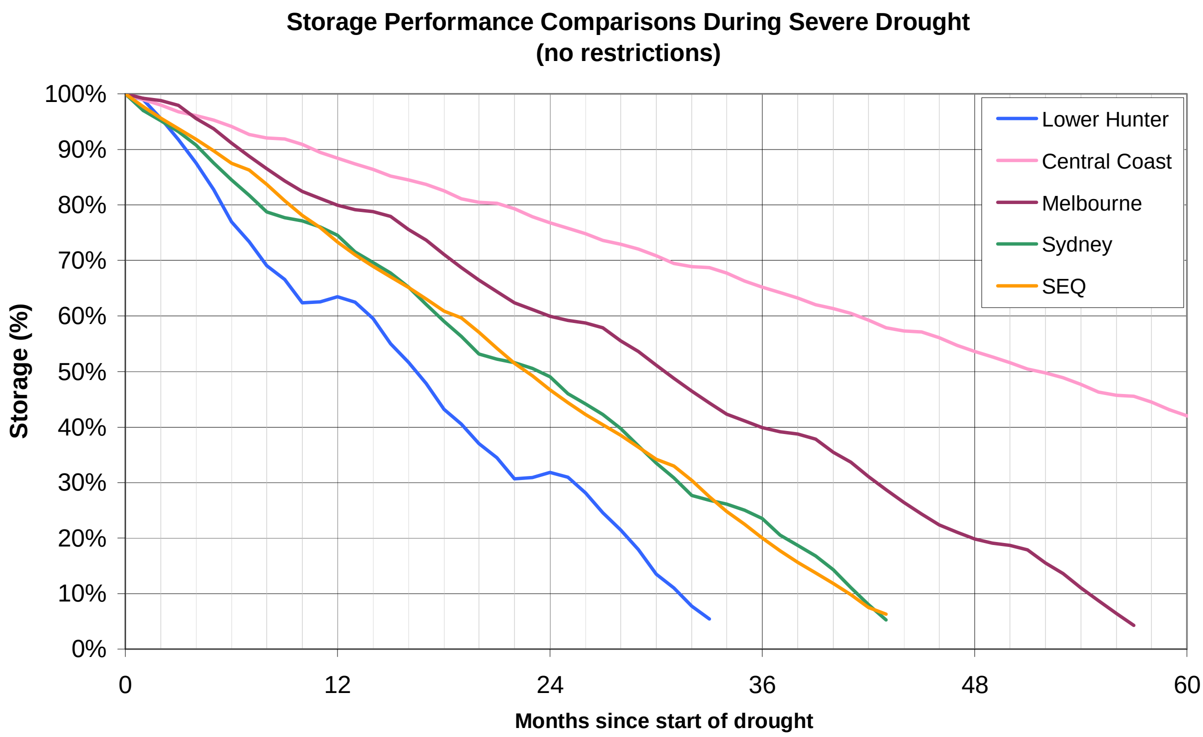


Figure 3.3 Storage performance comparisons during severe drought

Table 3.1 Water supply augmentations for major cities

	Augmentation	Capital Cost ($m)	Additional Yield (ML/d)	Capital cost per ML of additional yield ($m/ML/d)
Melbourne	Desalination	3,500 [1]	400	8.8
Sydney	Desalination	1,896 [5]	250	7.5
Adelaide	Desalination	1,800 [1]	150	12.0
South East Queensland [2]	Desalination	1,200 [1]	125	9.6
Perth	Desalination	1,000 [1]	130	7.7
Central Coast NSW	Linking sources to optimise performance	120 [3]	16 [4]	7.5
Tillegra Dam		*406*	*150*	*2.7*

1. Source: The Australian 23 January 2010
2. Gold Coast only. Additional plants are expected
3. Source: Wyong Shire Council media release 10 December 2009
4. Source: Central Coast WaterPlan 2050 – option 6 v base case
5. Source, pers com Susan Trousdale, Sydney Water Corporation

One option would be to immediately purchase the necessary land and undertake preconstruction planning, investigations and design of a desalination plant but to only start construction at the last practical moment in the hope that the drought would break in the meantime and the high cost of construction would be avoided. The four year timetable for emergency provision of desalination assumed that, wherever possible, planning and design activities would be undertaken in parallel with construction. Having planning completed and designs already available would only reduce the lead time required for emergency construction of desalination by a year to around three years. Thus the construction phase would need to begin when storages dropped to a level which still guaranteed three years of supply.

At current demand levels, this would occur when storages drop below 77% of full supply, an event which occurs around once every five years. Consequently, this strategy of being ready to move straight to the construction phase would not effectively turn desalination into a low likelihood last resort emergency measure. Construction of desalination would almost certainly need to begin in the near future, and would become more likely as demand increases with population growth.

Other measures which could buy sufficient time to allow desalination to be kept as a last resort emergency measure can be considered in two broad categories of; reducing total demand for water and increasing supplies of water.

3.2.2 Options for reducing demand

Note that the use of rainwater tanks and recycling of sewage effluent are treated as alternative supply options in the next sub-section.

A number of submissions suggest that the Lower Hunter region could be suitably protected from drought by reducing demand for water. These submissions, however, do not substantiate the assertions by quantifying the degree to which demand can be reduced and demonstrating that such reductions could effectively protect against prolonged drought. In response it is noted that the scope to reduce the total demand for water is limited by a number of factors which in combination make reliance on demand reduction inappropriate without supply augmentation.

These factors include:

- The availability and uptake rate of water efficient technology by customers
- The community's ability to change its behaviour to an extent which materially reduces demand
- The unavoidable loss of water due to evaporation from Grahamstown Dam and transpiration from the groundwater bore fields.

A large proportion of residential water used daily in the Hunter is required for the basic essentials of modern life, including washing, drinking, cooking and sanitation. Guaranteed substantive reductions are not as easy as some submissions suggest. In the most simple and obvious terms, outside watering can be banned and shorter showers can be taken, but dishes and clothes still require washing and toilets must be flushed.

This limitation is clearly demonstrated by comparing Hunter and Central Coast residential usage in 2005/06. After years of severe drought, education programs and the banning of all outdoor water use on the Central Coast, average household consumption on the Central Coast had fallen to just 12% below that of the Hunter which was free of any level of restriction (Australian Cities 2005/06 National Water Accounts, WSAA 2007). While Hunter Water is committed to demand management and water efficiency, the above statistic demonstrates that the scope for reductions in the underlying rate of total demand for water in the Lower Hunter is marginal and insufficient in itself to make the need for desalination a distant possibility rather than a near certainty.

The limited effect of reductions in residential demand and the dominance of evaporation and transpiration under drought conditions is further illustrated by modelling the effect on the Lower Hunter's storages should water restrictions be introduced earlier than at the 60% level set down in the current emergency Drought Management Plan. Introducing each level of water restriction at point 10% higher than the current plan, a measure substantially more stringent than merely adopting permanent low level restrictions as advocated in some submissions was found to have negligible effect as shown in Figure 3.4.

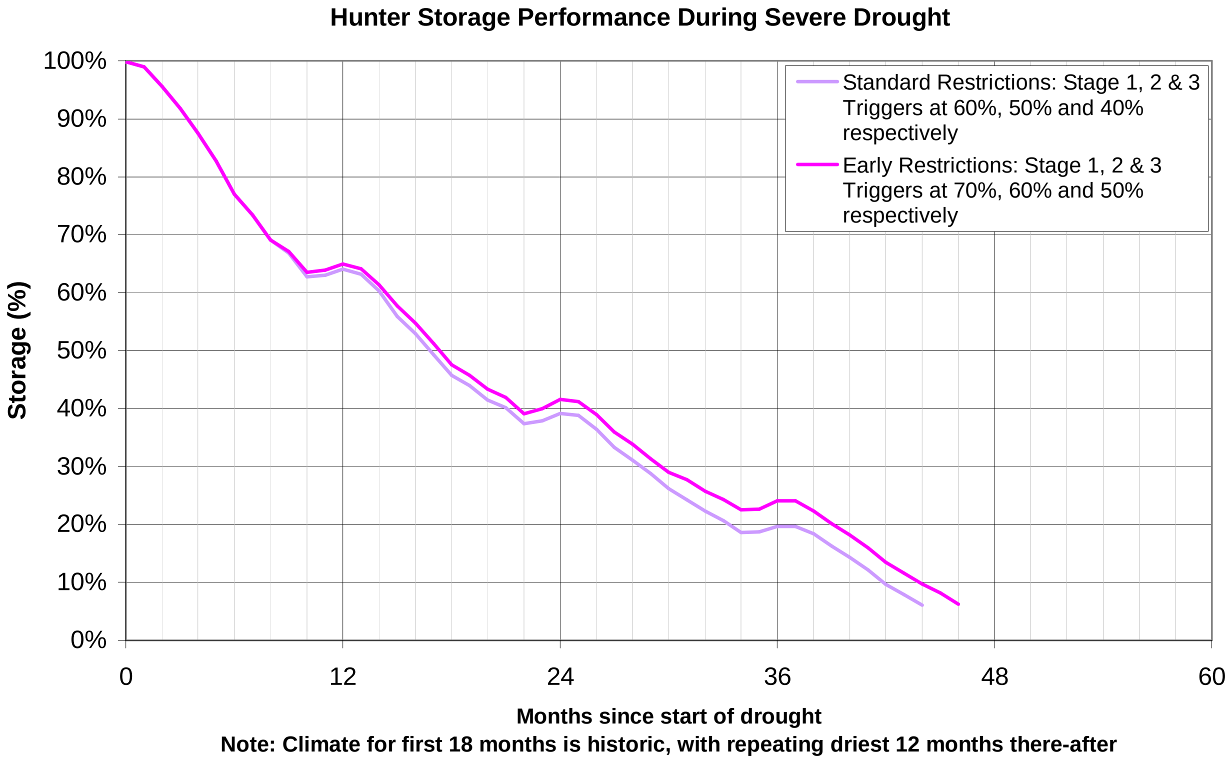


Figure 3.4 Storage performance under early introduction of restrictions

With the population of the Lower Hunter predicted to increase by 30% by 2031 (*Lower Hunter Regional Strategy*, October 2006, Department of Planning), any minor savings from demand management at a household level will be quickly negated at a total system level. Demand management does not offer any meaningful change to the need to take long term action now.

To ensure that the existing water supply system delivers maximum benefit to customers Hunter Water has committed $25 million to water efficiency and leakage minimisation measures over the next five years. Hunter Water also has an extensive program of measures to encourage the adoption of water efficient appliances and practices by way of refit programs, rebates, awareness campaigns and the support of broader regional and State initiatives. These are described in detail in Section 9.4 of Hunter Water's *$H_2$50 Plan* (Hunter Water's Water Resource Management Plan) (Hunter Water, 2008). Hunter Water also works closely with its major non-residential users to identify efficiency or source substitution opportunities.

3.2.3 Options for increasing supplies

A number of submissions suggested that alternative water supply sources had not been adequately considered, and that these options should be further investigated. These submissions, however, did not identify any options for consideration which have not already been comprehensively considered by Hunter Water as part of the *$H_2$50 Plan*. An extensive range of options for increasing supplies has been considered. These alternative options fall into a number of categories, including the fallback desalination option.

Options considered include:

- Current drought management measures
- Residential rainwater tanks
- Sewage effluent recycling
- Urban stormwater recycling
- Desalination
- New dams
- Upgrades of existing dams.

Current drought management measures

In conjunction with water restrictions and the curtailing of environmental releases from Chichester Dam, Hunter Water's current Drought Management Plan includes accessing additional emergency water supplies from a new bore field in the Worimi National Park (adjacent to North Stockton beach), and drawing more deeply from the Tomago bore fields. In addition to construction impacts, operation of a new bore field in Worimi National Park would have significant long term environmental impacts arising from drawing salt water into the aquifer.

Extensive studies show the Worimi National Park bore field can only provide 5 ML/d on a sustainable basis. However it is possible to access the groundwater relatively quickly in an emergency, and supply up to 40,000 ML until it is depleted. Figure 3.5 demonstrates the influence of commissioning the Worimi National Park bore field in an emergency. Even with this bore field in place, planning work on emergency desalination would need to commence when total storage falls to 69% to ensure that the four year lead time required to complete desalination is available before storages are completely exhausted.

On average, reaching 69% can be expected to occur once every 11 years based on historic weather conditions and current demand. The current drought management measures do not provide sufficient capacity to make the need for desalination a remote possibility rather than a near certainty considering population and demand growth.

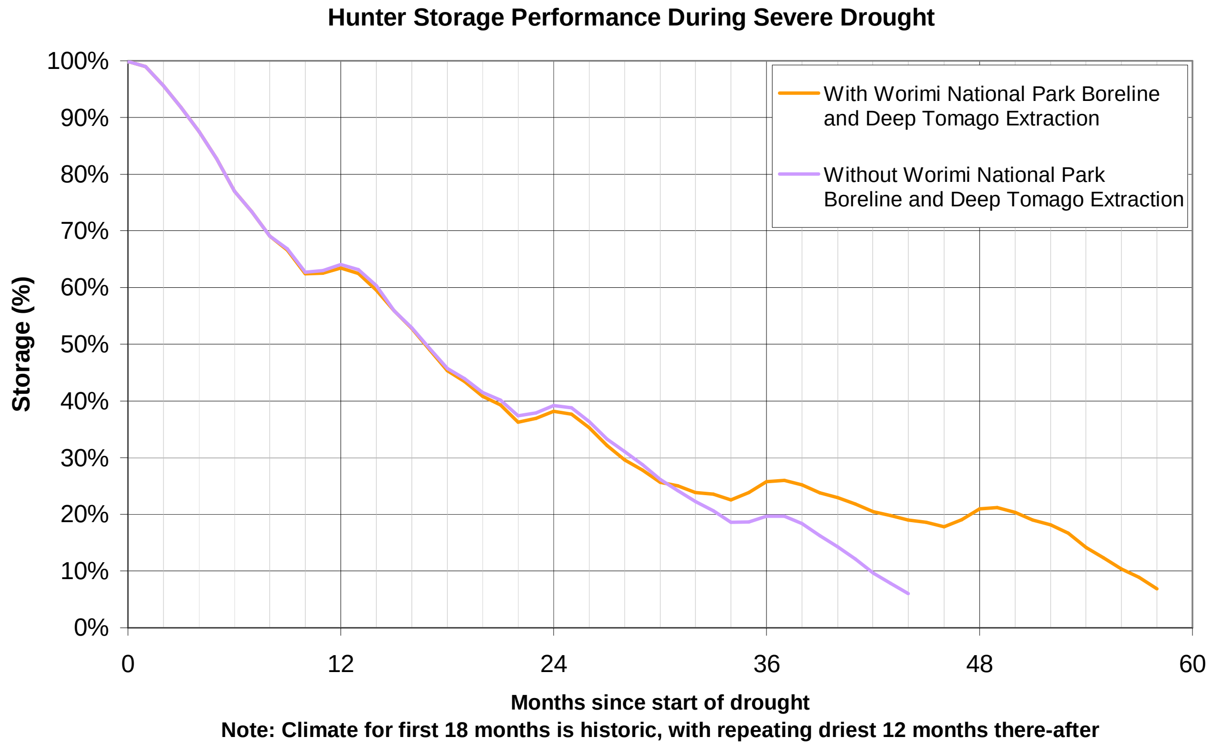


Figure 3.5 Storage performance with commissioning of Worimi NP boreline

Residential rainwater tanks

Residential rainwater tanks are a useful supplement to the urban water supply system. They can reduce pressure on urban stormwater systems and make more water available for the environment by reducing demand on other sources. Rainwater tanks are also efficient at making the most of brief storms due to the impermeable nature of roofing materials whereas natural catchments tend to absorb light falls. However, rainwater tanks provide little storage volume for protection against drought and represent a very high cost option per megalitre of storage.

The potential benefits of rainwater tanks have been assessed by modelling the effect on the Lower Hunter water system of providing 100,000 customers (about 50% of households) with standard 4.5 kL rainwater tanks at a total cost of around $300 million. An average roof area of 150 m^2 was assumed as a catchment for each tank with water being used for toilet flushing, in the laundry and gardening. The savings in mains supplied water produced by this analysis are consistent with results presented in the paper 'Analysis of the performance of rainwater tanks in Australian capital cities' (Coombes and Kuczera 2003). Compared to Hunter Water's calculation of around 70 kL per house per year saving under average climate conditions, Coombes and Kuczera show that slightly lower savings would be expected from rainwater tanks in Western Sydney and slightly higher savings would be expected in Brisbane. Hunter Water estimates that water production from the tanks would drop to around 50 kL per house per year for the climate sequence used in its drought planning.

While rainwater tanks provide a significant substitute for mains water during normal weather conditions, the impact of the tanks on overall depletion rates during drought is very small (Figure 3.6) compared with the cost of installing them. This is not surprising given that the 100,000 tanks provide only 0.1% of the storage of Tillegra but at 75% of the cost.

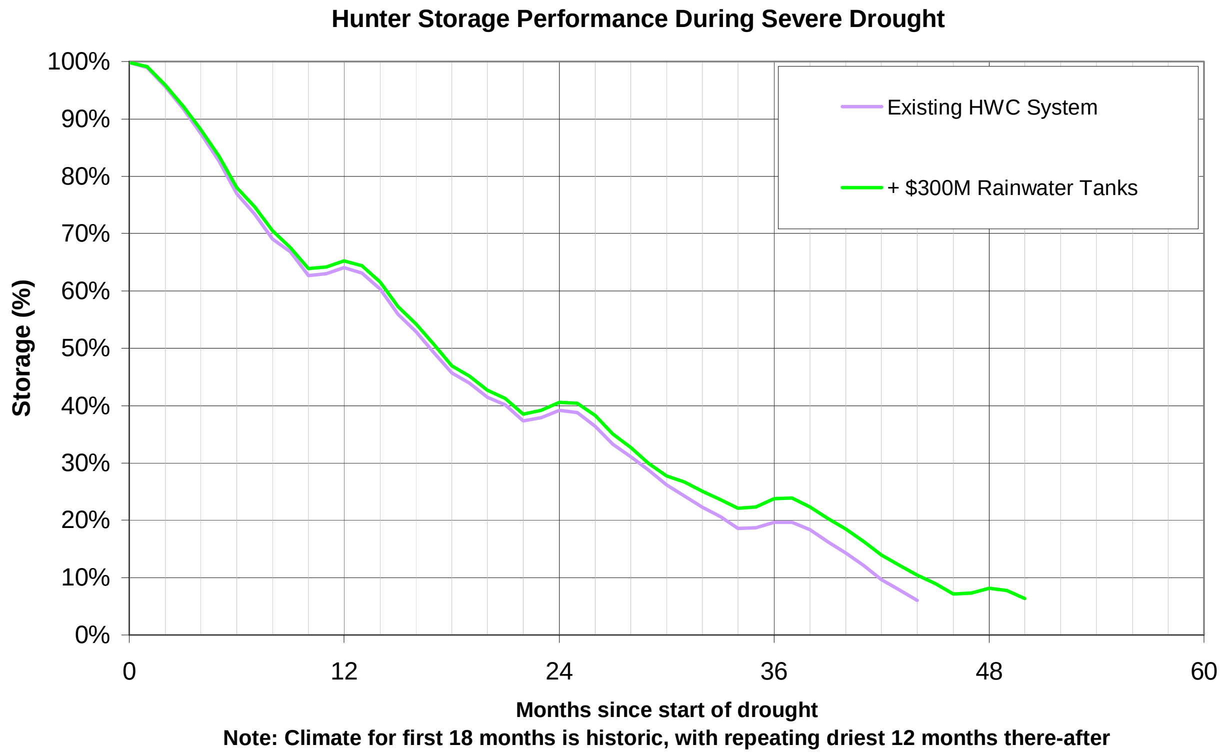


Figure 3.6 Storage performance with installation of rainwater tanks

Effluent recycling/indirect potable reuse

In 2006, Hunter Water commenced a $500,000 study to develop a Recycled Water Strategy. The aim of the study was to assess opportunities for the reduction of demand for potable water by implementing effective recycled water schemes. The Strategy that was developed from the study indicated that industrial recycling and 'third pipe' dual reticulation systems in new residential developments were the most cost effective methods to reduce the use of potable water.

Hunter Water has since embarked on a new recycling scheme for use by industries on Kooragang Island and installation of dual reticulation schemes in new housing developments in the Maitland area at a cost of around $90 million over the next five years.

A major component of this work is the Kooragang Island Recycling Scheme which will produce 3 GL/yr of treated sewage effluent for industrial use. When combined with 'third pipe' and existing schemes, the rate of recycling in the Lower Hunter will rise to around 10%, however, this would still be insufficient to impact on the need for emergency desalination as shown by Figure 3.7.

An option involving the injection of treated effluent into the Tomago Sandbeds had been considered but is now prevented by recent amendments to the *National Parks and Wildlife Act 1974*. In any case this option provided little improvement in capacity.

Of the other possible schemes identified, the most effective effluent recycling scheme involves indirect potable reuse. This scheme involves a large scale collection, reticulation and advanced water treatment network redirecting effluent from a number of major sewage treatment works into Grahamstown Dam. This scheme would provide 26 GL/yr and was fully assessed in the EA Report. Levelised costs for this option are presented in Section 3.2.6.

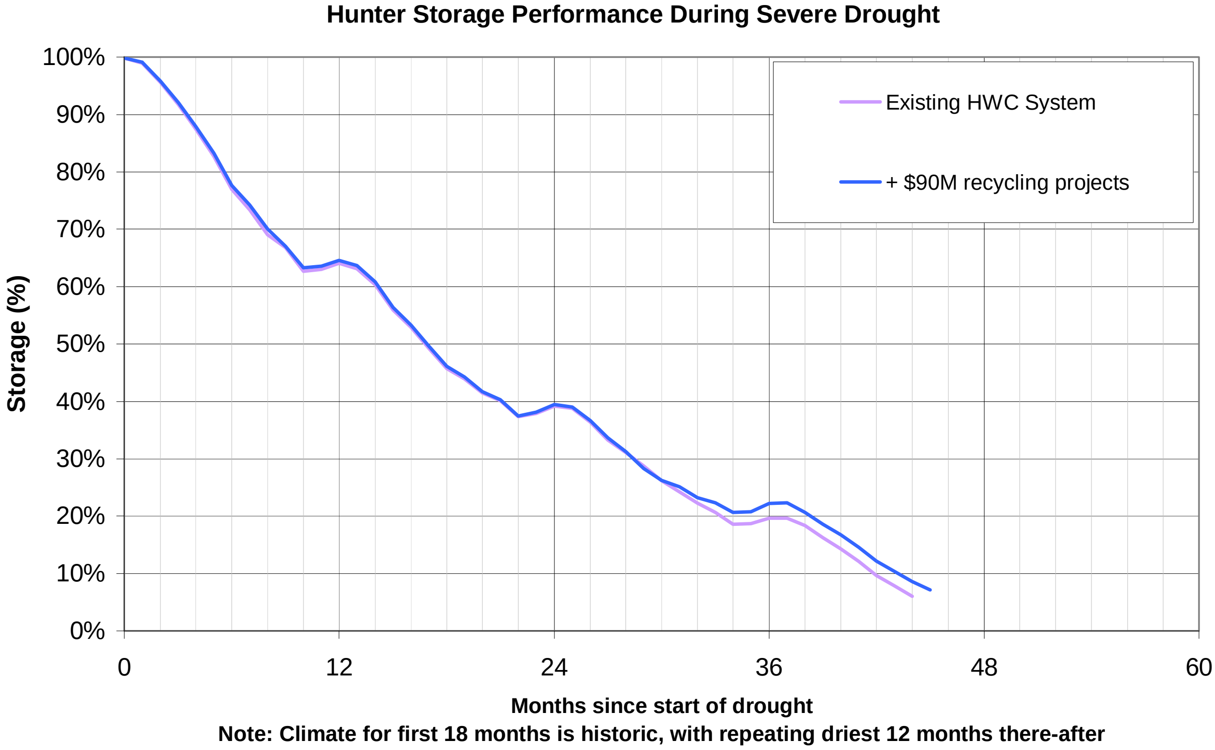


Figure 3.7 Storage performance with commissions of recycling projects

Urban stormwater recycling

Large scale urban stormwater recycling (as opposed to residential rainwater tanks) is an option receiving increased attention in large metropolitan areas. However, its effectiveness as a drought protection measure is entirely dependent on being able to store huge volumes of water during wet periods for reuse during drought. This can be readily done in cities sited on large aquifers by simply allowing stormwater to infiltrate directly into the groundwater reserves. Such schemes have been adopted in South Australia where the geology facilitates large economical schemes.

The geology of the large urban centres in the Lower Hunter is not appropriate for this approach and re-routing of stormwater to suitably sized artificial storage reservoirs is also clearly impracticable due to the size of the transportation and storage facilities that would need to be constructed in developed urban areas. For a storage reservoir to provide a similar level of drought security to that provided by Tillegra, that reservoir would need to be of a similar size as Tillegra (2,100 ha and averaging over 20 m deep).

Desalination

Sites for desalination plants at Belmont, Stockton and Williamtown were assessed by GHD in their June 2007 report. The preferred site is at Williamtown, primarily due to its proximity to major Hunter Water trunk mains. The recommended desalination plant would provide 46 GL/yr and was fully assessed in the EA Report. Levelised costs for this option are presented in Section 3.2.6.

New dams

From the early 1950s Hunter Water has undertaken numerous studies to identify possible new dam sites including 24 identified in the Hunter Valley by the then NSW Water Resources Commission in 1983. Most of these sites were discounted as being clearly unfavourable to supply the Lower Hunter due to remoteness and the high cost of transportation pipelines which can cost between $4 million and $6 million per kilometre depending on size and terrain. A shortlist of three new dam sites was considered in the EA Report: Tillegra, Mammy Johnson's Creek and a new structure downstream of the existing Chichester Dam. Hunter Water has had an interest in all three sites since the 1950s and owns land at all three sites. They have been described and assessed in the EA Report. Levelised costs for each are presented in Section 3.2.6.

Upgrades to existing dams

Two dam upgrade options are described and assessed in the EA Report. Grahamstown Dam, which has been upgraded a number of times since its construction, and Lostock Dam which is owned by State Water. Levelised costs for these options are presented in Section 3.2.6.

The upgrade of Hunter Water's only other dam, Chichester Dam, is not practical although the option to flood the existing dam by building a larger dam downstream is considered as a new dam option.

3.2.4 Combined options

While a number of options where shown to be ineffective as stand alone solutions, consideration was also given to a combination of options. Figure 3.8 shows the effect of combining early water restrictions, 100,000 rainwater tanks and the $90 million of recycling projects proposed by Hunter Water for the coming five years. The effect is clearly marginal and insufficient to make the need for desalination a remote possibility. In other words, Lower Hunter residents would still face the likelihood of funding a $1 billion desalinisation plant in the near future.

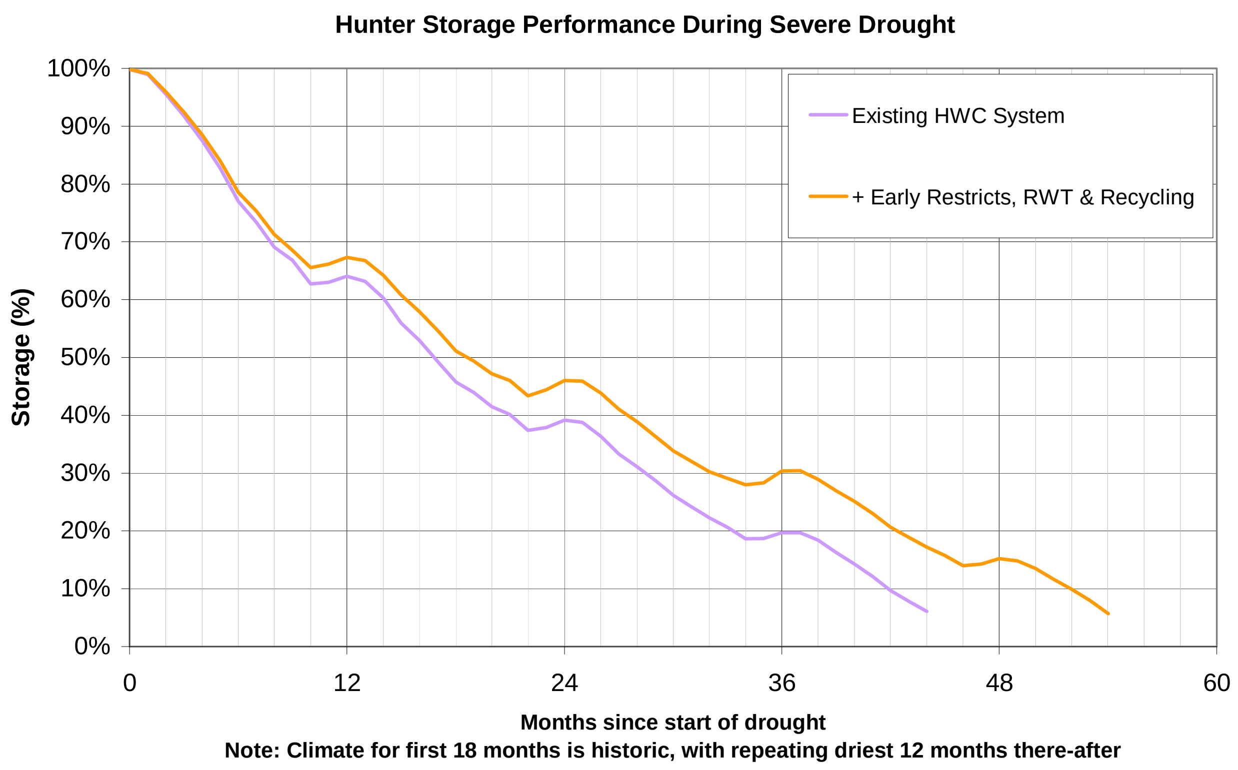


Figure 3.8 Storage performance with combined options

3.2.5 Summary of options for detailed analysis

In summary, the options which have the greatest potential to make desalination a last resort emergency measure rather than a certainty for the near future are as follows:

- New dams:
  - Tillegra
  - Mammy Johnsons
  - New Chichester
- Upgrades to existing dams:
  - Grahamstown
  - Lostock
- Recycling:
  - Indirect potable reuse

The assessment of these options and comparison with desalination is discussed in detail in the EA Report and the cost-effectiveness of these options is briefly summarised in Section 3.2.6.

3.2.6 Assessment of options

The primary need for action has been demonstrated in Section 3.1 to be independent of population growth or climate change. The relative value of each option, however, must be assessed based on its effectiveness at deferring the need to initiate emergency desalination over an extended period into the future. Thus some consideration must be given to trends in population growth, demand and climate change. Opportunities to provide for other project objectives, such as additional growth and an allowance for the uncertainty of climate change are important considerations; however, the assessment is designed in the first instance to consider the immediate requirements for drought security.

The basic measure used to compare the effectiveness of each option is the increase in yield the option provides where the yield is the amount of water that can be drawn annually from the supply system while maintaining a given probability of triggering the need to commence emergency desalination. For the purposes of this analysis a 1% probability of triggering the need to commence emergency desalination has been adopted. It should be noted that this probability has no effect whatsoever on determining whether or not action is required; it merely reflects what is considered an appropriate frequency for initiating ‘emergency measures’ and allows quantitative comparisons of fundamentally different options. Detailed discussion on this issue is contained in Section 3.4 in response to a specific submission from the Wilderness Society (the ISF report).

With yield having been determined for each option, including desalination, a levelised costing has been calculated on a $/kL basis. The costing illustrates the cost effectiveness of each option as detailed in the EA Report. Table 3.2, which is reproduced from the EA Report, clearly shows Tillegra to be the most cost-effective option at around 32% cheaper than the next most cost effective option, and 65% cheaper than desalination.

Note that the EA Report highlighted that levelised cost calculated by the cost effectiveness analysis was used to allow comparison of options and it would not be the basis for determining the final cost charged to the consumer should the Project be approved. Costs and charges are fixed by the Independent Pricing and Regulatory Tribunal (IPART) and include a consideration of a range of other factors undertaken by Hunter Water in accordance with the IPART operating licence.

Table 3.2 Comparison of options

Option	Yield (GL/yr)	Capital Cost ($m 2008-09)	Levelised Cost ($/kL)
Tillegra Dam	56	397	1.66
New Chichester Dam	48.5	586	2.45
Mammy Johnsons Dam	27.5	565	2.73
Grahamstown Dam upgrade	30	656	3.04
Indirect Potable Reuse	26.3	523	3.29
Lostock Dam upgrade	9.5	425	4.76
Desalination	46.2	990	4.80

3.3 Demand forecasts and yield

3.3.1 Overview of demand forecasts

The Hunter Water demand forecasts are made through the use of a spreadsheet model that considers:

- Projected population increases
- Historical usage trends
- Demand management trends
- Unmetered losses from the system
- A detailed review of industrial water needs for major customers
- Expected changes to demand in response to pricing and bulk water supplies in general.

Hunter Water's methodology for estimating demand was independently reviewed by IPART, the independent economic regulator for the electricity, gas, water and transport industries in NSW. IPART commissioned consultants Sinclair Knight Merz (SKM) to comprehensively review the process as it underpinned future revenue and pricing analysis. A full copy of the independent review can be obtained from IPART's website.

3.3.2 Calculation of yield

The Hunter Water yield estimates are made using a custom-built water supply system simulation model. The model simulates the total performance of Hunter Water's supply system by considering demand (mainly restriction policy in drought), evaporation and transpiration losses, inflows and outflows to storages, operational rules and transfers. The model can be used to assess system performance for either historical climate sequences or synthetic sequences to test system performance for events beyond those observed in history.

Where good quality historical stream flow data is available, as recorded by NOW and Hunter Water, it is used directly in the simulation of storage behaviour. Extension of stream flow records and infilling of gaps is calculated from rainfall records using SimHyd, a rainfall to runoff model widely used and accepted across Australia. The SimHyd model is calibrated against recorded flows measured by river gauging stations maintained by NOW.

Synthetic climate sequences of rainfall and flows are generated within the water supply simulation model using an algorithm first developed by the University of Newcastle in 1991. The algorithm is based on widely accepted principles for calculating synthetic hydrological sequences, first developed in the 1960s. The use of this stochastic model to consider potential stream flow sequences allows Hunter Water to consider a wider range of possible stream flow variations than those currently observed in the historical stream flow record.

Hunter Water does not model climate change nor does it explicitly include climate change modelling within its methodology for calculating yield. As clearly noted in Section 3.3.2 of the EA Report, there is currently an element of uncertainty in predicting climate change with different methodologies and outcomes reported by DECCW and CSIRO. Hunter Water has, however, considered that the uncertainty of climate change warrants consideration, and undertook a sensitivity analysis based on the CSIRO report produced in 2004 to ensure that decisions would not become invalid due to climate change.

At the time the CSIRO sensitivity analysis was undertaken it was based on the best climate science data available and the worst case was chosen to check for sensitivity. New climate estimates have since been made and future refinements are likely to warrant revisions of rainfall projections but all revisions appear to suggest less severe climate change impacts than the worst case assumed for the sensitivity analysis. This does not invalidate the need for Tillegra Dam, it simply indicates that the benefits that can be obtained from an augmented water supply through the construction of a dam would not be adversely impacted or reduced.

3.4 Consideration of the ISF report

3.4.1 Background

As noted in the introduction to this section, the ISF contributed a report to the Wilderness Society submission that was critical of Hunter Water's proposal to build Tillegra Dam. Specific criticism included selection of the Project as the preferred option to secure water supply, the method used by Hunter Water to assess system yield, and the methods used by Hunter Water to assess growth in demand.

The substantive criticisms made in the report are:

- Construction of the dam will incur a huge cost for an unnecessary and wasteful level of supply
- There is no need to construct a dam for drought security, additional population growth, to account for the uncertainty of climate change or to assist the Central Coast
- A sustainable water supply strategy should be developed by the community underpinned by demand management, waste water re-use, rainwater collection, stormwater harvesting and mandatory restrictions for high water users
- A robust drought management plan should be developed with 'readiness' options for groundwater and desalination.

This section responds to these criticisms and demonstrates that following the conclusions reached in the ISF report would, without reasonable doubt, lead to extensive damage of the Worimi National Park and commitment to $1 billion expenditure on desalination.

The ISF report was released in August 2009, a month before the EA Report for the Project was placed on public exhibition. The report is considered to have played a role in shaping the views of the community, as demonstrated by reference to it in a number of public submissions.

Given this it is essential to consider whether the ISF report is factually correct, whether it provides sound conclusions, and whether its recommendations are sound. This consideration has taken into account the information presented by the ISF report along with analysis undertaken by Hunter Water, the objectives contained within the WSAA *Occasional Paper No.14-Framework for Urban Water Planning,* and the independent review into Hunter Water's methodology for calculating demand and yield completed by SKM on behalf of IPART (SKM 2008 and 2009).

The WSAA Occasional Paper discusses a framework on how level of service objectives for water supply to a community could be set. That is, the underlying tenet of the paper is the need for water utilities to be able to provide a safe and reliable source of water. Such a supply has to have the capacity to maintain an adequate level of supply over most periods in the long term; the provision of a drought response plan to provide short term protection from running out of water, and an emergency contingency plan for extreme drought to ensure that a community's minimum needs can always be met. The objectives within the WSAA Occasional Paper are considered to be sound.

The reviews into Hunter Water's calculation of demand and yield completed by SKM for IPART contain a comprehensive analysis of the methodology employed by Hunter Water. The reviews completed by SKM have been examined and are considered to be sound.

The central theme of the ISF report is for water planners to consider all options to secure a sustainable supply, to promote water conservation, implement demand management, be prepared for drought, and involve the community in decision making. These principles articulated in the ISF report are considered to be sound.

While the principles within the ISF report are sound, the ultimate conclusions and recommendations are flawed. An analysis shows that the WSAA urban water planning principles could not be achieved in the Hunter if the recommendations of the ISF report were adopted. With consideration of the particular circumstances, relevant to the existing supply network, projected future consumption, and existing yield estimates in the Hunter, there is a considerable challenge in ensuring that a workable emergency Drought Management Plan could be implemented effectively.

It is further noted that the ISF report made a number of assertions for which no underlying supportive evidence could be identified and (in certain circumstances) available evidence suggested the contrary. Analysis shows that adoption of the ISF recommendations, even with a consideration of 'drought readiness' provisions, would expose the Lower Hunter to the risk of depletion in a severe drought and/or to the default construction of a desalination plant within the next few years.

When dealing with the environmental, social and economic aspects of the Project, the ISF report does not identify any of the positive long term economic benefits that the dam could provide to the Lower Hunter. The report does not include any discussion on possible management and mitigation strategies that could be brought to bear by the proponent to address environmental impacts. The ISF report fails to consider both costs and benefits in order to provide a balanced and rigorous review. This is despite a range of benefits and management actions being previously publicised by Hunter Water, even before the publication and exhibition of the environmental assessment.

3.4.2 Responses to issues raised in the ISF report

Hunter Water planning documentation

In its discussion of Hunter Water's planning documentation for Tillegra Dam, the ISF report fails to take into account or properly consider a number of key facts. For example, it does not consider that:

- There has been significant change to the normal management principles applied to urban water supplies since Hunter Water published its IWRP in 2003
- In response to the release of WSAA Occasional Paper No.14-*Framework for Urban Water Planning* and the continued impacts of drought across Australia, Hunter Water, like all other water authorities, began to review its Drought Management Plan and procedures for water supply planning
- Hunter Water's Board had strategic planning sessions on the need to change yield calculations and drought management plans in 2005.

The ISF report suggests that Tillegra Dam should have been identified as the preferred option for source augmentation within the IWRP. The IWRP was prepared in 2003, two years before the release of the WSAA Occasional Paper in 2005. This paper set in motion a fundamental shift in water supply planning across the industry. The principles contained within the WSAA Occasional Paper required a complete review of drought management planning.

The ISF report states that a review of the IWRP occurred in 2006 and this did not result in changes. This is incorrect as a full review of the IWRP did not occur at that time. Hunter Water reported progress against the IWRP (2003) in 2006, as it did every year, as required by its operating licence. A full review and/or substantial changes to the IWRP require a detailed process to be undertaken in accordance with the operating licence. In essence the ISF report fails to recognise the difference between an IWRP, which is formulated once during the five year IPART licensing period, and the IWRP Annual Report.

The ISF report also misrepresents a Hunter Water memo written in October 2006 (and released under parliamentary privilege in 2009) by suggesting that the memo indicates that there was no supply demand planning for the dam. In referring to the October 2006 memo, the ISF report suggests that there was no evidence for supply-demand planning relevant to Tillegra Dam. However, it then fails to note that the memo clearly indicates that a new IWRP was being prepared and that it would include Tillegra Dam. In fact, the Hunter Water memo clearly indicates that Hunter Water was in the early stages of preparing a new IWRP entitled *Water Futures*. This document was subsequently renamed the *$H_2$50 Plan*.

This memo also notes that the new IWRP (which became the *$H_2$50 Plan*) would consider four new water supply projects, these being a major new dam at Tillegra, a major recycling plant at Kooragang Island, a demonstration water recycling plant at Raymond Terrace and an upgrade of Balickera Pumping Station with larger pumps. Thus the memo clearly shows that concerns over Hunter Water's drought security had been identified and a range of options, including Tillegra Dam, were being considered. The memo further notes that the plan would be developed in consultation with the community. This information is not referenced within the ISF report.

The ISF report has noted that the Tillegra Dam announcement in response to the Central Coast's water crisis circumvented established water planning processes in preparing a new water plan and consulting with the community on the development of such a plan. The inference that no community consultation would occur is incorrect as the announcement of the Project did not and could not materially exclude community consultation as it is a mandated requirement of the Part 3A planning process. As a consequence, the ISF claim that there was no supply demand planning underway for the Project and that the community would be excluded from consultation is false.

It is also noted that at the time of the Project's announcement, the Central Coast's water supply had almost been exhausted and an emergency pipeline to convey water from the Hunter had just been completed. The Hunter had, and continues to have, a need for urgent implementation of a long term measure to provide adequate drought security for the region.

Consideration of the best option

The ISF report states that Hunter Water's documents *Why Tillegra Now?*, the *$H_2$50 Plan* and the authority's reporting to IPART do not question the need for the dam. The ISF report also states a NSW Government direction to IPART has prevented it from undertaking its independent regulatory role in 'deciding whether the dam was the best option for the Hunter and asking why Hunter Water customers should pay'.

In accordance with the EP&A Act it is the role of DoP to determine whether Tillegra Dam is the best option for the Hunter, not IPART. The role of IPART in providing regulatory oversight relates to ensuring that Hunter Water, as a State-owned utility, provides efficient services at a reasonable price for consumers, not necessarily the manner in which they are delivered. Further, a direction from Government to set terms of reference for an inquiry is generally standard practice.

Supply to the Central Coast

The ISF report further notes the reasons given by Hunter Water for construction of the dam and states that Tillegra Dam is not required for the Central Coast, will have significant environmental, social and financial costs and will be a massive oversupply for the Lower Hunter. The ISF report also quotes IPART as noting that as the dam is not required by the Central Coast, customers on the Central Coast will not be required to fund its construction. The ISF report notes that federal government funding of $80 million will be used to construct the Mardi to Mangrove pipeline and cites the Gosford Wyong Council's Water Plan 2050 as stating that water from Tillegra Dam is not needed.

The ISF citation of the Gosford/Wyong *Water Plan 2050* in this regard is materially incorrect. The Gosford Wyong *Water Plan 2050* states

> The NSW Government's proposed new 450,000 million litre dam at Tillegra, if built, could provide longer term benefits for the Central Coast's water supply system.

The *Water Plan 2050* goes on to note that

> This new dam would help ensure the security of water transfers between Hunter Water and the Central Coast in the longer-term which are an important part of the Water Plan 2050 strategy.

The ISF report does not provide any further substantive analysis of the Central Coast's water needs, current and projected demand, the amount of water that the Mardi to Mangrove link will yield, and whether the work would satisfy all of the Central Coast's potential water needs in order to substantiate its claims.

Review of the Mardi/Mangrove project material indicates that the work will increase the Central Coast's system yield by about 6 GL/yr. Demand projections from the Gosford Wyong Joint Water Supply Authority show that annual demand at 2001 was considered to be 33.2 GL/yr with this set to increase to at least 40 GL/yr by 2020, an amount closely matched to the increased yield gained from the Mardi to Mangrove pipeline link.

This indicates that the Central Coast may require additional water a few years after Tillegra Dam would commence operation and as a consequence, the proposal could be of value to the Central Coast for additional supply.

The ISF report provides no analysis of longer term population projections for the Central Coast. The ISF report does not respond to DoP's regional strategy projecting growth of up to 100,000 persons for the region by 2031. DoP also notes that this growth projection was increased from the original estimate of 64,250 additional residents, based on the premise that infrastructure, including a secure water supply, would be created to allow the region to prosper. The Tillegra Dam project is specifically referenced as a project of interest to the Central Coast within the planning strategy.

Review of the Gosford/Wyong *Water Plan 2050,* shows that the additional yield provided by the Mardi to Mangrove pipeline source augmentation will be finite. Future demand projections and the aspirational goals of *Central Coast Regional Strategy,* strongly suggest that the Tillegra Dam project could be an important part of the Central Coast's future development by providing an option for improved water security. This would be a matter for negotiation and discussion at that time, based on commercial terms.

Environmental, social and financial costs

The Tillegra Dam project would bring many benefits to the community as well as some unavoidable impacts. The ISF report adds nothing to change Hunter Water's assessment of those impacts or the measures proposed to mitigate those impacts. These are dealt with the EA Report and elsewhere in this submissions report.

For example, the ISF report claims that the dam's construction would have significant environmental, social and financial costs including local economic impacts, aquatic ecosystem impacts, impacts on the Hunter Estuary Ramsar wetlands, and destruction of the 'best last wild population' of bass on the NSW Coast. The ISF report also claims significant methane and carbon dioxide emissions would occur as a result of the dam's construction.

The EA Report acknowledges that the Tillegra Dam project would have environmental impacts within the Williams River and presents a comprehensive suite of actions to mitigate and offset these impacts.

Contrary to the ISF claims, the work undertaken in preparation of the EA Report concluded there would be no material impact on the Hunter Estuary Ramsar wetlands nor on the population of Australian Bass within the river. This conclusion was corroborated by additional modelling undertaken during preparation of this submissions report. The ISF claim that the bass population within the Williams River is the 'last best wild' population in NSW is considered unfounded. This species is common in most rivers on the east coast of Australia from Victoria to south east Queensland. These claims are therefore considered not to be based upon a considered analysis.

The ISF calculations relevant to methane and carbon dioxide emissions are based on an IPCC (2006) methodology which is clearly noted by the IPCC to be draft and in need of further development. The IPCC (2006) in fact notes that calculations using its methodology can be out by several orders of magnitude and utmost care must be taken. The ISF claims relevant to methane emissions are based on untested assumptions on emission rates and an overestimation of the time period over which they would occur.

Displacement of farming families

The ISF report claims that 90 farming families will be displaced by the Tillegra Dam.

This is unsubstantiated and incorrect. As stated in Section 12 of the EA Report, a total of 38 properties are required to allow construction of Tillegra Dam. Of these, the majority have already been purchased by Hunter Water on mutually agreeable terms. Further, a large proportion of the properties are either hobby farms or investment grazing properties.

Consultation

The ISF report states that the community will have to pay for the dam but will not be consulted.

Hunter Water has carried out extensive community consultation in relation to the Project since 2007, as described in detail in Section 4 of the EA Report and summarised in Section 2 of this report. The level of consultation undertaken is considered over and above the legislated requirements of the EP&A Act.

Oversupply to the Lower Hunter

The ISF assertion that the dam represents an oversupply and puts the risk of needing to introduce water restrictions much higher than the normal industry practice is simplistic. The ISF report states that the dam would triple Hunter Water's surface water storage and be able to meet 74% of all current demand in the Lower Hunter by itself and is a massive oversupply. There would be a 1 in 1,250 year chance of entering Level 1 water restrictions when industry standard is acceptance of a 1 in 20 year chance, and in many cities permanent 'waterwise' restrictions are now accepted as normal practice.

This assertion ignores the ability of Tillegra Dam to meet demand well into the future. Selecting an option which merely meets current demand would ignore our responsibility to efficiently cater for future generations and result in constant and inefficient expansion with ever increasing population growth and demand.

The ISF report does not consider that, based on DoP's strategy for developing the area as a major urban settlement area, projected demand by 2050 will likely be in the order of 120 GL/yr.

A benefit of the dam will be its ability to cater for this growth. The rationale for the dam is to provide a) drought security b) capacity for population growth and c) an allowance for the uncertainty of climate change. There is also the opportunity to assist the Central Coast under commercial terms. The frequency of entering water restrictions under current demand is irrelevant when these objectives are considered.

It is also important to note that while water restrictions are often accepted as normal practice within many cities, this does not necessarily mean that the benefits from such actions accrue impartially, or with equal effect, across different geographic locations.

Water conservation rules are designed to work within the capacity of the systems in which they operate. The ISF report provides no indication that they have evaluated in full the likely benefits derived from restrictions for the Hunter.

The independent SKM review has shown that water restrictions obviously have an important part to play in determining system yield however the quantities of water savings accrued from restrictions in the Lower Hunter can be significantly less in comparison to other cities. This is due to the high rates of loss due to evaporation from Grahamstown Dam and transpiration from the groundwater bore fields which continue independent of water restrictions. The low rate of residential water consumption in the Lower Hunter also provides less scope for savings due to water restrictions.

Hunter Water's assessment is that the majority of customers already adopt the principles underpinning the permanent water saving rules as evidenced by the region's low baseline consumption rate and hence adoption of permanent rules will have little or no effect. Hunter Water favours education as a necessary precursor to mandatory rules and penalties.

The adoption of mandatory rules requiring more frequent restrictions or indeed permanent water restrictions within the Lower Hunter is therefore unlikely to drive substantive savings as suggested within the ISF report. As a consequence, the ISF report's observations that permanent 'water wise' rules remove the need to consider augmenting supply are incorrect. The position is considered to be fundamentally flawed when translated to the Lower Hunter.

No evidence is provided within the ISF report to demonstrate that the community of the Lower Hunter in fact supports permanent water restrictions. Further, there is no evidence provided to show that water restrictions would in fact provide a substantial improvement to the water supply within the particular constraints of the existing supply system.

It is therefore concluded that without presentation of additional information to the contrary, there appears to be no evidence to support the ISF claim that Tillegra Dam would supply an extraordinary and unwarranted supply of water to the Lower Hunter.

Drought security criterion

The ISF assertions regarding Hunter Water's drought security criterion are not supported by the actual conclusions of independent consultants SKM nor from consideration of recent developments in the industry which have seen the author of the drought security criterion widely recognised for his work. Failure to adopt the criterion would equate to ignoring the realities described earlier in this report and result in proceeding to the least cost effective option of desalination.

The ISF report specifically asserts that the HWC drought security criterion introduced in 2006 is unusually complex, containing flaws and arbitrary assumptions. The criterion has not been used elsewhere. The criterion is considered, according to SKM, to be conservative and unique. Further, without adopting the criterion no reduction in yield occurs and therefore a new supply is not required. The proposition is put forward that the independent review by SKM supports these conclusions. This is not correct.

The HWC drought security criterion is that the long run risk of reaching the 48 month trigger in the drought management plan should not exceed 1 in 100. This has been reported elsewhere with the SKM and ISF reports as providing four years of supply below the drought trigger and enough storage above the trigger to satisfy demand in a 1 in 100 year drought.

This is not a complex criterion. Hunter Water's basic objective is to ensure that it can reliably supply water to the Lower Hunter and not to have to implement an emergency drought management plan more than once every 100 years on average. Should such a drought occur, this would constitute an emergency and Hunter Water's objective is then to ensure that it has enough water to continue supply, even in a restricted manner, while it implements an emergency response plan.

The plan would include the construction of a desalination plant. As previously mentioned, construction of a plant is estimated to take four years, hence the requirement for four years (48 months) of supply below the drought trigger point in the criterion.

The ISF report notes that the drought security criterion has not been used elsewhere in Australia and quotes SKM as noting that that the criterion is unique and possibly conservative. As noted previously, supply management strategies need to be designed on a case-by-case basis to suit the characteristics of the particular water supply system in question. Adopting a criterion that is unique to a particular system is therefore not very surprising.

It is worthwhile noting that in the *South East Queensland Water Strategy (2009)* prepared by the Queensland Water Commission, (currently on public exhibition), the Queensland Government is proposing to adopt a similar drought trigger criterion, although to complement a more extensive range of level of service criteria.

The ISF argument against the drought security criterion rests on the SKM independent review which noted that the criterion was possibly 'unique and conservative', the inference being that the criterion is 'inappropriate'.

This argument however is unsupported by the SKM review. Within the same paragraph of the SKM report that is quoted by the ISF, the SKM reviewers agree that previous reliability criteria were not acceptable. That is, previous estimates of what equated to a reliable yield, were no longer relevant. They also go on to benchmark the performance of the new drought criterion against other water systems, such as that managed by the Sydney Catchment Authority (SCA) and found that the criterion does in fact provide a similar level of reliability in supply, as maintained by the SCA. In other words the ISF claim is incorrect.

The SKM report further concludes that:

> … HWC has adopted an appropriate approach to estimate system yield. Their water resource planning model is conceptually sound and well calibrated.

The ISF review notes the SKM documents are a key platform for their analysis. It would appear that the ISF report fails to identify or recognise the key conclusions of the SKM report that Hunter Water's '…yield estimates are considered to be reasonable and robust'.

The Hunter Water approach to drought management planning and its incorporation into the determination of yield was first presented at the 31st Hydrology and Water Resources Symposium in April 2008 and was reproduced in the *Australian Journal of Water Resources* in 2009. The technical journal paper is reproduced in full as Appendix B with the permission of the Journal.

The author of the journal article from Hunter Water received the *GN Alexander Medal for Hydrology and Water* in recognition of the ground-breaking work on drought management planning. This prestigious award is made annually by the National Committee on Water Engineering, to the author of the best scientific paper on hydrology and water resources printed in a relevant Australian publication.

The provision of the GN Alexander Award indicates that the Hunter Water methodology for drought management planning has been reviewed by a number of well qualified and experienced individuals appointed to the National Committee and on balance, is unlikely to have been nationally acclaimed if it contained flawed or arbitrary assumptions, as claimed in the ISF report.

Climate change and supply planning

The ISF report states that the introduction of climate change into supply planning seems simplistic as it applies a 10% reduction in rainfall for every day and has not addressed a range of climate change scenarios. The ISF recommends that Hunter Water model a range of scenarios based on the latest climate change projections for the Hunter region.

The ISF report investigates at length the disadvantages of using a 10% reduction in rainfall for the determination of system yield. It is not clear why the ISF has gone into such detail critiquing this issue as the Hunter Water yield estimate does not incorporate any allowance for anthropogenic climate change.

While the ISF report has critiqued part of a yield assessment methodology which has not, in fact, been used by Hunter Water, it is important to note that Hunter Water has undertaken sensitivity testing on how the Lower Hunter water supply system may perform under a climate change scenario of a 10% reduction in rainfall. The purpose of this sensitivity testing may have been confused by the ISF. As stated previously, the sensitivity testing was based on the CSIRO reporting of potential climate change impacts in 2004. At the time, the sensitivity analysis was performed in 2006, this was the most robust climate change information available to Hunter Water. It is explicitly noted however that neither the existing system yield calculation of 67.5 GL per annum, nor the projected yield of 120 GL/yr if Tillegra Dam is approved, contain any allowance for climate change.

The calculated yields, as well as the manner in which they were derived, are clearly reported in *Why Tillegra Now?,* the *$H_2$50 Plan,* and the Tillegra Dam EA Report. An entire section (Section 3.3.2 of the EA Report) specifically noted the issues preventing reliance on climate change modelling for yield calculation. The SKM independent review also clearly notes that the Hunter Water methodology does not include an allowance for climate change.

The ISF report recommends that Hunter Water model a range of scenarios based on the latest climate change projections for the Hunter Region within its conclusions. On page 13 of the same ISF report, however, the ISF notes that it agrees with the recommendations of SKM that on balance climate change modelling is not required as there may be an increase in rainfall, however this may be offset by evaporation.

Hunter Water believes that it would be prudent to understand the possible consequences of climate change as shown by the sensitivity analysis, maintain a watching brief on the evolution and development of climate change modelling and projections, note the considerable uncertainty for planning purposes, and develop future responses as climate change projections are progressively refined. In the interim, the existing yield projections are considered to be satisfactory, as confirmed by the SKM report.

Appropriateness of drought security criterion

The ISF report asserts that Hunter Water's third and most recent drought security criterion introduces flawed and arbitrary assumptions into the yield assessment and the criterion has not been sensitivity tested.

It is noted that the 1 in 100 year trigger point adopted by Hunter Water within the drought security criterion was benchmarked by SKM during its independent review for IPART. The drought security criterion was adopted after a thorough review by Hunter Water. As previously noted, other water management agencies, such as the Queensland Water Commission, are moving to adopt a similar criterion.

Given the extreme consequences of reaching the trigger point, it is imperative that setting of the probability of reaching the trigger is not done arbitrarily or without a full appreciation of the consequences. Reaching the trigger would see commitment to a $1 billion dollar investment of the community's money into desalination, and which could otherwise be spent on other vital public infrastructure. This could be avoided by implementing an alternate, less costly and pragmatic solution. Other components of the current Drought Management Plan may also be triggered resulting in extensive impacts to the Worimi National Park.

The ISF report references Erlanger and Neal (2005), the primary authors of the WSAA Occasional Paper, and claims that Hunter Water has misinterpreted the paper's recommendations of developing a zero risk drought security strategy. However, the WSAA paper clearly indicates that this is exactly what the authors propose, stating that a safe and reliable supply

> …does not mean that there will never be restrictions, but it does mean that a community can expect never to run out of water.

Hunter Water concludes that the ISF either does not understand the purpose of the WSAA framework or does not endorse the principles of managing risk promoted within it. Hunter Water's adoption of a zero risk drought strategy is completely in line with the recommendations and framework set out in the WSAA Occasional Paper.

Lead time for construction of desalination

The ISF report notes that drought contingency planning is best practice, however, Hunter Water's assessment of a 48 month (four year) lead in time is highly conservative as the *Metropolitan Water Plan* noted that a larger, more complex plant would be built within 26 months. The ISF recommends that a standard drought security criterion which reflects what it believes to be normal industry practice should therefore be used instead when setting the yield estimate and that this should be set to reflect a very low probability of reaching critical storage levels. It is noted currently that there is no 'normal' industry set practice.

The ISF report fails to mention that the 26 month construction period excludes a number of major activities which must be accommodated within the lead time. Even if environmental assessment, planning approval and design (which are included in the 48 month lead time) are completed in advance at considerable expense, tendering processes could not be undertaken before the decision was made to proceed to construction. It is evident from GHD's study that lead time could only be reduced to three years.

The objectives of the Tillegra Dam project proposed by Hunter Water is to adopt the WSAA principles to eliminate risk to supply. While risk can be significantly reduced, the consequences of running out of water are extremely high, causing an extreme hazard category to be assigned to the Lower Hunter's supply. The ISF position appears to be that it is appropriate to assume the risk no matter how severe the consequences.

A key assumption in the yield estimate calculations adopted by Hunter Water, specifically in relation to drought security, is the 48 month lead time assumed for planning, design and construction of an emergency desalination plant. This assumption was adopted by Hunter Water in 2007 following a detailed assessment of desalination site options in the Newcastle area by consultants GHD.

The GHD study included a broad investigation to identify potential sites within the region, followed by a detailed assessment of the costs, environmental impacts, infrastructure and other constraints for each of the preferred sites that were identified in the first part of the study. It also included an assessment of the likely required lead times for Hunter Water to plan for and build a desalination plant.

The Hunter Water emergency drought management plan relies on preserving and accessing every possible water source within the Lower Hunter to provide the 48 month lead time for planning and construction of the desalination plant.

The plan considers:

- Four stages of demand reduction. The first three stages include increasing severity of water restrictions culminating in a complete ban on outdoor use of hoses. The fourth stage is intense education and advertising targeting minimising demand to lowest possible level. There is also a provision in the plan to approach IPART to seek permission to undertake price manipulation as part of the fourth stage, to further reduce demand
- Continued promotion of and use of rainwater tanks and spear points, although their absolute utility within a drought event is considered to be limited
- Revision of environmental flows from Chichester Dam
- Revision of access rules to Seaham Weir Pool and Williams River low flows
- Access to Worimi National Park groundwater reserve
- Access to deep Tomago groundwater reserves
- Desalination. This component of the emergency Drought Management Plan is currently being held in abeyance by Hunter Water until a determination on the Tillegra Dam project is provided. Should the Project not gain approval, work on desalination planning would begin.

There is also potential to take action to further refine operational and reticulation losses as well as reuse effluent in a manner not considered to be economically viable under normal operating conditions.

The most substantive contributors to the emergency drought plan are the sand beds within the Worimi National Park and at Tomago. The sand beds can be used to extend the normal length of time Hunter Water reserves could last in a drought if the system is both developed and drawn from, prior to the existing surface water reserves running dry.

It is not possible to draw enough water from the Worimi National Park Sand beds and from within deep reserves at Tomago alone to satisfy demand. Water must therefore be supplied in parallel with other sources. Currently, without implementing the Drought Management Plan, with the exception of water restrictions, the existing storages would last around 3.5 years. With implementation of the Drought Management Plan with the majority of additional water being drawn from Worimi National Park and Tomago, storage life could be extended by just over a year.

The greater the volumes of water that can be drawn from Worimi National Park, the more benefit it will have in terms of extending supply in a severe drought. The proposal for the Worimi National Park scheme, which is included in the Hunter Water emergency Drought Management Plan, is to construct a major boreline along the centre of the sand beds. This boreline would be designed to deliver around 60 ML/d for a two year period, after which the aquifer would become affected by salt water intrusion. The volume of water that is assumed could be extracted from Worimi National Park alone during a severe drought is in the order of 44 GL and is thus used in the emergency plan to extend water supply in a drought by around eight months.

The deep Tomago Scheme proposal is to access water beneath the current maximum extraction point of the existing bore lines by a further 1.3 m. Water within this deep storage component of the Tomago groundwater reserves can extend water supply in a drought by five months.

Hunter Water believes that implementation of the Worimi National Park scheme will have substantial consequential environmental effects in terms of both surface habitat destruction within Worimi National Park (it would involve a 20-25 km long clearing for the boreline), and subsurface extraction that causes salt water intrusion. The Worimi National Park sand beds are also of high cultural value to the Worimi Aboriginal people. The proposed boreline route is already known to lie in an area that is rich with relics from past Aboriginal activities, including middens and burial sites.

In addition, extraction from this source will impact on known groundwater-dependent ecosystems, draw in salt water impacting upon irrigation use and result in acid from the oxidation of acid sulphate soils, to be released into the adjacent Port Stephens Marine Park. It is estimated that it would take at least 5-10 years for salt water to be flushed from the system back to baseline conditions after using the system in a severe drought. Accessing this source therefore requires careful consideration of the consequences.

Hunter Water believes the Deep Tomago Scheme will have similar implications to that described for the Worimi National Park scheme; however the extraction of water from Deep Tomago is estimated as being likely to irreparably oxidise pyrites and mobilise soluble iron, arsenic and manganese within the sand beds. Beyond possible impacts to groundwater-dependent ecosystems and the general environment, this will result in major upgrades of water treatment plants being required at considerable cost. Accessing this source, therefore, requires careful consideration of the consequences.

It is noted that Hunter Water does not have major project or concept approval for the actions within the emergency Drought Management Plan, such as accessing water within Worimi National Park and Deep Tomago. Without access to these major sources, and the 13 months of additional supply they would provide, the amount of time that is available for piloting, approval, construction and commissioning to full production of a desalination plant is reduced from 48 months to 35 months.

It has been suggested by the ISF report that if the environmental assessment, site selection and site acquisition tasks are removed from the process (ie if they were undertaken in advance) the lead time for a desalination plant could be reduced to 26 months. This suggestion is based on the timeframe assumed by Sydney Water Corporation (Sydney Water) when adopting a desalination readiness strategy as part of the 2006 *Metropolitan Water Plan*.

Planning for the Sydney Water desalination plant commenced in late 2004 with first water delivered on 28 January 2010, about five years after the project commenced. The construction phase commenced around September 2007 and did in fact take 28 months in close agreement with the time period estimated by Sydney Water and suggested as being practical by the ISF. Achieving construction within this time period is also generally considered to be an excellent result within the water industry.

It is noted, however, that this time period did not include the tender process: advertising for expressions of interest from construction companies, short listing, the completion of a final tender, assessment of bids, the finalisation of contractual arrangements with the successful bidder or site set up and establishment. In fact, an EOI for the desalination contract was first called by Sydney Water on 21 December 2006 (Sydney Water 2009), almost nine months prior to construction starting. The final time period for Sydney Water to complete the desalination plant (and pipeline) was therefore 37 months.

The proposition in the ISF report that a desalination readiness strategy would provide a better outcome for the Lower Hunter requires careful consideration. While pre-planning and completion of the environmental assessment could reduce time, it is important to understand that gearing up for expressions of interest, advertising tenders, the tender assessment and award process, can take considerable time. These activities cannot be “pre-prepared” and concluded for ‘drought readiness’.

Consequently a drought readiness strategy for desalination could not be readily achieved for an operational plant within 26 months. It would be possible, however in the Hunter Water circumstance to reduce the desalination lead time by about a year, from the estimated 48 months to about 36 months.

This acceleration approach is also dependent on having an ‘open ended’ project approval for a desalination plant. It is likely that the desalination plant would be assessed under Part 3A of the EP&A Act. The Act includes a provision (Section 75Y) where:

> An approval under this Part may be subject to a condition that it lapses on a specified date unless specified action with respect to the approval has been taken (such as the commencement of work on the project or the submission of an application for approval to carry out a project for which concept approval has been given).

The Act also includes an allowance that:

> Any such condition may be modified under this Part to extend the lapsing period. The Minister is to review the approval before extending the lapsing period and may make other modifications to the approval (whether or not requested by the proponent).

The inclusion of a period for lapsing of approvals is not a requirement in the project approval; however, it is likely that the Minister for Planning would include such a provision. Most project approvals lapse within five years although they can be extended. The concept approval for the Sydney Desalination Plant included a condition that required construction to begin by December 2015 which is approximately 10 years from the date of approval. Consequently, the adoption of a shorter lead time for construction based on pre-approval for the project could also potentially require an additional ongoing and costly assessment process to maintain the project approval status in readiness for construction. Such costs would be in the order of $5 to $10 million per occurrence.

Adopting a desalination readiness strategy would require a major up front investment of around $100 million to cover environmental assessment, site acquisition, pilot plant studies and all phases of design. After this investment, desalination would become the next system augmentation by default. This is a far less attractive option to Hunter Water than Tillegra due to the high capital cost and high energy intensity of desalination.

The uptake of desalination would also require Hunter Water to be reliant on aggressive emergency groundwater extraction strategies for both Worimi National Park sand beds and Deep Tomago reserves, because together these sources account for 13 months of supply in the Hunter Water emergency drought management plan.

Without access to Worimi National Park and Deep Tomago groundwater reserves, desalination piloting and environmental approval processes will need to commence immediately to allow sufficient time for the desalination plant construction phase if storage levels fall. At current demand levels, the desalination construction phase would need to begin when storages drop below 77% of full supply, an event which occurs around once every five years. Increased demand due to population growth will leave less time for the desalination plant construction phase which will need to be triggered earlier. Growth in demand in the next five years is expected to result in the construction phase needing to begin when storages drop to 91% of full supply, a level routinely reached every year within the Lower Hunter in the summer months as illustrated in Figure 3.2.

In other words, if the Tillegra Dam proposal does not progress, Hunter Water would be obliged to move immediately to advance the desalination proposal.

If Tillegra Dam was approved, the necessity of accessing Worimi National Park and Deep Tomago is relegated to a very low risk and further action (needing to access Worimi National Park or Deep Tomago and constructing a desalination plant within five years time) can be avoided with an almost 100% certainty.

Risk for triggering of drought management plan

The ISF report continues to argue that criteria for deciding when a desalination plant should be constructed should not be assigned a 1 in 100 chance of occurrence and a sensitivity test should be performed to determine whether a higher level of risk could be assumed, resulting in a higher yield.

Hunter Water’s selection of the drought security yield criterion is based on an assessment of the order of risk required to achieve a robust emergency Drought Management Plan. The performance of the plan is related to demand in the sense that the planning triggers are a function of demand. The higher the demand, the faster storages deplete and hence the higher the trigger levels need to be set in order to ensure that the system cannot run out of water while actions are implemented. Figure 3.9 shows how the trigger levels have to be increased as demand increases for the current supply system. The 48 month trigger is the first major trigger and would require a commitment to an expenditure of around $100M for design of a desalination plant, site acquisition, and fast track design of an emergency borefield. The 36 month trigger is the construction trigger for both the emergency boreline and a desalination plant.

Given a current demand of around 73 GL/yr, it is evident from the above figure that for the existing system the trigger levels are quite high and will increase further as population and demand grows. The emergency Drought Management Plan would become unviable, if it is not already, if the triggers are at storage levels that do not inherently create a sense of urgency. In other words it is difficult to convince the community that it is necessary to spend $1 billion on desalination and significantly damage Worimi National Park when storages are at 80% or 90% full.

The adoption of 1 in 100 chance as the acceptable frequency of hitting the first major action in the emergency plan means that the plan is saved for genuine emergencies, and that the required level of support could be mustered to carry out the steps in the plan as required to ensure ongoing supply of water. If a higher risk threshold is adopted, there is a very real risk that the plan would not be enacted in a timely fashion as there would be no sense of urgency in the community, so if a drought eventuated for which the plan is designed, it would fail to ensure the ongoing supply of water.

The ISF report recommends considering whether the chance of occurrence in triggering the drought management plan should be adjusted, to once in every 50 years as an alternative. Taking such action would have a dramatic impact on the resulting yield. As noted previously in this chapter however, the criterion has been previously endorsed via an independent review. Adopting a low acceptable risk is especially important in the context of the extreme environmental and financial consequences of initiating emergency actions.

Minimum supply requirement

The ISF report suggests that a minimum supply requirement of 70% of normal use is too high as the community would accept a much more stringent reduction in the amount of water that they would be allowed to use during a drought.

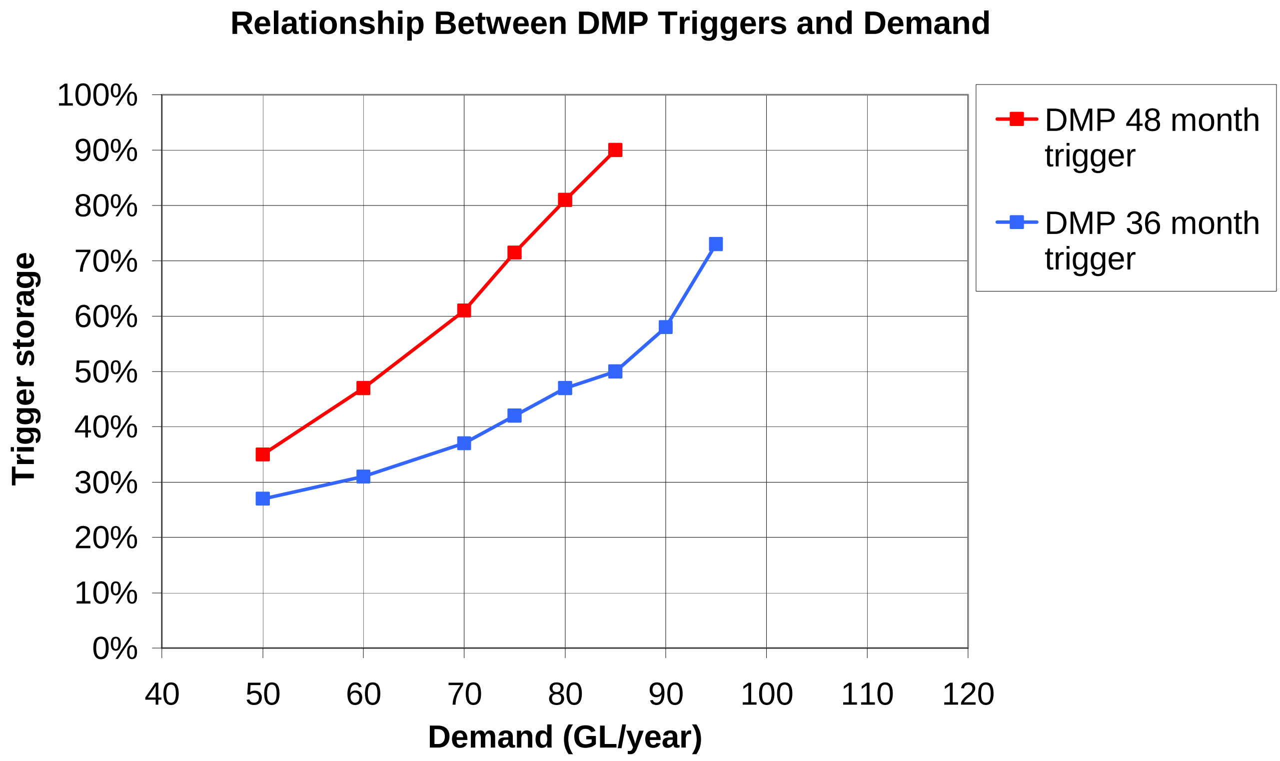


Figure 3.9 **Relationship between DMP trigger levels and demand**

It is noted that the overall restriction policy proposed by Hunter Water assumes far greater demand savings than would be achieved under the restrictions used in the Sydney yield assessment which ISF promotes in other sections of the report. The issue is not so much what the community would accept, but how effective the restrictions are in reducing rates of depletion. Given the low baseline demand in the Hunter, savings below 70% are not realistic. Further, as noted previously, other factors such as evaporation rates are far more critical in determining rates of depletion of the Hunter's specific system.

Use of repeated drought sequence

The ISF report suggests that the use of a repeated drought sequence without historic precedence in the estimation of yield is not appropriate

The rate of depletion of the existing storages within the Hunter Water supply system is one of the key issues driving the need for additional supply. Hunter Water has incorporated a back-to-back, repeating 12 month sequence of drought conditions (worst on record) into the assessment of yield to determine a 'worst case' scenario. The ISF report challenges this approach, questioning the dependence of Hunter Water's yield assessment on this drought security criterion and the resulting assumption that Hunter Water storages can fall as rapidly as they fell in the worst drought on record over an extended period of time.

Hunter Water has found that this approach is a close approximation of the median rate of depletion when calculating yield. The median rate of depletion is calculated through the use of stochastic modelling that generates thousands of years of synthetic climate data to simulate a range of possible drought sequences and potential rates of storage decline.

Testing the rate of depletion requires a huge number of climate sequences to be analysed, and to capture the statistics relating to the rate of depletion for the events where the system would otherwise run out of water. Figure 3.10 is extracted from the Drought Management Plan (Hunter Water 2006) and shows the rate of depletion between reaching 60% storage and reaching 10% storage within the scenarios. It is noted that the Lower Hunter's storages are generally considered to be empty when system reaches 10% as ability to access all water in groundwater aquifers, siltation of surface water storages and limitations to the accuracy of predictions makes it dangerous to assume that every single litre of water in the supply system can be accessed.

Figure 3.10 shows that the median rate (50th percentile) of depletion from 60% storage to 10% storage is around 37 months. This is approximately the same but more rapid than back to back repeats of the known worst drought on record. Accordingly, Hunter Water draws little distinction between the median rate of depletion and the potential for a drought to occur that repeats the sequence of the known worst drought on record. The latter is generally used by Hunter Water as it is far easier to describe and explain in layman's terms, rather than the intricacies of stochastic modelling.

It is noted that Hunter Water storages can potentially fall up to 50% faster than is derived from the repeating sequence of the driest 12 months on record, and the real worst case scenario is actually substantially worse than a back-to-back repeat of the worst drought on record. This occurs because the worse drought on record within the particular sequence includes a period of runoff generating rainfall.

Hunter Water agrees with the ISF report that arbitrarily repeating a climate sequence of the worse drought on record is not appropriate when estimating yield, but as this actually corresponds to the calculated median rate of depletion using stochastic modelling for the Lower Hunter, its adoption is not flawed or arbitrary. It is noted however that Hunter Water should footnote its documents to explain the duality of the median rate of depletion against the back-to-back repeat of the worst drought on record to avoid potential future confusion.

Sensitivity testing of drought parameters

The ISF report states there is no sensitivity testing of drought parameters used when estimating yield. It recommends that Hunter Water conduct sensitivity analysis of critical parameters and optimise the yield of the existing system. It contends that Hunter Water's assessment of yield at 67.5 GL does not reflect the actual historic performance of the system, as Hunter Water's calculations show there is only a 1 in 1 million chance

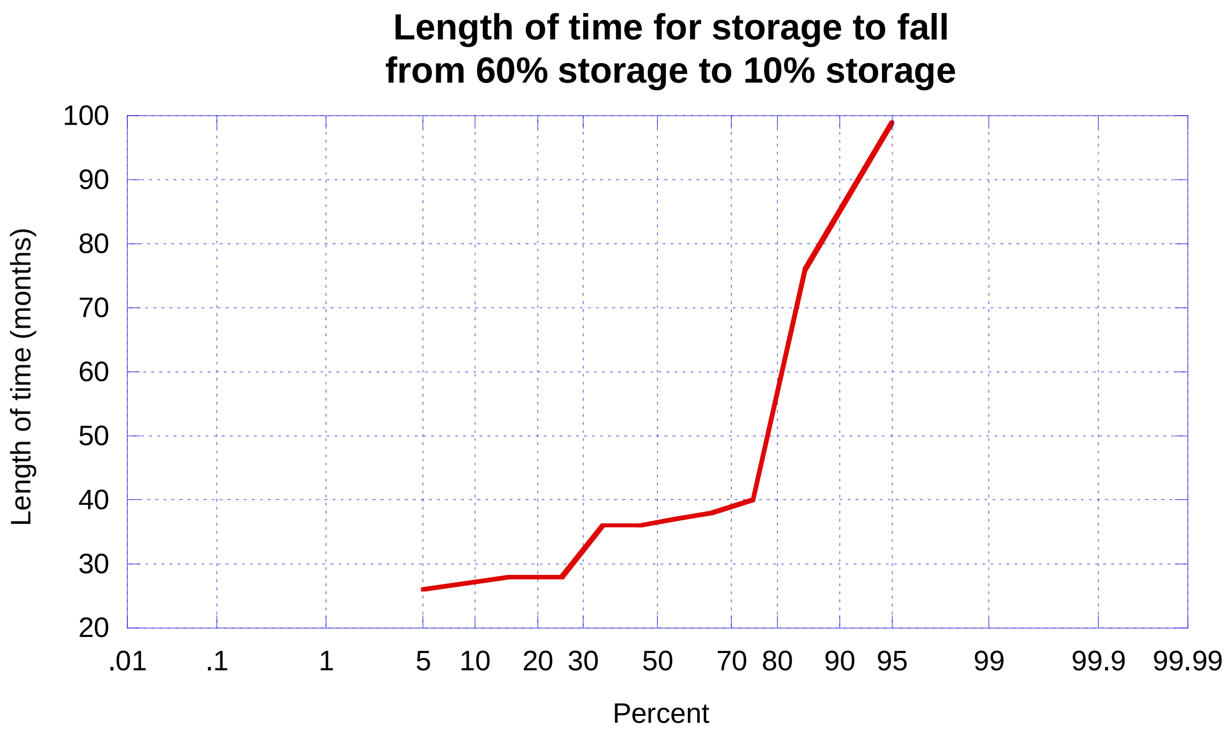


Figure 3.10 Storage depletion

of reaching 10% of storage capacity, and SKM's analysis shows that there would be a 1 in 10,000 chance of supplies failing to 20% of storage capacity if demand was allowed to rise to 85 GL/yr.

As previously noted it would be naïve and irresponsible to base calculation of yield solely upon historical records when experiences across the continent during the recent drought have demonstrated how inadequate such records are. Relying on 80 years of historic data, as is available for the Lower Hunter, to predict events of a probability of less than 1 in 80 is statistically unsound.

Hunter Water has undertaken a sensitivity analysis of a range of critical parameters relevant to drought management planning, which are contained within its 2006 Drought Management Plan as revised and cited by the ISF report. For example, Hunter Water considered bringing forward or delaying the imposition of restrictions and the effect that it would have on reaching the desalination construction triggers and having Stage 4 restrictions. By introducing restrictions 10% earlier than normally planned, approximately 6 GL of water could be saved (about one month worth of storage at the 2006 assumed rate of demand) and the trigger point for construction of a desalination plant could be dropped by 3% of total storage, from 46% to 43%.

Modelling cited by the ISF indicates that there is only a 1 in 1 million chance of running out of water should a median (back-to-back) drought event occur. Without access to Worimi National Park and Deep Tomago reserves, however, the risk is reduced to 1 in 100,000 at current demand, and with a minor increase in demand to 79.5 GL/yr, the risk is reduced to 1 in 40,000.

The ISF report has failed to note that the Hunter Water probability calculations, as cited in the ISF report, are clearly footnoted in the source documents as having questionable accuracy. The documents containing this modelling information were released to the ISF under a Freedom of Information request. It is noted that additional information was not sought from Hunter Water by the ISF on the stochastic modelling methodology despite the cautioning footnotes, nor was Hunter Water contacted by ISF to have the accuracy of the reports clarified.

The sensitivity analysis and calculation of annual exceedance probabilities are severely impinged due to the fact that the Lower Hunter has less than 100 years of historical records. These records only capture three major drought events. The accuracy of the modelling is therefore limited when used to estimate the annual probability of exceedance, greater than a 1 in 100 chance. Beyond this level of estimation, probability figures could be out by several orders of magnitude. Indeed, a 3% saving in storage volume, which is about a month's supply, can in certain circumstances make the difference in the analysis between the chance of a 1 in 100,000 event and a 1 in 1,000,000 event occurring, such as the complete exhaustion of existing storages at current demand. The chances could as equally be 1 in 1,000 or 1 in 100,000,000.

To put these numbers in perspective, in the worst case a 1 in 1,000 chance of running out of water would mean that within a person's lifetime, if they were fortunate enough to reach the age of 100 years, they would have 1 chance in 10 of witnessing the city of Newcastle and surrounding areas run out of water.

In effect, while Hunter Water has undertaken the exercise of performing a risk analysis within its drought management planning, the climate history is too short to make accurate claims about the risks and lengths of extreme droughts.

The ISF report has suggested that the Hunter Water assessment of yield is at odds with the system's performance, implying that yield should be based on historical data. As has been shown repeatedly across most of the continent, the history of the region's climate and storage behaviour is too short from which to draw valid conclusions.

While the lack of historical records place water planners at a severe disadvantage, through either the use of stochastic modelling or through the assessment of past storage performance, what is understood is that extreme droughts do occur, such as that which has had a severe impact on the Central Coast. An alternate process to deal with this risk therefore, is the adoption of the WSAA framework for urban water planning and implementing a plan that removes the risk, allowing the water supply authority and the community to take control of its own future.

Willingness to pay to avoid drought measures

The ISF report suggests that the community should be surveyed on its willingness to pay to avoid drought measures and level of service.

The ISF report misquotes Erlanger and Neal (2005) regarding consultation relevant to drought criterion. The passage quoted by the ISF is in fact discussing setting level-of-service criteria for the frequency and duration of general restrictions, not drought security criteria.

The ISF conclusion, further quoting from Erlanger and Neal (2005) on the necessity of the urban water industry to engage with customers and stakeholders about how supply systems work and the reliability of supply they can expect, is of course valid.

This is why Hunter Water produced and publicly exhibited the *$H_2$50 Plan*, as well as making representations to DoP to allow a 60 day public exhibition period for the Tillegra Dam EA Report.

Accuracy of demand forecasts

The ISF report suggests that the Hunter Water's demand forecast is wrong. Increases in demand to 90 GL by 2031 and 110 GL by 2051 as reported by Hunter Water are unrealistic. The historical demand data has not been corrected for climate using accepted methods according to the SKM independent report. Most utilities use end use modelling to forecast demand and this is also the ISF preferred method. The ISF believes that the Hunter Water method for forecasting demand is wrong and that this view is supported by the SKM independent review of the demand forecasting methodology commissioned by IPART which states that there is weakness in the method.

The ISF report has misinterpreted the SKM report's conclusions.

Hunter Water's demand forecasting uses a customer segmentation approach. The customer segmentations allow customers of similar demand characteristics to be aggregated together to generate an overall consumption forecast. Forecast consumption is calculated for each of the segments including unmetered supplies, domestic, non-domestic, bulk supplies and demand management. Each segment is further broken down into its base components for more precise estimation. For example, there are several domestic customer segments, such as pre-1989 connections, recent connections, new rainwater tank BASIX customer, new Dual reticulation BASIX customer, existing house or existing flat/unit. Similar breakdowns are made between heavy industry, light industry, commercial, rural, parks, schools and other connections.

Numerous demand management savings are used to provide end-use level resolution to the forecast. This forecast methodology allows for a transparent demand model to be generated that incorporates end-use demand impacts.

The Hunter Water demand forecasts have been independently reviewed by SKM, the results shown to be robust and this has been subsequently accepted by IPART. In fact the independent review noted that

> HWC has used a sound methodology to estimate future consumption, which includes analysis of historical consumption and trends in use, population growth, and the impact of demand management and water recycling initiatives.

The SKM report also notes

> …the consumption estimates prepared by HWC are within 1 to 2% of the expected climate adjusted consumption. We therefore recommend that the HWC estimates be adopted.

BASIX reductions

The ISF report states that Hunter Water has not forecast a 40% reduction in demand within new residential buildings, although the legislation requires a 40% reduction to be achieved.

It is noted that adjusting the demand forecast, to apply a 40% reduction from BASIX, will result in an erroneous factor being introduced into the demand forecast. Hunter Water forecasts less than a 40% reduction in water use, as the pre-BASIX baseline from which to make the forecast already captures the average water usage of households which commonly have BASIX measures already installed, such as dual flush toilets and other water saving devices. Applying a full 40% reduction against the pre-BASIX consumption average effectively double counts a proportion of the measures made mandatory by the BASIX rules. A more precise estimate of consumption is therefore obtained from Hunter Water's billing information and analysis.

Future demand management

The ISF Report states that Hunter Water has not forecast savings that may be accrued from future demand management initiatives.

This is incorrect as evidenced by the SKM independent review which clearly states that the impact of demand management and water recycling initiatives are contained within the demand forecast.

Price increases

The ISF report considers that there has been an underestimation of savings through price increases.

Numerous reviews on water price elasticity indicate that demand is responsive to price, but movements are not substantial and normally only result in small decreases in demand. The Hunter Water methodology for assessing demand used the accepted IPART pricing elasticity co-efficient.

Exclusion of Central Coast transfers from demand forecasts

The ISF report considers transfers to the Central Coast should be excluded from the demand forecast as the Central Coast does not need the water due to the Mardi to Mangrove link.

In 2009 around 1,200 ML was transferred to the Central Coast and in the first two months of 2010 around 800 ML was transferred. The forecast must therefore account for this demand. The forecast includes the consideration of transfers until 2012, after which water transfers from the Hunter may not be required. The Hunter Water demand forecast consequently excludes consideration of such transfers after that time.

Population projections

The ISF report states that population projections used by Hunter Water in forecasting demand are wrong. Hunter Water uses a rate of 1.1% a year stated in the DoP's regional strategy but should use the 2005 DoP and ABS growth rate estimated to be 0.8%.

Hunter Water must respond to the DoP's regional strategy and make an allowance in its forward planning to provide the necessary underlying infrastructure to ensure the strategy is successful. It would be inappropriate to use anything but the population growth rates as estimated in the strategy.

Adopting a different growth rate effectively prevents Hunter Water from responding to the NSW Government's policy on regional development and, in effect, would consign the DoP's regional strategy to failure. Population growth of 160,000 people as promoted in the strategy cannot be accommodated in the Lower Hunter without a secure water supply.

Recent ABS statistics available from the Bureau's website (2010) indicate that nationally, the population growth rate between 1997 and 2007 has averaged 1.3% and over the last two years has increased to 1.5%. Further, the *Regional Strategy Update Report* (Department of Planning 2009) clearly shows that growth in the Hunter is currently tracking at 1.3%.

Accordingly, the population projection of 1.1% used by Hunter Water in its demand forecast is considered to be appropriate and may in fact need to be revised upwards if growth continues to accelerate.

Supply-demand balance

The ISF report considers Hunter Water should re-evaluate the water supply demand balance in the Lower Hunter in accordance with an alternate yield forecast put forward by the ISF. The ISF report also discusses alternative methods for calculating system yield in the Lower Hunter. Much of this investigation is based on the results of a review of yield estimates for the Lower Hunter that was completed by SKM (2008).

Two options are put forward by the ISF report. The first option involves using the Hunter Water reliability criteria for yield in combination with the SCA criteria for drought security, which results in a yield estimate of 90 GL/yr. In this option, the ISF report selects the least conservative criteria from the Hunter Water proposed criteria and the SCA proposed criteria for each aspect of the system yield calculation so that the highest possible value for yield in the Hunter system can be obtained.

Hunter Water disagrees with both the 'pick and choose' approach put forward in the ISF report and also the relevance of the SCA drought security criterion for the Hunter Water system. The Lower Hunter and Sydney systems have completely different storage behaviour characteristics. The SCA system is nowhere near as vulnerable to rapid depletion as the Hunter system, and has nowhere near the same relative abundance of water in 'average' years. The SCA criterion provides no measure of the level of vulnerability that HWC has to rapid depletion.

The second option that the ISF report presents is an alternative criterion for drought security invented by the ISF. This new criterion proposed in the ISF report is an acceptability limit on the number of months that storage levels are below 20% based on SKM's independent analysis of Hunter Water's storages.

First, the SKM analysis shows the annual risk of storages dropping to the given storage level, not the number of months that it remains at or below that level. Second, as with the SCA criterion for drought security, the criterion proposed in the ISF report effectively adopts the philosophy that there is an acceptable risk of running out of water, and does not investigate whether or not the emergency Drought Management Plan would be effective. As a consequence, the criterion put forward in the ISF report does not reflect the issues that the ISF report itself has identified as being required inputs in the determination of yield.

Ultimately the risk of reaching 20% storage is immaterial as a criterion because the emergency Drought

Management Plan is designed to ensure that the system doesn't run out of water. The real issue of importance is whether or not the risks of triggering the cost and environmental impacts of the plan are acceptable.

The unsuitability of the alternative approach to evaluating supply capability promoted in the ISF report can be clearly shown by investigating what it would mean to supply 90 GL/yr from the existing Hunter Water system, how the emergency plan would work, and the level of risk involved. The two primary components in assessing the performance of the Hunter Water system at 90 GL/yr are:

- The storage levels at which contingency measures would need to be implemented (the emergency Drought Management Plan triggers)
- The risk of reaching the emergency Drought Management Plan triggers.

To consider the ISF report's recommendation that yield be revised to 90 GL/yr, two scenarios are investigated. The first is based on the same assumptions that exist in current Hunter Water planning in relation to access to water from Worimi National Park sandbeds and access to deep groundwater at Tomago Sand beds. These two sources are assumed to be able to provide 69 GL of water over a two year period prior to causing irreversible damage at Tomago, and prior to salt water intrusion at Worimi National Park reaching the emergency boreline. The second scenario is based on Worimi National Park and deep water access at Tomago not being available for environmental reasons.

Storage decline and storage risk curves for the two scenarios are presented in Figures 3.11 and 3.12.

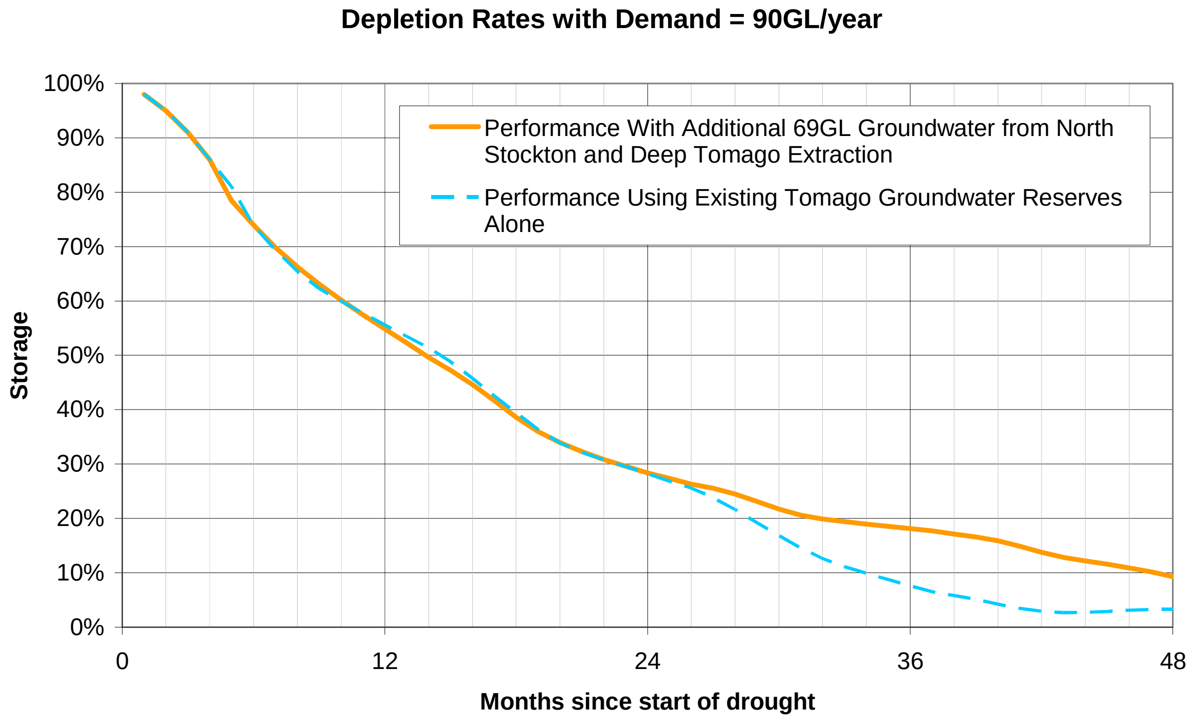
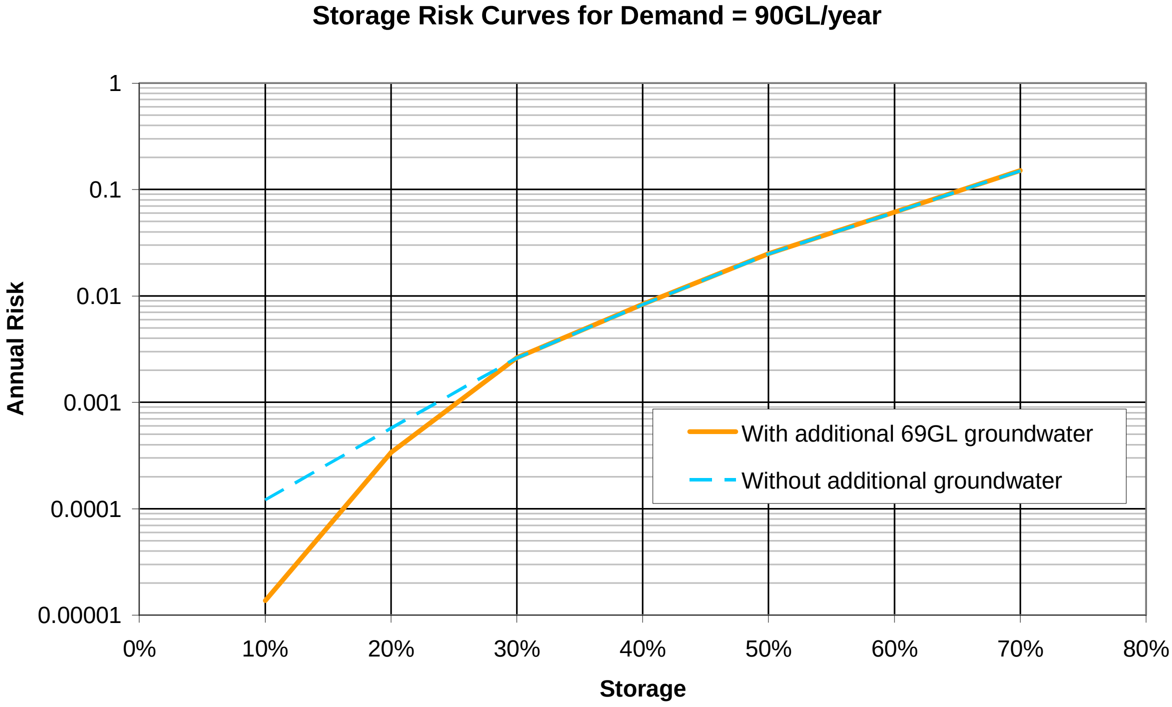


Figure 3.11 Depletion performance under drought conditions (repeating sequence of driest 12 months on record) of existing Lower Hunter system at 90 GL/yr with and without benefit of 69 GL groundwater from Worimi National Park and deep access at Tomago sandbeds



Note: there is considerable uncertainty in storage risk assessments, especially for risks that have recurrence intervals that are greater than the length of historic data. Risks of less than 1 in 100 (0.01) should be treated as provisional at best.

Figure 3.12 Storage risk curves for existing Lower Hunter system at 90 GL/yr with and without benefit of 69 GL groundwater from Worimi National Park and deep access at Tomago sandbeds

It can be seen from Figure 3.11 that with a demand of 90 GL/yr, the Hunter Water system can decline from 100% full to 10% full (deemed to be empty) in a period of just two years and 10 months if the emergency groundwater reserves are not used, or just under four years if the groundwater reserves are fully utilised.

Given that the lead time for construction alone of a desalination plant (not including pre-work) is around three years, it would not be possible to construct a desalination plant quickly enough in a severe drought for an underlying demand of 90 GL/yr without having access to the emergency groundwater reserves at Worimi National Park and Tomago.

If the extra groundwater is used, the Hunter system can deplete in just under 48 months for an underlying demand of 90 GL/yr. This rate of depletion includes allowance for 44 GL to be sourced from Worimi National Park Sand beds and 25 GL from below the normal ‘empty' level at Tomago Sand beds, and includes the benefit of a severe restriction policy that includes a total ban on outdoor water use once storage drops below 40%.

Figure 3.13 shows the major steps in the supply side of the contingency plan that would be required under this scenario. It is important to consider that as noted previously, pre-work on desalination can occur at a cost of $100 million with routine repeating of the approval process at additional costs, however a full 12 months is still required for tendering and contracting that would otherwise be undertaken in parallel to the pre-work period.

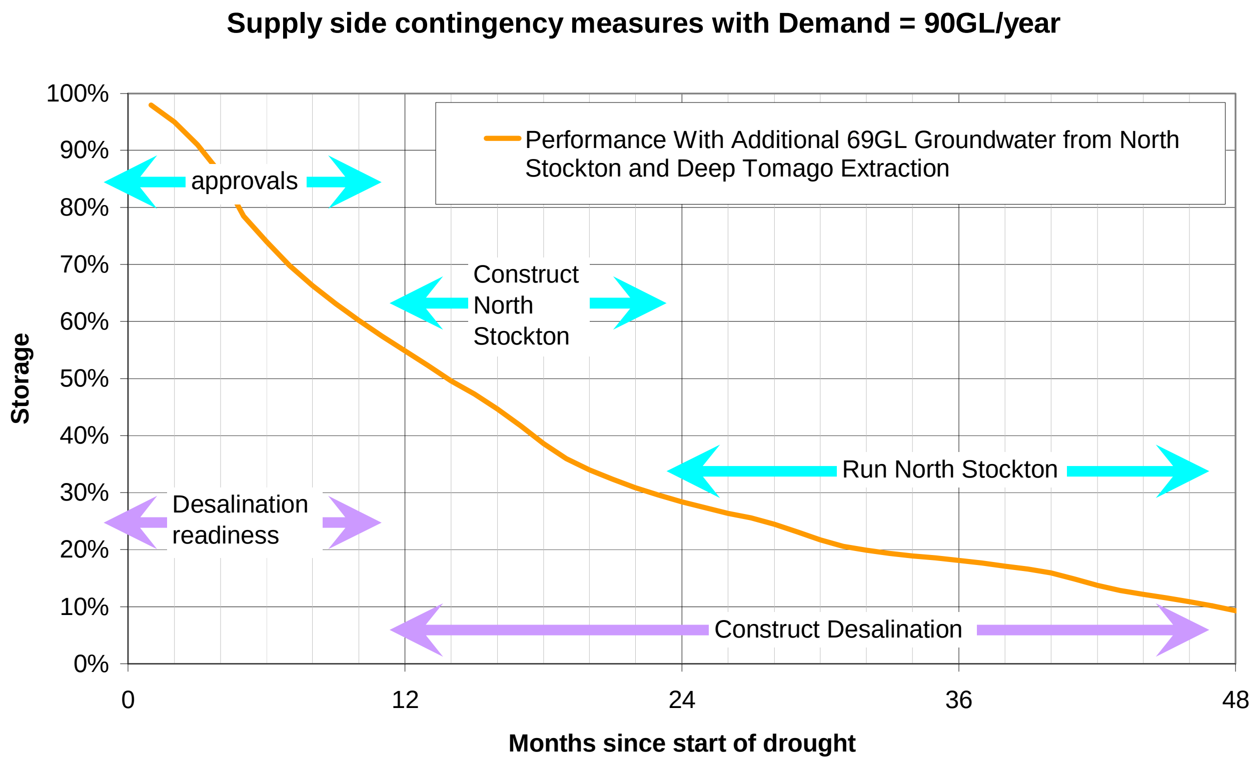


Figure 3.13 Supply side contingency measures for demand = 90 GL/yr

As shown in the evaluation, there are four fundamental flaws in allowing demand to reach 90 GL/yr for the existing Hunter Water system. These flaws are:

- Approvals for accessing Worimi National Park would need to be obtained within 12 months before reaching the Worimi National Park construction trigger, which would be set at around 57% for a demand of 90 GL/yr. This is practically impossible under the timing requirements for procedural aspects stipulated by the Part 3A planning approval process.
- The application of the NSW *Water Management Act 2000* to the Worimi National Park groundwater aquifer would need to be suspended through Ministerial intervention, as the Act does not allow unsustainable use of groundwater aquifers
- Advertising, tendering and contracting process for desalination would need to be set in motion, at almost 100% system capacity
- Even if approvals could be obtained, the approach of allowing demand to grow to 90 GL/yr using the existing system would not be a good planning outcome. If the trigger to construct is ever reached, desalination would become the next source for the Hunter Region by default. Reading off Figure 3.11 the trigger is 57% and reading off Figure 3.12, the annual risk of reaching 57% is 0.05, or 1 in 20. While 1 in 20 sounds small, it is actually a very high risk. Over any given decade, for example, a 1 in 20 annual risk equates to a 40% chance of occurrence. The net result is that allowing demand to reach 90 GL/yr would effectively block other source augmentation planning options because it is more likely than not that desalination would become the next source by default.

In summary allowing demand to grow to 90 GL/yr is neither feasible nor desirable. If it was adopted, there would be:

- A high risk of the emergency drought management plan failing during the construction approval process
- An ongoing high risk of triggering damage to the Worimi National Park and Tomago sand beds for a scheme

that has no long term benefits

- A high chance that desalination would become the next source for the Lower Hunter whether or not it is a desirable long term option.

The alternative methods for assessing supply capability promoted in the ISF report do not achieve appropriate outcomes for the Lower Hunter and its residents, both now and in the future, as they would result in the unavoidable and unsustainable use of the community's natural resources at Worimi National Park and Tomago, as well as the almost certain, default investment of almost $1 billion in desalination with its associated high running costs and energy consumption.

3.5 Consideration of issues raised by the public

In total, all of the 2,463 form letters raised concerns and objected to the Tillegra Dam project proceeding. The recurring views presented within the form letters that were received in both postcard and general letter form were as follows:

- The Hunter region has ample supplies of water and the dam is unnecessary
- Hunter Water customer's bills will increase and the cost of the dam will rise
- Significant environmental damage will occur to the Williams River
- There were no planning documents available for the dam prior to the NSW Premier's announcement of the Tillegra Dam project
- Hunter Water's documentation shows that the dam is not needed
- Tillegra Dam is not required to account for climate change
- Tillegra Dam provides an excessive level of drought security.

The majority of these issues were raised collectively in the first instance within the ISF report on supply and demand planning. As a consequence, an adequate response is considered to have been made in the preceding section of this report.

Of the additional 206 general submissions made above and beyond the form letters, 130 of these objected to the Project need and justification on the following grounds:

- There appears to be no need for the dam as the existing supplies are sufficient (26%)
- More consideration needs to be given to other alternatives (24%)
- The dam is a significant financial investment; its affordability is questioned (17%)
- The dam is not justified as supply / demand forecasts are not correct (10%)
- There will be environmental impacts to the river, estuary or wetlands (5%)
- The HWC climate change analysis is flawed (3%)
- Independent reviews show that the dam is not required (3%)
- The Central Coast does not require the dam or the Hunter should not help (2%).

Within the specific 130 submissions a diversity of other issues were also raised. Examples include citations relevant to DECCW and NOW papers being released to the NSW Upper House of Parliament, the closure of industrial steel plants reducing regional water demand, water tanks being preferable to the dam and simply, that a new dam was not wanted.

Hunter Water has no constructive commentary in response to various papers, memos and emails tabled in the NSW Legislative Council apart from noting that the opinions contained therein are the prerogative of the authors or agencies to which they are rightly entitled to express. Release of all such information is encouraged to ensure a transparent planning process.

One matter raised within submissions related to Hunter Water de-rating what it considered to be its sustainable yield, from 79.5 GL/yr to 67.5 GL/yr. As noted in the previous section on supply demand planning and the independent review conducted by the ISF, the sustainable yield of the existing system is calculated in a manner to ensure that the community never has to face the consequences of running out of water pursuant to the principles detailed with the WSAA Occasional Paper No 14.

Hunter Water's historical approach to providing a secure water supply could therefore not meet the new objectives with the continuing recognition of the existing yield at 79.5 GL. Consumption at this rate of demand in the future was far too optimistic. It would not provide satisfactory lead in times for construction of a desalination plant or the implementation of emergency measures. An acknowledgement was therefore required that water resource consumption at this higher rate was in fact unsustainable. Action was therefore taken to revise downwards the sustainable yield to ensure that it was set at a pragmatic and reasonable level.

Other opinions also expressed in public submissions related to changes in industrial use, the usefulness of water tanks and other measures are generally valid and gratefully received. Comments received that simply noted that the dam is not wanted are also specifically highlighted, as while the context of these comments cannot be analysed or responded to, it is considered important to ensure that these sentiments are captured within this document and formally reported.

During the public exhibition period a total of eight public information sessions at regional libraries and venues were undertaken. The aim of the sessions was to exchange information between Hunter Water and any interested community member, as well provide the opportunity to raise concerns.

Advertisements were place in relevant local newspapers and on the internet. These information sessions were attended by 39 people. The predominant issues raised with Hunter Water staff by the 39 attendees was as follows:

- Pricing: many attendees indicated that a stronger price signal was required for people to seriously take action to conserve water and current pricing did not provide the incentive for people to save water. This matter was most commonly raised.
- Need for the dam and objection to its construction: general discussions were held on a variety of matters relevant to the dam such as general impacts to the environment
- General interest in the proposal and dam engineering: a number of community members simply expressed a desire to learn more about the Project and engineering processes that would be required during construction
- Several attendees at the Dungog and Gresford sessions discussed personal matters relevant to the dam project such as land purchase negotiations or business matters of relevance to the Project and Hunter Water. One attendee at Dungog contended that the Project had affected his livestock transport business and as such was causing a negative socioeconomic impact on the local community.

For the reasons provided earlier in this section, Hunter Water strongly believes that the existing water supplies are not sufficient, particularly when considered in light of providing an emergency response to drought. Concerns raised by the public are however noted and have been considered elsewhere in this submissions report.

In relation to alternatives, Hunter Water draws attention to the *$H_2$50 Plan* previously prepared and notes that there is simply no other alternative that supplies the same amount of water at the least financial cost. Further of all of the dam options, Tillegra Dam is predicted to have the least environmental impact of the various alternatives.

In relation to affordability, Hunter Water notes that prices for water and waste water services will continue to be regulated by the IPART and this will ensure that consumers in the Hunter are delivered the best service and the most efficient price. Hunter Water's pricing structure is one of the most competitive in NSW. Further discussion on the socioeconomic impacts of the cost of the Project is presented in Section 5.2.1.

Of the total current bill, within the existing pricing determination, a very small amount is attributable to Tillegra Dam. In the longer term, water rates will still be extremely reasonably, with water being supplied from the dam at a cost of $1.66/kL, substantially more cost effective than any other source.

Hunter Water notes that supply demand forecasts have been comprehensively reviewed independently by

IPART, and the results of these reviews are available from the IPART website. The review has shown that the supply demand forecasts made by Hunter Water are correct.

It is noted that as raised in submissions, there will be significant environmental impacts on the natural environment of the Williams River, some of which however, are unavoidable. A substantial range of mitigating actions and offsetting strategies will be implemented to manage and reduce impacts as noted in the projects statement of commitments. Further discussion on the environmental impacts of the Project is presented in the following chapters of this report.

Hunter Water thanks all respondents in taking time to make a submission on the project in order to share their concerns and objections against the dam as well as on occasion, their support. Each and every one of the 2,669 submissions has been read by planning officers within DoP during the cataloguing of submissions and the general project management team with Hunter Water. The views and various sentiments within the submissions are all important considerations for the final decision making process applied to the Project.

3.6 Conclusion – why Tillegra Dam is justified

Hunter Water has responded to the feedback provided from the EA Report exhibition process. This has been reflected, in part, by a number of modifications to the Project (refer Section 8 of this submissions report) and through revision of the draft Statement of Commitments (refer Section 10 for the Final Statement of Commitments). Overall, however, It is considered that no substantive new information has been presented or issues raised in the submissions to alter Hunter Water's strongly held view that the preferred option of Tillegra Dam is essential to secure the water future of the Lower Hunter.

Certainly the Project has generated extensive debate as is evident from the large number of submissions that have objected strongly to the proposal. However, as noted within Chapter 21 of the EA Report, the Project is a key element to fulfilling the objectives of the *$H_2$50 Plan*. In turn, it would contribute to meeting the objectives of other planning strategies including the:

- *NSW State Plan*
- *NSW State Infrastructure Strategy*
- *Lower Hunter Regional Strategy*
- *Central Coast Regional Strategy*.

Consequently, the Project is expected to have significant environmental, social and economic benefits at the local, regional and State scales.

The construction of the dam will all but eliminate the vulnerability of the Lower Hunter water supply system to drought. The supply and demand assessment methodologies used by Hunter Water have been independently assessed and found to be satisfactory.

The construction of the dam will substantially reduce the probability of Hunter Water needing to access groundwater reserves at Worimi National Park and Tomago, in a manner that would otherwise create significant environmental damage to these water sources and the existing environment.

The construction of the dam will allow Hunter Water to avoid the construction of a desalination plant at an estimated cost of almost $1 billion, an investment that may not be used to its full potential should drought breaking rains occur partway through construction. Further, this would be an investment that has significant operating costs, $26.6 million per year, of which up to 60% would most likely result from electricity consumption.

The dam would provide almost three generations of growth potential for the region. Even with the prospect of climate change, its uncertainties and its difficulty in modelling its effects at regional and local scales, Tillegra Dam is considered to be the best solution for the Lower Hunter region. It adds to the diversity of supply options and caters for a population growth projected at 160,000 over the next 25 years.

The dam has the ability to provide for additional growth on the Central Coast. The dam is identified as an important piece of infrastructure for the long term water security of the region, and this is acknowledged not only by Hunter Water, but also by the Gosford Wyong Joint Water Supply Authority's own water plan.

The construction of the dam is also feasible. The proposed dam site is ideally located on a river with appropriate hydrological and environmental characteristics to ensure that it will fill, and be able to efficiently supply water.

The site also contains all of the construction material necessary to construct the dam wall, with the exception of cement, steel and associated material. The amount of cement and other material that needs to be imported to the site is however a minor fraction of the millions of tonnes of suitable rock and fill that is available on site for construction.

The site is geologically suitable. There are no geological impediments to construction. Geotechnical studies are typically undertaken in stages, pre-feasibility, feasibility, concept and detail design stages. Pre-feasibility and feasibility studies were undertaken between 1952 and 1970. Concept phase investigations have been presented in the EA Report and are sufficient to prove the suitability of the site and the scope of engineering works required. Detailed design phase investigations are ongoing and provide the information necessary for the fine detail. Each phase of investigations builds on the previous phase filling in the gaps and allowing refinement of the design. There is nothing inconsistent about these investigations. The investigations have been completed by competent geologists working for the NSW Department of Commerce. Their investigations have been independently peer reviewed by four internationally acclaimed geotechnical experts, lead by Emeritus Professor Robin Fell from the School of Civil and Environmental Engineering at the University of New South Wales.

The geology of the site will not cause major project cost escalations. The major cost implication with respect to geological complexity when building a dam is rim instability. The Rim Stability Report as annexed to the EA Report concludes that no engineering works are required to stabilise the Tillegra Dam's rim. This conclusion is accepted as satisfactorily proven by both the Independent Peer Review Panel and the NSW Dams Safety Committee.

The foundation conditions at the dam site are also sufficiently understood and do not represent a significant cost issue as noted within the foundation reports and concept design papers annexed to the EA Report. Again this conclusion is accepted as satisfactorily proven by both the Independent Peer Review Panel and the NSW Dams Safety Committee.

A wide range of alternative options for water supply have been considered by Hunter Water within the *$H_2$50 Plan.* The plan was publicly exhibited by Hunter Water. Hunter Water has analysed the most logical alternate options in respect to Tillegra Dam, in terms of likely environmental consequences and economic costs. The environmental costs and benefits of Tillegra Dam have also been examined extensively by Hunter Water.

Of all the possible reasonable supply options, Tillegra Dam has the lowest cost and is likely to have the least environmental impacts. The dam is proposed to be located on a river system that is already regulated by dams and a weir, in a catchment that is also highly developed for agriculture and flows to a major industrialised port, and which has already adjusted to great human induced change.

Hunter Water has developed a range of management and mitigation strategies to prevent, reduce and where necessary, offset environmental harm. Such commitments include a substantial environmental flow release strategy downstream of the dam to maintain the aquatic ecosystem as well as providing for existing uses downstream, such as irrigation.

Significant commitments have been made to aquatic ecosystem monitoring, improvement and management, partnered with water quality monitoring, geomorphological monitoring and general improvement works. These works include the remediation of at least four priority barriers to fish passage within the Hunter region under the guidance of I&I NSW in lieu of a fishway at Tillegra Dam. This agreement between Hunter Water and I&I NSW will open up hundreds of kilometres of river to fish migration elsewhere in the Hunter catchment and is considered would satisfactorily offset about 30 kilometres of fish passage lost as a consequence of the dam.

These management and mitigation measures have also been refined in response to representations received during the public exhibition period, ensuring that the communities concerns and aspirations are incorporated within the project. The most notable refinements include the dedication of a 1,300 ha national park to the NSW Government to promote biodiversity conservation within the Williams River catchment and the Barrington Tops.

Refinements however have not overlooked issues which are important for the community. The Project Statements of Commitments have been refined to ensure that freshwater anglers can access and make the most of the reservoir for recreational purposes. Adjustments have been made to the location of the proposed rural fire station in close consultation with the RFS.

A multi-disciplinary team of scientists were engaged to consider potential impacts on the Ramsar wetlands located in the Hunter estuary. This work was headed up by Professor Max Finlayson from Charles Sturt University and who is incidentally the Oceania representative and a prior Chair of the Ramsar Scientific and Technical Review Panel. This multi-disciplinary team led by Professor Finlayson did not identify any significant impacts of note that would be caused by the Tillegra Dam project, which would otherwise require redress.

Additional representations were received during the exhibition period related to the estuarine hydrodynamic modelling performed by the multi-disciplinary team. The team used the best modelling available to them at the time, to quantitatively provide data on possible impacts. Nonetheless in response to those representations, Hunter Water provided access to its source model to NOW and its consultant, in order to calibrate and help finalise a new modelling technique, which could perform dynamic state computations. This model was re-run to confirm whether there were any issues or discrepancies with the previous work, and further, whether impacts would occur to irrigators reliant on the Hunter tidal pool. The new modelling work confirmed that which was previously undertaken, that there would be no material impact.

It is of course noted that the Tillegra Dam project will have environmental impacts which simply cannot be avoided with an infrastructure proposal of this scale and dimension. However, all practical measures would be taken to mitigate environmental harm.

Some localised economic impacts, such the reduction of farms lost to the local area from the inundation area cannot be avoided, however local property owners have had their properties purchased on fair and generous terms. The project has also included options to promote social benefits and community ownership in the project, including full recreational access to the dam and the provision of supporting infrastructure, despite these measures being ancillary to the objectives of providing a safe and reliable water supply. It is expected that these actions may offset local impacts to the agricultural sector of the local economy with benefits to the tourism and service sectors.

Significant commitments have also been made in regards to managing road maintenance and safety impacts, far in excess to the likely impacts that will be in fact caused by haulage of materials to and from the dam site given that most material will be quarried on site.

The economic benefits of the project to the region are likely to be considerable. The project will increase aggregate investment within the Hunter to increase by $588 million (undiscounted). It will stimulate a discounted national welfare benefit of around $2.3 billion as measured by deviations in real household consumption for the Hunter region, rest of NSW and rest of Australia. It would increase real Gross Regional Product of approximately $1.18 billion in the Hunter region.

The environmental assessment also suggests direct employment of some 280 construction workers and within this figure, a large proportion of workers will be recruited locally. Flow on employment has been estimated to create a substantial number of additional jobs, in total with direct construction positions, up to 1849.

These estimates of economic performance are considered to be conservative, as the economic modelling employed only provides projections for 25 years, and the results were based on an estimate of $300 million. Contrary to some suggestions made within public submissions, these estimates made by Monash University are considered to be sound.

Taking action to approve the Project and progressing with its construction would therefore:

- Remove the future risk of substantial water restrictions being brought routinely into service, for long periods of time.
- Greatly reduce the economic consequences of reduced water supply on local and regional industries and

business enterprises reliant on a secure water supply for ongoing operations

- In a severe drought, greatly reduce the likelihood of business and industry from being shut down to conserve water for essential household supply
- Prevent reduced/rationed water supplies for essential social services such as emergency services, health facilities and educational facilities during a worse case drought scenario
- Significantly reduce the likelihood of the community being forced to invest in alternative emergency sources of water (such as an emergency groundwater boreline and desalination plant) which would require a substantial financial commitment both in terms of capital investment and recurrent operating costs
- Help avoid environmental impacts associated with the potential use of water resources within Worimi National Park, as well as within the existing Tomago water reserve and Tillegerry state conservation area.
- Facilitate regional population growth, remove uncertainty and cater for investment in the region's economy. This would encourage the creation of jobs both directly during construction and indirectly by supporting the region's population growth
- Have the least cost, compared to other potential water supply solutions for the Lower Hunter region
- Have the least environmental impacts on social, economic and environmental grounds, compared to other potential water solutions for the Lower Hunter region.

It is clear that Tillegra Dam is essential for the Lower Hunter if its future as a major regional urban and industrial centre is to be realised, as promoted within the regional strategy. It ensures that the community within the Lower Hunter is able to take control of its water future, without concern of significant drought, as recently experienced by the region's neighbours, the Central Coast. The project eliminates the uncertainty of climate change, anthropogenic or otherwise, and reserves the existing emergency Drought Management Plan for just that - an emergency, given its high environmental and economic cost.

Overall, it is considered the Tillegra Dam project would achieve project objectives, achieve acceptable environmental and social outcomes, deliver substantial economic benefits and provide drought security well into the foreseeable future. The Project is, therefore, considered justified.