Critique of the 'Integrated Water Supply Options for North East New South Wales and South East Queensland, SMEC Report'

by

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Authorship and Contributions

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Executive Summary

This report critically evaluates a number of the key assumptions and conclusions put forward in the Snowy Mountains Electricity Report: *Integrated Water Supply Options for North East New South Wales and South East Queensland* (referred to as the SMEC Report in this document). In particular, it raises serious questions about the validity of the Snowy Mountains Electricity Commission Report to be used to assess water options for South East QLD.

There are a number of statements made in the SMEC Report that are challenged by the findings in this report. There are also a number of issues that should have been included in the assessment of the viability of the selected preferred options. The major points of contention with the report are as follows:

1) Climate change impacts have not been considered on yield estimates.
2) Climate change has not been factored into environmental flow and regulation issues.
3) Issues with climate change and methods of assessment lead to lower expected yields and therefore increase costs of water.
4) There remain serious questions over the methods of assessment of storage sizes, yields and regulation of all the selected preferred options.
5) The preferred options impacts on the nationally listed endangered Eastern River Cod and other fauna.
6) The preferred options will significantly impact National Parks.
7) It fails to acknowledge Indigenous Land Use Agreements.

A more comprehensive assessment is needed before any conclusions can be drawn concerning the viability of any of the options listed in the SMEC report.

1.0 INTRODUCTION

A number of concerns have been noted regarding the outcomes of the Snowy Mountains Electricity Report: *Integrated Water Supply Options for North East New South Wales and South East Queensland* (the SMEC Report) and this document explores those concerns in more detail. Analysis by hydrographers, environmental planners, ecologists and financial analysts has revealed that there are significant assumptions and limitations in the SMEC Report that need re-examination.

1.1 Overview and Purpose

This report evaluates the following aspects:

- the impacts of climate change on the SMEC Report conclusions;
- reassessment of water availability based on local water arrangements and environmental assessments critical to the viability of the selected preferred options;
- Indigenous land management issues - included because of recent changes in land use agreements in Northern NSW, and
- re-assessment of the cost estimates (in consideration of the points above).

This report acknowledges that the SMEC report recommended further work be conducted to determine the hydrological, environmental and socioeconomic aspects of the potential for water supply options from Northern NSW. Not withstanding this recommendation this report presents evidence that seriously questions the conclusions of the SMEC report.

1.2 Summary of SMEC Report: Selected Preferred Options

The following excerpts are taken from the *Forward* of the SMEC report. These are given here to give a background to this document. It is important to acknowledge that the critique of the SMEC report acknowledges that the scope and purpose of the SMEC report did not include detailed environmental, economic and social assessment. Additionally, it is also acknowledged that it was a desktop study with major limitations. However, the purpose of this report is to critique the SMEC report in light of the possibility that the SMEC report is used to make policy decisions on the alternative water supplies for NSW and SEQLD. For background purposes the most salient section of the SMEC Forward has been given below.

> "The review recommends five options for further investigation. Four of the five options are based on storage and transfer from the Clarence River whilst the fifth (and cheapest) is based on storage and transfer from the Tweed River catchment. A dam on the Clarence River upstream of Duck Creek with a pipeline to the Logan River could provide up to 100,000 Megalitres (ML) per annum at a price of around $1.73 per kL. This proposal stands out as the best value for money with the capacity to effectively serve both SEQ and NE NSW in the medium to longer term. It is dependant however on construction of a large storage and will require detailed environmental scrutiny.
>
> The review recommends five options for further investigation. Four of the five options are based on storage and transfer from the Clarence River whilst the fifth (and cheapest) is based on storage and transfer from the Tweed River catchment."

Table 1 Selected Preferred Options – SMEC Report Executive Summary Table p2.

Option	River	Description	Estimated Yield	Unit Cost Bulk Water($/KL)

TW7	Tweed Dam on Oxley River. Pipeline from	Brays Park Weir to Nerang River	20,000	$1.42
CL3b	Clarence Dam on Clarence Upstream of Duck	Creek. Pipeline to Logan River	100,000	$1.73
CL5b	Clarence Dam on Tooloom Creek.	Pipeline/tunnel to Logan River	20,000	$1.65
MA1	Clarence Weir on Mann River. Pipeline to	Logan River	50,000	$2.12
MA2	Clarence Dam on Mann River. Pipeline to	Logan River	100,000	$2.04

1.3 Points of contention with the SMEC Report

There are a number of statements made in the SMEC Report that are challenged by the findings in this report. There are also a number of issues that should have been included in the assessment of the viability of the selected preferred options. The major points of contention with the report are as follows:

i) Climate change was not discussed in the report.

ii) Decreases in potential yields resulting from climate change were not considered.

iii) Climate change and subsequent decreased flows predicted for the region will exacerbate all environmental issues.

iv) Climate change and subsequent decreased flows predicted for the region will exacerbate river regulation issues.

v) The approach to the storage-yield assessment is not aligned with a typical hydrological assessment. There appears to be no information in the report on the hydrological efficiency of the proposed storages. It appears that a desired yield has been identified and then a storage size has been determined to provide this yield.

vi) Regulation and the ratio of storage capacity to annual inflow for the selected preferred options of CL3b, MA2 and TW7 exceeded the SMEC Reports own targets. The regulation targets of 15% and low ratios of storage capacity to annual inflow were set to ensure environmental and riverine ecology health and ensure the viability of storages.

vii) Failure to identify present regulation in the Mann/Nymboida system that impact on potential yield, river regulation and environmental flows.

viii) Serious questions over the actual data presented at the Upper Clarence above Duck Creek selected Preferred option (CL3b). The SMEC data presented in the report overestimates the yield from this site. A more realistic lower yield has been recalculated based on SMEC's own data.

ix) Points raised in vi) and vii) means that the regulation issues of environmental and riverine ecology health are exacerbated.

x) The questioned flow estimates coupled with stream flow reductions due to climate mean that yield will be considerable lower than reported at the upper Clarence above duck creek dam site option and highly likely in the Mann River (MA2) option.

xi) A more realistic, decreased yield in the Mann River and Upper Clarence options will increase costs estimates significantly.

xii) Impacts on species and communities will become more acute with decreasing flows caused by climate change. All rivers at the selected preferred option sites were identified as experiencing high environmental stress.

xiii) Impacts on National Parks will occur in all selected preferred options tabled in the SMEC report. Some parks will have severe and adverse impacts on the integrity park features.

xiv) There are a number of threatened species listed under NSW legislation that will be affected by the proposed selected preferred options.

xv) The selected preferred options of on the Mann River (MA2) and the Upper Clarence (CL3b) will impact on the critically endangered eastern freshwater cod (*Maccullochella ikei*).

xvi) Federal assessment under the EPBC Act (Environment Biodiversity Conservation Act) will most likely occur if the CL3b and the MA2 options are to proceed.

xvii) Recent Indigenous Land Use Agreements involving the Yabbra National Park and Tooloom National Park will mean that potential dam construction is subject to consultation with the Githabul People.

1.4 Scope and Limitations

This report was written in response to the extended deadline to examine the SMEC report within the Senate Inquiry into Additional Water Supplies for South East Queensland – Traveston Crossing Dam. As such further work needs to be conducted to a examine many of the issues raised in this report.

This review of water availability and storage assessments of the SMEC report have been undertaken using the SMEC data itself, additional local information and stream flow data from the Dept. of Land and Water NSW. It is acknowledged that issues identified in this report needs to be verified by more extensive modelling work. However, the conclusions made in this report indicate that the outcomes of further extensive modelling will most likely result in seriously questioning the viability of the preferred selected options outlined in the SMEC report.

The water Issues of the Tweed River have not been examined in detail. The Tweed River Water Strategy outlines how future water issues should be addressed that balance increasing water extraction demands with environmental flow requirements (and other social and environmental issues). The SMEC Report outcomes are not in alignment with that strategy. Further assessment and consultation should be undertaken before judging the viability of the options for water transfer to South East QLD from that system.

2.0 CLIMATE CHANGE

2.1 Failure to Account for Existing Decreased Rainfall and Flow

The SMEC report has not acknowledged the impact of climate changes on storage size and yield calculations. There is strong evidence indicating significant decreases in rainfall and runoff in Northern NSW. The SMEC report does not consider this evidence. In NSW

> NSW annual total rainfall has decreased 14.3mm/decade since 1950, dominated by high year-to year variability. Temperature increases in NSW mean that there is a tendency for more recent dry periods to be accompanied by warmer temperatures than in the past. Decreases in the annual intensity and frequency of extreme daily rainfall events in NSW are consistent with the decline in annual mean rainfall since 1950, with strongest decreases at coastal locations.
> NSW Government P1

This conclusion is evidenced later in this report after assessment of stream flows in the Upper Clarence was conducted. That assessment showed that annual average runoff has been decreasing since 1965 in the Upper Clarence.

2.2 Climate Change Projections

The findings and conclusions of the report fail to account for future impacts climate change. There is considerable evidence to suggest that there will be a decrease in annual rainfall and subsequent decrease in runoff in the catchments of the selected preferred options in the SMEC Report

A report by the CSIRO indicates significant changes are likely in the region.

> Over NSW, average decreases in annual moisture balance are largest in the north and smallest along the coast. By 2030, annual average decreases range from 0 to 195 mm along the

> coast and 20 to 325 mm in the north, relative to 1990.
> (Hennessy etal. 2004, p9)

The Clarence and the Mann river systems whilst may be considered coastal are about 100km inland. These catchments will be more impacted upon by climate change when compared to the Tweed system. Thus reduced rainfall is expected in these systems.

Additionally the likelihood of increases in drought frequency is high.

> The projections indicate that increases and decreases in drought frequency are possible, but there is a tendency toward increases, especially in winter and spring.
> (Projected changes in climate extremes NSW Gov P19)

This will mean that the yields for the run of river options identified in the SMEC report will be lower than reported. Implications for expected yields from storages are that the size of storage will generally need to be larger to capture expected yields. This has major implications for environmental flows and regulation issues.

A general estimate of the likely decrease in runoff is given below. It is relevant to Northern NSW because the rainfall patterns are similar to South East Queensland, particularly the Upper Clarence catchment. The implication for runoff is outlined in the Queensland Government's submission to the senate inquiry

> A preliminary assessment of the impact of climate change on inflows into SEQ storages has been conducted using the outputs from a range of general circulation models and an approximate method of down-scaling the climate information to the catchment scale. The results show average annual inflows tending to decrease by up to -16%. The impact on yields is similar but may further reduce yields if future down-scaling work reveals longer embedded dry periods.
> (QLD Government senate inquiry submission 2007, p.87)

Based on this information presented above, a decrease in runoff should have been factored into the yield estimates, environmental flow requirements, and future local water regulation. Not doing so overestimates the available water for delivery to South East Queensland. It should also be stated that the16% decrease in average annual inflows is considered as conservative.

Assuming normal conditions will continue is not appropriate. The yield estimates for all selected preferred options listed in the SMEC report will not be achievable with the same environmental flow and regulation requirements. Additionally, some selected preferred options will be affected more than others because of the differences in catchment locations relative to the coast and latitude. This will have an impact of bulk untreated costs estimates. The cost of bulk untreated water will increase because of falling yield. Changes to water availability and cost estimates as a result of climate change are given in those sections later in this report.

2.2 Climate Change and Stressed Rivers

Overall, climate change will have a negative affect on biodiversity, as it will exacerbate existing stresses on ecosystems, as well as creating new ones (CSIRO 2003). Therefore, with increasing human demands for water it is paramount that environmental needs are adequately represented and catered for in management decisions. (Climate Action Network Australia. retrieved April, 2007).

The SMEC report has identified the Upper Richmond River as a ‘highly stressed river’ but fails to acknowledge that the Clarence and the Mann Rivers at the position of selected preferred options have been assessed as having high environmental stress characteristics. Mann and Clarence have not been identified as hydrologically stressed in SMEC report. This is an oversight in process for the Mann River (MA1 and MA2) assessment.

Specific recommendations exist regarding the water regulation of river systems. For example, the Nymboida River, upstream of its confluence with the Mann, is already subjected to high levels of extraction. It is classified by the

NSW Stressed Rivers Assessment as having high hydrologic stress. Furthermore, the Healthy Rivers Commission of New South Wales (1999) identified that there was a “pressing need to contain further growth in water extractions (under most flow conditions) from the Nymboida River, both to protect the river itself and to protect those existing users who have already made investments in water using activity.”

Decreased runoff under climate change scenarios will exacerbate the stress in these all river systems assessed in the SMEC Report. This is a significant issue because all of these the rivers have already been rated as having high environmental stress.

3.0 WATER AVAILABILITY

There are a number of issues with the way SMEC Report has assessed water availability. The specific issues are detailed in each section below.

3.1 Methods of Assessment

The SMEC Report does not explain its method of assessing the selected preferred option . It can only be assumed that the methods used to determine the yields reported in the SMEC Report are adequate and the yields reported are reasonably reliable. This is a considerable assumption given the gravity of the potential impact this report could have on the future development of northern NSW and climate change.

From the brief description of the conceptual methodology for this assessment it seems that the approach to the assessment is not aligned with a typical hydrological assessment. It also appears that a desired yield has been identified and then a storage size has been determined to provide this yield. Normally a storage site would be identified and then this site would be analysed to determine the most efficient size of storage for that site.

A storage site would usually have a hydrological point of inflection up to which point an increase in storage size will produce an increase in yield but after which point an increase in storage size would only produce a very small increase in yield. An economic assessment of such a site would normally determine that a storage size around this hydrological point of inflection will be the most economical. There appears to be no information in the SMEC Report on the hydrological efficiency of the proposed storages.

3.2 Critique of Upper Clarence Options

There are two main concerns associated with the assessment of the yields and flow regime impacts for the upper Clarence River storage options. Firstly, there seems to be a disparity with the figures presented that were used for

storage inflows and secondly, it appears the impacts of climate change on potential yields were not considered.

3.2.1 Disparities with Data presented for the Upper Clarence

A number of the tables included in the SMEC Report contain conflicting data with regard to the inflow estimates. It appears this has led to an over estimation of the historic annual yield and therefore seriously compromises the reported outcomes. This questions the ability for the system to provide maintenance of environmental flows and allocations downstream from the storage.

Table 4.1 “Estimated annual natural runoff at selected diversion points” (p40) and Table 4.5 “Potential dam sites details” (p48) cite the flow for the dam site upstream from Duck Creek as 400,000ML/yr. However, this contradicts the information presented in Table 3.3 and 3.4 (p28-29) where the annual average flow rate for the dam site upstream from Duck Creek is cited as 650,000ML/yr. It can only be assumed that the figures calculated for this site and presented in Tables 3.3 and 3.4 have been based on the larger and incorrect figure of 650,000 ML/yr. It is therefore likely that the stated yield would not be able to be secured. If this yield could not be secured the following implications would result.

Assuming a yield of 100,000 ML/yr, the ratio of storage capacity to storage yield and the ratio of average annual inflow to storage capacity will be affected considerably. In short, the ratios will increase markedly as will the percentage of regulation at the dam site.

This strongly suggests that the yield is inaccurate and the impact on downstream flows is underestimated. The dam is unlikely to be efficient as it has to be very large to account for the fact that it is in a smaller than assumed catchment and its failure rate is likely to be considerably higher than reported. The following tables outline some likely alterations to the reported figures as a result of this discrepancy. It should be noted that as there was very little information provided on the method of assessment it is difficult to accurately determine the implications of these discrepancies.

It should also be noted that the storage size ratio is:

> "a relationship between the average annual inflow to a dam and its storage capacity is a good index for sizing storages. The ratios give an indication of the hydrologic limits. High ratios point towards difficulties in filling the storage." SMEC. 2007,p29)

Table 2. Recalculation of Ratios of Average Annual Inflows to Storage Capacities for the Storage Site on the Upper Clarence upstream of Duck Creek (CL3b).

Time Period	**Flow at Tabulam (ML/yr)**	**Flow at Dam Site (ML/yr)**	**Ratio of storage size to average inflow at dam site** (Assuming 250,000 ML storage)
1909 To date (SMEC report)	756,000	650,000	38%[1]
1909 To date (recalculated)	**756,000**	**400,000** [2]	**63%**

1 It is proposed this figure is incorrect based on a discrepancy in the inflows adopted in the SMEC report.

2 This is the (correct) annual average flow at the proposed dam site as quoted in table 4.1 and 4.5 in the SMEC document.

3.2.2 Contemporary Trends – Reduced Annual Inflow

There is evidence to suggest the runoff in the catchments of the Upper Clarence is decreasing and has been decreasing for some time. An investigation into how the ratio of storage size to average inflow has been changing over time suggests issues such as climate change are already affecting system flows. Table 3 presents the change in this parameter over time. It should be noted that the period from 1909 to date includes the significant drought at the beginning of the century so the data is not necessarily skewed by the recent drought.

This shows that the figures presented in the SMEC Report are potentially misleading and if the figures shown here are considered correct, the viability of a dam at this site is reduced. These revised figures show quite clearly that a

storage at this location would have too much impact on downstream flows and the yields and corresponding reliabilities expressed in the SMEC Report would be unachievable.

Table 3. Contemporary Trends in Ratios of Storage Capacity to Average Annual Inflow for the Storage Site: Upper Clarence upstream of Duck Creek (CL3b).

Time Period	Flow at Tabulam (ML/yr)	Flow at Dam Site (ML/yr)	Ratio of storage size to average inflow at dam site*
1909 To date	756,000	400,000	63%
Aug 1965 to date (40.6Years)	676,921	351,999	71%
1987-to date (20 years)	514,502	272,686	91%
1997 to date (10 years)	317,763	168,414	148%

Assuming 250,000 ML storage and that the ratio of dam site flow to flow at tabulam can be used to infer stream flow data.
Source: NSW Gov, Provisional River Data

3.2.3 Climate Change and New Calculations of Storage In-Flow

It is generally accepted that all contemporary yield assessment should be done with consideration for climate change as has been discussed in Section 2 of this report. If this consideration is included into the assessment the impacts on yields and flow related impacts will be further exacerbated.

Tables 4 and 5 present the impact climate change would have on storage capacity and regulation issues. The issues are highlighted through assuming two scenarios. The first is the climate change scenario indicating a general decrease of 16% in flows of the period from 1909 to date. The second is that there will be a decrease in flows based on contemporary flow regimes. Despite the fact that further rainfall runoff modelling needs to be undertaken, the results broadly identify the yield, storage and regulation issues of decreased rainfall and runoff in the catchment. Table 4 illustrates two climate change scenarios in ratios of average annual inflows to storage capacity of the

250 000ML dam site at Upper Clarence, upstream of Duck Creek.

Table 4. Climate Change Scenarios in Ratios of Average Annual Inflows to Storage Capacities (Upper Clarence, upstream of Duck Creek option (CL3b))

Scenario	**Annual Average Flow** ML/Yr at Dam Site	**Ratio of storage size to average inflow at dam site** (Assuming 250 000 meg storage)
Climate change 1 (16% decrease runoff using data:1909 to date)	336 000	74%
Climate change 2 (16% decrease runoff using data:1965 to date flow)	295 679	85%

Source: NSW Gov, Provisional River Data

Table 4 shows that there are high ratios of storage size to average inflow at the upper Clarence above Duck Creek dam site given climate change scenarios. The large percentage ratios indicate that under the climate change scenarios the storage performs poorly. This has implications for the possibility of realising 100 000ML flow yield at this site for all years as stated in the SMEC Report. The economic implications will be discussed in the relevant section below. This has implications for downstream effects if the proposed 100 000 ML/yr yield is be realised in all years. Table 5 shows the percentage of flow regulated given the climate change scenarios.

Table 5. Percentage of flow regulated (Dam Size 250 000ML)

Dam Site	**Yield**	**Ratio of storage size to average inflow at dam site**	**Annual Average Flow**	**Percentage of flow regulated**
Upstream Tabulam - Upstream Duck Creek	100,000	38%*	400,000	25%
Climate change 1 (16% decrease runoff 1909 to date)*	100 000	63%	336 000*	29%
Climate change 2 (16% decrease runoff on 1965 to date flow)*	100 000	85%	295 679*	33%

Under the guidelines set down in the SMEC Report the proposed storage in the upper Clarence, upstream of Duck Creek, exceeds the regulation limits. In the SMEC Report the following limit on regulations of stream flow exists.

> "Limits on levels of regulation and adoption of the NSW's stressed rivers policies of providing minimum flows from dams formed an important consideration of this study in sizing storages. Regulation of rivers was limited to around fifteen percent as a basis for environmental and riverine ecology health. The ratio of storage capacity to annual inflow was also generally kept below unity to ensure the viability of the storages" (SMEC 2007 p.3)."

The proposed storage after the revised calculations and especially after factoring climate change does not fit the SMEC Report criteria regarding minimum flows from dams and the viability of the storages.

3.3 Critique of Selected Preferred Mann River Options

The options listed for the Mann River have not taken into account existing water availability and allocations. The following points indicate that the Mann River weir is not viable and the dam option seriously undermines water availability and environmental flow characteristics of the Mann/Nymboida/Clarence catchment.

3.3.1 Clarification of Flow Regimes

The authors of the SMEC Report have obviously not been aware of existing flow diversion and water use activities upstream of the Mann River options (MA1, MA2). This has resulted in the use of incorrect flow gauge information to estimate water available to satisfy NSW environmental flow requirements and for dam yield. The use of the Mann river flow data has not recognised cumulative impacts of upstream extraction and as such has underestimated the environmental flow requirement, the percent regulation at the dam site, and overestimated the dam yield. It also has major negative implications for flow regimes if the weir at Jackadgery is built.

3.3.2 Mann River Data Does Not Reflect Natural Flow Regimes.

The Mann River has three major tributaries upstream of the Jackadgery stream gauge: the Nymboida, Boyd and Mann rivers. The Nymboida River provides the largest contribution to low and medium flows recorded in the Mann River at Jackadgery (refer flow data file :Nymboida and Mann daily flows for 2001 and 2002).

Significant volumes of water (up to 860 ML/day) have been extracted from the Nymboida Weir since 1924, which is almost the entire period for which flow records exist at the Mann River Jackadgery (since 1910). It is expected that the Mann River 80thpercentile flow (250 ML/D) estimated from Jackadgery stream gauge data would more closely reflect less than the 95th percentile of natural flow, assuming that the remaining tributaries (Boyd and Mann) collectively contribute more than 25 ML/D during these periods. An assumption supported by flow data collected on the Mann River at Mitchell and Boyd River at Broadmeadows.

3.3.3 Regulation and Environmental Flows Upstream on the Nymboida

Water is extracted from a weir pool on the Nymboida River for hydroelectricity power generation and to provide town water supply for the communities of the Lower Clarence Valley and Coffs Harbour. A new storage is being constructed for water supply to Coffs Harbour. It is expected that the 30 000ML Shannon Creek Dam will come online by mid-2008.

Following the Healthy Rivers Commission Inquiry environmental flow rules were introduced downstream of the weir to protect:

- 100% of the instantaneous natural flows when these are less than the 95th percentile (at Nymboida Weir) and
- 30% of instantaneous natural flows (at Nymboida Weir).

Nymboida water extraction has significantly decreased the low and medium flows recorded on the Mann River at Jackadgery. Annual 80th percentile flow recorded for the Nymboida River upstream of the extraction weir pool is 400 ML/D, significantly greater than that recorded downstream on the Mann River at Jackadgery (250 ML/D) (Table 6).

Table 6. Difference in percentile Flow at Mann River and Nymboida

Annual percentile flow	Nymboida at Nymboida 204001	Mann at Jackadgery 204004
95th	225 ML/D	70 ML/D
80th	400 ML/D	250 ML/D

Thus, Mann River flow data (Jackadgery) cannot be accurately used to:

- determine downstream minimum environmental flow requirements (80thpercentile, 95thpercentile) and
- assess the water availability for weir and dam yields.

The SMEC Report needs to examine data from a period that is more reflective of contemporary flow regimes.

3.4 Storage Management Approach – MA2, CL3b and CL5b.

In addition to the above issues about the viability of the sites, the approach to storage management, mentioned in the SMEC report (p1), is contentious. Below is an approach outlined to decrease the impact of such large storages on the Mann River and Upper Clarence.

> Under normal weather conditions, these storages would remain full and all inflows would be passed through the dam, minimising impacts on downstream users and ecology. Operational modeling will be required to offer confirmation on the potential yield increases whilst minimising environmental and social impacts. (SMEC 2007 p.1)

Whilst acknowledgement that this approach to environmental and regulation is a positive one, based on the amended storage-inflow ratios and percentage regulation figures presented above, the likelihood of these storages remaining full and all inflows would be passed through the dam is lessened dramatically. The point of contention lies with the assumption that stream flows will be normal in the future and that the SMEC data correctly estimates the inflow.

3.5 Tweed Catchment Selected Options

The selected preferred option for the Tweed River system is a dam on its major tributary at Rocky Cutting near Mt Warning National Park – just downstream from the town of Tabulam. The 25 000-45 000 ML proposed storage would inundate farmland, riparian rainforest and possibly impact on the township of Tyalgum (no maps supplied in the SMEC Report). Potential impacts include reduction in stream flows, possible resumption of national park (Wollumbin National Park) significant socio-economic impact of relocating affected residents.

The impact of the dam at Rocky Cutting would have adverse impacts on an already stressed river system.

> "In terms of overall condition, most north coast river catchments are in 'better than average' condition compared to other NSW coastal river catchments. However, the Richmond, Tweed and Brunswick are in worse than average condition. Half of the 159 north coast sub catchments are under high environmental stress, while one in six have been identified as having high conservation values." (Healthy Rivers Commission. March 2003 p.36)

Regulation of the Oxley River for diversion to Queensland is a significant issue for the Tweed Shire. The levels of regulation below the Rocky Cutting option on the Oxley River is 26% (for a Queensland diversion limit of 20,000 ML/yr)

The SMEC Report also adds

> "If the measurement location were to be Brays Park Weir (356,000 megalitres per year), with Tweed's future demand of 28,0000 megalitres per year, the levels of regulation from the Rocky Cutting option would be about 11% and 13.5% for diversion limits of 10,000 and 20,000 megalitres per year respectively."

However, this does not change the fact that at the Rocky Cutting dam site there will be 26% regulation of flow (it is acknowledged that water is released downstream of the proposed dam to flow to Bray Park Weir for subsequent diversion to QLD).

4.0 REVISED COST IMPLICATIONS

Before discussing the costs section of the SMEC Report it should be noted that its authors noted that

> "The results of the financial analysis demonstrate the viability of the options developed although they were based on a number of sweeping assumptions due to the restricted time frame, the nature of the study and the lack of access to recent financial data."

It is from this position that the following discussion is based. Notwithstanding this disclaimer, there appears to be certain assumptions that need to be considered before this document can be used to evaluate the relative merits of the selected preferred options proposed.

4.1 Clarification of SMEC Methodology

The variable that can have a large impact on the cost per ML/yr is yield. It appears that an economic assessment of sites have not determined the storage size around the hydrological point of inflection that dictates the most economical size. Abstraction of annual yields seems to be the approach to determine storage size. Further work is needed to determine site specific storage yield parameters. This is critical for an accurate cost of water from each site.

4.2 Realistic Assumptions in Costing Selected Preferred Options

The costing of different dam and weir options were outlined in section 6 of the SMEC Report. The assumptions underlying the option costing were also outlined. One of the foci of this report has been to examine the assumptions and methods of the SMEC Report. Based on the findings presented so far in this report there is sufficient evidence to strongly recommend that the SMEC Report costings should be re-evaluated. Additionally, in this section further assumptions of the SEMC Report are challenged. This casts doubt over the

usefulness of the SMEC Report for valid comparison between options in Northern NSW as well as the comparison between of the relative water costs from Northern New South Wales and Queensland.

Two major issues cast doubt over the costing options of the SMEC Report:

- A precautionary approach using a climate change scenario should be the baseline from which to calculate yield and option costs. Sensitivity analysis should be undertaken centred on these costs.

- Annual average yields are questionable based on the high likelihood that supply yields will not be fully utilised in all years at the Upper Clarence and the Mann river sites. Therefore, bulk untreated water unit costs will increase differentially for each site because of decreased yields unaccounted for by the SMEC Report.

Additional to these issues there are concerns regarding costing assumptions. These concerns have a high likelihood of raising the bulk untreated water unit costs uniformly and differentially across all options.

The assumptions that need to be factored into the bulk untreated water unit costs before sensitivity analysis are:

- Assumptions of land resumption costs are equal across all options. The dam options of the Oxley River, Upper Clarence and Mann river have significant land acquisition costs. Not factoring these into the bulk untreated underestimates the costs of these options and makes comparison with other options questionable.

- It was assumed in the SMEC Report that the NSW Natural Resource Management bulk water charges should be ignored. This was done on the basis that the charge is less than 0.5c/kl (SMEC 2007, p 58). However, it cannot be assumed that NSW will be prepared to sell their water for this price given: increasing water demands because of growth in the region; increased pressure of regulated and stressed river

systems; and opportunity costs associated with pricing water at this level.

- The economic risks associated with dams on the Upper Clarence, above duck Creek (Cl3b) and the Mann River at Jackadgery (MA2) is substantial. The estimated cost for each option is approximately 1 320 million and 1 500 million respectively. Sensitivity analysis can assess this risk. However failing to factor climate change, inclusion of local flow regulation, inclusions realistic flow data and other assumptions outlined in this section increase the likelihood costs would be prohibitively high.

4.3 Climate Change and Costings- Upper Clarence Dam Option (CL3b)

To illustrate the significance of not including a climate change scenario into yield estimation and subsequent costs the Upper Clarence Dam Option (CL3b) is recalculated. The costings are assumed as constant. The only difference is the reduced yield because of a reduction in 16% of average annual flows. See Table 7 for the increased cost.

Table 7. Revised Bulk Untreated Cost Given Climate Change

	Annual Cost ($m)	Projected Yield (ML/yr)	Projected $/KL	Revised Yield -16% (Climate change)	Revised $/KL -16% (Climate change)
TW7	28.3	20	1.42	16.8	1.68
CL3b	173.2	100	1.73	84	2.06
CL5b	33.1	20	1.66	16.8	1.97
MA1	106.1	50	2.12	42	2.53
MA2	203.6	100	2.04	84	2.42

The results in Table 7 show that for CL3b an increase to $2.06KL will occur based on the revised flow rate under climate change of a 16% decrease in stream flows.

A further scenario is then added. In Table 8 a decrease of 20% in annual yield will be assumed. This scenario is a more realistic estimate of potential annual average yield from this site given the corrections in section 3.21. Although it is an abstraction, it will serve to illustrate the point how much bulk untreated cost increase if yield decreases. The following scenarios are presented below in Table 8.

Table 8. Revised Bulk Untreated Cost Given Decreased Yield

Dam Site	Revised Projected Yield -36% (20% decrease plus 16% climate change)	Revised $/KL -36% (20% decrease plus 16% climate change)
CL3b	64 000 ML/yr	2.706

The implications of the decreased yield caused by climate change and a more realistic annual average flow is an increase in bulk untreated cost. Undertaking sensitivity analysis would show the economic risks associated with this option are high. This is especially so because of the large outlay for capital works.

5.0 ENVIRONMENTAL ISSUES

Environmental issues are outlined for the Clarence and Mann River preferred selected options below. Further assessment of environmental issues are needed for the Tweed options.

5.1 Endangered and Threatened Species

Two sites were examined for the presence of threatened species. The two sites were dams on the Clarence River upstream of Duck CK Option (Cl3b) and the Mann River near Jackadgery (MA2). The Oxley River dam site was not assessed for endangered species. Further evaluation of this option is needed.

5.1.1 Clarence River upstream of Duck CK Option (Cl3b)

The proposed section of dam on the Clarence River, upstream of Duck Creek, falls within the Woodenbong Catchment Authority (WCA). The NSW threatened species website, identifies 101 endangered or vulnerable fauna species (*Appendix 4A*) for this area. Using an approximate radius of 50km surrounding Duck Ck, encompassing numerous National Parks (NP), State Forests (SF) Timber Reserves (TR) and freehold lands, the NSW National Parks and Wildlife Service, Atlas of NSW Wildlife (NSW Wildlife Atlas), identifies 40 vulnerable or endangered species (*Appendix 4B*). The Department of Environment and Water Resources, Protected Matters Search (DEW Search) identifies 109 threatened species, 3 threatened communities and 17 migratory species for a similar search area (*Appendix 4C*).

Of the many endangered and vulnerable species identified, 4 that have the potential to be affected by any change in hydrological conditions for the area, include the frog species:

- Litoria brevipalmata, the Green-thighed Frog, status Vulnerable;
- Mixophyes fleayi, Fleay's Barred Frog, status Class 1 Endangered;
- Philoria loveridgei, Loveridge's Frog status Class 1 Endangered; and
- Philoria richmondensis, status Class 1 Endangered.

5.1.2 Clarence River downstream of Duck CK

This proposed section for dam construction also falls largely within the threatened species search conducted for the above Duck Creek section. Therefore the species can be assumed to exist in both areas with reasonable degree of confidence.

5.1.3 Mann River near Jackadgery MA2

The proposed section of dam / weir on the Mann River, near Jackadgery, falls within the Dalmorton Catchment Authority (DCA). The NSW threatened species website, identifies 95 endangered or vulnerable species (*Appendix 4A*) for this area. Using an approximate radius of 50km surrounding Jackadgery, encompassing numerous National Parks (NP), State Forests (SF), Timber Reserves (TR) and freehold lands, the NSW Wildlife Atlas, identifies 28 vulnerable or endangered species (*Appendix 4B*). The DEW Search identifies 81 threatened species, 2 threatened communities and 15 migratory species for a similar search area (*Appendix 4C*).

Of the many endangered and vulnerable species identified, 2 that have the potential to be affected by any change in hydrological conditions for the area, include the frog species:

- Litoria aurea Green and Golden Bell Frog, status Class 1 Endangered; and
- Mixophyes balbus, Stuttering Frog, status Class 1 Endangered.

5.2 Threatened Species and Key Threatening Processes

Schedule 3 Section 8 of the NSW Threatened Species Conservation Act 1995, Key Threatening Processes (*Appendix 4D*), identifies two key threatening processes directly associated with the construction of dams for potable water use, they include:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and
- Clearing of native vegetation

Key threatening processes, threatened or endangered frogs within the proposed Dam sites have in common, are:

- Modification and loss of habitat; and
- Changes in water quality and water flow patterns either increase or decrease.

5.3 The Environment Biodiversity Conservation Act

Federal assessment under the Environment Biodiversity Conservation Act (EPBC Act) will most likely occur through the EIS process if the proposal the selected preferred options on the Upper Clarence and the Mann River were to proceed. The Nymboida, Mann and Clarence Rivers contain part of the only remaining wild breeding population of the critically endangered eastern freshwater cod (*Maccullochella ikei*). Also found in the locality of the dam sites are other critically endangered flora that are included under this legislation.

6.0 IMPACT ON NATIONAL PARKS

The preferred options outlined in the SMEC Report (2007: 2) involve significant impacts to established national parks in the northern NSW region including the Nymboida NP on the Mann River; Yabbra NP on the Clarence River and Wollumbin NP on the Oxley. These areas are covered by the *National Parks and Wildlife Act 1974* and in some sections (e.g. Nymboida NP), the *Wilderness Act 1987*.

National parks, according to the *National Parks and Wildlife Act 1974:*

> "…protect and conserve areas containing outstanding or representative ecosystems, natural or cultural features or landscapes or phenomena that provide opportunities for public appreciation and inspiration and sustainable visitor use"

As collective public goods national parks provide important direct and indirect public benefits that are greatly valued by the community at a local, national and international scale. These include: protecting the integrity of the environment and wildlife; ensuring the purity of water supplies to nearby communities; cultural heritage; scenic amenity; recreation and tourism opportunities and education.

6.1 The Nymboida NP on the Mann (options MA1 & MA2)

The Nymboida National Park that lies on the Clarence River is part of the Gibraltar Range Group of Parks. This park will be adversely affected by construction and inundation of MA2 (Dam on Mann River).

According to the management plan this park "encompasses some of the most diverse and least disturbed forested country in New South Wales. The Parks contain a stunning landscape of granite boulders, expansive rainforests, tall trees, steep gorges, clear waters and magnificent scenery over wilderness forests" (2005, pii).

The area proposed by the SMEC Report for the Nymboida National Park is also covered in the *Wilderness Act 1987*. In accordance with section 9 of the Wilderness Act, wilderness areas must managed according to the following wilderness management principles: to restore (if applicable) and to protect the unmodified state of the area and its plant and animal communities; to preserve the capacity of the area to evolve in the absence of significant human interference; and to permit opportunities for solitude and appropriate self-reliant recreation.

6.2 Yabbra NP on the Clarence (option CL3b)

Yabbra National Park was added to the Parks and Reserves of NSW in 1999. It covers an area of 8,890 hectares. The Upper Clarence above Duck Creek option (CL3b) will impact on the southern edge of the park. The Upper Clarence, Tooloom creek option (CL5b) will most likely impact on Yabbra State Forest. However site analysis using maps displaying inundation areas (not shown in SMEC appendices) are needed to verify this impact.

6.3 Wollumbin NP on the Oxley (option TW7)

Wollumbin National Park and Wollumbin State Conservation Area are the latest addition to the Parks and Reserves of the Tweed Caldera established in 2003 under the *National Parks Estate (Reservations) Act 2002*. Whilst not a designated World Heritage Area, Wollumbin National Park directly adjoins the western side of Mt Warning NP which is an area of international significance recognized by inclusion in the Central Eastern Rainforest Reserves (Australia) World Heritage Property (World Heritage CERRA).

The area as a whole represents natural heritage of international significance with high biodiversity and unique geological landforms. This is an area of international significance and recognized under the World Heritage Convention for being outstanding examples of ongoing ecological processes.

The Rocky Cutting Dam on the Oxley River (Tweed Dam at rocky cutting TW7) am will most likely impact a small section of the northern edge of the park where it borders the Oxley River.

7.0 INDIGENOUS ISSUES

The proposed Dams on the Upper Clarence (CL3b, CL5b) will impact on national parks that have a new indigenous land use agreement in operation. The largest indigenous land use agreement (ILUA) ever made in NSW was made on the 27th of February 2007. This is the first step towards a consent determination that will recognise the Githabul People's native title rights and interests to this land tenue and other tenue in the region. Under such agreements the Githabul people must be consulted on any contracts or tendering processes and must be given opportunity to comment on the preparation, implementation and amendment of the plan of management, the construction of public works, infrastructure, facilities or repair or demolition work on the parks.

The Clarence River Dam, upstream of Duck Creek (CL3b) will impact on Yabbra National Park and the other dam option in the Clarence system on Yabbra State Forest. The extent of the impacts of the dams on these parks is unclear, as the SMEC Report did not supply maps of dam sites and inundation zones. However, the dam sites were ascertained from the satellite maps of the SMEC Report used to show delivery routes from the dam sites. Based on this and the assumptions about dam wall heights it can be assumed that significant sections of the riverine landscapes and lower slopes of the of the southern section Yabbra National Park and the southern section of the Tooloom National Park would be inundated.

Dam and pipeline construction work will also impact on other national parks of the region. These national parks also are covered by the same indigenous land use agreement (ILUA).

8.0 CONCLUSION

This document has explored a number of concerns regarding the outcomes of the Snowy Mountains Electricity Report: Integrated Water Supply Options for North East NSW and South East Queensland (the SMEC Report). The inclusion of climate change and the inclusion of water availability based on local water arrangements were seen to be lacking. This had an impact on expected yield from all selected preferred options. This resulted in more cost per KL from all options.

Significance of environmental impacts should have been included in preliminary assessment of selecting preferred options. This is also the case for national park impacts. Indigenous land management issues should also have been included into initial assessments.

This report has raised serious questions about the validity of the Snowy Mountains Electricity Report in its capacity to be used to assess water options for South East QLD.

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