Submission No 9

INQUIRY INTO ADEQUACY OF WATER STORAGES IN NSW

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Mr Glenn Wall

Adequacy of water storages in NSW

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Attachments -:

Mr. Glenn Wall – Tillegra Dam Environmental Assessment Report Submission.

References -:

CARMA Research report – 15 June 2007.

Money flowing like desalinated water – Adelaide Independent Weekly – 15 May 2009

Tillegra Dam Proposal – Director – General's Requirements – 8 January 2008.

Water Engineering Australia - August 2009

Alternative Water Supply Options for the Hunter & Central Coast Regions of NSW – Dr. Charles Essery – March 2007

An Independent Review Of The Need For Tillegra Dam - UTS 2009

IPART Report - Water scarcity: Does it exist and can price help solve the problem? –January 2008

Tillegra Dam Environmental Assessment Report – 28 August 2009

Introduction -: I would commend the NSW Legislative Council's Standing Committee on State Development for conducting an inquiry into the adequacy of water storages in NSW and appreciate the opportunity to offer comment via this submission.

1. **The capacity of existing water storages to meet agricultural, urban, industrial and environmental needs -:**

   Information on water usage, storage and management is complex. I have witnessed firsthand media debate and discussion that is contradicting, including claims and counter-claims by various politicians, environmentalists, farmers' groups and other vested interests such as landholders affected by a proposed dam or residents potentially affected by construction works. There is a comprehensive lack of objective information and education for the public to make informed decisions.

   There is some debate with regards to Drought Management Plans being sufficient to ensure that both State and Local Government owned water supplies are adequate. This is a **hypothesis,** due to the fact that Development approval will need to be in place for desalination and other such water harvesting infrastructure for critical supply in times of extended drought. It is already enshrined that the overriding consideration in any Drought Management Plan is water restrictions.

   During the recent extended drought, some commentary stated *"Given that similar water restrictions are now permanent 'water wise' rules in most other Australian cities and surveys around the country have shown that low-level water restrictions have very high levels of community support".* I find it absolutely inconceivable that any scientific community or Government believes that water restrictions are supported by community.

   There is no undeniable fact that water storage (Off & On River) provides -:

   - Drought security for communities.
   - Allow for significant growth in areas affected by drought.
   - Help create a robust water supply system with an allowance for climate change uncertainty.
   - Adequate redundancy; if incorporated into dam design (pipelines linking dams), water levels can be maintained at a lower level to utilise the storage as Flood mitigation measures.

- Provide adequate water security and environmental flows to river systems in time of drought, if redundancy measures (pipelines linking all new and existing water storages / dams) are in place.
- By providing adequate redundancy with water storage (including linked pipelines), any major works required by the NSW Dam Safety Committee / Periodic Maintenance can be carried out on dams, by lowering water levels without impact to regions water supplies.

2. Models for determining water requirements for the agricultural, urban, industrial and environmental sectors.

One methodology that can be adopted is the Cost Effective Analysis (CEA) that assesses the least cost impact of providing greater water security to any region

This can comprise the following steps:

- **Problem definition** – establishing the water supply schedule and gap using demand growth projections and other forecasts.
- **Identifying potential measures** – specifically augmentation options that would close the supply schedule gap and meet the yield objective. This could include; expanding the capacity of existing potable and agricultural purpose dams, construction of new dams, indirect potable reuse and desalinisation.
- **Collecting information on costs and effectiveness of each measure** – identifying capital costs, operating costs and supply volumes of potential augmentation measures; Project sequencing and timing of measures; environmental and social impacts of the measures and their implications on the costs (eg road relocation costs, services relocation costs, environmental offsets, etc); and costs to include any tangible environmental and social impact mitigation that would form the capital and operating costs for the measures.
- **Model development** – comprising a cash flow of capital development costs for each measure over a 40 to 60 year period; and a schedule of operating and maintenance costs (eg labour costs, energy costs, pumping costs and other maintenance costs) for each measure for the same period. Any model has to take into account water transport and treatment costs within the existing water distribution network.

- **Evaluation method** – the application of a Project discount rate to reflect a weighted average cost of capital (WACC) for water businesses. This enables the development of a quantitative investment criterion of *Present Value* (PV) of costs and the derivation of a levelised cost.
- **Comparing individual measures and combination of measures** – use of the levelised cost to identify the most effective augmentation option. The most effective option is that which achieves the predefined objective at the lowest cost. A Cost Effectiveness Model has been developed so that the cost inputs and discount rate can be readily adjusted using Excel macros to test changes within the potential augmentation measures and different combinations of these measures. This is a reasonable methodology, but it should be compared and cross referenced to the more **defined "Triple Bottom Line"** requirement. Local Government Water & Sewerage Authorities have to implement "Triple Bottom Line" scenarios when designing their own Integrated Water Cycle Management Plans. This approach is robust as it encapsulates the parameters of Environment, Society and the Economy. To use TBL allows such issues as flow, ecology, resources, infrastructure, public health, recreation and water quality to be scrutinised extensively when determining holistic water management programs. Any individual water supply option considered can appear accurate. Whilst not considering TBL / CBA, the figures presented when comparing all Water Options, clearly illustrate the parameters of CAPEX, Yield, OPEX, Levelised Cost ($/kL), Satisfaction of Demand, Present Value of Total Capital Costs and Present Value of Total Ongoing Costs. An example of this would be the results of a study of stormwater projects across the Sydney region, that noted that the average cost of treated stormwater was $10 per kilolitre (with a range from $0.52 to $42). Cost is dependent on factors such as existing storage facilities, proximity of distribution areas and the size of the scheme. This is further reiterated in a report by the CEO of South Australia Water Industry Alliance, Mr. Joe Flynn, who reported when looking at sustainable water solutions for S.A. including Virginia Pipeline, Mawson Lakes and water reuse such as stormwater, could be harvested and purified for about 0.2 cents per litre

($20/kL). **TERM** (**T**he **E**normous **R**egional **M**odel) is a "bottom-up" CGE model of Australia which treats each region as a separate economy. The key feature of TERM, in comparison to predecessors such as MMRF (Monash Multi-regional Forecasting Model), is its ability to handle a greater number of regions or sectors. Again this methodology is robust when considering a **REGION,** but it **DOES NOT ADDRESS THE IMPACTS OF A PROJECT SUCH AS NEW DAM CONSTRUCTION AT THE MICRO LEVEL (i.e. the impacts specifically relating to any Local Government area / region).** The CGE modelling results may be considered conservative because benefits are likely to continue beyond the 25 year period of analysis in the model. This is because the effective asset life of any new dam will be in excess of 50 years. However, the present value results need to be carefully interpreted as they do not represent a precise point estimate of future economic benefits given the large number of CGE modelling assumptions required to estimate economic impacts. Instead, they indicate that the direction of the economic impact is positive. Further, as the order of magnitude of the impact is in billions of dollars, it can be considered significant and material in terms of the national, NSW and regional economies. But to further reiterate, all models used must project the economic impacts on the locality most affected by any infrastructure project.

3. **Storage management practices to optimise water supply to the agricultural, urban, industrial and environmental sectors.**

All our existing and **future** dams should be linked by pipeline to allow water to be transferred to parts of the state as required (particularly the Western Regions and Murray Darling Basin). Water from the eastern seaboard (high rainfall areas) could be provided in times of drought (and up and down the seaboard) to supplement dams in affected areas and could also be used to supplement environmental / Agricultural water supplies to river systems affected by drought. As I implied above the Murray / Darling system is a natural water source that could be supplemented for agricultural and environmental flows in time of drought. All these principles can also be linked to the National Water Initiative. I would also emphasise the point that if dams were linked by pipeline, Water Authorities would have the capacity to also

use dams as Flood Mitigation infrastructure by not keeping them at maximum levels at all times. To link all water storages throughout the State would allow an abundance of redundancy for any unforseen circumstance.

4. **Proposals for the construction and/or augmentation of water storages in NSW with regard to storage efficiency, engineering feasibility, safety, community support and cost benefit.**

Attached is my previous Tillegra Dam Proposal Submission to the Environmental Assessment Report. It encapsulates commentary with regards to storage efficiency, engineering feasibility, safety, community support and cost benefit.

5. **Water storages and management practices in other Australian and international jurisdictions,**

- **Shannon Creek Dam -** This strategy, which secured a reliable bulk water supply for the Clarence Valley and Coffs Harbour, has two key elements; a $180 million bulk water supply project coupled with a regional water efficiency program**.** The dam comprises a 47 metre high zoned earthfill embankment with a crest length of 400 metres and a capacity of 30,000 megalitres. Associated works included a spillway, inlet/outlet tower, pipework, pumping station, valve house destratification system, public viewing area, picnic facilities and a 66kV/11kV substation. The design of the dam enabled future raising of the embankment without having to relocate or remove existing infrastructure. The current capacity of the storage is 30,000 megalitres. Raising the crest by 9.6 metres will increase the capacity to 70,000 megalitres. Prior to the completion of the Regional Water Supply project, separate water schemes supplied the Clarence Valley and Coffs Harbour. The strategy has linked these schemes, providing a high level of drought security and improved protection of the rivers from which the water is extracted. The dam will provide sufficient water to meet community needs well beyond 2035. Shannon Creek Dam has won industry accolades for its timely delivery within budget while achieving environmental outcomes of the highest standard. The extensive community consultation program resulted in wide public support for the project. The biodiversity of Shannon Creek has

been protected by the installation of equipment that releases water from the storage to mimic the natural creek flows. Environmental protection areas have been established in the vicinity of the dam, including riparian areas downstream of the dam, buffer zones around the storage and 1100 hectares of compensatory habitat

- **Hunter Water Supply to the Central Coast. -** Prior to the Tillegra dam announcement Hunter Water and the Wyong / Gosford Councils (now the Central Coast Water Authority) embarked on a $29 million dollar increased pipe conveyance augmentation and upgrade (two additional pumps) of Balikera Pumping Station to supply water to the Central Coast. Then anecdotal figures suggested the Central Coast Council's investment to Pumping Station upgrade to be approximately $8 – 10 million dollars. This investment certainly indicates the ongoing transfer of water between the Hunter and the Central Coast. The pipeline link between the Central Coast's Mardi – Mangrove Dams is an equalisation measure that will extend the water supply capacity temporally, but it does not produce additional water supply. The additional water supply component will only come from the increase of the NSW Office of Water licence to draw water from the Wyong River from its current level of 125 Ml / day to 320 Ml / day. Obviously this water can only be transferred in times of high flow and does not provide "ensured drought security" or the need for continued water restrictions during extended drought.
- **Water Tanks Retrofit and New Demand -** The use of water tanks to supplement domestic water supplies is sound and would certainly reduce some consumption levels. From 2006 to 2008 the Queensland Government and Brisbane City Council paid out $216 million and $61 million respectively to subsidise water tanks, which has given the region an extra capacity of 362 megalitres, or one day's supply. The Lord Mayor of Brisbane admitted that the water projects were expensive because governments had to rush to solve the water shortage crisis. The *Think water, ACT (Canberra) water* strategy (April 2004) states that the cost to install rainwater tanks to existing households (based on a 200 square metre house, with the entire roof

connected to a tank and plumbed to the toilet and laundry) would translate into about $4 per kilolitre (kL) for fitting to existing houses. The ACT Water Authority has determined that assuming a cost of $5,000 - $10,000 per property for over 90,000 houses, it is estimated that the cost for installing a tank in all households would be in the region of $450 million to $900 million for 8 gigalitres per year. This cost would be met up front by today's generation (assuming the property owner or ACT Government did not borrow to fund the works). The water authority indicates the time required to implement these rainwater tank systems in all households would be many years, based on the limited supply of rainwater tanks, limited availability of plumbers and drainers for installation, and the logistics of fitting systems to approximately 90,000 semi-detached residential properties. The *Think Water, act water* strategy is however looking at ways to accelerate the uptake of rainwater tanks through an expansion of its rebate scheme with mandatory installation in all newly developed suburbs. The authority also determined that Rainwater tanks need to be continually managed by ongoing monitoring and regular maintenance, to avoid health issues. They are also dependent on rainfall which in the ACT is irregular and inconsistent, reducing the benefit of rainwater tanks during drought periods. Based on this, the authority determined there is limited opportunity (in the short term) for city-wide rainwater tank use at levels above what is already being put in place. To extrapolate this scenario above using a projected estimate of over 180,000 (very moderate assumption) residential customers in the Hunter Catchment by 2031, this cost would be in the order of $900 million to $1.8 billion. The projected actual figures for residential customers in the Hunter will exceed 250,000.

- **Grey Water Reuse - The** installation of a sophisticated greywater system has been estimated at $10,000 - $15,000 per household. This cost would be met up front by today's generation (assuming the property owner or NSW Government / LG Authority did not borrow to fund the works). The time required to implement these greywater systems in all households, would be many years. This is largely due to the limited supply of greywater systems,

limited availability of plumbers and drainers for installation, and the logistics of fitting systems to existing and new properties. Greywater systems need to be continually managed including ongoing monitoring and regular maintenance; otherwise health and amenity issues can arise.

- **Storm Water Capture and Reuse- Stormwater** is generated by rainfall events through urban areas and usually comes in large volumes over short time periods. Therefore, there is a need to store and treat this water until it is required for use. Ponds and lakes can be used for the storage of stormwater, but if the water levels vary too much, it can have significant impacts on the amenity and aesthetics for the community, fauna and flora. Because the stormwater is generally of low quality with a high level of pollutants, it should only be used for irrigation and have secure backflow prevention devices in place. It is possible to build in mechanisms to divert the first flush and then transport the rest of the stormwater to the surface water storage reservoirs where it is then treated in conjunction with the overall raw water flows. This is in place in Singapore and is an important part of the island's overall potable water supply. Findings on a study of stormwater projects across the Sydney region noted that the average cost of treated stormwater was $10 per kilolitre (with a range from $0.52 to $42). Cost is dependent on factors such as existing storage facilities, proximity of irrigation areas and the size of the scheme. Due to this cost impediment, there would be limited opportunity for urban-wide stormwater harvesting at significant levels above what is already in place and planned for the future.
- **Desalination Plants -** Desalination plants should only be considered as Drought planning initiatives or when potable water storage is not feasible. The recent Victorian Desalination Plant was constructed at a cost of $3.5 Billion and produces between 150 – 250 GL /yr. The Victorian Government had only been able to guarantee to the customer base that water accounts **will not double before 2012**.

  The Western Australia, Kwinana Desalination Plant cost $387 million to construct and can only produce 45 GL /yr. The expected operation and maintenance costs of this plant are $19.8 million a year.

6. Any other matter relating to the adequacy of water storages in NSW.

The following excerpt below is from an Indian website for **educational purposes** throughout the Sub Continent. This is what they are teaching their youth. It encapsulates exactly what some of the poorest nations in the world are attempting to do. Provide reliable potable and agricultural water to their people. As an advanced Country, the Australian and NSW Government is best placed to demonstrate exactly how best to provide water to one of the driest Countries throughout the world, Australia. We have an opportunity to combat the impacts of drought and I believe NSW, given this Inquiry can start the process.

As I have implied over many years, I will continue to advocate that our Communities need to work collaboratively with Government to ensure the very best outcomes are achieved. This not only encapsulates initiatives as indicated above, but well into the future when considering matters such as the long term viability of the our States water supplies and the known impacts on our communities when considering all options in securing NSW's needs and future augmentation. If indeed all of us strive to *"Get it Right the First Time"*, as I have indicated to the current and previous NSW Premiers and a myriad of Water Ministers, I truly believe the people of NSW will look back in future years and acknowledge the innovative direction of this Government and the wonderful opportunity this inquiry provided.

Benefits Of Large Dams

Water is essential for sustenance of all forms of life on earth. It is not evenly distributed all over the world and even its availability at the same locations is not uniform over the year. While the parts of the world, which are scarce in water, are prone to drought, other parts of the world, which are abundant in water, face a challenging job of optimally managing the available water resources. No doubt the rivers are a great gift of nature and have been playing a significant role in evolution of various civilizations, nonetheless on many occasions, rivers, at the time of floods, have been playing havoc with the life and property of the people. Management of river waters has been, therefore, one of the most prime issues under consideration. Optimal management of river water resources demands that specific plans should be evolved for various river basins which are found to be technically feasible and economically viable after carrying out extensive surveys. Since the advent of civilization, man has been constructing dams and reservoirs for storing surplus river waters available during wet periods and for utilization of the same during lean periods. The dams and reservoirs world over have been playing dual role of harnessing the river waters for accelerating socio-economic growth and mitigating the miseries of a large population of the world suffering from the vagaries of floods and droughts. Dams and reservoirs contribute significantly in fulfilling the following basic human needs: -

WATER FOR DRINKING AND INDUSTRIAL USE
IRRIGATION

FLOOD CONTROL
HYDRO POWER GENERATION
INLAND NAVIGATION
RECREATION

Water for drinking and industrial use:

Due to large variations in hydrological cycle, dams and reservoirs are required to be constructed to store water during periods of surplus water availability and conserve the same for utilization during lean periods when the water availability is scarce.

Properly designed and well-constructed dams play a great role in optimally meeting the drinking water requirements of the people.

Water stored in reservoirs is also used vastly for meeting industrial needs.

Regulated flow of water from reservoirs help in diluting harmful dissolved substances in river waters during lean periods by supplementing low inflows and thus in maintaining and preserving quality of water within safe limits.

Irrigation:

Dams and reservoirs are constructed to store surplus waters during wet periods, which can be used for irrigating arid lands. One of the major benefits of dams and reservoirs is that water flows can be regulated as per agricultural requirements of the various regions over the year.
Dams and reservoirs render unforgettable services to the mankind for meeting irrigation requirements on a gigantic scale.
It is estimated that 80% of additional food production by the year 2025 would be available from the irrigation made possible by dams and reservoirs.
Dams and reservoirs are most needed for meeting irrigation requirements of developing countries, large parts of which are arid zones.
There is a need for construction of more reservoir based projects despite widespread measures developed to conserve water through other improvements in irrigation technology.

Flood Control:

Floods in the rivers have been many a time playing havoc with the life and property of the people. Dams and reservoirs can be effectively used to control floods by regulating river water flows downstream the dam.

The dams are designed, constructed and operated as per a specific plan for routing floods through the basin without any damage to life and property of the people.

The water conserved by means of dams and reservoirs at the time of floods can be utilized for meeting irrigation and drinking water requirements and hydro power

generation.

Hydro power generation:

Energy plays a key role for socio-economic development of a country. Hydro power provides a cheap, clean and renewable source of energy.
Hydro power is the most advanced and economically viable resource of renewable energy. Reservoir based hydroelectric projects provide much needed peaking power to the grid.
Unlike thermal power stations, hydro power stations have fewer technical constraints and the hydro machines are capable of quick start and taking instantaneous load variations.
While large hydro potentials can be exploited through mega hydroelectric projects for meeting power needs on regional or national basis, small hydro potentials can be exploited through mini/micro hydel projects for meeting local power needs of small areas. Besides hydro power generation, multi purpose hydroelectric projects have the benefit of meeting irrigation and drinking water requirements and controlling floods etc.

Inland navigation:

Enhanced inland navigation is a result of comprehensive basin planning and development, utilizing dams, locks and reservoirs that are regulated to play a vital role in realizing large economic benefits of national importance.

Recreation:

The reservoir made possible by constructing a dam presents a beautiful view of a lake. In the areas where natural surface water is scarce or non-existent, the reservoirs are a great source of recreation.
Along with other objectives, recreational benefits such as boating, swimming, fishing etc linked with lakes are also given due consideration at the planning stage to achieve all the benefits of an ideal multipurpose project.
While dams provide a yeoman service to the mankind, the following impacts of the construction of dams are required to be handled carefully: -

Resettlement and Rehabilitation
Environment and forests
Sedimentary issues
Socio economic issues
Safety aspects

The above problems related to the construction of dams may be resolved successfully in case the approach of management is objective, dynamic, progressive and responsive to the needs of the hour.

Mr. Glenn Wall

Tillegra Dam Environmental Assessment Report – Submission

Fluvial Geomorphology:

The modelling that was undertaken using two scenarios, one simulating current hydrology, and one a base case 'with dam' scenario intended primarily as a means of characterising the important geomorphological processes in the river is similar to studies carried out for other river systems. This approach appears sound and proven when compared to other findings and reports (Bourman, R.P., 'Geomorphology of the Lower Murray Lakes and Coorong', in Jensen, A., Good, M., Harvey, P., Tucker, P. & Long, M., *River Murray Barrages Environmental Flows*, report to Murray-Darling Basin Commission, Canberra, ACT, Wetlands Management Program, Department of Environment and Natural Resources, Adelaide, South Australia.)

- The base case 'with dam' scenario would have the effect of reducing, for each Average Recurrence Interval (ARI), the event magnitude. Thus, for a given discharge threshold, the ARI was predicted to decrease. The data indicated that bed material mobility would still be achieved under the base case 'with dam' scenario, but the frequency of occurrence would generally decrease at each site (sites located from Tillegra gauge to Glen Martin Gauge). Macrophyte disturbance under the base case 'with dam' scenario continued to be a common occurrence. However, there would possibly be more opportunities for macrophyte colonisation at Tillegra. Grass and shrubs were rarely disrupted under the current flow regime. Under the base case 'with dam' scenario this will continue to be the case, although such events would be even rarer. Flushing of silt and sand from the bed surface would continue to be a common event under the base case 'with dam' scenario. The implication of the combined effects of reduced bed material mobilisation, increased chance of macrophyte colonisation, and reduced disruption to in-stream vegetation is that; under the base case 'with dam' scenario, over time the channel would become more stable, with more in-stream vegetation. The flows would still maintain the basic geomorphic processes, but the useable channel area may contract somewhat. This effect was predicted to lessen with distance from the proposed dam. While the opportunity for bed material mobilisation would be reduced under the base case 'with dam' scenario, bed material transport would still occur, and under the situation of bed material being trapped by the dam, the bed would tend to scour, with more scour predicted closer to the dam. The implications of this are discussed in more detail in a later section of this submission.
- The Modelled discharge data of the Williams River was 1931 to present seems adequate to assess flow regimes for Low, peak, drought and flood events.
- The period 1931 to present (77 year long gauged and modelled time series) available for the Williams River are adequate to estimate floods between the 50 year and 100 year ARI with 10 – 25 percent error. For more frequent events the accuracy is better, being close to 10% for the 10 year ARI event.

Whilst the following issues have been identified, the comments below and proposed actions allow for mitigation and monitoring -:

- Altered frequency, duration and timing of channel maintenance flow events in the Williams River downstream of Tillegra, potentially leading to changes in the

physical channel structure that could impact ecological processes. The channel would initially become more stable and have denser in-stream vegetation cover.

- Reduced sediment transport in the Williams River downstream of Tillegra due to trapping by the proposed dam, potentially leading to changes in the physical channel structure that could impact ecological processes. The bed would scour, leaving coarse sized bed material, and the channel bed would deepen. This effect would be partly mitigated by the dam itself, which would reduce the frequency of flows with the capacity to transport coarse bed material. Bedload transport capacity would be reduced downstream of the dam by a factor of three, but scour will occur due to the dam removing the upstream supply that would otherwise replace the transported material.
- Reduction of the base level of the Williams River in the vicinity of the confluence with the Chichester River, due to bed scour, could lead to the migration of a head cut up the Chichester River. This would probably not be of a catastrophic scale because the Chichester river has long been subject to scour due to the existence of Chichester Dam, and because any migrating head cut would only reach as far upstream as the first major bedrock bar, or deposit of coarse, immobile bed material.
- The altered bed material transport regime would present a risk to increasing bank instability, but the risk is considered to be relatively low. Many factors contribute to bank instability, and the existence of bank erosion at the present time demonstrates that at least some of these factors are currently active.
- Risks to stability of in-stream structures, such as revetments and grade control structures. The main risk could be the potential for bed scour, not from altered hydrology. However, the risk is considered to be relatively low in most cases as general bed lowering is not expected along the length of the river, and these structures were designed to create geomorphologically stable conditions.
- Increased water clarity and lower nutrient concentration in the water immediately downstream of the dam. The difference compared to current would be most apparent during minor to moderate flood events.
- Altered hydrology leading to altered channel and overbank hydraulics, meaning that some physical features such as bars and benches, floodplain surfaces and wetlands, would experience reduced frequency of inundation. The implication of this is reduced opportunities for flushing of carbon and propogules to the river. The vegetation composition and structure on these surfaces could change, with the trend towards territorialisation.
- The risk of erosion of the channel banks within the Seaham Weir pool would more than likely not be increased significantly by operation of a dam at Tillegra.
- The above issues require consideration for the dam filling phase, normal operation mode and drought operation mode, as the pattern of outflows from the dam would be different in each case.
- Erosion of the reservoir shoreline, largely due to the effect of wind waves, leaving an exposed bank, and delivering a volume of eroded soil to the storage. The volume of eroded material would be relatively small (Geological and Geotechnical reports) and would not significantly threaten the capacity of the Dam (predicted maximum 0.3 percent loss of dam capacity and this can be mitigated against).
- Deposition of river-sourced inflowing bed material within the storage, potentially decreasing its capacity over time. However, the rate in infilling would be very slow and the volumes relatively small, so this process would not significantly threaten the capacity of the Dam (predicted 0.2 percent loss of dam capacity over 100 years).

Conclusion -:

In assessing the report compiled by Dr Christopher Gippel and Dr Brett Anderson, I am confident that the following mitigation measures are adequate to address the fluvial geomorphic impacts considerations of the proposed dam -:

Flow management

The strategy of releasing flow transfers in the form of a series of pulses of peak magnitude in the order of 1,500 ML/d would inundate the riffles and the lower exposed gravel bars in most places. These pulses would also assist in maintaining clean gravel surfaces free of fine sediment deposits and heavy biofilm build-up. These events are predicted to transport relatively small quantities of bedload. Thus, they do not represent a catastrophic threat to the stability of the bed or banks of the river, nor do they present a major risk to in-stream structures.

The requirements for environmental flows cannot be decided on the basis of geomorphological processes alone. Processes that rely on flows greater in magnitude than 1,500 ML/d will likely suffer reduced frequency of occurrence under a 'with dam' scenario. Whether this reduced frequency of geomorphological processes is adequate to maintain the ecological processes that are directly or indirectly dependent on these events is a matter that only expert ecologists can determine (See Ecology submission - '90/30' environmental release strategy during both the filling and operational phases).

River Management

From a geomorphological perspective, the base case 'with dam' flow regime would be better suited to a river of smaller dimensions. Over a long interval the river will adjust to suit the new regime. The readjustment could involve initial bed scouring, but this is likely to be localised and discontinuous (such as has occurred with Chichester and Lostock dams). Mobilisation of bed material could also lead to deposition in places, such as building of in-channel benches at new levels. The predicted bed scour will not necessarily lead to increased rates of bank instability, because the bed level of river is currently fixed in many places by bedrock bars. This situation has a long history, with the river having incised in response to past management practices. The bed material comprises a wide range of sediment sizes. The scour process will selectively sort this material, so that while the fine component would likely be removed from the bed close to the dam wall, the coarse material will remain, and form an armour layer.

The channel may become more heavily vegetated with shrubs and trees. In the past there has been a policy of removing vegetation growing on bars in order to increase conveyance (presumably to reduce flood risk). The dam would have a significant flood mitigation effect, in which case the argument to remove vegetation on the grounds of reducing flood risk would be weakened. Increased riparian and in-stream vegetation is likely to improve habitat conditions for macroinvertebrates and fish. It would also act to slow the bed scouring process. Thus, the consultants / authors recommendation is to allow channel adjustments to take place. This is a logical conclusion.

Sediment Management

There is little that can be done to prevent the scour process downstream of dams, short of ongoing augmentation of the sediment supply (Bunte 2004).

Bed material augmentation downstream of dams is an expensive and logistically difficult procedure, and would only be warranted if it could be demonstrated that there would be no significant negative impacts and the gravel-dependent ecological, economic and social assets of the river were of sufficient value. Many factors related to gravel transport processes are still poorly understood. The outcome of gravel augmentation projects therefore involves a degree of uncertainty. Bunte (2004) suggested that one way forward was to use adaptive management. Under this strategy, the gravel augmentation project would be treated as a scientific experiment with uncertain outcomes, and Hunter Water Corp (in conjunction with DECCW) should be prepared to make the necessary adjustments to the programme as more is learnt about the process through observation. (See ecology notes in Recommendations below)

Shoreline Management
Treatment techniques for managing shoreline erosion include rock rip-rap and gabion walls to bio-engineering (use of live and dead vegetation for reinforcement and protection of soil). Areas of high use recreation (boating etc) of the inundation area should be afforded protection (if required – see notes below). Another means of preventing wake wash / erosions could be to install floatation devices such as oil spill boom to prevent wash reaching the shoreline in areas prone to degradation and not exposed to wave erosion. This would only be in areas that are sheltered (ie not subject to the proposed 0.4 m wave height)

Recommendations -:

1. Flow management be further assessed in conjunction with the Ecology Report
2. Shoreline Management techniques be implemented and installed in wash/wake areas of the inundation area where deemed appropriate.

Socioeconomic:

The methodology adopted for the Cost Effective Analysis (CEA) assesses the least cost impact of providing greater water security to the Hunter region (and other bulk water transfers). This comprised the following steps:

- **Problem definition** – establishing the water supply schedule and gap using demand growth projections and other forecasts from HWC.
- **Identifying potential measures** – specifically augmentation options that would close the supply schedule gap and meet the yield objective including consideration of the following infrastructure developments: an expanded Chichester Dam; an expanded Lostock Dam; construction of Upper Johnson's Creek Dam; an expanded Grahamstown Dam; indirect potable reuse and a desalinisation plant.
- **Collecting information on costs and effectiveness of each measure** – identifying: capital costs operating costs and supply volumes of potential augmentation measures; Project sequencing and timing of measures; environmental and social impacts of the measures and their implications on the costs (eg road relocation costs, services relocation costs, environmental offsets, etc); and costs to include any tangible environmental and social impact mitigation that would form the capital and operating costs for the measures.
- **Model development** – comprising a cash flow of capital development costs for each measure over a 40 to 60 year period; and a schedule of operating and maintenance costs (eg labour costs, energy costs, pumping costs and other maintenance costs) for each measure for the same period. The model does not take into account water transport and treatment costs within the existing HWC water distribution network.
- **Evaluation method** – the application of a Project discount rate to reflect a weighted average cost of capital (WACC) for water businesses. This enables the development of a quantitative investment criterion of *Present Value* (PV) of costs and the derivation of a levelised cost.
- **Comparing individual measures and combination of measures** – use of the levelised cost to identify the most effective augmentation option. The most effective option is that which achieves the predefined objective at the lowest cost.

A Cost Effectiveness Model has been developed so that the cost inputs and discount rate can be readily adjusted using Excel macros to test changes within the potential augmentation measures and different combinations of these measures. This is a reasonable methodology, but it should be compared and cross referenced to more **defined "Triple Bottom Line"** requirements. Local Government Water & Sewerage

Authorities have to implement “Triple Bottom Line” scenarios when designing their own Integrated Water Cycle Management Plans. This approach is robust as it encapsulates the parameters of Environment, Society and the economy. To use TBL allows such issues as flow, ecology, resources, infrastructure, public health, recreation and water quality to be scrutinised extensively when determining holistic water management programs.

The individual water supply options shown in the EAR (Socioeconomic Impacts) appear accurate. Whilst not considering TBL / CBA, the figures presented when comparing all the Water Options available (i.e. Tillegra Dam, Lostock Dam, New Chichester Dam, Grahamstown Dam Upgrade, Mammy Johnsons Dam, Desalination and Indirect Potable Reuse), clearly illustrate the parameters of CAPEX, Yield, OPEX, Levelised Cost ($/kL), Satisfaction of Demand, Present Value of Total Capital Costs and Present Value of Total Ongoing Costs. It should also be noted that transportation costs and additional water storage facilities within the wider water distribution network have not been included in the CEA. The report states “they are considered to be equally applicable across all options for the purpose of the assessment”; however, this assumption distorts the findings. An example of this would be the results of a study of stormwater projects across the Sydney region noted that the average cost of treated stormwater was $10 per kilolitre (with a range from $0.52 to $42). Cost is dependant on factors such as existing storage facilities, proximity of distribution areas and the size of the scheme. This is further reiterated in a report by the CEO of South Australia Water Industry Alliance, Mr. Joe Flynn, who reported when looking at sustainable water solutions for S.A. including Virginia Pipeline, Mawson Lakes and water reuse such as stormwater, could be harvested and purified for about 0.2 cents per litre ($20/kL).

TERM (**T**he **E**normous **R**egional **M**odel) is a "bottom-up" CGE model of Australia which treats each region as a separate economy. The key feature of TERM, in comparison to predecessors such as MMRF (Monash Multi-regional Forecasting Model), is its ability to handle a greater number of regions or sectors. Again this methodology is robust when considering a **REGION,** but it **DOES NOT ADDRESS THE IMPACTS OF A PROJECT OF THIS NATURE AT THE MICRO LEVEL (i.e. the impacts specifically relating to Dungog Shire Local Government Area)**

The CGE modelling results may be considered conservative because benefits are likely to continue beyond the 25 year period of analysis in the model. This is because the effective asset life of Tillegra Dam will be in excess of 50 years. However, the present value results need to be carefully interpreted as they do not represent a precise point estimate of future economic benefits given the large number of CGE modelling assumptions required to estimate economic impacts.
Instead, they indicate that the direction of the economic impact is positive. Further, as the order of magnitude of the impact is in billions of dollars, it can be considered significant and material in terms of the national, NSW and regional economies. But to further reiterate, all models used project the economic impacts on the region, **with no modelling being carried out within Dungog Shire. Dungog Shire is not inclusive or a part of the Lower Hunter and the CGE model to assess the economic impacts of the construction and operational phases of Tillegra dam has been carried out for the Lower Hunter only.**

Conclusion -:

I am satisfied that the Cost Effective Analysis or Cost Benefit Analysis modelling and the Monash University Computable General Equilibrium modelling supports the Tillegra Dam water supply option when compared to other competing project scenarios to meet the region's yield objective. The Tillegra Dam option produces a levelised cost of $1,661 per megalitre from a present value (ie discounted) of total costs of $377 million. This represents the lowest cost option to meet future expected water demand over the next

50 years. After consideration of the full EAR, a Triple Bottom Line projection across all the project scenarios would have extrapolated similar conclusions in my opinion, with the exception of CO_2 emissions from desalination and storm water harvesting and treatment, but it would have been advantageous to conclusively demonstrate this.

Recommendations -:

1. That a comprehensive Socioeconomic study, specific to Dungog Shire, be carried out that concentrates on the **scoping**, the **profiling current impacts** (often referred to as establishing a 'baseline' rate of change), and the **projecting and estimating impacts** phases. Whilst this does not cover formulating alternative impact scenarios it is considered these will likely have been developed prior to the impact assessment. The monitoring, mitigation and management, and evaluation of impacts phases needs further examination and monitoring, however, the data gathered using the methods discussed would provide a suitable basis for subsequently monitoring, mitigating and managing impacts of Tillegra Dam.

   The following criteria are considered essential in providing a study that can be **linked** to the Regional CGE report (TERM) -:
   - . scoping an impact assessment
   - profiling the current context and identifying who is likely to be impacted
   - assessing direct socio-economic impacts
   - Assessing indirect socio-economic impacts.
2. A reverse policy needs to be compiled, clearly indicating "**if the dam is not approved**, What Hunter Water proposes to do with the land parcels purchased and the full implications to the Community of either Hunter Water retaining the land (lease back) or land banking it for a future use."
3. The Government should be required to consider the cumulative impacts on the greater Dungog Shire (particularly the Regional Road network and community implications) in consideration of the proposed Tillegra Dam (State Significant - $477 million), The Proposed AGL Gas Pipeline Project (State Significant - $200 million) and the TRASGRID Power Distribution upgrade (State Significant - $51 million). The Dungog Shire Route Access Study needs to be fully funded by both the State and Federal Governments.
4. Compensation should be afforded to Dungog Shire Council in consideration of road works and bridges constructed in the inundation area (Hunter Water advised Council in 2004 that the Tillegra Dam proposal would not be considered for at least 20 years with regards to their future water supply augmentation).
5. The proceeds of bulkwater supplies to the Central Coast should not be returned to the NSW Government (calculated as dividend and returned to consolidated revenue) and be retained and forwarded to the Hunter Communities. Dungog Shire should receive a greater portion of this retained fund on a yearly basis **(similar to a Section 94 Levy). This should not be inclusive of the existing Hunter Water Corporation Water / Environmental Community Grant programme.**

Water Quality:

The site (water sampling) selection being based on a review of previous macroinvertebrate studies (Chessmanand Growns 1994), and information gleaned from the habitat characterisation, site accessibility and availability of suitable aquatic habitats appears to the untrained layperson to be reasonable and proven. The sites selected for sampling, divided into river reaches that are depicted in the text would seem to be adequate to address all the criteria when assessing water quality, hydrology and other

considerations such as environmental flows. The sites selected appear robust when considering the upper reaches of the Williams River (above the dam), the inundation area, the convergence of the Williams and Chichester Rivers, the Seaham weir pool and downstream of the Seaham Weir.
Of concern is that sites W11, W12 and the Seaham Weir Pool samples were not conducted, due to environmental constraints. **This needs further clarification and / or explanation.**

Management of the releases to meet relevant downstream water quality objectives will be adequately achieved by release of surface water from the dam. The installation of a multi-level off take at Tillegra Dam will enable warmer, well oxygenated surface water to be released to the Williams River. The benefits of this approach compared to a water release from the bottom of the reservoir, is essential.
The key water quality criteria considered to be relevant to demonstrate the benefits of the proposed offtake to downstream aquatic life are temperature, dissolved oxygen and blue-green algae.
The aim of the surface release is to mimic the dam inflow temperatures and dissolved oxygen and to have blue green algae levels in the river which meet the NH&MRC guidelines for **recreational use**. These measures are expected to protect downstream aquatic life, including fish-spawning and larval development. This assumes that the biological requirements of the fish and other aquatic life are adapted to the natural seasonal variation in the Williams River temperatures.

Conclusion -:

This investigation provides a characterisation of the existing Williams River system and highlights possible water quality and hydrology issues relating to the construction and operation of the proposed Tillegra Dam. The following has been noted:

- Water quality in the Williams River is reasonably good although regular outbreaks of algal blooms occur in Seaham Weir Pool during the spring and summer
- Flows within the Williams River have been regulated with the construction of Chichester Dam in the 1920s and Seaham Weir in the late 1960s. Over the last 77 years average flows at Tillegra and Glen Martin are around 260 megalitres per day and 880 megalitres per day, respectively
- The Williams River was characterised by 5 reaches from its upper headwaters to its confluence with the Hunter River. A number of potential key water quality and hydrology issues may arise with the construction of the proposed Tillegra Dam. These are as follows -:
    1. Reach 1 – No impact.
    2. Reach 2 – Stratification, Algal Blooms, Nutrient trapping.
    3. Reach 3 - Changes in river flow and quality, Cold water pollution.
    4. Reach 4 – Stratification, Algal Blooms.
    5. Reach 5 – Possible saline ingress.

The hydrology modelling depicted “after the dam is constructed” indicates between 70 per cent and 80 per cent of historic average annual flow would pass the dam and between 75 per cent and 85 per cent of historic average annual flow would reach Glen Martin. This is achieved by the Environmental flow scenarios which include -:

- a base environmental release
- periodic run-of-river transfers to Grahamstown reservoir
- surges that mimic natural flow variations,
- uncontrolled flows over the spillway

The Environmental flow regime for the river system has taken the following factors into consideration:

- season
- flow components/events (low flow, freshes, high flows, bank full and over bank flow)
- frequency of and duration of flow events
- depth of flow
- Water quality.

Recommendations -:

1. Sites W11, W12 and the Seaham Weir Pool samples were not conducted, due to environmental constraints. **This needs further clarification and / or explanation.**
2. Section 5.5.4 Issue: In-storage recreation states *that to reduce the effects of in-storage recreation on the water quality the following measures may be adopted -:*
    - *Ensure recreational activities are consistent with maintaining water quality.* **(Water Quality versus Recreation Use should determined using quantitative data in accordance with recreation currently enjoyed on the Williams River (be it swimming, sailing, motor boat activities etc)**
    - *ensure recreational facilities (eg picnic areas/toilet facilities) are adequate to accommodate potential recreational users*
    - *Ban recreational use during the filling period and review after 10 years.* **(The prohibition of on water recreation on the dam during filling is reasonable (recreation should be allowed at 75% FSL); however, a review of recreation use after 10 years is not. If the dam is approved allowing full recreation, then it should remain as such. To remove the recreation use of the dam will create undue economic and social impediments. A review of risk / exposure management procedures, in accordance with National Health and Medical Research Council guidelines and the Guidelines for the Recreational Use of Water Storage Areas (DoH, 2005*), would be more appropriate and one would expect this to be carried out as part of the dams ongoing monitoring).**

3. To allow full recreation on the proposed dam, such as is currently permitted on the Williams River, will allow DECCW the opportunity to limit the amount of recreation on the Williams River in and around Clarence Town / Seaham Weir and prevent further degradation of the river banks in this precinct.

Aquatic Ecology:

The Aquatic Ecology Assessment prepared by “The Ecology Lab Pty Ltd” of Brookvale, NSW is a concise, descriptive report that considers “without glossing over” physical setting, water quality, riparian and aquatic vegetation, aquatic Macroinvertebrates, Fish and Threatened Species, Populations, Communities and Key Threatening Processes.
The methodology of testing was again based on a review of previous macroinvertebrate studies (Chessmanand Growns 1994), and information gleaned from the habitat characterisation, site accessibility and availability of suitable aquatic habitats. It appears to the untrained layperson to be reasonable and proven. The sites selected for sampling, divided into river reaches that are depicted in the text would seem to be adequate to address all the criteria when assessing water quality, hydrology and other considerations such as environmental flows. The sites selected appear robust when considering the upper reaches of the Williams River (above the dam), the inundation area, the convergence of the Williams and Chichester Rivers, the Seaham weir pool and downstream of the Seaham Weir.
Again the study considered impacts at construction, fill stage and completion / operational phase of the proposed dam.

Conclusion -:

This investigation provides a characterisation of the existing Williams River system and highlights possible issues relating to physical setting, water quality, riparian and aquatic vegetation, aquatic Macroinvertebrates, Fish and Threatened Species, Populations, Communities and Key Threatening Processes. There are no listed threatened or protected fish or aquatic macroinvertebrates within the study area.

Recommendations -:

Sediment Control

The mobilisation of sediment into Williams River and its tributaries can be minimised through the use of standard sediment and erosion control procedures during construction of the dam and the relocated section of Salisbury Road.

The proposal that Erosion and sediment controls should be installed prior to any construction or earthworks, including bunding, silt fences, silt curtains, drains and settlement ponds is sound.

Environmental Flows

Low base flows and smaller peak flows would be protected by the proposed '90/30' environmental release strategy during both the filling and operational phases. Impacts may arise during the filling phase from the loss of larger base and peak flows for ecological processes related to magnitude and frequency of peak flows. Similarly, the predicted distribution of Run-of-River transfers would create changes to the natural flow regime in Reach 3 and 4 and may affect those species with seasonal flow requirements.

Therefore the recommendations that multiple larger peak flow events (e.g. freshes) be released each year during the filling phase; the timing and relative frequency of additional fresh event releases should mimic any pattern and seasonality in the historical flow distribution; and Run-of-River transfers should commence prior to the dam reaching FSL are all intrinsic to the well being of the river system.

Also Run-of- River transfers could be used to replace some added fresh event releases on a 1:1 ratio. The temporal variability and profile of all environmental flows should occur within the expected limits of equivalent historical flows (see Fluvial Geomorphology comments). Similarly, environmental releases should not be made on the basis of demand or price for electricity generated in the hydroelectric plant (which might generate erratic or diurnal flow patterns) and the rate of rise and fall of releases should remain within natural limits.

As described in the detailed report the suggestion that seasonal flow distribution during dam operation mimics that of the historical period is essential (i.e. to mitigate the current prediction of a disproportionate allocation of Run-of-River transfers to spring and summer).

Also the recommendation that "should the storage fall below FSL" the additional peak event releases are re-initiated until the storage reaches FSL and the potential for spilling resumes should be implemented.

To mitigate the impacts during the fill stage of the dam, the proposal to increase the minimum number of events during the time taken to reach FSL should be increased to reduce possible accumulating impacts of the filling phase release regime

Whilst the addition of some flow events during the filling phase may not ameliorate impacts of processes related to flow volume and/or frequency of peak events, such as the recruitment of bass or the availability of riffle habitat, it may benefit evolution with life histories/behaviour cued by seasonal elevated flows and restore physical processes such as macrophyte disruption and the flushing of fines. Similarly, the maintenance of natural temporal patterns in flow would facilitate seasonal flow-dependent events such as the upstream migration of juvenile fish (Salt water – Fresh water migration).

Fishways

The recommendation that a fishway be constructed to maintain linkages between fish populations and allow fish passage past Tillegra Dam (upstream and downstream)

between Reaches 1-2 and Reaches 3-5 **needs further examination** by those with greater knowledge than mine. Whilst the report outlines certain constraints, it needs further research carried out by experts in this field. The suggestions as outlined in the Environmental Flow and River Management – Document "D" need greater scrutiny as regards impact on fish passage. A final decision regarding a fishway / ladder should be determined by DEECW in accordance with the document *"Fish Passage and Fishways in New South Wales: A Status Report"* compiled by Cooperative Research Centre for Freshwater Ecology -Technical Report 1/2000 - May 2000 and **the failure of existing fishways in other "High Wall" dams**.

The upgrading of the Seaham Weir fishway, favouring a single exit ungated vertical slot fishway appears to be a good outcome and will improve the migratory behaviour of certain species.

Replenishment of Scoured Bed Material

As described in the Fluvial Geomorphology report, bed material augmentation downstream of dams is an expensive and logistically difficult procedure, and would only be warranted if it could be demonstrated that there would be no significant negative impacts and the gravel-dependent ecological, economic and social assets of the river were of sufficient value. This should be considered in a monitoring program (below) and if required a replenishment program utilising appropriate size classes of particles should be initiated when and where they are needed.

Monitoring

The recommendation that a monitoring program should be implemented to examine potential effects the environmental release strategy could have on aquatic biota and to demonstrate the efficacy of mitigation measures designed to reduce impacts from the construction and operation of Tillegra Dam. Specific ecosystem components to be measured should be mandated.

Inundation Area / Lake Habitat

Vegetation in the inundated area should be left in place to provide habitat for fish, where it does not impede on high speed motor boat recreation (ie skiing). These standing snags would provide habitat for surviving or stocked native species.

The recommendation to Stock the storage with Australian bass is essential in supporting a recreational fishery.

Terrestrial Ecology:

The Terrestrial Ecology Assessment prepared by "Ecotone Ecological Consultants Pty Ltd" of Waratah, NSW, is a concise, descriptive report that again considers "without glossing over" the flora and fauna within the inundation area and the river system above and below the proposed dam wall.

This flora and fauna assessment for the proposed dam has been prepared based on a combination of literature review and field surveys within the study area.

The subject site provides known habitat for a number of threatened species and endangered ecological communities and potential impacts on these species and communities have been assessed under the relevant legislation.

Field surveys resulted in a total of 315 flora species from 100 families have been identified. This total includes 21 ferns, 220 dicotyledons and 73 monocotyledons (grasses & lilies). Of the total species recorded, 78 species of exotic flora were identified, representing approximately 25% of the total species. With regards to fauna, a total of 157 fauna species were positively identified during the field surveys (comprising 95 bird, 32 mammal, 16 frog and 14 reptile species). A further five species of insectivorous bat were given a probable identification and two species given a tentative (possible) identification based on ultrasonic call analysis. Six of the species recorded, the black rat, brown hare, common myna, dog, house mouse and rabbit, are introduced species.

Considering the agricultural land use of the study area the terrestrial biodiversity is regarded as being high and probably reflects the large size of the study area, the

diversity of habitats within naturally vegetated remnants as well as the cleared paddocks, particularly where scattered habitat trees occur.

In terms of flora, no threatened species or endangered populations have been recorded during field surveys. I am satisfied from various discussions and interpreting literature (A Descriptive Catalogue of Plants Occurring in the Watersheds of the Paterson, Allyn and Williams River Valleys – Noel Jupp OAM & Rosemary Wall) this to be correct.

The study area has been found to contain two endangered ecological communities (EECs) plus small areas of one intergrade EEC that are listed by the NSW TSC Act. Most of the riparian vegetation along the river appears to be the EEC *River-flat Eucalypt Forest on Coastal Floodplains* with small elements of embedded *Subtropical Coastal Floodplain Forest*. Most of these EECs in the study area would be inundated by the proposal (estimated 145 ha), and therefore the local impacts would be substantial (estimated 22.5% loss) but at the regional level the proportion of the EEC affected would be minor (estimated 0.7% loss). Additionally, a greater abundance of the EEC probably occurs locally than estimated by the regional mapping (NPWS 1999). As this EEC is unlikely to regenerate above the high water level of the proposed dam (a drier open forest is most likely to occur) any offsets would need to be carried out by the restoration of riparian habitat upstream and downstream of the inundation area. This would be required in order to fulfil the **local provenance principal or better conservation outcome expected for the creation of offsets.**
The adoption of this strategy could mean that less funding would be available for the creation of the proposed fauna corridors above the expected high water level thus resulting in a reliance on the occurrence of natural revegetation. As this land would not be owned by the Hunter Water Corporation any revegetation proposal would need to be carried out with the permission of land owners in these areas.
It is considered unlikely that the existing riparian habitat downstream of the proposed dam wall will be impacted upon by the proposal. It is possible that there will be an increase in riparian vegetation, particularly within the river channel, as a result of the minor changes to flow regimes.
Small patches of subtropical rainforest that qualify as the EEC *Lowland Rainforest* occur in moist, sheltered gullies in parts of the study area. A small area (approximately 0.2ha) of this EEC may be affected by construction of the proposed Salisbury Road deviation both at the local and regional levels.
The potential presence of the EECs *Lower Hunter Spotted Gum – Ironbark Forest* and *Hunter Lowland Redgum Forest* has been ruled out by the underlying geology (being Carboniferous rather than of Permian origin), although the species composition of two communities in the study area bears a superficial resemblance to these EECs.

With regards to threatened fauna, eight species, the speckled warbler, eastern bent-wing bat, east coast freetail-bat, southern myotis, squirrel glider, brush-tailed phascogale, koala and grey-headed flying-fox, were positively identified within the study area during the survey period. Two additional species, the eastern false pipistrelle and greater broad-nosed bat, were given a probable identification based on ultrasonic call analysis and one species, the golden-tipped bat, was tentatively identified from a poor, short ultrasonic call. A number of other threatened fauna species have potential to occur within the study area as suitable habitat occurs. All of the above species are listed as vulnerable in Schedule 2 of the NSW TSC Act. With regards to the Commonwealth EPBC Act, only the grey-headed flying-fox is listed as vulnerable within the Act.
No listed critical habitats or endangered populations of fauna were recorded or are expected to occur within the study area.
The main potential impacts associated with the proposal are the loss of habitat and potential movement corridors (particularly along the Williams River). Areas of important fauna habitat features, including winter-flowering tree species, riparian habitat and hollow-bearing trees will be reduced in the local region. The proposed natural

regeneration of habitat and tree planting would help to alleviate some of these losses in the longer term however it would take 100+ years for replacement tree hollows to form. Over time the proposed revegetation works around the perimeter of the dam would substantially increase the area of available fauna habitat when this is compared to the existing habitat.
Threatened fauna species most likely to be impacted by the proposal are those known or likely to breed within the study area. Such species include the brush-tailed phascogale, east-coast freetailbat, koala, southern myotis, speckled warbler and squirrel glider. Additional species have some potential to forage and possibly breed within the study area, including the glossy black-cockatoo, golden-tipped bat, hollow-roosting bats, spotted-tailed quoll, stuttering frog, threatened forest owls and threatened woodland birds. For those species that do occur and breed within the study area, the loss of habitat is likely to result in a corresponding decline in population numbers. Ameliorative measures such as replanting and rehabilitation of cleared land would assist in mitigating impacts for some of these species, particularly if corridor links are formed.
With regard to the stuttering frog, the small areas of potential habitat are already isolated by long stretches of unfavourable riparian habitat. The probability of the species occurring is also considered to be low given the isolation of the habitat remnant, the clearing of much of the vegetation for agriculture and past riverbank and snag removal works. On a precautionary basis it is assumed that individuals actually occur within the inundation area, however overall, due to the limited habitat area, impacts cannot be considered as significant for the species.
A number of threatened fauna species are reliant upon hollow-bearing trees for roosting and breeding purposes. Given the large land area likely to be flooded or cleared as a result of the proposal, it is expected that a large number of hollow-bearing trees would be lost, thus removing potential roosting and breeding hollows for threatened fauna.
The southern myotis is likely to roost under bridges and culverts within the study area and there is potential for a breeding colony to occur (particularly under the Tillegra Bridge). The eastern and little bent-wing bats could also potentially roost in these areas, although no breeding habitat for these species occurs within the study area. The installation of artificial roosts under new and unaffected bridges further downstream would assist in ameliorating the impacts on microbat species. Individuals could potentially be killed if a bridge or culvert containing roosting bats is destroyed or removed. If a breeding colony of the southern myotis does occur under Tillegra Bridge the proposal would result in the loss of that colony. The bat management plan provided in the report aims to address and ameliorate against these potential impacts.
No known camp sites for the grey-headed flying-fox are likely to be affected as a result of the proposal, though this species could form temporary seasonal camps in rainforest pockets or riparian vegetation within the study area. Some foraging habitat for the grey-headed flying-fox is likely to be lost as a result of the proposal, including important winter-flowering trees. The loss of winterflowering trees may also affect other species, such as the swift parrot and regent honeyeater. The loss of this foraging habitat is unlikely to have a significant impact on the local population of any of these species however it would reduce the availability of foraging habitat within the study locality.
However, over time, the proposed natural regeneration of habitat and tree planting above the full supply level would more than compensate for any loss of foraging habitat.

I am pleased, whilst not intended as part of the Terrestrial Ecology Assessment, aquatic mammals have been addressed in the report. Although not listed as threatened species, aquatic mammals; the platypus and perhaps, to a lesser extent, the Australian water rat, are likely to suffer most impact as a result of proposal.
The 'ideal' platypus habitat identified by several habitat studies, including Ellem *et al.* (1998) were summarised by Grant and Temple-Smith (1998) as '*a river or stream with relatively steep earth banks consolidated by the roots of native plant species whose foliage overhange the banks. The river or stream itself has a diversity of habitats,*

including aquatic vegetation and logs, and consists of a series of distinct pools of less than 5m in depth, with little sand accumulation, and separated by cobbled riffle areas'.
Effects may include drying up of small headwater creeks (Campbell and Doeg 1989), siltation, changes in stream flow resulting in loss of foraging habitat, loss of shading Koch *et al.* (2001) indicated that platypus are significantly less abundant in headwater streams recovering 15 years after disturbance from clearfell and burn forestry (pre-Code practices) compared to headwater streams in relatively undisturbed catchments. In headwater areas platypus are known to utilise habitat up to 20- 30m away from the stream edge for burrowing (Otley *et al*. 2001, Munks *et al.* unpubl. data). If less than this is reserved, survivorship and fecundity may fall.

Whilst a large number of weirs and dams have been constructed on river systems, historical records indicate that river regulation has had little effect on the distribution of platypus. They can still be found immediately downstream of large water storages such as Burrinjuck and Blowering (Grant 1995) and are also occasionally sighted in the lower reaches of the Murrumbidgee and Murray rivers, both of which are highly regulated and vastly degraded.

In the Tillegra scenario, the platypus will be unlikely to survive in the water deeper than 5m and the filling of the dam would result in burrows being progressively flooded. This is predicted to result in no breeding taking place within the inundation area (a 19.2 km stretch of the Williams River) over at least the period of time required for the dam to reach full capacity. It is feasible, given the dam will predominately held at a 90 – 100% capacity, the populations of platypus may establish within creek side arms.

Also In consideration that the Environmental flow regime for the river system (Post Dam) has taken the following factors into consideration:

- season
- flow components/events (low flow, freshes, high flows, bank full and over bank flow)
- frequency of and duration of flow events
- depth of flow
- Water quality.

and that multi-level off take at Tillegra Dam will enable warmer, well oxygenated surface water to be released to the Williams River, given the research material investigation, I believe if the regime of flows and fluvial geomorphology mitigation issues are addressed, platypus will be unaffected upstream and downstream of the dam. **(DECCW may want to consider Environmental protection zones be afforded to the river system / banks to the head of the Williams River and to the convergence of the Williams / Chichester Rivers).**

Conclusion -:

Given my overall basic knowledge, I am satisfied that the assessment describes the existing biological environment of the study area in relation to terrestrial flora and fauna and discusses the potential impacts of the various components of the proposal on any threatened species, populations or ecological communities that occur or are likely to occur within the study area.
I am also satisfied that the report has adequately considered the impacts and adequately recommends measures proposed to mitigate those impacts.

Hunter Estuary Wetlands occur directly downstream from the subject site. I concur with the assessment that The Ramsar site will not be affected by the proposal given the long intervening distance, the existence of the Seaham Weir and considerable buffer between the subject site and the wetland.

Recommendations -:

I would concur with the recommendations below and urge the proponent to ensure these mitigating measures are carried out -:

1. Given the large area of native vegetation to be cleared or inundated, appropriate offset areas for fauna habitat are to be secured. This is to be achieved by rehabilitating or revegetating currently cleared or degraded Hunter Water Corporation owned land above the full supply level of the proposed dam. It is intended to create a north-south vegetated corridor along the eastern side of the dam and a south-west link from the proposed dam wall to Mount Butterwicki. It is intended to allow natural regeneration of vegetation to take place in designated habitat corridors. Where regeneration is found to be poor revegetation is proposed. It is suggested that priority be given to restoring habitat for threatened species and endangered ecological communities, including the restoration and enhancement of corridor links. The loss of *Lowland Rainforest* (0.2 ha) can be easily offset by allowing regeneration around the edges of existing pockets of the EEC. Offsets for the riparian vegetation are more problematic in that regeneration of this EEC is unlikely around the edge of the proposed dam. Therefore any regeneration/revegetation of riparian habitat upstream or downstream of the dam is likely to be mainly outside Hunter Water Corporation land and any works would be out of their control (A collaborative approach can be achieved with DECCWW and the Hunter – Central Rivers CMA). The proposed regeneration/revegetation would also be used to offset greenhouse emissions resulting from the proposed dam. Regeneration/planting in areas identified as corridor links outside the inundation area, particularly the link between Tillegra Reserve and Mount Butterwicki, should commence as soon as possible. This should include the removal of stock and allow time for trees and shrubs to reach a suitable size to be utilised by species such as the koala, squirrel glider, speckled warbler and brush-tailed phascogale as a corridor link for displaced fauna to safely access similar habitat during clearing activities for the dam wall and associated facilities. Flora species introduced for planting in offset and corridor areas are to be **local provenance species.**
2. Prior to any clearing in the Tillegra Travelling Stock Reserve, surveys of all hollow-bearing trees should be undertaken. Removal of these trees should be timed to avoid the peak bird and bat breeding season (September – January inclusive). This timing would also cover the period that young brush tailed phascogales would be left in the nest however the squirrel glider can breed over an extended period therefore the complete avoidance of young in a nest would be difficult to achieve.
3. Prior to vegetation clearing nest boxes suitable for known hollow dependant threatened species (brush-tailed phascogale, squirrel glider and insectivorous bats) are to be erected in retained remnants above the high water level, particularly in areas where hollow bearing trees are absent or scarce. This will provide short term shelter (+10 years) for displaced threatened species and allow new territories to be established.
4. DECCW could consider Environmental protection zones be afforded to the river system / banks (100 mtr buffer zone) to the head of the Williams River and to the convergence of the Williams / Chichester Rivers.

Sustainable Resource Use:

The report highlights components that are dependent on the use of natural resources that have been analysed to identify the most efficient allocation and use of resources over the life of the Project. Additional analysis during detailed design would include explicit consideration of the viability of suitable alternatives to conventional construction materials. On the premise that all relevant materials considered for use in dam or road

construction could be demonstrated as being durable and safe, material selection would be undertaken on a sustainability basis and include a review of issues such as:

- recycled content
- embodied energy
- life cycle/reliability of the product
- cost.

In relation to waste, the proponent recognises that while avoidance is the most desirable outcome, it is not always possible. The principles to follow when avoidance is not possible are to reduce, reuse and recycle and this is commendable. The NSW Department of Environment and Climate Change & Water (DECCW 2008) defines the process as follows -:

- reduce - to create less waste
- reuse - to use a product again for a different use without going through processing
- Recycle - to process an old product into a new one.

Minimisation or avoidance of resource use is most effective at the design stage of a project through innovation and early consideration of key sustainability issues. However, it can also be meaningfully implemented at the construction and operation stages.

CO_2 Emissions and Carbon Offsets.

The report indicates that overall the dam can be constructed to be Carbon neutral. Given the intention to construct a Hydro Electricity plant and the intended planting of 331,800 trees, I believe the figures to be a reasonable assumption. With regards to the emission of methane (CH_4), whilst the report does not detail methane emissions, some points are certainly worth taking into consideration and should be explored further.

As indicated in the report (UTS – An assessment of Greenhouse Gas Emissions for Tillegra Dam - 2009) the Intergovernmental Panel on Climate Change (IPCC -2006) figures produce a relatively conservative total carbon flux median estimate of 2300 tonnes of methane and 124,000 tonnes carbon dioxide from reservoirs (in a warm temperate climate). What is not being taken into consideration is the loss of methane emission from the inundation area with the loss of primary production.

The NSW DPI beef stocking rate using a Dry Sheep Equivalent (DSE) of 10 (24 -30 month turnoff EU market bullock) for an area of 2100ha (prime agricultural land – Class 2 /3), is sustainable for approximately 724 head of cattle (or 2.9 ha/beast).

Given that a head of cattle produces approximately 450g of methane a day, the following can be interpreted -:
724 cattle = 325 kg of methane / day or 118,625 kg (118.625 Tonne) of methane / year. Therefore over a 20 year period the approximate amount of methane from 724 cattle would be 2,372.5 Tonne / 20 yrs.

Given that the IPCC figure for a reservoir in a warm temperate climate is expected to produce a total carbon flux level of 2,300 tonnes of methane, then this can be assumed to be mitigated by the loss of primary production due to the inundation of the area.

Conclusion -:

The sustainable use of resources is an important consideration in the overall sustainability performance of the Project. The approach taken by Hunter Water to implement a resource management approach, which incorporates best practice measures to achieve the sustainability goals of the Project, is encouraging. Specifically, the proponent aims to achieve a carbon neutral status, in addition to achieving a high performing ranking for various social, economic and environmental impacts captured

within the sustainability assessment framework. I would endorse the initiatives, but again raise the issue that the **Socio – economic impacts need to be addressed at the Micro Level (Dungog Shire).**

The report has provided estimates of the resource needs of the Project and potential avoidance, minimisation and mitigation measures for the use of energy, water and materials.

The mitigation measures contained within this report are therefore important in fulfilling the sustainable resource use objectives of the Project in the context of the over-arching sustainability assessment framework. The proponent should implement these measures, including -:

- efficient resource use
- avoidance of unnecessary resource consumption
- minimisation of resources consumed
- resource recovery
- waste management
- integrated resource management and planning.

This report also identifies that Hunter Water will attempt to achieve carbon neutrality for the Project. Again the mitigating and carbon offset initiatives need to be implemented.

Recommendations -:

1. That a comprehensive Socioeconomic study, specific to Dungog Shire, be carried out to identify all impacts, including the consequence on the Council Landfill. If the proponents proposed Wast Management Plan identifies utilising Dungog Shire Councils Landfill, then the **NSW Government's Section 88 of the Protection of the Environment Operations Act 1997 Levy imposed on Dungog Shire should be removed.** If the levy is not removed, the **NSW Government** should install a weighbridge at the landfill site to allow tonnage delivered to be assessed accurately and if required provide additional land to increase the landfill site to offset the dam construction impacts.
2. Hunter Water should achieve carbon neutrality for the Project. The mitigating and carbon offset initiatives need to be implemented.
3. Hunter Water should offer reused sheds and building materials to Dungog Shire Not – For Profit Organisations, prior to consideration of sale or disposal.
4. The existing concrete bridges that will be inundated should be considered for removal (i.e. M Lock type structures) and given back to Dungog Shire Council for future use / bridge replacement.

Cemetery Relocation:

The report details the sensitive nature of addressing the inundation of the existing cemetery and relocation of such, and recognises the efforts of the proponent and indeed the Tillegra Dam Community Reference Group – Cemetery Sub Committee to deal with such a personal matter. I would also commend all involved for their involvement and the way that individual Families have been engaged to date.

I am pleased that Hunter Water has taken the approach it has and that they are committed to providing reasonable and sufficient time for next of kin to consider their options so that they do not feel pressured to make an immediate decision. Given that it is expected that specific discussions need to be carried out with individual families, the decision to wait for a final determination of the dam to carry out such is sound.

Conclusion -:

I am convinced that Hunter Water and the TDCRG have tried to deal with this very sensitive issue to the best of their ability. The report is comprehensive and outlines concisely all matters that need to be considered.

Recommendations -:

1. Section 7.2 Transfer of Burial reservations from existing cemetery (dot point 3) -: I would suggest that any holders of existing plots that may wish to cancel their internment site be dealt with by Hunter Water, rather than incorporate another layer of bureaucracy (Dungog Shire Council). I would also suggest that Hunter Water reimburse the initial cost plus CPI increases from the year of purchase to any person/s that has a plot that wishes to cancel.
2. If relocations of the Military Graves are to be effected, then I would suggest after receiving the advice from the OAWG, that the families be afforded the offer of the involvement of the relevant Australian Defence Force Organisation (Navy, Army Air Force) to be used as bearers etc. I would recommend that Hunter Water ask the families if they would like the Returned Services League of Australia (or other Ex Service Organisations) involved in the Service.

Construction Environmental Management Plan:

The report outlines that the purpose of this document is to provide guidance to the successful construction contractor/s in the preparation of an effective construction Environmental Management Plan. This is a standard practice for all large scale developments and obviously a large amount of information provided in other reports within the EAR will be transposed to the CEMP (hours of operation, dust mitigation, noise & vibration etc – see comment below).

As is standard practice the EMP will provide the following outcomes -:

- impacts on the environment are avoided or minimised and mitigated to the greatest extent practicable
- compliance with all relevant conditions attached to the Minister for Planning's approval for the Project
- compliance with applicable requirements of all other relevant legislation
- incorporation of relevant commitments from the Statement of Commitments (SOCs) provided in the EA Report
- a responsive and transparent approach to dealing with any adverse and/or unforseen environmental impacts
- involvement of key stakeholders and the community in the environmental management process
- effective documentation of environmental management outcomes for Project construction.

A secondary objective of this guide is to inform interested parties, including the Greater Community of how impacts would be managed during construction.

Responsibility for preparation of the construction rests with the successful construction contractor/s and it would form part of the contract documentation for the Project. It should be noted, however, that if approved, the Project approval conditions would likely assign ultimate responsibility for preparation and implementation of the construction EMP to HWC.

This chapter of the EAR is a guide only. It is not intended to replace these documents below -:

- *Guideline for the Preparation of Environmental Management Plans* (Department of Planning)
- *Environmental Management Systems Guidelines* (NSW Construction Policy Steering Committee).

As with any other large scale construction project, the contractor/s would make appropriate reference to them in developing the Project construction EMP.

Conclusion -:

Given that this Chapter of the EAR is a guide only, I am satisfied that it achieves the directions outlined within the current DoP Guidelines and the NSW CPCS directives.

Recommendations -:

1. That Hunter Water instigates a Community Representative Committee (similar to the Tillegra Dam Community Reference Group) immediately a determination of the application is made. Regardless of an approval / refusal determination, this would be required to consider all matters.

Roads and Other Infrastructure.

The document Roads and Other Infrastructure depicts the current road standard. The Traffic figures utilised in the study have been transferred from the Dungog Shire Route Access Study.

Points that need clarification are -:

- The report fails to accurately identify the current level and the proposed increase in heavy vehicle movements greater than class 3 South of Dungog and does not consider the increase in heavy vehicle use of Chichester Dam and Salisbury Roads, (both local roads). The increase in heavy vehicle movements North of Dungog is estimated by Council at 47% and South of Dungog by 12.69%.
- Whilst the report considers the road network to be reasonable, the Dungog Shire Council Roads Asset Management Plan describes **48.2%** of the regional road network to be rough to poor condition.

Regional Roads (Rural & Urban) Ratings by Surface Defect Area

	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	Total
Road Length	14981	49068	24296	23520	11853	123718
Network %	12.1%	39.7%	19.6%	19.0%	9.6%	100.0%
Av. Required Width (m)	9.5	9.5	9.5	9.5	9.5	
Sq. Metre Rate for Rehab	$40.00	$40.00	$40.00	$40.00	$40.00	
Cost for Rehab	**$5,692,621**	**$18,645,839**	**$9,232,587**	**$8,937,786**	**$4,504,146**	**$47,012,981**

Table - regional road condition rating

Rating	Description
1	<1% area affected of the segment's total Trafficable Area
2	1 to <5% area affected of the segment's total Trafficable Area
3	5 to <10% area affected of the segment's total Trafficable Area
4	10 to <20% area affected of the segment's total Trafficable Area
5	>20% area affected of the segment's total Trafficable Area

- Road pavements are designed for a finite life. When the designer needs to determine a design life for the road they typically choose a period of approximately 20 to 30 years. Having a design life, the designer then needs to determine the number of Equivalent Standard Axles (ESAs) that the road is anticipated to carry in that design period, and this figure can then be used to determine a pavement thickness. A 'Standard Axle' is a design equivalent to enable various differently loaded axles to be factored into the pavement design. It takes into effect the load and axle configuration of heavy vehicles. The standard axle in which all others are related is a single axle load of 8.2 tonnes (80 kN) on dual tyres. For vehicles that have different axle loadings, the equivalent loading can be calculated from the following formula:

  $N_{ESA} = [Pc / P_{ESA})^4$

Where:
Pc load on axle group
P_{ESA} load on standard axle group

For a motor car of approximately 1.6 tonne (standard Falcon or Commodore) the load on each axle group is approximately 800 kg.

$N_{ESA} = (0.9/8.2)^4$
$= 0.1^4$
$= 0.0001$

(or 1 10,000th of an equivalent standard axle)

Therefore one truck movement is the equivalent of 10,000 car movements!

Because cars are so insignificant when compared to heavy vehicles, the design method for calculating total ESAs ignores normal traffic and only utilizes the heavy vehicle traffic.

As such, traffic counts are often expressed as Average Annual Daily Traffic (AADT) and a % heavy vehicles. From the AADT and %HV, the ESA for the life of the road can be calculated from the following equation:
N = n x c x r x 365 x P x F (formula 1)

Where

n = daily traffic in one direction
c = percentage of heavy vehicles
r = expected traffic growth rate
P = design life (years)
F = equivalent number of standard axle groups per heavy vehicle (average of 2.8 for Rural roads)

Therefore using the figures taken from the report that 19,345 Tonnes of material will be transported (B Double capacity 24 tonne) = 1600 heavy vehicle movements, the following road impacts can be predicated -:

P remaining = remaining life of the road asset (yrs) – 9 years
c = % of heavy vehicles prior to increase – 21%

P new = new remaining asset life following additional traffic

C increase = increase in heavy vehicles as % of total traffic – 3%

P increase = time of increased heavy vehicle usage (yrs) -3 year

Pnew = (P remaining x c – Pincrease x Cincrease) / (c)

MR 301
P remaining = Avg Sectionalisation -: 9 years
c = 21%
C increase = 3%
P increase = 3 yrs

Pnew = (9 x 0.21– 3 x .03) / (0.21)

= 1.8 / 0.21
= 8.57 years

So reduction in asset life is 9 years – 8.57 years = 0.43 years for the 3 years of additional heavy vehicle loading.

This additional H.V traffic will cause implications for Council over the life of the road. When you consider that a sectionalisation of the road was considered, the greater part of the road that has not been recently upgraded will deteriorate very quickly.

Impacts on Pavements.
This section of the document states "Given the existing poor pavement condition of many sections of the likely access routes, and which was readily apparent through simple visual inspection, it was considered there would be little value in collecting quantitative data such as by the methods noted. In short, these approaches are not considered to be practical for two main reasons":

- existing poor road pavement conditions and the potential for further deterioration or other rapid changes
- relatively low traffic volumes associated with the Project relative to over all traffic volumes (including percentage of heavy vehicles), meaning that the majority of pavement damage would not be a result of the Project but through normal wear and tear attributable to all road users.

The above is describing an "Each Way Bet". It acknowledges the poor condition of the roads, but does not support that additional H.V traffic will have a further impact. It also does not take into consideration additional impacts post dam. Whilst it is not Hunter Water's responsibility to consider the cumulative effects that may occur, the impacts need to be considered holistically by Government and when one considers that there may be three significant developments occurring within the Shire concurrently, being the Tillegra Dam (if approved), The AGL Gas Pipe Line (if approved) and the $51 million upgrade to the Transgrid power distribution network, the impacts on the community and infrastructure are enormous and these matters seem to be disregarded.

Post-construction
The comments that there may be an increase in vehicle movements due to local (Dungog) and out of town visitors to the dam (and storage) locality, is correct. The statement that "It is difficult to predict the magnitude of any such increase as it would in part be dependent on the type of development which may take place (beyond that proposed as part of the Project)" is not correct. The greater Dungog Shire Community has already commented through Councils consultation session held in 2008 that they want the dam to be utilised for full recreation. The scoping study carried out in the road access study demonstrates the expected traffic volumes and visitation numbers with only basic recreation infrastructure.

Tillegra Dam Recreational Facilities Scoping Study
Assumed visitation numbers
On the basis of consultations with other dam recreational facility managers that have some similarity to what is proposed at the Tillegra Dam, it is considered that yearly visitor numbers will be in the range of 8,000 to 32,000 for the first few years.
After that, visitor numbers will depend, to a large degree, on the perceived attractiveness of the dam for the wider community. This may be determined by such factors as the quality of the freshwater fishing and whether large specialist groups, such as school camps, water skiers and other specialist recreational groups such as canoe clubs are attracted to the dam and the facilities provided. Assuming this does happen, we have, for modelling purposes worked on visitor numbers building to an estimated 48,000 in Year 4

(assuming 2013 is Year 1), which is the benchmark for the development of camping facilities at the site.
Table below contains the full 16-year projections.

Table - Estimated Visitation Numbers

Year	Date	Total Users	Day Use	Campers
1	2013	8,000	8,000	
2	2014	16,000	16,000	
3	2015	32,000	32,000	
4	2016	48,000	28,000	20,000
5	2017	53,000	32,000	21,400
6	2018	57,245	34,347	22,898
7	2019	61,252	36,751	24,501
8	2020	65,540	39,324	26,216
9	2021	70,128	42,077	28,051
10	2022	75,037	45,022	30,015
11	2023	80,289	48,173	32,116
12	2024	85,909	51,546	34,364
13	2025	91,923	55,154	36,769
14	2026	98,358	59,015	39,343
15	2027	105,243	63,146	42,097
16	2028	112,610	67,566	45,044

Note – Modelling derived from Burnett River Dam, Keepit Dam, Lake Glenbawn and Glennie's Creek Dams visitation figures and estimates.

Three underlying development philosophies emerge from this finding:

- A staged, incremental approach to recreational development is pursued, preferably market lead, where consumer demand dictates private – or leased supply of facilities.
- Early developments, eg day use facilities, should not preclude the possibility of upgrading or expanding to bigger facilities on the same site, eg a camp ground in the future
- Day use recreation facility infrastructure – eg picnic tables, BBQ's, toilets etc are essentially a community service rather than a profit making opportunity

However, the experience at several other dams in the region is that the time frame and staging of various facilities can be bought forward through the involvement of Hunter Water and Private Developers in the provision of facilities and support infrastructure that has been facilitated through appropriate planning and through successfully securing available funding.

Traffic Issues

1. Traffic Volumes

Traffic associated with the recreational areas will comprise generated traffic (i.e. new to the area) and traffic attracted from nearby recreational areas. The attracted traffic could include, for example, fishers who currently visit adjoining areas or visitors to Newcastle, Port Stephens or Great Lakes who are after an inland experience. In the absence of detailed volumes, it is difficult to quantify the potential levels of attracted traffic although these are estimated to be small in comparison to the level of generated traffic.
The projected number of visitors to Tillegra Dam in 2028 is 112,610 per year (above). With an average occupancy of 2.5 visitors per vehicle, this corresponds to 90,088 vehicle trips per year (i.e. one trip in and one trip out). The average annual daily traffic (AADT) to the recreational areas is 247 trips per day. It has been assumed that during holiday

seasons such as Christmas and Easter the average patronage levels will triple. This equates to 741 trips per day to the recreational areas.
Assuming a peak annual event of 10% of visitors over a three-day period, peak traffic is estimated at 3,003 vehicle trips per day to all recreational areas.

2. Vehicle Classification and Maintenance Issues

Traffic associated with the recreational areas is expected to be predominantly light vehicles such as sedans, four-wheel drives and utilities. A proportion of these may be towing trailers, caravans or boats and will still be classified as light vehicles. Heavy vehicle traffic associated with the recreational facilities is envisaged to be a small proportion of total traffic and is most likely to include maintenance vehicles and buses carrying school groups or backpackers and trucks for Primary Production purposes above the dam.

Conclusion -:

The document Road Infrastructure and Other Infrastructure draws conclusions that do not accurately estimate the expected impact on our roads and infrastructure. Of particular concern is the failure of the report to assess construction and operational traffic (for all end users) addressing heavy vehicle traffic generated only with a brief reference to the construction workforce light vehicle movements.
The assessment also fails to differentiate between the various classes of heavy vehicle currently using the road network when considering the level of increase in heavy vehicle movements during the dam and road construction phase.

Specific examples of the inaccuracies or omissions in the report include:

- The report fails to accurately identify the current level and the proposed increase in heavy vehicle movements greater than class 3 South of Dungog and does not consider the increase in heavy vehicle use of Chichester Dam and Salisbury Roads, (both local roads). The increase in heavy vehicle movements North of Dungog is estimated by Council at 47% and South of Dungog by 12.69%.
- Traffic count data in Table 2 of this section of the EAR is estimated at 500 AADT whereas actual counts vary from 1157 North of Dungog to 618 South of Salisbury Road
- Structural details provided for Wallarobba Creek, Wallaroo Creek and Myall Creek bridges and the Rail Bridge on Main road 301 are incorrect
- Tabbil Creek Bridge is listed as being on Main Road 301 but is on Main Road 101 and the LG Clements Bridge South of Paterson is not referred to in the report
- The report underestimates the amount of material and traffic movements for the road and dam construction and proposes 24 tonne B Double transport (whereas B Doubles of this size are not permitted beyond Woerdens Road on Main Road 301)
- The report nominates an overall 10-20% increase in traffic on sections of the route where Council estimates that on some local roads this increase could be as high as 60-70% during construction.
- The report fails to address the hazard caused generally by the increase in heavy vehicle movements and the hazard to pedestrian safety with the main route passing a number of schools and sporting facilities within both Clarence Town and Dungog.
- The report does not address the long term impacts as regards vehicle movements after the construction, Hunter Water has given a commitment that the Dam will be available for recreational use but the longer term impacts on the roads has not been addressed.
- Whilst it is not Hunter Water's responsibility to consider the **cumulative effects** on the road network that may occur, the impacts need to be considered holistically by Government (NSW Dept of Planning) and when one considers that

there may be three significant developments occurring within the Shire concurrently, being the Tillegra Dam (if approved), The AGL Gas Pipe Line (if approved) and the $51 million upgrade to the Transgrid power distribution network, the impacts on the community and infrastructure are enormous and these matters seem to be disregarded.

Recommendations -:

1. The Dungog Shire Route Access Study should be fully funded (MR 301) by the NSW Government and Federal Government. The last proposal put forward by the TDCRG and Tillegra Dam Whole of Government Taskforce was a proposal that $10 Million (total) from the State Government and $10 Million (total) from the Federal Government be provide to Dungog and Port Stephens Council over an extended period (6 to 8 years) with a split ratio of 68:32 respectively.
2. The proponent be responsible for all upgrading and repairs on Chichester Dam Road and Salisbury Road and then these two roads be reclassified as Regional Roads.

3. The estimates required in determining exact dollar values of damage caused and risk exposure to travellers by these additional Vehicle Kilometre Travelled (VKT), is such that Council has to take the stance that the road infrastructure serving the dam and the surrounding area has significant shortcomings and that these additional access roads should be funded and rehabilitated **(This requires a further Government commitment).**
   The following work is recommended:

Glendonbrook Road Upgrade	$4,600,000
Allyn River Road Upgrade	$6,800,000
Salisbury Road Upgrade	$1,100,000
Salisbury Gap Road Upgrade	$980,000
Gresford Regional Roads (Rehabilitation)	$1,200,000
Dungog Urban & Main Streets (Upgrade & Rehabilitation)	$1,350,000
Total	$16,030,000

   Note -: Projects above should be prioritised.

4. Hunter Water should ensure that Mobile telephony is available throughout the Tillegra, Salisbury districts. This will mean that a carrier such as Telstra will need to install appropriate signal towers. Telstra should also install replacement fibre optic distribution networks (old copper wires will be inundated) to allow fast speed internet capability rather than relying on dial – up or satellite technology.
5. Hunter Water should ensure that Country Energy replace the power distribution network and allows for increased land use development (increased load without voltage drop issues).

Air Quality.

I concur with the assessment that there would minor exceedances of relevant NSW DECCWW air quality criterion at some receptors for cumulative PM10 emissions. These are all on HWC-owned land. Based on the modelling undertaken, it is not expected there would be any exceedance at receptors on private land.
As part of the construction air quality mitigation measures, it is recommended that HWC consider terminating the leases for receptors 9, 10 and 19 prior to construction. It is understood the residence at receptor 20 is not occupied (this needs to be confirmed).

Given their proximity to the dam construction site, receptors 1, 2 and 8 (particularly the latter) could also experience reduced air quality which, while not exceeding applicable criteria, may affect amenity. Similarly, receptors 13 and 14 could experience reduced air quality while road construction activities are undertaken in proximity to their residences. The recommendation that these receptors be consulted with respect to the air quality management measures that would be implemented for construction is a necessity.
HWC has met with the occupants of the privately owned residences at receptors 1, 2 and 8 to discuss air quality issues. With respect to air quality issues, HWC **should** commit to:

1. installation of monitoring equipment to record levels of particulates during construction and to identify any issues not adequately resolved through the construction environmental management plan
2. work with the affected residents to develop a practicable and satisfactory resolution to the issue(s) in question.

Recommendations -:

1. HWC **should** commit to:
    - installation of monitoring equipment to record levels of particulates during construction and to identify any issues not adequately resolved through the construction environmental management plan
    - work with the affected residents to develop a practicable and satisfactory resolution to the issue(s) in question.
2. That Hunter Water instigates a Community Representative Committee (similar to the Tillegra Dam Community Reference Group) immediately a determination of the application is made. This will allow dissemination of information such as Air Quality Monitoring / Complaint monitoring etc.

Noise and Vibration.

This report clearly assesses the noise and vibration aspects associated with the Tillegra Dam project and their impact on the surrounding environment. The carrying out of an environmental noise survey to quantify the existing environment (background noise levels and natural harmonics) followed by predictions of the noise and vibration which would be emitted from construction and operation of the associated infrastructure which includes the dam wall and Salisbury Road realignment is standard practice. Predicted noise levels are evaluated against applicable criteria to determine compliance. These are in accordance with all the relevant Government and Industry legislation, policies and guidelines.

Recommendations -:

1. HWC **should** commit to:
    - Implementing all the mitigating measures described in section 7.1 *Construction noise mitigation.* It should also be incumbent of the proponent to carry out dilapidation reports on all dwellings (and other buildings) within the receptor area that will remain post dam (that are not owned by Hunter Water).
    - installation of vibration monitoring equipment (multi accelerometer to monitoring / alarm equipment) to record levels of shock and transient vibration during construction and to identify any issues not adequately resolved through the construction environmental management plan
2. That Hunter Water instigates a Community Representative Committee (similar to the Tillegra Dam Community Reference Group) immediately a determination of the application is made. This will allow dissemination of information such as Vibration Monitoring / Complaint monitoring etc.

Contemporary Heritage.

The Contemporary Heritage report complied by Environmental Resources Management Australia of Pyrmont, NSW is a concise report detailing the results of the heritage values assessments of the 48 items and the impacts analysis of the 47 potential built and archaeological items and sites. ERM were also commissioned to prepare preliminary impact mitigation measures and recommendations. The assessments carried out deal with historic heritage values and impact assessment, building upon the Stage one historic heritage study undertaken by Archaeological and Heritage Management Solutions. It is a reasonable hypothesis that the report will in the future be an historic recollection with regards to the Tillegra Dam proposal.

Conclusion -:

The impacts analysis that was conducted for those items of local heritage significance and in consideration that the Project will have a negative heritage impact on is comprehensive. The range of mitigation measures including relocation, archaeological assessment and excavation, archival and photographic recording and salvage that have been identified will reduce the heritage impact of the Project. I would agree with the recommended mitigation measures so that the negative heritage impacts can be reduced to an acceptable level. The most sensitive task will be the relocation of the Quart pot Cemetery (see Cemetery comments).

- The Munni House relocation needs further consideration. Whilst Hunter Water is the current owner, I believe the house should only be relocated if the immediate past owners (Smith Family) wish to see the heritage component of the house removed. If the decision to leave the house in its current position is determined, I would suggest that a “mirror image” of the residence be constructed at the proposed interpretation centre and be made part of the Visitor Information precinct. If there are cost benefits by not removing the existing residence (if deemed a suitable outcome), these should be redirected to additional recreation facilities around the dam.

Aboriginal Heritage.

The Aboriginal Heritage report prepared by Cultural Heritage Connections Pty Ltd of Dulwich Hill, NSW again is very descriptive and concise. The report of the archaeological suggests that many of these sites may not be preserved in the archaeological record. However the area does contain important evidence of past Aboriginal occupation that will contribute to the region’s heritage value.

The suggestion that a positive outcome for the Project would be to create a museum-type display of the artefacts and information compiled during the current study is of merit and this complex should form part of the “Old Munni House / Cricket Ground facility. This could be a valuable educational tool and interesting for locals and visitors alike. Obviously further consultation would need to be undertaken with the Aboriginal community, and DECCWW is required.

It is imperative that a suitably qualified archaeologist should be engaged to formulate a research design for archaeological salvage within the study area prior to any impact. Salvage should occur in areas of direct impact including the dam wall area and sample locations along the proposed road diversion as well as in areas of inundation impact. Salvage in the inundation area should be limited to areas of identified archaeological potential.

Point of Clarification

The report states in Section 5.1 Ethnohistory that the Aboriginal word ***“Munni”*** was recorded as the Aboriginal name for the area and is said to mean ‘a good hunting

ground' Dungog Chronicle, Brian Brock (1957, cited in Koettig 1986). With respect to the previous mentioned authors and Vanessa Hardy (BA Hons) the eminent archaeologist who undertook the reporting of the assessment, **I believe more research needs to be done regarding the word *"Munni"*.** The author of the book Port Stephens Blacks : recollections of William Scott - prepared by Gordon Bennett (Dungog Chronicle 1929) on page 36 articulates the word ***"Munni"*** to mean "Star". An analogy presented to me some time back by Members of the KALC, indicates the derivation of the area known as "Munni" as in "Munni" ridge etc, could possibly come from the "ridge leading to the stars" (i.e. Barrington Mountain) or the place to get the best view of the stars. It could also have been the place where stars (comets) had fallen. The Barrington Mountain Range is an extremely significant landmark/place in Aboriginal History. It was the capital or main meeting place for clans from Muswellbrook, Tamworth, Maitland and the Coast. This needs further investigation. If indeed the water body was to be called a name of significance, I would like to think ***"Munni"*** as in Munni Lake etc is in consideration (with consultation and approval of the Wonnrua Land Council and the Mindaribba, Karuah, & Worimi LALC's and Elders). The dialect needs further interpretation to ensure it is correct.

Recommendations -:

1. Undertake recording of oral history and information about culturally significant places.
2. Consider the request of Aboriginal community representatives to undertake further consultation about past Aboriginal cultural activity in the study area.
3. Undertake salvage and recording of a sample of archaeological sites preserved in the study area by means of focusing excavations on known sites and identified areas of archaeological potential.
4. If additional impacts outside the defined study area are identified prior to construction, additional archaeological impact assessment may be required.
5. Consider development, in consultation with stakeholders, of a local display of information and artefacts relating to the study area.
6. Copies of this report should be provided to the registered Aboriginal community groups, the Dungog Historical Society, the Dungog local studies library, the DECCW local office and the DECCW AHIMS registrar

Integrated Land Use Plan.

The Integrated Land Use Plan (ILUP) that has been prepared allows for the development of a plan of action and management for the proposed Tillegra Dam, storage and surrounding area. The ILUP is certainly a management tool for HWC and the community and outlines the future operational and recreational activities that could occur on and around the storage as well as identifying implementation processes. The ILUP has a 5-10 year focus for the implementation of specified actions, underpinned by HWC's 50 year vision for the future of the storage. The plan also supports the Dungog Shire Council Draft Land Use Strategy (Tillegra Dam Precinct) and both documents support depicted use of the water body and strategically link land use and opportunities for potential development.

As the timeframe for completion of filling of the storage is dependent on the frequency and intensity of rainfall, it is recommended that review of the ILUP occurs within one year of the storage reaching 90 per cent capacity, rather than a specific date. After this point, the recommended review period is every five years. The review process would provide an opportunity to incorporate changes arising from the dynamic nature of planning processes and changes in stakeholder roles, responsibilities and strategic directions, coupled with community expectations and demand management. Obviously Community

participation and land use Managers / Tourism operators need to be inclusive in this process.

Recommendations -:

1. Section 2.1.1 “Summary of issues raised by the TDCRG” - Objectives and Vision – Dot Point three states **“the 'storage' should be referred to as a dam and not a lake”** is ill conceived and detracts from the Tourist potential of the precinct. As I have described in the Section Aboriginal Heritage, I believe that the naming of the water body including the word “Munni” is quite appropriate.
2. Further work needs to be undertaken with Dungog Shire Council to develop appropriate Strategies that deal with development implications and changes to Councils current LEP and Development Control Plans.

Geotechnical Reports – Volumes 7 - 9.

Given the comprehensive data included in these reports, as an individual who does not specialise in the field of Geology / Geotechnical Investigations, it is extremely difficult to interpret the reports and extrapolate information.

As such I am satisfied that the work conducted was done in a professional and expert manner as the people involved are clearly very competent.

From my perspective, the Dam Safety Committee and the Peer Review Panel will be the overriding bodies regarding the seismic studies and works to be undertaken with regards to the dam construction.

The Peer Review panel report on Storage Rim Stability and Seepage Potential indicates that the engineering analysis for this component of the dam construction poses no immediate concern in my untrained opinion.

The Review Panel’s Report regarding the Design Concept analysis raises a number of issues.

Of major concerns are the implications of suitable quarry material and no evidence of a foundation grouting plan. As the report indicates, there are a range of studies and reports still to be forwarded / completed and it is of vital importance the findings of the design aspects and deficiencies (as identified by the Peer Review Panel) in the reports to date are made public as soon as possible.

Project Summary:

Over the past three years, there has been vigorous discussion with regards to the proposed Tillegra Dam. In compiling my submission on the Dam Proposal, I have attempted to ensure that the following concerns and issued commented on by community and NGO’s have been considered in my submission. The following is a précis of the more salient points raised over the past years:-

- *He hasn't heard that respected independent water experts are agreed that Tillegra Dam is completely unnecessary and doesn't know this was also the view expressed in Hunter Water documents right up until the Government made its unexpected announcement to build it.*

  He hasn't heard that the 10 per cent decrease in rainfall used by Hunter Water in its revised, post announcement, storage simulation is completely at odds with the Governments own Department of Environment and Climate Change predictions.

He hasn't heard that there is a world wide economic crises and that already in the 2007-2008 financial year Hunter Water had to place 12,930 customers on payment plans and thousands of Hunter home owners narrowly avoided losing their properties because of unpaid council rates.

He hasn't heard the estimated cost to build the dam has increased from $300 million to over $400 million since it was announced, a third extra in two years.

Ramsar wetlands would be affected, valuable agricultural land would go and the impact on the environment would be devastating.

- *The withheld letter about Tillegra Dam highlights yet again that political survival rather than proper planning was the reason this project was announced ("Dam was not costed, memo reveals", July 2)*

- *How is it that raising the wall of an existing dam by seven metres (Grahamstown) is 50 per cent more expensive than building a new dam from scratch? Why is the expansion of Chichester Dam, an overflow reservoir, also 50 per cent more expensive than Tillegra? Do all the Figures include amounts paid for land acquisition and estimates for land not yet acquired? If you're still "finalising its environmental assessment report" why did you announce and continue to pronounce that it is going ahead? Finally, why don't you pipe water into the underused dams of the Upper Hunter? Filling up Glenbawn and Glennies Creek will bank more water above their normal storage than Tillegra will hold.*

- *The destruction of the only pristine river left in the Hunter that can be enjoyed by Maitland anglers and swimmers, the complete annihilation of water sports at Clarence Town and the inundation of prime agricultural land.*

- *(Land Owner) is being pressured to sell his fertile family property for the sake of a dam that Newcastle doesn't need or want ("No dam way" Herald 31/7). Mr Costa and Hunter Water need to back off. How would they feel if all that they held sacred, parents' graves and five generations of family history, were to be buried in a watery grave? Newcastle people are not stupid. They realise this dam is mainly for the benefit of Sydney and Gosford and, once again, Newcastle pays.*

- *This land was laboriously cleared by our pioneering families in the 1800s because of the high fertility of the land and has, through several generations, been maintained in productivity by skilful land management. The many ridges and folding hills feed water and nutrients down to the numerous level valleys of the area, supporting a healthy dairy and beef industry. This valley should continue to be utilised for growing crops and food locally - Australia imports far too much produce and this creates an environmental, economic and social cost. It would also be a perfect place to educate more people to grow food organically or biodynamically with no fertilisers and using far less water than conventional methods.*

- *THE study Hunter Water wasted our money on failed to tell us that the proposed Tillegra Dam will probably cost $1 billion to build ("$1.2bn to flow in dam booster" Herald 3/4). Further, the roads to get the materials to the dam site could cost another $1 billion. Hunter Water customers will have to pay the money. As I see it we will be asked to invest our $2 billion to achieve an investment of $1.2 billion on a dam that we can't use and may not be full for 30 years. I smell Labor.*

- *Regarding Tillegra Dam, the authorities cannot get around the fact that its construction will mean big price increases for the Hunter. Moreover, I dispute assertions from the Minister for Water that Tillegra is the best solution. In papers subpoenaed by Parliament's Upper House, there is no evidence to show that Tillegra was even on the radar as a solution for the Hunter's long-term water management. The Government can expect a voter backlash from people who don't want to pay for an enormous white elephant.*

- *WATER Minister Phil Costa, in a recent radio interview, referred to Tillegra Dam as the Hunter's Warragamba Dam. But Sydney Water does not consider dam construction the answer to Sydney's future water security. It has stated publicly it will be relying on better water management and education, water recycling, stormwater collection and purification and desalination. The last attempt by Sydney Water to promote any dam idea was Welcome Reef more than 20 years ago. Since then Sydney Water has seen the light. Warragamba is a dinosaur costly to build, costly to maintain, with questionable structural integrity and built in the wrong place. Warragamba is at the level it is now due to the pumping of water from the Shoalhaven (now a ruined river) at Tallowa Dam south-west of Sydney. It is typical of a 1950s and 1960s way of thinking - about the same time Tillegra was dreamt up.*

- *It's good to read the dam debate is gaining momentum in the Hunter region and people are exercising their right as free individuals to question the validity of a project of this magnitude in our farming community. Readers may have seen an article in the Sydney Morning Herald on February 4 entitled "Huge dam may have triggered Sichuan earthquake, scientists say". Bearing in mind the fault lines that exist in the Tillegra Valley and to quote from the article: "Scientists in China and the United States believe that the weight of water, and the effect of it penetrating into the rock, added to the pressure on the fault line, possibly leading to a chain of ruptures leading to tie quake. Tran Xiao, a chief engineer at the Sichuan Geology and Mineral Bureau in Chengdu, said it was 'very, likely' that the construction and filling of the reservoir in 2004 had led to the disaster. 'There have been many cases in which a water reservoir has triggered an earthquake. This earthquake was very unusual for this area', he said." There are people in the Dungog area with the expertise and knowledge of the geological formations in Tillegra who have seriously questioned the safety of the site and Hunter Water's glossing over these concerns. I and many others live in the path of a possible dam burst. I remain unconvinced of the competency and impartiality of Hunter Water's safety investigation into the Tillegra site. The Sichuan earthquake last year took 70,000 lives. Do we need a dam the size of Sydney Harbour in our valley, to hold our breath and just hope the unstable geology is good enough? I may be missing something, but I cannot see the sense in this dam.*

- ***Who cares what the Government says about whether the dam is safe and how much it will cost*** *(Pte Herald, March 5 Dam cost in dispute). The point is, the public aren't stupid. They are still up for at least a 57 per cent water rate increase. The heralding by Water Minister Costa that the dam was now 'safe' fails to acknowledge one thing. The report released by the Minister on December 4 relates only to the storage rim - not the dam. This is a misinterpretation of the facts. Also, the international expert committee who Minister Costa refers to, consists of an engineer and an engineering geologist from Sydney and two New Zealanders. Costa also stated in his press release that Tillegra was the best solution. This is interesting, in that the subpoenaed papers by Parliament's Upper House on December 18, failed to show that Tillegra was even on the radar as a solution for the Hunter's long term water management. In the end you have got to ask yourself, why Mr Costa is travelling to the Hunter a lot lately and why Hunter*

Water's CEO is writing letters to the editor. Answer: voter backlash from ratepayers who don't want to pay for this enormous unnecessary white elephant.

- *So our Mayor feels the shire is hurting (Dungog Chronicle April 8), well I've got news for him. If he thinks it is hurting now just wait till the dam is full. At least now there are cattle grazing Hunter Water's land under lease arrangements, nearly all the houses which were sold are occupied by tenants, a few of the original families are still in possession of their properties and Hunter Water is paying rates to the shire. When the dam-fills there will be none of these. Hunter Water has forecast the annual operating costs of the dam at $600,000. How much of this do you think will stick in the Dungog Shire, Mr Wall? Half, maybe? Oh sorry, - I have forgotten to mention that at times during the year the dam will attract an influx of big spending campers and fisher folk. They'll save us.*

- *I was pleased to read over the weekend that Charlestown Labor MP Matthew Morris has organised a meeting between Hunter Water's Kevin Young and the Hunter Labor Taskforce (made up of Hunter Labor MPs) to ask some specific questions about the Tillegra Dam proposal. He has stated that he "would like to understand exactly the circumstances around the decision" and that "the detail in terms of that decision-making process is what I want to get a better handle on" Does this mean that even though publicity supporting the dam, local members are unaware of the reasons why they do support such an ill-conceived plant to build the Tillegra Dam'? This doesn't help to dispel the thoughts of many that the Tillegra Dam proposal is nothing but a political decision. People of the Maitland electorate would expect that Frank Terenzini will participate actively in this investigation of the reasons for the Tillegra Dam and that he will understand the folly of such a plan as so many people of' this electorate have already realised.*

- *No, (name removed) (Short takes, 15/6), Tillegra Dam will not be used to augment future water supplies for the Central Coast. By building the Mardi pipeline, the Central Coast authorities have worked out how to use existing supplies more wisely and efficiently. It's a pity that Hunter Water has not been compelled to do the same.*

- *How to turn bunnies into cash cows. First, tell the bunnies you are going to build them something they need (which they don't), which is really needed for elsewhere. Then you tell them that they have to pay for 95 percent of it so they become the cash cows for "elsewhere".*
  1. *Key: 1 For "something" read Tillegra Dam.*
  2. *For "bunnies" read Hunter Water ratepayers who believe Hunter Water.*
  3. *For "elsewhere" read Sydney and the coal industry.*

  Do we need this dam? When did we last have water restrictions?
  Last week two of our four storages were listed at 100 per cent full, one at 75 per cent and the other was over 75 per cent. We have been selling water to Gosford, and Sydney is not much further.
  The coal industry: Remember (former NSW Premier) Bob Carr's plan to dam the little Barnard River and pipe it across to the Upper Hunter (thus robbing the Macleay/Taree area). Have you noticed who buys water rights when they are auctioned in the Upper Hunter? Almost invariably it is the coal mines; farmers can't compete. Hunter Water ratepayers must get active or they will be paying for this for many years to come. Finally, I ask our local member, Maitland MP Frank Terenzini to stop being the usual mouthpiece for Labor Party headquarters and do something big for the people who elected him.

- *Hunter Water and the NSW Government have taken spin and disinformation into the Orwellian realm with their most recent rebranding of the proposed Tillegra*

Dam as a stimulus package. To be sure they needed something since everything else they've tried as justification has evaporated. But think about it. A stimulus package is what the Commonwealth Government is doing when they give us more money to spend so the economy will keep turning over. What the NSW Government is proposing, via its agency Hunter Water, is to take money out of our pockets leaving us with less to spend. It is effectively the same as introducing a new selective tax on all Hunter Water customers at the worst possible time. The proposed Tillegra Dam does not represent a stimulus package it represents more homelessness in the Hunter. Only with doublethink can increased taxes be spun into a stimulus package. The claimed economic flow on from the construction would be the same had it been spent by each Hunter Water ratepayer on the things they actually need. Look at the claimed 280 construction jobs. Aren't 90 farms going under because of these construction jobs. Surely each farm supported at least three people so that will be 270 permanent jobs lost for the same number of short term jobs. To put it simply this is nothing more than robbing Peter to pay Paul. There is no nett gain just a change in ownership. Think about it again. If we have to pay for the dam why don't we get to own it. As investors we should at least be given shares equal to our contribution. Personally I think we should all disconnect and buy a water tank. That way the hundreds of dollars we wouldn't be paying Hunter Water each year would be a real stimulus package.

- *Hunter Water's use of Monash University's report regarding the proposed Tillegra Dam is economic trickery. They claim the proposed dam will "pump" $1.2 billion into the economy. However considering that the money will come from Hunter Water ratepayers you might as well say that it will drain $1.2 billion from the economy. Dungog Mayor Glenn Wall says the local economy is already losing $7 million annually just from the fact that the existing farms are no longer operating. Hunter Water says recreation and tourism will generate $588 million because of a camping ground and walking trail they will build. However it is not the darn which is the tourist attraction. Surely if walking trails and camp grounds were on the existing river they would generate at least the same income.*

- *HUNTER Water Corporation's Nicole Holmes would have us believe the Tillegra Dam proposal was a rational decision based on evidence and devoid of politics ("Rest assured on Tillegra" Letters 18/7). But I believe the proposal is irrevocably tainted with politics, as confirmed by recently released secret documents. These documents show the proposal was uncosted, had not been properly analysed and was not under active consideration six weeks before it became the must-have policy. The reports cited by Ms Holmes, Why Tillegra Now,? And the H250 plan, were delivered one year and two years, respectively, after the proposal was announced. You cannot have objective, independent reports if the decision to build the dam is predetermined. As the eddies of doubt swirl ever larger around the dam, I and the community I represent will in no way "rest assured". Now is the time for a full, independent inquiry into all water supply options for the Hunter.*

- *I wonder if Gil Reid and the retired water resources engineer Colin Gratwick would be so inspired if Tillegra Darn is constructed and the unthinkable occurs should the wall collapse. Undoubtedly they would not have time to admire the magnitude, technology, grandeur and impressiveness of human achievement and engineering works of great interest nor will others whose short sightedness inspires them. If there is the slightest possibility, of structure collapse this monster should never be constructed. A matter of enormous concern is the possibility of sabotage or terrorist contaminating major water storages, resulting in thousands of people facing death and property destruction. As the majority of us are aware, such an event is possible. If the construction of major water storage is considered*

necessary at this time, I understand there is sufficient less productive land already owned by the water board where less private properties and people would be affected. If supposed global warming (seasonal conditions rotating to be more precise) continues the more productive land should be retained to enable reliable less costly food production now and for future generations.

- *Chris Holstein, NSW Liberal candidate for Gosford, discusses the mismanagement of the Joint Water Authority and a NSW Coalition Government's plan to fund a self-sustainable water strategy for the Central Coast. He also says ratepayers will still be paying for water from the Tillegra Dam when it's built, just as they currently pay for water from Hunter Water.*

- *NSW Member for Peats Marie Andrews says that water is an essential NSW election issues. She says when the Tillegra Dam is built it will ensure the Central Coast's water supply. She says Central Coast residents will still have to pay for the water supplied by Hunter Water.*

- *Councillor Greg Best, Wyong Shire Council, discusses his alarm about council's rising debt to secure the local water supply, buying water from the Hunter and spending millions digging for groundwater. He says when he is elected as an independent he will sack the dysfunctional Joint Water Authority. He says the Tillegra Dam won't be built for 10 years.*

- *Kerry Yates, Wyong Shire Council, discusses council's draft management plan, increasing the size of Mardi Dam and storm-water harvesting. He also says council has a legal agreement with Hunter Water to supply the Central Coast. Mardi Dam is supplying the Central Coast with some of the water from the Hunter.* ***Gosford Council and Wyong Council are helping to fund new pumps in the Hunter Area which will increase capacity into the pipeline to Wyong Shire. Total usage on the Central Coast is about 70. That pipeline is the way water will be taken out of the Tillegra dam if it goes ahead. The Councils believe Tillegra is important to them****. Yates says he is keeping on the periphery of the issues in Dungog, 'that is an issue for Hunter Water'. Yates says the only difficulty at the moment is the time taken to build the dam,* ***the Missing Link will fill in whilst we are waiting.***

- *Federal member for Dobell Ken Ticehurst discusses the Federal Government's announcement of full funding for the Mardi to Mangrove pipeline. He says the Tillegra was always pipe-in-the-sky. He says at the moment, Hunter Water is actually using Central Coast water. He says it is not beyond the NSW Government to impede the project.*

- *ABC Radio Interview 06/08/07 – NTDG Chair raises concerns with Geological aspects and that the Faults are identified running in the wrong direction and that if constructed the dam could have catastrophic failure. Given these concerns commentary was made that other suitable dam sites (Johnson Creek) should be utilised.*

- *Chair of the No Tillegra Dam Group (NTDG) said water minister Phil Costa, in his rush quell mounting opposition in the Hunter to the Tillegra Dam proposal, has pre-empted the role of his own Dams Safety Committee. "It is the Dams Safety Committee which has the final say on safety and dam design," the Chairperson said. "This committee has yet to agree on the recently released geotech report. "The minister has turned a report merely on the storage rim into a statement that the dam is safe.*

Given the comments from the community and others, I would offer the following summations -:

Hunter Water Supply to the Central Coast.

Prior to the dam announcement Hunter Water and the Wyong / Gosford Councils (soon to become the Central Coast Water Authority) embarked on a $29 million dollar increased pipe conveyance augmentation and upgrade (two additional pumps) of Balikera Pumping Station to supply water to the Central Coast. Anecdotal figures would suggest the Central Coast Council's investment to Pumping Station upgrade to be approximately $8 – 10 million dollars. This investment certainly indicates the ongoing transfer of water between the Hunter and the Central Coast.

The pipeline link between the Central Coast's Mardi – Mangrove Dams is an equalisation measure that will extend the water supply capacity temporally, but it does not produce additional water supply. The additional water supply component will only come from an increase of the existing DECCW licence to draw water from the Wyong River from its current level of 125 Ml / day to 320 Ml / day. Obviously this water can only be transferred in times of flow and does not provide "ensured drought security" or the need for continued water restrictions during extended drought. **Nor does it address the salinity problems that currently occur for the production of feed water for Electricity station boilers.**

As such the Central Coast will have a genuine need to draw water from the Hunter as and when the need arises.

Water Tanks Retrofit and New Demand.

The use of water tanks to supplement domestic water supplies is sound and would certainly reduce some consumption levels.
From 2006 to 2008 the Queensland Government and Brisbane City Council have paid out $216 million and $61 million respectively to subsidise water tanks, which has given the region an extra capacity of 362 megalitres, or one day's supply. The Lord Mayor of Brisbane admitted that the water projects were expensive because governments had to rush to solve the water shortage crisis.

The *Think water, ACT (Canberra) water* strategy states that the cost to install rainwater tanks to existing households (based on a 200 square metre house, with the entire roof connected to a tank and plumbed to the toilet and laundry) would translate into about $4 per kilolitre (kL) for fitting to existing houses.

The ACT Water Authority has determined that assuming a cost of $5,000 - $10,000 per property for over 90,000 houses, it is estimated that the cost for installing a tank in all households would be in the region of $450 million to $900 million for 8 gigalitres per year. This cost would be met up front by today's generation (assuming the property owner or ACT Government did not borrow to fund the works).
The water authority indicates the time required to implement these rainwater tank systems in all households would be many years, based on the limited supply of rainwater tanks, limited availability of plumbers and drainers for installation, and the logistics of fitting systems to approximately 90,000 semi-detached residential properties. The *Think Water, act water* strategy is however looking at ways to accelerate the uptake of rainwater tanks through an expansion of it's rebate scheme with mandatory installation in all newly developed suburbs.
The authority also determined that Rainwater tanks need to be continually managed by ongoing monitoring and regular maintenance, to avoid health issues. They are also dependent on rainfall which in the ACT is irregular and inconsistent, reducing the benefit of rainwater tanks during drought periods. Based on this, the authority determined there

is limited opportunity (in the short term) for city-wide rainwater tank use at levels above what is already being put in place.

To extrapolate this scenario above to the Hunter Water expectation of over 180,000 (very moderate assumption) residential customers by 2031, this cost would be in the order of $900 million to $1.8 billion. The actual figures for residential customers in the Hunter will exceed 250,000.

Grey Water Reuse.
The installation of a sophisticated greywater system has been estimated at $10,000 - $15,000 per household. This cost would be met up front by today's generation (assuming the property owner or NSW Government / Hunter water did not borrow to fund the works). The time required to implement these greywater systems in all households, would be many years. This is largely due to the limited supply of greywater systems, limited availability of plumbers and drainers for installation, and the logistics of fitting systems to 180,000 (again low figure used) existing and new properties.
Greywater systems need to be continually managed including ongoing monitoring and regular maintenance, otherwise health and garden issues can arise.

Storm Water Capture and Reuse.

Stormwater is generated by rainfall events through urban areas and usually comes in large volumes over short time periods. Therefore, we need the ability to store and treat this water until it is required for use. Ponds and lakes can be used for the storage of stormwater, but if the water levels vary too much, it can have significant impacts on their amenity and aesthetics for the community, fauna and flora.

Because the stormwater is generally of low quality with a high level of pollutants, it should only be used for irrigation and have secure backflow prevention devices in place.

It is possible to build in mechanisms to divert the first flush and then transport the rest of the stormwater to the surface water storage reservoirs where it is then treated in conjunction with the overall raw water flows. This is in place in Singapore and is an important part of the island’s overall potable water supply.

Findings on a study of stormwater projects across the Sydney region noted that the average cost of treated stormwater was $10 per kilolitre (with a range from $0.52 to $42). Cost is dependant on factors such as existing storage facilities, proximity of irrigation areas and the size of the scheme.

Due to this cost impediment, there would be limited opportunity for urban-wide stormwater harvesting at significant levels above what is already in place and planned for the into the future.

Desalination Plants.

Desalination plants are considered as options and should only be considered as Drought planning initiatives or when potable water storage is not feasible.

The recent Victorian Desalination Plant was constructed at a cost of $3.5 Billion and produces between 150 – 250 GL /yr. The Victorian Government have only been able to guarantee to the customer base that water accounts **will not double before 2012**.

The Western Australia, Kwinana Desalination Plant cost $387 million to construct and can only produce 45 GL /yr. The expected operation and maintenance costs of this plant are $19.8 million a year.

Drought Management Plan.

There is some debate with regards to Drought Management Plans being sufficient to ensure the Hunter's water supply. This is a **hypothesis,** due to the fact that Development approval will need to be in place for desalination and other such water harvesting infrastructure (Again, approval required under Part 3A of the EP&A Act, with a degree of uncertainty). However the overriding consideration in any Drought Management Plan is water restrictions.

Some commentary states *"Given that similar water restrictions are now permanent 'water wise' rules in most other Australian cities and surveys around the country have shown that low-level water restrictions have very high levels of community support".* I find it absolutely inconceivable that any scientific community believes that water restrictions are supported by community.

Other commentary also implies *"The Tillegra Dam proposal represents a generous buffer supply, which comes at a high economic and environmental cost. The Lower Hunter community needs to be consulted if they are to pay for such a 'gold plated' water supply system."*
I would argue that the economic and environmental costs are within acceptable levels (provided all the mitigation principles are adopted) and it is quite reasonable that Hunter Communities and the Central Coast (watergrid) should have a *"Gold Plated"* water supply. I am absolutely certain, that if Perth, Melbourne, Adelaide and Canberra had scope to construct a dam similar to Tillegra (same catchment, rainfall and precinct) they would all do so immediately.

Conclusion.

With due consideration, this is the third occasion that the Tillegra Dam proposal has been imposed on the Tillegra / Munni communities and Dungog Shire, and the expectation should be on this occasion **"it be determined"**.

Over 90% of those in the inundation area have already sold their properties to Hunter Water Corporation, they have resigned themselves to relocation and they need to move on with their lives.

Given my interpretation and comments made in my submission, I cannot see any major impediments to prevent the dam being determined and subsequently approved (with appropriate conditions and mitigation control).

Chichester dam is currently located upstream of the confluence of the Williams / Chichester Rivers and Seaham Weir is located some 86 km's from the proposed Tillegra Dam storage. The Hunter / Williams River confluence is another 15 km's downstream of Seaham Weir. Some may propose that the Williams is pristine and untouched, but the infrastructure already in place (as above) does not support such statements and the sheer distance involved to the confluence of the Hunter River poses no threat to the Hunter River or the RAMSAR wetlands.

As such, the proposed Tillegra Dam in relationship with Chichester Dam, Seaham Weir and the pumping arrangements from Balickera to Grahamstown Dam is logical when considering the overall water grid arrangements with the Central Coast and safe guarding the Hunter Communities water needs now and into the next generation.