From: **Bruce Robertson** <brucerobertson1@bigpond.com>
Date: 8 January 2014 08:33
Subject: Risk Assessment of AGL's Gloucester Gas Project
[redacted]

Dear Chris,
Thank you for meeting with us on 16 December 2013. It was greatly appreciated that you came to Taree to meet with some representatives of the community.
I apologise for not having responded to you earlier however the meeting gave rise to a number of issues that previously we had not addressed.
Please find attached a submission completed by Mark Anning and myself. It is authored by us and represents our views.

In particular we have completed a risk assessment of AGL's project at Gloucester. This should aid your work in this area. It covers the key areas of risk assessment, a compliance summary, the likelihood of a catastrophic event occurring and the consequences of a catastrophic event. We would like to highlight that the risk assessment shows that high to extreme risks are constantly being taken by AGL in this project. Risk taking can not be viewed in isolation as taking a number of high risks compounds and leads to the summary that extreme risks are being taken with this project.

The submission encompasses the following issues:
1. the lack of a sustainable method of disposal of waste products from Coal Seam Gas operations in Australia.
2. The lack of compliance with existing regulations and the laws as they stand in NSW at AGL's Gloucester Gas project.
3. The lack of baseline data at AGL's Gloucester Gas project.
4. A risk assessment of AGL's proposed project at Gloucester.

I have also attached, as requested by Mary O'Kane, soft copies of Teresa James's submission to you on the lack of compliance of the environmental report for AGL's irrigation project, her resume and I will attach the Gloucester Groundswell report which is a comprehensive review of all aspects of AGL's Gloucester Gas project on a separate email. This report also has significant section on risk assessment.

The submission calls on the chief scientist to take a number of actions with regard to AGL's Gloucester Gas project and more generally Coal Seam Gas in NSW.

We would ask that you consider the submission carefully and fully. The future of the State relies on it.

Yours Faithfully,

Bruce Robertson
ph[redacted]

Submission to the NSW Chief Scientist following the meeting with Manning Clean Water Action Group on 16th of December 2013.

Date: 2nd January 2014

Submission Authors- Bruce Robertson and Mark Anning

Introduction

This submission is being written in response to a number of issues arising out of the meeting with the Manning Clean Water Action Group and the NSW Chief Scientist held at Taree on 16th December 2013.

The Authors would like to thank the Chief Scientist for appearing in Taree to hear our concerns regarding AGL's Gloucester Gas Project.

This submission encompasses the following issues:
1. The lack of a sustainable method of disposal of waste products from Coal Seam Gas operations in Australia.
2. The lack of compliance with existing regulations and the laws as they stand in NSW at AGL's Gloucester Gas project.
3. The lack of baseline data at AGL's Gloucester Gas project
4. A risk assessment of AGL's proposed project at Gloucester.

1. The lack of a sustainable method of disposal of waste products from Coal Seam Gas operations in Australia.

One aspect of the meeting in Taree that we found particularly concerning were the statements made by the Office of the NSW Chief Scientist regarding the disposal of salt and brine produced by Coal Seam Gas mining in Australia.

In that meeting the Chief Scientist stated that " I think that there are solutions" in response to the statement that was posed by Bruce Robertson "doesn't that go to the nub of the whole issue, this industry has been operating now here for how many years and no one has a solution , no one has come up with a solution for what to do with the salt"

Indeed CS First Boston in a report dated April 10 2013 stated:
Brine disposal
- **Brine disposal – the unsolved environmental issue:** We are still uncomfortable that none of the coal seam gas projects in Queensland have a great solution to the disposal of brine (salt) solution. We believe burial of any residual salt is a last option, with a preference for improved recovery of water and beneficial use of any residual salt. Projects such as APLNG have various studies underway, which we will be following with interest. However, as yet ORG has not ruled out on-site

burial and subsequent remediation as part of its brine disposal strategy. We are concerned that costs may increase once a solution is found.

More recently Dr Khan, a man who you stated was chosen to write reports for the Chief Scientist due to his impeccable credentials and impartiality stated:
Dr Khan said. “It is very surprising the complete lack of solutions at the moment for dealing with large quantities of salt,” said Dr Khan, an associate professor in the school of civil and environmental engineering. “You've got huge amounts of water and salt looking for a home.”

Source of Dr Khan’s comments: http://www.smh.com.au/environment/coal-seam-gas-industry-faces-salt-overload-20131204-2yqx8.html#ixzz2pMiKHHQq

I have been unable to find any evidence that this position has changed. On site burial is not an acceptable solution. The volumes of salt are massive. As Dr Khan states in his report to your office on page 9 (Coal Seam Gas: Produced Water and Solids, 22 November 2013) the volume of salt produced in the Surat Basin alone will be 1.8 million tonnes over the 30 year life of the project. The sheer volume of 1.8 million tonnes is staggering. The long term pollution effects of burial would be catastrophic for the environment and inland freshwater systems.

Science is an evidence based discipline. While the Coal Seam Gas (CSG) industry has repeatedly and often stated that there are going to be beneficial uses for its highly contaminated salt as yet not one of these large, well resourced companies has come up with a beneficial use for the salt or brine produced as a consequence of their water treatment programs. APPEA “the voice of Australia’s oil and gas industry” has often repeated that the industry is going to find a beneficial use for the salt and many of the major companies involved have echoed these statements. The fact that a statement is consistently repeated does not make that statement valid. Currently there is no evidence that a beneficial use for the toxic salts that are produced by the CSG industry will be found or that the quantities of pure salt, if it can technically be produced, will have a market.

What hard evidence can the Chief Scientist produce that a solution will be found?
To us the statement that “ I think that there are solutions” is not scientific as it is not based on the available evidence. There is no evidence that a solution will be found. As yet there is not one plant in the world that is treating the toxic contaminated salt produced from the Coal Seam Gas water purification process. Not one of the major multinationals and large domestic companies operating in Australia has come up with a solution despite the passage of many years and the considerable resources spent.

2. The lack of compliance with existing regulations and the laws as they stand in NSW.

We have noted a number of instances of lack of compliance with the existing laws and regulations such as they are in NSW. As background the regulation of this industry is well behind the development of the industry. Indeed it has often been stated that the industry has developed in a regulatory vacuum and the various authorities are well behind the industry. The cart is before the horse.

The few regulations and laws such as they stand are not, in many instances being followed.

The instances of lack of compliance listed below are in no means a comprehensive expose of AGL's lack of compliance. They are merely examples of a lack of regard for the law as it stands in NSW.

a) Pollution Events.

At present, produced water storage dams are required to be double lined with water monitors placed at the base of the dams to monitor leakage. Clearly it has been determined that this water is not of a quality that can leach into the environment.
In the EPA letter on page 6 that can be found at :
(http://images.smh.com.au/file/2013/11/21/4941228/EPA%2520letter.pdf?rand=1384985471486)
it states:
"

- The seepage of produce water from dams has not been assessed. The monitoring bore results at the TMB 04 and 05 show high EC levels (8300 and 8770 µS/cm) which may indicate a problem with the already existing storage dams; and

The level of 8300 and 8700 micro siemens /cm which are shown here are extremely high and indicate that the dams have been leaking.
There does not appear to have been any prosecution following this pollution event.
What remedial action has been taken to remedy this situation?

b)Lack of compliance with environmental impact laws.

Please see the attached report by Teresa James. It is a comprehensive review of the ecological assessment report prepared by Alison Hunt and associates to support AGL's proposed irrigation trial.
In it it is alleged that AGL has failed to comply with the law as it stands in NSW.
Specifically she has outlined the following issues :

Issue 1 – Inadequate level of survey and compliance with government (OEH) guidelines

No targeted or general flora and fauna survey was undertaken for the report and no species list provided.

Issue 2 – Failure to consider the potential presence of an endangered ecological community (EEC) Subtropical Coastal Floodplain Forest (SCFF) of the NSW north coast bioregion

The riparian woodland/forest present along the Avon River and Dingo Trap Creek is likely to support this EEC. Although the vegetated zone is generally narrow it is up to 90-100m wide in some places and is likely to contain a range of species representative of this community.

Issue 3 – Impact assessment fails to adequately consider threatened flora and fauna, and the extent of impact

Issue 4 – Report fails to consider regional guidelines and local provisions for protecting watercourses and aquatic/riparian habitat

The report does not refer to or consider compliance with section 6.1 of the Gloucester Shire Local Environment Plan (2010) in respect of flood behaviour and the environment including protection of riparian vegetation and aquatic ecosystems. Similarly, there is no consideration of objectives and guidelines identified in the Hunter Central Rivers CMA Catchment Action Plan. The recognition and inclusion of riparian protection zones is fundamental to local environmental and catchment management but is not considered in the report.

Issue 5 – Mitigation measures fail to provide reasonable certainty

Teresa sums up her findings as follows:

The report does not provide reasonable scientific certainty that biodiversity will be protected as required under Special Condition 4. Survey and reporting as documented in the report lacks compliance with current OEH standards and guidelines. There is no evidence of targeted survey for threatened communities or species despite the requirement to assess the potential for their occurrence. In the absence of reliable data the precautionary principle should be applied and all threatened entities identified within the locality with potential habitat present be assessed accordingly. A summary of the report objectives and compliance is provided below:

Report objectives	**Review**
Identification of flora and fauna and their habitat, including frog populations	Inadequate reported survey & poor documentation of flora & fauna (including frogs) providing an inadequate basis for assessment of impacts.
The potential for endangered ecological communities, threatened species and/or their habitat listed under TSC Act or EPBC Act to occur within the study area	Inadequate survey, documentation or critical assessment of threatened flora & fauna providing no certainty they will not be impacted. One EEC not identified in the report is likely to be present and if

	confirmed will be impacted. At least one threatened fauna is known to be present and is likely to be impacted.
Management of any impacts on flora and fauna, and their habitat	Management plans provide no detail or certainty that impacts will be adequately managed. Full range of known or potential impacts & affected threatened entities is not considered in assessments.

It is likely that native vegetation in lower parts of the site and along Dog Trap Creek and the Avon River includes Subtropical Coastal Floodplain Forest (SCFF) of the NSW North coast bioregion, an endangered ecological community listed under the TSC Act (state only). No documentation of this vegetation is provided in the report. One threatened fauna species, the Grey-crowned Babbler, is known to occur at the site but impact assessment for this species is incomplete and adequacy of proposed management uncertain. Impact assessment of salinity on soils, the river systems and biodiversity is similarly incomplete (but maybe covered in other reports?) and the report fails to consider important regional and local provisions and guidelines for river & riparian health. The irrigation area extends close to the creek & river with no proposed buffer or riparian protection zones identified or recommended. The long-term viability of proposed revegetation and enhancement of connectivity values along the northern boundary to compensate for loss of Grey-crowned Babbler habitat is uncertain due to encroachment by the proposed irrigation area as shown in figure 3-3 of the report.
Uncertainty relating to the presence of and impacts on an endangered ecological community, potential significant impacts on at least one threatened species and biodiversity generally, and on riparian/aquatic habitat is sufficient to trigger the requirement for preparation of a Species Impact Statement (SIS) under the TSC Act.

Conclusion
It would appear that, according to Teresa James, the law has not been applied when it comes to the approval of AGL's irrigation trial in respect of the above issues.

3. The lack of base line data and commencement of operations prior to studies being completed.

If you fail to plan you plan to fail.
AGL's Gloucester Gas project is planned to fail in a number of key aspects.

a) Lack of baseline ecological and water data

AGL has not studied the ecology of the local river systems or given base line water quality data for the rivers that it may affect with its project. It has failed to provide base line studies for the lower Avon, the Gloucester river downstream of the Avon intersection or the Manning river downstream from the Gloucester river. This is a deliberate omission. Without base line data no assessment of the effects of the project can be made. Put simply it is NOT scientific and as such should be roundly condemned by your office.

b) Failure to complete a flood study.

AGL has constructed much infrastructure prior to completing a flood study.
In its project approval it only used rainfall data going back to 1970 when good rainfall data exists going back to 1880. This means that its key rainfall statistics may be incorrect with regard to averages and variance. Indeed prior to 1950 the rainfall exhibited greater variance in other words the floods and droughts were bigger. This means that they have probably constructed their produced water dams with walls that are too low and have located the dams too low on the floodplain. This lack of appropriate planning could lead to a catastrophic failure to contain produced water leading to an OK Tedi situation where the river is destroyed.

c) Lack of Whole of Basin Hydro – Geological Study

Commencement of a hydraulic fracturing program at Waukivory scheduled to start in January 2014 prior to the completion of a whole of basin hydro- geological study.

d) Lack of Water Study

Commencement of a hydraulic fracturing program scheduled for January 2014 and irrigation of produced water project prior to a whole of basin water study being completed.

In all of these key aspects AGL is operating prior to base line data being collected and prior to completion of the relevant studies. The risks involved in doing this are obviously high, the consequences catastrophic and the likelihood of the worse case scenario highly probable.

4. A risk assessment of AGL's proposed project at Gloucester.

a) Fracking

Fracking is occurring at Gloucester prior to the geological modeling being completed, prior to a flood study and prior to whole of basin water study being completed. With a water supply for 75,000 people and one of the few great east coast river systems at risk surely the science should be done first?

The Chief Scientist has herself written that the geology of Gloucester is complex and poorly understood.

AGL has repeatedly stated that they do not understand the nature and extent of connectivity at Gloucester:
"The fracture stimulation and pilot testing program is also important to assess water production volumes and whether there is any connectivity between shallow aquifers and deep_coal seam_water bearing zones."(REF ES.1)

AGL's own expert has stated that:
In the peer review by Dr Evans, he makes the following comments about one of the monitoring bores established for the Stratford flow testing:
"This suggests there is hydraulic continuity laterally (and also possibly vertically)…and this hydraulic connectivity is not negligible." (Evans, p.19).
And with respect to another:
"The results do not support a conceptual model of hydraulic isolation of interburden layers." (Evans, p. 20).
In fact, Evans' assessment of AGL's monitoring bore data states:
"These observations suggest that deeper confining units are responding to recharge relatively quickly, and are not hydraulically isolated units" (Evans, 2012, pp19-24)

In our meeting with you in Taree, you stated that you are well acquainted with Professor Pells' views on the hydro geology of the Gloucester Basin. He has repeatedly stated that fracking in the Gloucester Basin represents an unacceptable risk.

Given that if the beneficial acquifers are indeed as you, Dr Evans, Professor Pells and AGL suspect connected to the coal seams and if this is so it may lead to poisoning of our water supply.

Risk Assessment summary

Given
1. the lack of knowledge,
2. the views expressed by eminent scientists both employed by AGL and independent of AGL,
3. the commencement of fracking prior to relevant studies being completed
Any risk assessment can only conclude that the hydraulic fracking that is proposed at Waukivory is a **high risk** activity.

Compliance Summary

The AGL REF has concluded otherwise. Again a failure of risk assessment is evident in this process.

Likelihood of Catastrophic Event Summary
The worse case scenario is not that unlikely given that AGL's own independent hydro-geologist is stating that there is connectivity and its consequences for all mid north coast residents is catastrophic. Again AGL's Gloucester gas project is High Risk.
Consequences of a Catastrophic event
We risk losing our water supply, the irrigation water for a number of farms, the oyster industry, local fisheries and of course industry such as local abbatoirs and other water users. We would be remiss not to mention the tourism industry that relies on the waterways, a clean environment and provision of fresh water to survive.
To our knowledge there is no remediation that can repair a fracked acquifer.
The consequences are therefore **extreme**.

b)Well Casing Failure

Risk Assessment Summary

The earth's geological strata are not laid out in the nice deep rows that we've seen in the pictures in every gas company PR brochure. The strata are complex, folding and moving - and until the gas company starts drilling though them, unknowable.

We put it to the Chief Scientist that the strata will be even more unknowable after the gas company drills through them and the well casings fail.

AGL have repeatedly stated that they want to start fracking simulation to know what they are dealing with. They don't know.

AGL's May 2013 project update: " to develop an initial understanding of the hydrogeological characteristics of the area."
http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20Community%20News/Gloucester/Community%20Updates/2013/May/130516%20projectupdate.pdf

Schlumberger, the global gas & oil industry drilling giant, confirms that the industry average failure is "60% of gas well casings will fail within 30 years".
[1] http://www.timesunion.com/opinion/article/Fracking-is-hardly-leakproof-3646458.php
[2]http://www.slb.com/~/media/Files/resources/oilfield_review/ors03/aut03/p62_76.ashx

Compliance Summary

The NSW Department of Trade and Investment, in consultation with the gas industry, has come up with their "Code of Practice for Coal Seam Gas - Well Integrity"

http://www.csg.nsw.gov.au/__data/assets/pdf_file/0010/37873/Code-of-Practice-for-Coal-Seam-Gas-Well-Integrity.PDF

The NSW Department of Trade and Investment compliance document develops APPEA's theory that nothing will go wrong up to the stage "Mandatory requirements and recommendations ... Well abandonment"

The NSW Department of Trade and Investment code of practice demonstrates concern "throughout the entire well life cycle" - but not beyond that.

Once the gas company has signed off on "well abandonment" apparently any problems occurring after that become the taxpayer and community's problem.

Likelihood of a Catastrophic Event Summary

100% of gas well casings will eventually fail. Cement crumbles, steel rusts, earthquakes occur, geological strata continually shifts and folds, and continental shift is real. Any or all of these facts will cause all gas well casings to fail over time.

Likelihood = 60% of gas well casings will fail within 30 years, 100% will eventually fail.

Leaking methane wells will continue to contribute to global warming, air pollution, bushfire risk and groundwater contamination long after the gas company has undergone corporate restructure or gone bankrupt and absolved itself or anyone of any responsibility. An example of a corporate entity restructuring and leaving the clean up and health problems to the community is the $100 million bill to taxpayers to clean up the AGL Gasworks at Millers Point.
[1] http://www.coal-seam-gas.com/australia/gloucester05.htm
[2] http://www.environment.nsw.gov.au/resources/clm/docs/html/n21122.htm

Consequences of a Catastrophic Event

If thousands of gas wells with casings guaranteed to fail are allowed to be drilled through groundwater aquifers, we put it to the Chief Scientist that this generation is planting a time bomb under the feet of future generations.

Aquifer contamination is extraordinarily difficult to detect and impossible to repair.

C) Produced Water Quality

AGL constantly state that their toxic contaminated mine tailings or as they refer it their "produced" water is, to quote John Ross AGL chief hydrologist:
"This is simply old salty groundwater removed during the CSG extraction process."

and

"The salts we're getting are sodium chloride, which is basic table salt, and bicarbonate."

(Source: http://www.gloucesteradvocate.com.au/story/1516691/irrigation-trial-a-salty-issue/?cs=433)

Nothing could be further from the truth.

AGL's toxic contaminated mine tailings is not just high in sodium choride and bicarbonates. They also are high in Aluminium, Nickel, Copper, Manganese and Zinc. The field Ph is also high.

(Source phase 2 Groundwater report as quoted by Professor Pells at : http://www.pellsconsulting.com.au/downloads/onTheDisposalOfProducedWaterFromCoalSeamGasProductionACaseStudyGloucesterNSW.pdf Page 3

Taking just Alumium as it is the first on the list:

- the levels recorded are some 20 times the ANZECC guidelines
- no known form of life uses aluminium salts metabolically.
- Aluminium restricts the growth of plant roots
- Aluminium is primary among factors that reduce plant growth on acid soils. (most soils in our region are acidic.)

Risk Assessment Summary

As this is a water supply for 75,000 people we expect that in any assessment of AGL's project the chief scientist will take into account possible effects on:

- Human health
- Health of watercourses
- Cumulative effects over time of such toxic mine tailings

The effects on agriculture of the salt load alone on the river systems will in time be devastating

There are notable omissions in the water quality data.
AGL has failed to provide the levels of for example:

- BTEX chemicals
- Levels of Strontium
- Levels of Volatile Organic compounds
- Levels of dissolved hydrocarbons

Without this data, that I am sure your office will obtain, a full risk assessment summary is not possible.

Compliance Summary
The toxic mine tailings water is outside guidelines for irrigation (refer to the irrigation project section below) and is outside ANZECC guidelines for direct river discharge.
Likelihood of a Catastrophic Event Summary
As no flood study has been completed and inadequate rainfall records have been used in the approval process of this project the chances of a tailings dam overflow would have to be quite high.
No cumulative impact study of the components of this toxic mine tailing water has been completed further increasing the likelihood of a catastrophic event.
Consequences of a Catastrophic Event
The consequences of a catastrophic event such as an overflow of the toxic mine tailings water are:
1. Death of rivers – This is a freshwater river system and the toxic mine tailings water falls well outside of ANZECC guidelines.
2. Possible cumulative poisoning effects of the people of the Manning Valley. The effects of many of the contaminants are slow and insidious and hard to trace.
3. Contamination of farmland from the mine tailings. Flood events will ensure that the mine tailings water will in time destroy much of the prime river flat land in the valley.

d) The Irrigation Project
Background
We cannot honestly believe in the year 2014 that we are writing to the Chief Scientist to explain that salt kills land and kills rivers.
This self evident fact has recorded in history since well before Christ was born.
However at the risk of explaining the obvious we will endeavour to keep the argument strictly scientific.

The Facts
Dr Khan's report commissioned by the Office of the Chief Scientist states on page 19:

"Summary guidelines for interpreting SARW values are provided as follows (NSW Department of Primary Industries, 2004):

- <3: no problems as the water is non sodic;

- 3 to 6: minor effect on clayey soils may occur (depending on overall salinity);
- >6: has increasing effect on all soils at low to moderate salinity and starts to reduce growth of most crop and pasture plants;
- >9: severe risk of increasing soil sodicity on most soils."

The EPA letter on page 5 states quite clearly that the water to be irrigated, according to AGL's Review of Environmental Factors (REF), has an SAR of 30 to 78.

(Source of the EPA letter http://images.smh.com.au/file/2013/11/21/4941228/EPA%2520letter.pdf?rand=1384985471486)

Even diluting this water 3:1 gives an SAR value of 7.5 to 19.5 well above the severe risk of increasing soil sodicity.

(Source of the 3:1 ratio http://www.gloucesteradvocate.com.au/story/1516691/irrigation-trial-a-salty-issue/?cs=433)

AGL have stated that they are using deficit irrigation to avoid run off into local water courses. In other words they are irrigating less water than the plants need. However according to Professor Willgoose:

But Professor Garry Willgoose from the University of Newcastle agrees the "produced water" can be used, but believes the practice needs to be closely monitored.

He says irrigators need to make sure more water than the plant technically requires is used.

"So the saline water is flushed through the root zone," said Professor Willgoose.

"And the more saline the water, the more water you have to put on, in excess of the technical demand of the plant.

"If you don't put enough water on the salt will built up in the soil creating a major problem in years to come."

(Source of Professor Willgooses comments : http://www.abc.net.au/news/2013-11-28/csg-water-professor/5122696)

The science is unequivocal. The land will over time be destroyed and set up a toxic plume that will leach into the rivers for decades to come.
The irrigation project over time will lead to increased soil sodicity. The volume of salt to be irrigated is 2500 tonnes per annum or 37,500 tonnes over the 15 year life of the project. However this vastly understates the true amount of salt that will be

irrigated by AGL. Already AGL is planning a stage 2 to the project of 220 wells, twice the size of stage 1.

Stage 2 will result in approximately 7500 tonnes per annum of salt being irrigated onto the river flats of the Avon River. Over the combined stage one and two of the project this represents 112,500 tonnes of salt over the life of the projects.

However this vastly understates the true long term position that we find ourselves in. In Queensland the CSG industry has grown exponentially over its very short history. There is no reason to believe that the same will not occur in NSW. At Gloucester the stage 2 of the project is already twice the size of stage 1. AGL is a well resourced company and can comfortably finance rapid expansion. Stage 3 of the project, which is as yet unplanned will in all likelihood be twice the size of stage 2. This is not speculation this is what in all likelihood will occur given the available evidence and it will occur in the short term. One only has to look at how quickly the Coal Seam Gas industry has grown in Queensland to see that this is what will occur.

Mr Mike Moraza from AGL has stated that:

"Long term we believe 10 similar-sized irrigation projects would be sufficient to deal with all the produced water from our operations in the valley."

http://www.gloucesteradvocate.com.au/story/1935415/water-trial-reaps-harvest/?cs=435

So we have 10 similar sized irrigation projects that will cover approximately 120ha of the valley.
This amount of land will obviously increase exponentially as the project inevitably grows setting up a series of toxic plumes that will leach contaminated salt into the river system for centuries to come.

The bicarbonate alkalinity levels presented in the REF for this proposal are >395 mg / litre (please note the greater than sign, it is material in any assessment of this project) in AGL's Tiedman south dam and 872mg/litre in the Tiedman North dam.

Again the report commissioned by you and written by Dr Khan states on page 46 that:

"The Queensland Government have provided a detailed assessment and guidance for salinity impacts of coal seam gas produced water on soils and surface streams when used for irrigation (Biggs et al. ,2013). Subsequently, the following criteria have been developed to apply to the general approval for beneficial use of produced water for irrigation purposes (Department of Environment and Heritage Protection, 2013):

- The maximum sodium adsorption ratio (SAR) shall not exceed 8;
- **The maximum bicarbonate ion concentration shall not exceed 100 mg/L;"**

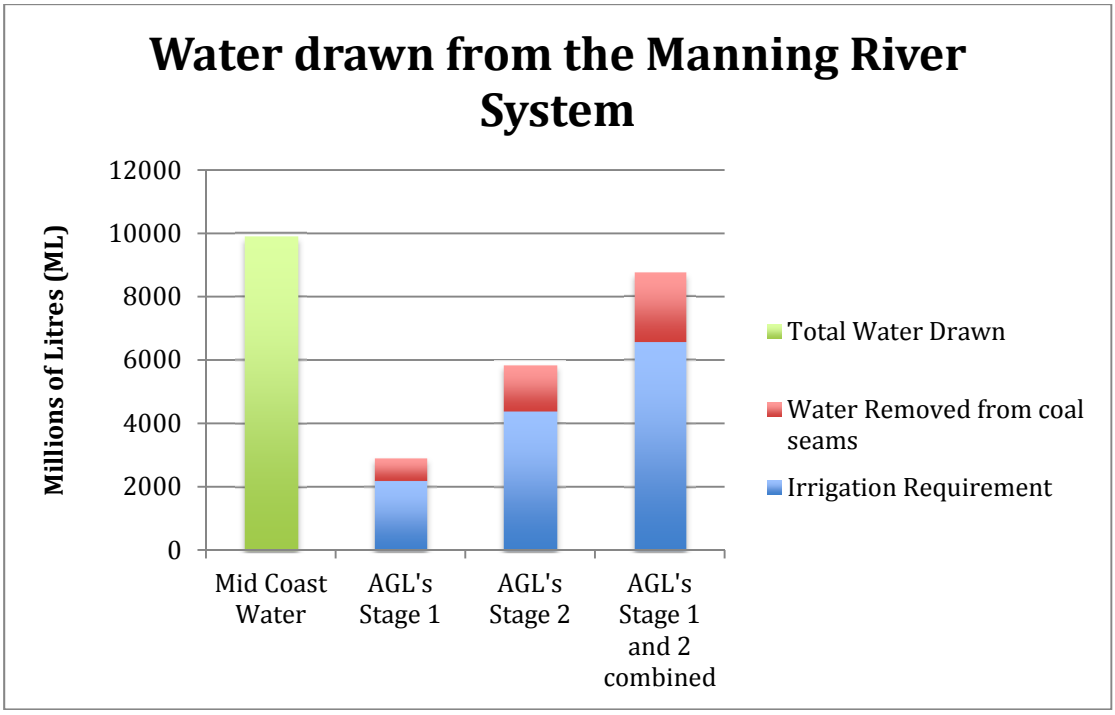
Even diluting 1:3 the bicarbonate levels from the two dams are at Tiedman South dam are >99 in all likelihood exceeding the Queensland government guidelines and the water in the Tiedman North dam are 218mg/l far in excess of the 100mg/l limit.

AGL has often stated that the irrigation method is their preferred method of mine tailings water disposal. Indeed they have as yet provided no other alternatives.
Their irrigation license has just been increased from 30ML to 60ML per annum.
This will allow them to irrigate 20ML of mine tailings per annum at the stated dilution ratio of 3:1.
In stage one of their project alone they produce have a license to produce 730ML of mine tailings.
Evaporation ponds are banned in NSW and AGL will have to dispose of their mine tailings in a timely fashion.
In stage one alone they will need to increase their irrigation license to 2190ML.
There simply is not that much water in the Avon River.
Obviously, this understates the water needs of AGL's project.
The planned stage 2 of the project will require 6570 ML of water.
The obvious question that has to be asked is where on earth will they get this much water from?

Impact on water supply
This is a massive impost on the drinking water supply a supply I would note has struggled from time to time in recent years to cope with an increasing population.
Mid coast water currently supplies 37,000 households with water.
This will increase to 50,000 households by 2050 according to mid coast water.
(Source: http://www.midcoastwater.com.au/site/water-supplies)

There have been many occasions in recent years when mid coast water has been unable to pump from the Manning River, due to low flows or turbidity, and has had to rely on its small dam at Bootawa (a dam without a catchment) to supply its customers.
The Manning River supplies 90% of mid coast waters customers.
Mid Coast Water supplies 11 billion litres of water per annum.
Therefore it draws around 9900ml per annum out of the Manning River System.
AGL will need 2190ml of irrigation water to dispose of its mine tailings from just stage one of its project. This is equivalent to 22% of mid coast waters draw on the water supply.

Stage 2 of AGL's project will need an irrigation license of 6570ML of water.
This is equivalent to 66% of mid coast waters draw on the water supply.



	Irrigation Requirement	Water Removed from coal seams	Total Water Drawn	Percentage of Mid Coast Water's Annual Draw
Mid Coast Water			9900	100%
AGL's Stage 1	2190	730	2920	29%
AGL's Stage 2	4380	1460	4380	44%
AGL's Stage 1 and 2 combined	6570	2190	8760	88%

Naturally, these figures understate the true medium term position that we find ourselves in as the as yet unplanned Stage 3 of the project will in all likelihood be twice the size of stage 2.

Clearly this amount of irrigation water if indeed it exists at all in the Avon River Catchment is not a sustainable draw if mid coast water will be able to supply its customers.

Impact on Water Quality for Mid Coast Water

The mid north coast is a high rainfall area with annual averages across the catchment of around 1m. Taree's annual average is 1178mm .
(Source: http://www.bom.gov.au/climate/averages/tables/cw_060030.shtml)

There is tremendous variability to the rainfall and the area is subject to large floods. (Refer to the link above for variance data)

There will be significant periods of time when AGL will not be able to irrigate due to low river flows or excess rainfall.

The production of the toxic contaminated mine tailings water does not stop due to the weather. The Dams that AGL have will only hold a small amount of mine tailings water. What is the company proposing to do in extended periods of either no rain or extended wet periods?

One can only assume that some water will have to be irrigated regardless of the weather. This will lead to contamination of the water supply.

Risk Assessment summary

Even diluting the AGL's toxic mine tailings with fresh water from the Avon River at the stated 1:3 ratio the water exceeds Queensland Government guidelines bicarbonates. The water to be irrigated is too saline even with dilution. The Sodium Adsorption Ratio (SAR) ratio according to the NSW Department of Primary industries is in the High Risk category.

Risks are not isolated. The combination of two high risk qualities puts the irrigation project in the extreme risk category.

Compliance Summary

We do not consider that the irrigation project complies with the NSW Department of Primary Industry guidelines for SARW.

AGL do not have the requisite irrigation licences to dispose of the amount of produced water they are proposing to irrigate.

We fail to understand where AGL will source the massive quantities of water required to irrigate its produced water in just stage one of their project. The Avon River is simply not big enough.

Likelihood of Catastrophic Event Summary

We will use the definition of a catastrophic event as the permanent impairment of the Manning River system as a water supply.

Given the absence of any semblance of science in this irrigation project the only conclusion that can be reached is that the likelihood of a catastrophic event is high if the project is allowed to proceed.

Consequences of a Catastrophic event

Loss of amenity of a beautiful freshwater river system.

Loss of employment in the tourism, primary production, processing industries, fisheries, oyster industries etc In short devastation of the regional economy.

Permanent cost running into the billions of dollars on a net present value basis to supply a growing population of 75,000 people with water. The Manning River is our only water supply.

Conclusion

We note that the office of the chief scientist web site states that:

"The role of the NSW Chief Scientist & Engineer

As NSW Chief Scientist and Engineer, Professor O'Kane consults widely with academia, industry and government to ensure scientific knowledge and research can be adapted and used to benefit NSW.

She is responsible for:

- providing the NSW Government with the best quality advice on policy decisions requiring science and engineering input
- seeing that the State's research system operates to maximise its productivity, economic value and social responsibilities"

(Source: http://www.chiefscientist.nsw.gov.au/about)

Due to:

- **the absence of any scientific basis for AGL's irrigation trial,**
- **the lack of compliance with catchment management plans of the project,**
- **the lack of compliance with the various environmental assessment acts**
- **the lack of assessment of impacts on threatened species**
- **the effects on the water supply of the project**
- **The economic effects on the local economy**
- **The lack of social and environmental responsibility displayed by AGL**

We call on the Chief Scientist to advise the Minister for Resources to immediately cease the trial of irrigating AGL's untreated mine tailings at Gloucester.

e) The Food Experiment

Risk Assessment Summary

In adopting 'world's best practice' consideration must be given to what is best practice from around the globe as regulatory authorities rush to come to terms with the recent boom in fracking.

The New Zealand dairy supplier Fonterra forbids accepting milk from cows coming into contact with fracking waste water, quoting their concerns to protect the 'branding' of their clean industry, which has taken decades and millions of dollars and man-hours (both government and private enterprise) to establish.

In Pennsylvania, USA, cattle that came in contact with 'natural gas' (a gas industry marketing term used instead of 'methane') drilling wastewater were quarantined. The US Department of Agriculture said "drilling wastewater has high salinity levels, but it also contains dangerous chemicals and metals."

"Cattle are drawn to the taste of salty water," said Agriculture Secretary Russell Redding. http://www.coal-seam-gas.com/usa/pennsylvania31.htm

The Department of Agriculture secretary noted the recommended guidelines from the Food Animal Residue Avoidance and Depletion Program:

• Adult animals: hold from food chain for 6 months.
• Calves exposed in utero: hold from food chain for 8 months.
• Growing calves: hold from food chain for 2 years.

As we can see from the Pennsylvania example, live animal testing is not possible because tissue sampling is required. Any risk aversion must therefore be done prior to potential contaminants being fed to cattle, or spread on crops.

In Gloucester, the property on which AGL is conducting their cattle fodder experiment is being leased to "Gloucester grazier Norm Bignell" (The Land, 26 December 2013). http://www.coal-seam-gas.com/australia/gloucester40.htm

Compliance Summary

The irrigation experiment was approved by the New South Wales Department of Trade and Investment (Division of Resources and Energy), the New South Wales Office of Water, and the Environment Protection Authority. http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20Community%20News/Gloucester/Community%20Updates/2013/May/130516%20projectupdate.pdf

We note that Trade and Investment are the lead agency. As we've seen on the ABC 4Corners program Gas Leak, public servants and environmental scientists tasked with assessing Coal Seam Gas projects have been bullied, harassed and directed to provide a 'bankable outcome' for the projects to proceed, despite important sections of the submissions either not provided or edited by government staff. http://www.coal-seam-gas.com/australia/gasleak.htm

The National Water Quality Guidelines (ANZECC 2000) were written for irrigation water, prior to the addition of slickwater* into Australian coal seam gas fracking. An environmental scientist familiar with the approval process of coal seam gas projects has highly recommended that these guidelines be updated and enhanced to include provisions for fracking contaminants, so that the applications can be properly assessed.

* Slickwater combined with horizontal drilling made "The Father of Fracking" George Mitchell a millionaire in 1998 when he made fracking economically viable, thus fuelling the current gas boom. The modern fracking process has not been 'safely done for decades' as the gas industry claims and certainly not on the scale that the industry proposes.

http://www.waytogoto.com/wiki/index.php/Slickwater

http://www.economist.com/news/business/21582482-few-businesspeople-have-done-much-change-world-george-mitchell-father

Section 4.2.6 of the National Water Quality Guidelines (ANZECC 2000) contains long-term and short-term trigger value concentrations for heavy metals and metalloids in irrigation water and Section 4.2.9 contains trigger values for the radioactive quality of irrigation water, but many of these dangerous substances are not tested for, or test results are not released publicly.

An AGL report, for example, on an irrigation trial at Gloucester using CSG water fails to report concentrations and volumes of radioactive, heavy metal and other contaminants including: arsenic, beryllium, cadmium, chromium, cobolt, lead, lithium, mercury, nickel, selenium, radium 226, radium 228, uranium 238, benzene, toluene, ethylbenzene, xylene and other volatile organic compounds.

Prepared by Fodder King for AGL Upstream Investments Pty Ltd, August 2013. Soil quality monitoring and management - Report 2 - Irrigation (Activities from 1 April to 30 June 2013) Tiedman Irriation Trial.
http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20Community%20News/Gloucester/Community%20Updates/2013/September/FK%20AGL%20DRE%20Rpt%202_Final_LowRes.pdf

In Pennsylvania, US Department of Agriculture said "the main element of concern is the heavy metal strontium, which can be toxic to humans, especially in growing children. The metal takes a long time to pass through an animal's system because it is preferentially deposited in bone and released in the body at varying rates, dependent on age, growth status and other factors."

The NSW Government has banned coal seam gas evaporation ponds. However, in AGL's 'irrigation trial' exactly the same method is in use - the produced water sits in ponds until it is sprayed over the crops. The AGL produced water sat evaporating in a pond for a year before the seven month experiment started.

Likelihood of a Catastrophic Event Summary

Environmental groups typically invoke the pre - cautionary principle. That is, if an action is suspected of causing harm to the environment, then in the absence of a scientific consensus, the burden of proof falls on the individual or organization taking the action. The oil and gas industry has typically rejected this analysis and has approached the issue in a manner similar to the tobacco industry that for many years rejected the link between smoking and cancer. That is, if one cannot prove beyond a shadow of doubt that an environmental impact is due to drilling, then a link is rejected. This approach by the tobacco companies had a devastating and long-lasting effect on public health from which we have still not recovered, and we believe that a similar approach to the impacts of gas drilling may have equally negative consequences.
IMPACTS OF GAS DRILLING ON HUMAN AND ANIMAL HEALTH
MICHELLE BAMBERGER ROBERT E. OSWALD
http://www.psehealthyenergy.org/data/Bamberger_Oswald_NS22_in_press.pdf

Consequences of a Catastrophic Event

The 'mad cow' scare decimated the UK beef industry in the 1990s. Not that we're suggesting mad cow is caused by fracking, merely pointing out the economic consequences of inappropriate and ill-advised experimentation with the food chain. This author can never donate blood again as a consequence of being in the UK at the time.

The potential consequence of inadequate and/or rushed approval for future CSG irrigation involving crops entering the food chain for humans & cattle alike is death or injury (permanent).

The potential consequences for the dairy, beef and agricultural industries are loss of international reputation and branding, and loss of both short and long-term income.

Irrigation recommendations

The Chief Scientist, Mary O'Kane told the authors of this submission that she has no jurisdiction to comment on the AGL project or any project that has prior approval by the NSW Government. Perhaps in future, with regard to coal seam gas projects that directly impact on the food chain, consideration might be given to:

1. The assessment and monitoring of the fodder grown with frack waste water be conducted by a truly independent authority and not by a gas company sub-contractor.
2. That the reporting be done on a very regular basis, and not in 'six monthly reports' as is currently the case with AGL's Gloucester experiment.
3. After a series of breaches of license, such as the EPA infringements issued to AGL in 2013 for failing in their reporting requirements, that their license be revoked.
4. That the silage bales be numbered and identified as being sourced from a gas company experiment enabling appropriate and timely tracking in the advent of contamination.
5. That the dairy and beef cattle farm, and any other farm growing foodstuffs with mining waste, also be monitored with publicly available reporting on a timely basis in the advent of system failure.
6. Food labelling or other public declaration of the source of the experimental farms to give the public a choice whether to participate in a gas company experiment.
7. Considering the risks to the food chain and human health, we highly recommend that adequate insurance be a requirement on any gas company's licensing. AGL informed a recent Gloucester town hall meeting that they have $1 million insurance to cover all environmental clean ups, and health claims, which seems inadequate.
8. The extra compliance and insurance costs borne by the farmers should be covered by the gas company.

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Gloucester Coal Seam Gas Project – Irrigation Proposal

Brief review of ecological assessment report
Teresa James December 2013

1. Introduction

A brief review was undertaken of the ecological assessment report prepared by Alison Hunt and Associates dated August 2012. The purpose of the report was to support a proposal by AGL to expand water storage and irrigation across the Tiedman property located c. 3 km NE of Stratford and 10 km S. of Gloucester. Approval has subsequently been granted subject to a number of conditions including Special Condition 4 relating to biodiversity protection. Specific ecological issues to be addressed under this condition include:

- Identification of flora and fauna species and their habitat present at and in the vicinity of the project site, including frog populations;
- The potential for endangered ecological communities, threatened species and/or their habitat listed under the NSW Threatened Species Conservation Act 1995 (TSC Act) to occur within the study area;
- The potential for presence of any matters of National Environmental Significance listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) to occur within the study area;
- Management of any impacts on flora and fauna, and their habitat.

2. Review

The following key issues were identified and are briefly discussed.

Issue 1 – Inadequate level of survey and compliance with government (OEH) guidelines

No targeted or general flora and fauna survey was undertaken for the report and no species list provided. The report assumes that additional survey was not required due to previous studies and the highly cleared/modified condition of the site. Although several reports are quoted there are no details or data from previous studies provided or integrated into the report and accordingly the location, extent, intensity and relevance of surveys is unknown. The assumption that there is no significant native vegetation present is inconsistent with evidence from aerial photography and the limited description provided. Native vegetation at the property is represented by extensive woodland areas in the east, scattered remnant paddock trees and riparian vegetation including woodland/forest along Dingo Trap Creek and a short section of the Avon River.

Reliable identification of threatened flora and fauna, effective mitigation of impacts and protection of biodiversity requires strategic and targeted survey as specified in the Threatened Biodiversity Survey and Assessment Guidelines (2004) prepared by the Office of Environment and Heritage (OEH) . The purpose of these guidelines is to provide a consistent, systematic and comprehensive approach to survey and assessment. The minimum level required to address ecological issues under special condition 4 include:

- Identification of a study area i.e. the affected land and any adjoining lands that may be impacted e.g. vegetation along the Avon River downstream of the site.
- Identification and mapping of vegetation zones within the study area e.g. woodland (moderate to good condition), riparian forest (low and/or moderate to good condition) and scattered remnant paddock trees (low condition).
- Survey using plots and/or transects within vegetation zones to assist in identification of native vegetation communities.
- Comprehensive listing of flora and fauna species present within the study area.
- Targeted survey for threatened flora and fauna recorded previously for the site or known from the locality if suitable habitat is present.

The subject study fails to comply with these minimum requirements or indicate that they are satisfied by previous investigations.

Issue 2 – Failure to consider the potential presence of an endangered ecological community (EEC) Subtropical Coastal Floodplain Forest (SCFF) of the NSW north coast bioregion

The riparian woodland/forest present along the Avon River and Dingo Trap Creek is likely to support this EEC. Although the vegetated zone is generally narrow it is up to 90-100m wide in some places and is likely to contain a range of species representative of this community. The report fails to describe vegetation along the watercourses, identify vegetation types or critically compare with known EEC's within the locality. All vegetation within the study area should be identified and assessed for direct & indirect impacts.

Although constrained by the lack of information it is likely that the Subtropical Coastal Floodplain Forest EEC is present based on key criteria as described in the Final Determination for this community under the TSC Act including:

- location within the North Coast bioregion;
- watercourses are within the Manning River catchment and occur on a coastal floodplain;
- Scattered paddock trees and the few understorey species identified in the report are consistent with the EEC e.g. Cabbage Gum (*Eucalyptus amplifolia*), Paperbark (*Melaleuca decora*) Grey Box (*Eucalyptus moluccana*), Willow Bottlebrush (*Callistemon salignus*) and Silkpod (*Parsonsia straminea*).

The condition of vegetation within the study area is largely irrelevant to identification of the EEC e.g. even paddock trees can be regarded as a low condition state of the community. A full description of the EEC can be found in the Final Determination and associated threatened species profile available at www.bionet.nsw.gov.au.

Issue 3 – Impact assessment fails to adequately consider threatened flora and fauna, and the extent of impact

The proposal includes construction of an additional dam to store water from wells and expansion of existing irrigation activities including installation of a pump and pipelines to convey water from the Avon River to the water storage dams.

Table 1: Identification and discussion of known or potential adverse impacts of irrigation proposal

Activity	Type of impact (direct & indirect)	Report assessment	Review comments
Construction of new dam	• Loss of agricultural pasture • Soil erosion & sedimentation of watercourses • Disturbance of fauna	• Some loss of fauna habitat but negligible • Potential indirect impacts on flora & fauna including downstream • Impacts ameliorated by Sediment & Erosion Control Plan (SECP)	• Agree that impacts possible on aquatic & riparian habitats – details of SECP required to assess • Independent monitoring required of vegetation & water quality on and off-site • Potential disturbance impact on Grey-crowned Babbler
Installation of pump & pipes from Avon River to dam	As above	No direct reference or specific assessment included.	As above
Pumping of water from Avon River to dilute saline water	• Reduced water levels in aquatic & riparian habitats • Water dependant flora & fauna likely to be impacted	No recognition of impacts or assessment.	• Documentation of aquatic & riparian communities is required including collection of base-line data. • Impacts of water extraction including in droughts to be assessed as well as impacts of not pumping for extended periods (if not possible). Identification of critical thresholds required. • Specific assessment for sensitive species e.g. frogs & ecosystem processes • Independent monitoring & adaptive management to be included in management plans
Irrigation of land (to 40-50 ha) on low-lying land adjacent to creek & river.	• Loss of paddock trees in stage 1A • Loss of pasture & soil health affecting fauna • Higher soil salinity impacting on soil biology, vegetation & aquatic habitat • Changes to hydrological regime	• Paddock trees belong to drier woodland community, not of conservation significance. • Other areas of native vegetation & threatened species not adequately assessed. • Impacts mitigated through implementation of management plans and revegetation offset along northern boundary.	• Number of paddock trees to be removed underestimated • Paddock trees & remnant vegetation likely EEC not adequately offset by revegetation proposal • Remnant vegetation likely to be affected by salinity, waterlogging etc. • Loss of fauna habitat & connectivity across site not adequately assessed

The area under irrigation will significantly increase from 8.6 ha to 40-50 ha in two stages. Most of the lower floodplain parts of the site will be affected by the proposal through direct and indirect impacts. The primary adverse impacts are identified and summarised in table 1.

There is a range of adverse impacts that have not be adequately considered or assessed in relation to biodiversity including threatened entities as follows:

- Potential Subtropical Coastal Floodplain Forest EEC along watercourses & in low-lying areas, including paddock trees. Irrigation areas extend to within 10-20 m of the creek in some places and encroach on the patch of Paperbarks between stages 1A and 1B on both sides.
- Aquatic & riparian ecosystems both on and off-site.
- Roadside and other habitat of the Grey-crowned Babbler, a vulnerable species listed under the TSC Act and known to occur in the northern part of the property at least.
- Threatened species with potential habitat on creek banks: *Asperula asthenes* & *Pomaderris queenslandica* (flora) and fauna particularly water dependant & sensitive species such as frogs (Giant Barred Frog & Green and Golden Bell Frog).
- Other biodiversity including the iconic Platypus, many records of which occur along the Avon River and its tributaries in the vicinity of the site.

There is a serious lack of information in the report to reliably determine impacts on biodiversity and where affected species are identified, the assessment fails to consider all impacts. The seven-part test (appendix C) for the Grey-crowned Babbler, for example, only considers the threat of road traffic and does not consider loss of habitat/food resources as a result of tree or pasture removal and higher soil salinity despite being identified as impacts (see table 1 above) and the stage 1A irrigation area extending into known habitat along the northern boundary of the site. Proposed re-vegetation along this boundary may be compromised by high salt levels, changes in soil structure and increased waterlogging.

Issue 4 – Report fails to consider regional guidelines and local provisions for protecting watercourses and aquatic/riparian habitat

The report does not refer to or consider compliance with section 6.1 of the Gloucester Shire Local Environment Plan (2010) in respect of flood behaviour and the environment including protection of riparian vegetation and aquatic ecosystems. Similarly, there is no consideration of objectives and guidelines identified in the Hunter Central Rivers CMA Catchment Action Plan. The recognition and inclusion of riparian protection zones is fundamental to local environmental and catchment management but is not considered in the report.

Issue 5 – Mitigation measures fail to provide reasonable certainty

Mitigation of impacts relies on implementation of three management plans, the Project Environmental Plan, Sediment and Soil Erosion Plan and Contingency Plan. There is significant uncertainty, however, as to the effectiveness of these plans. Matters of concern include:

- Detailed plans are not provided for review.
- Due to inadequate survey and reporting actual biodiversity present within the study area is poorly known and many impacts may go undetected both on and off-site e.g. loss of species, changes in species composition of vegetation communities & habitat degradation.

- Contingency plan relies heavily on increasing dilution of saline water with fresh water from the Avon River but this will also have impacts and it may not be possible or desirable at low water levels during drought periods.
- Current knowledge of the impacts of high salinity on specific communities and species is poorly known.
- Likely impact of increased salinity on proposed revegetation along the northern boundary has not been assessed. Known habitat of the vulnerable Grey-crowned Warbler is consequently at risk.
- Total reliance on best practice management, reliable monitoring and ongoing enforcement.
- High costs and feasibility associated with above.
- Cumulative impacts of stages 1 & 2 have not been considered and as part of the larger gas project.

3. Summary

The report does not provide reasonable scientific certainty that biodiversity will be protected as required under Special Condition 4. Survey and reporting as documented in the report lacks compliance with current OEH standards and guidelines. There is no evidence of targeted survey for threatened communities or species despite the requirement to assess the potential for their occurrence. In the absence of reliable data the precautionary principle should be applied and all threatened entities identified within the locality with potential habitat present be assessed accordingly. A summary of the report objectives and compliance is provided below:

Report objectives	**Review**
Identification of flora and fauna and their habitat, including frog populations	Inadequate reported survey & poor documentation of flora & fauna (including frogs) providing an inadequate basis for assessment of impacts.
The potential for endangered ecological communities, threatened species and/or their habitat listed under TSC Act or EPBC Act to occur within the study area	Inadequate survey, documentation or critical assessment of threatened flora & fauna providing no certainty they will not be impacted. One EEC not identified in the report is likely to be present and if confirmed will be impacted. At least one threatened fauna is known to be present and is likely to be impacted.
Management of any impacts on flora and fauna, and their habitat	Management plans provide no detail or certainty that impacts will be adequately managed. Full range of known or potential impacts & affected threatened entities is not considered in assessments.

It is likely that native vegetation in lower parts of the site and along Dog Trap Creek and the Avon River includes Subtropical Coastal Floodplain Forest (SCFF) of the NSW North coast bioregion, an endangered ecological community listed under the TSC Act (state only). No documentation of this vegetation is provided in the report. One threatened fauna species, the Grey-crowned Babbler, is known to occur at the site but impact assessment for this species is incomplete and adequacy of proposed management uncertain. Impact assessment of salinity on soils, the river systems and biodiversity is similarly incomplete (but maybe covered in other reports?) and the report fails to

consider important regional and local provisions and guidelines for river & riparian health. The irrigation area extends close to the creek & river with no proposed buffer or riparian protection zones identified or recommended. The long-term viability of proposed revegetation and enhancement of connectivity values along the northern boundary to compensate for loss of Grey-crowned Babbler habitat is uncertain due to encroachment by the proposed irrigation area as shown in figure 3-3 of the report.

Uncertainty relating to the presence of and impacts on an endangered ecological community, potential significant impacts on at least one threatened species and biodiversity generally, and on riparian/aquatic habitat is sufficient to trigger the requirement for preparation of a Species Impact Statement (SIS) under the TSC Act.

Curriculum Vitae: Teresa Ann James

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Key positions:

- Botanist/ecological consultant specialising in vegetation survey, plant identification and conservation assessment.
- Until October 1998 held position of Identifications Botanist, Plant Sciences, National Herbarium of New South Wales, Royal Botanic Gardens, Sydney.

Qualifications:
Bachelor of Science (Combined Honours in Biology and Geography) - University of Exeter, England. 1978.

Accreditation:
Accreditation awarded (2008) as a BioBanking Assessor under the Threatened Species Conservation Act 1995 (NSW); accreditation renewed 2012. Accreditation number 0017.

Employment:

1978 (3 months)	Technical Assistant, Biological and Chemical Research Institute, Rydalmere (Department of Agriculture).
1978-1998	Employed at the Royal Botanic Gardens, Sydney.
1978-1979	Temporary Herbarium Assistant
1980-1982	Technical Officer, Botanical Information Section
1982-1986	Acting Identifications Botanist, Botanical Information Section
1987-1991	Technical Officer, Botanical Information Section
1991-1994	Acting Identifications Botanist, Botanical Information Section
1994	Secondment 4 days/week to World Heritage Assessment of the Blue Mountains (consultancy for NSW National Parks & Wildlife Service).
1994	Permanent appointment as Identifications Botanist.
1994-	Appointed Botanical Information Section Co-ordinator.
1996-1997	Secondment to NSW National Parks & Wildlife Service as Flora Officer for Urban Bushland Biodiversity Survey. Stage 1: Western Sydney.
1994-1998	Identifications Botanist & Botanical Information Section Co-ordinator.

Oct 1998-present - self- employed flora/ecological consultant

- Undertake a range of surveys, reviews and assessments primarily for government departments. Preparation of seven (eight)-parts tests and species impact statements.
- Expert witness in the Land & Environment Court.
- Botanical training for local councils and community groups.

<u>Longer-term projects:</u>

1998-1999	Vegetation sampling for NSW National Parks & Wildlife Service - Western Sydney Vegetation Mapping Project.
1999	Flora consultant to Eastern Gas Pipeline (Duke Australia Operations).
2000	Preparation of Fire Ecology Manual for Rural Fire Service and UWS.
October 2000-2003	Flora consultant to Biosis Research for Penrith City Council – proposed developments & TSC Act issues at Erskine Park.
2001	Field sampling and truthing for vegetation community mapping project - Baulkham Hills LGA. Baulkham Hills Shire Council.
2001-2003	Qualitative and quantitative vegetation surveys (including rare plant species and ecological communities, weeds and other threats, environmental assessment) of Wingecarribee Swamp with Sainty & Associates for the Sydney Catchment Authority.

February 2002-May 2002	Review of wetland boundaries and general vegetation mapping and condition assessment within Baulkham Hills local government area (for Baulkham Hills Shire Council).
2003	Vegetation survey in the Hunter, Nattai & Bargo districts as part of the National Parks & Wildlife Service Vegetation Survey Program.
2002-2007	Flora survey/monitoring at Dr Charles McKay Reserve, Mt. Druitt for Blacktown City Council.
September 2005 –2006	Field validation for Foreshore Vegetation Mapping Project on Sydney Harbour for Botanic Gardens Trust and NSW Maritime Services.
September 2000-2008	Flora consultant to Liverpool City Council – provide review & advice relating to Development Applications & special projects.
February -May 2007	Field survey for Sydney Metropolitan Catchment Management Authority/DECC vegetation mapping. Plot data recorded for 100 sites within SMCMA.
May 2008-2010	Vegetation mapping and assessment of Blue Gum High Forest and Turpentine Ironbark Forest in Ku-ring-gai local government area
August 2008-present	Flora advice to Ku-ring-gai Council - review of Development Applications, Land and Environment Court proceedings
February-August 2012	PAS2 Expert Interviews for NSW threatened species with Office of Environment & Heritage.

*See consultant reports for complete list of projects/surveys.

Botanical Information Section Co-ordinator/Identifications Botanist
The botanical information section of the herbarium provides plant identifications and botanical/ecological information to other government departments, educational institutions and the wider community. Responsibilities included:

- Provision of plant identifications and botanical/ecological information
- Vegetation surveys and assessments as required
- Supervision and welfare of staff and volunteers within the section
- Effective operation of the botanical information service

Special projects:
Assessment of the World Heritage Values of the Blue Mountains and surrounding plateaus
An assessment of the natural and cultural values of the sandstone plateaus of the Blue Mountains and surrounding areas was funded by the Federal and State Governments to determine the potential for world heritage nomination. A team of people worked on the project from the Royal Botanic Gardens, Australian Museum (cultural values) and experts from local universities. I was project co-ordinator for the assessment, wrote much of the text for the natural values sections and was editor of the final report. This report was used as a basis for the successful Blue Mountains World Heritage nomination (June 1998).

NPWS Urban Bushland Biodiversity Survey. Stage 1: Western Sydney
Documentation of biodiversity and conservation values in Western Sydney was the first priority project undertaken within the State Biodiversity Survey Program. The survey gave emphasis to threatened species, communities and habitats. The region was documented on a local government area basis. I co-ordinated the flora surveys and was principal author for the flora reports.

Committee & community participation
- Member of NPWS Cumberland Plain Woodland Recovery Team (1998).
- Member of NPWS Acacia pubescens Recovery Team (1998 to 2002).
- Member, Green Corridors Strategy Steering Committee.Upper Parramatta River Catchment Trust. (1997-2000).
- Member, Water Quality Strategy Steering Committee. Upper Parramatta River Catchment Trust (1995-7).
- Member, State of the Environment Report Steering Committee for Holroyd City Council (1995-2002).
- Botanical Advisor for Management Committee, Greystanes Creek Restoration Project (1993-2000).
- Blue Gum High Forest Workshop / Advisory Committee – Ku-ring-gai Council. (2007).

Particular expertise:

Plant Identification:

- New South Wales plants, native and naturalised (18 years experience in the Botanical Information Section of the Royal Botanic Gardens, Sydney). Specimens received from all over state. Also cultivated plants.
- Specialist in Sydney flora.
- Prepared taxonomic treatments for various plant families in the publication Flora of New South Wales, volumes 1-4, produced by the Royal Botanic Gardens, Sydney.
- Conduct plant identification workshops both through the RBG and the University of Western Sydney.

Documentation and conservation/ impact assessment: plant communities and species

- Extensive range of sites surveyed with species lists compiled over the last twenty five years, particularly in Western Sydney, the Blue Mountains and Southern Highlands. Plant specimens collected and incorporated into the National Herbarium of N.S.W. Information used in numerous reports and books eg. World Heritage Assessment of the Blue Mountains, the NPWS Urban Bushland Biodiversity Survey, Rare Bushland Plants of Western Sydney and various papers.
- Prepare Tests of Significance and Species Impact Statements as required under current legislation (TSC Act, EPBC Act).
- Prepare Statements of Evidence & affidavits for the Land & Environment Court.
- Provide advice to local residents, environmental groups, developers, government agencies and councils concerning the identification of communities and species, impacts of proposed developments, the ecological effects of urbanisation, flood mitigation and management practices such as mowing, burning etc.

Education & training

- Involvement on committees or in groups providing technical advice and training eg. Greystanes Creek Management Committee, Upper Parramatta River Catchment Trust steering committees, Hawkesbury Rainforest Network.
- Presentations/talks eg. National Parks Association, Society of Australian Plants, University of NSW, Landcare groups, local councils.
- Conduct plant community and species identification workshops/courses/tours through the Royal Botanic Gardens and the University of Western Sydney. Community Links Courses presented include: An introduction to Cumberland Plain Woodland (1998), Introduction to the identification of grasses (1999) and Cumberland Plain Woodland and River-flat Forest of Western Sydney-identification and conservation assessment (1999).
- Prepared Fire Ecology Manual for Rural Fire Service (2000).
- Training for local government in threatened species, endangered ecological communities and biodiversity conservation.
- Publications eg. primary author of revised edition of Rare Bushland Plants of Western Sydney (Royal Botanic Gardens 1999*)*, contributor to Flora of New South Wales *(*Royal Botanic Gardens).

Recent courses/workshops & tours provided to local councils/catchment management trusts/consultancies:

- Sept. 2004 - Threatened Species Tour for Baulkham Hills Shire Council bush care workers & council staff
- October 2004 – Significant Plant Communities-of Baulkham Hills Shire Council – tour for council staff
- February 2005 – Community workshop in Cumberland Plain Woodland for Holroyd City Council
- July-August 2005 - Biodiversity training for Liverpool City Council – 3 workshops for council officers
- September 2005 - Threatened Species Tour for Baulkham Hills Shire Council bush care workers
- August 2007 - Threatened Species Tour for Baulkham Hills Shire Council bush care workers
- October 2007 – Identification of plants in Cumberland Plain Woodland – for Hawkesbury Nepean CMA.
- April 2008 – Basic grass identification course for Baulkham Hills Shire Council (for bushcare volunteers).
- August 2008- Threatened Species Tour for Baulkham Hills Shire Council bush care workers
- November 2008 to April 2009 – Weedy Grass Identification Workshop x 3 for Sydney Metro CMA.
- August 2009- Threatened Species Tour for Baulkham Hills Shire Council bush care workers
- October 2009 – EEC identification field day for Hawkesbury-Nepean CMA
- August 2010 - Threatened Species Tour for Baulkham Hills Shire Council bush care workers
- October 2010 – Cumberland Plain Woodland identification training for SMEC Australia
- April 2011- – Cumberland Plain Woodland identification training for SMEC Australia
- April 2011 – Field training in identification of communities & plants on the Cumberland Plain for Hawkesbury Nepean CMA.

- June 2011 – Presentation to council staff on threatened flora & fauna and biodiversity conservation within the Hills Shire.
- August 2011- Threatened Species Tour for Hills Shire Council bush care workers
- June 2012 – Eucalypt Identification workshop for Hills Shire Council.

Courses completed:
4WD Operators course (1993) NSW Traffic Education Centre, Armidale.
Low risk driving course (1993) as above
St. Johns Ambulance Advanced First Aid Course & Remote Area First Aid Course (1993, 1997, 2001)
Fred Pryor seminars:
Self-directed Work Teams (1993)
How to Handle Difficult People (1993)
Management Problems of the Technical Person in a Leadership Role (1994)
How to Supervise People (1995)
How to Manage Stress (1995)

Publications/booklets:
- Stepnell, K. & James, T. A. (1986). *Australia's Native Flowers*. Child & Henry Publishing Pty. Ltd.
- James, T.A. (1988). *Bertya ingramii* (Euphorbiaceae) a new species from New South Wales. *Telopea* 3(2): 285.
- Bedford, D. & James, T. (ed.) (1992). *Collection, Preparation & Preservation of Plant Specimens.* Royal Botanic Gardens, Sydney.
- Powell, J.M. & James, T.A. (1993) *Epacris sparsa* (Epacridaceae) reinstated. *Telopea* 5(2):375-380.
- James, T.A. (1990-1993) in *Flora of New South Wales*. Royal Botanic Gardens, Sydney
- Volume 1: Euphorbiaceae (part), Violaceae.
- Volume 2: Fabaceae (part).
- Volume 3: Celastraceae, Rubiaceae (part).
- Volume 4: Iridaceae (part), Poaceae (part).
- James, T.A. (1994). Observations on the effects of mowing on native species in remnant bushland, Western Sydney. *Cunninghamia* 3(3).
- Kodela, P.G. & James, T.A. & (1994) Aspects of the ecology and conservation status of the rare herb *Gentiana wingecarribiensis*. *Cunninghamia* 3(3).
- James, T.A. (1994) Review of a Key to Australian Grasses by B.K. Simon. *Australian Systematic Botany Society Newsletter* No.78.
- Contributer to Bowen Mountain Bushwalks (1994). Bowen Mountain Association.
- Kodela, P.G, James, T.A & Hind, P. (1996). Vegetation and flora of swamps on the Boyd Plateau, Central Tablelands, New South Wales. *Cunninghamia* 4(3).
- James, T.A. (1996). New combination in *Viola* (Violaceae). *Muelleria* Vol. 9 pp.35-36.
- James, T.A. NSW NPWS. (1997). Urban Bushland Biodiversity Survey. Stage 1: Native flora in Western Sydney.
- Hosking, R. J & James, T.A. (1998). An analysis of the native and exotic flora of the North Western Slopes upstream of the junction of the Peel and Namoi Rivers, New South Wales.
- James, T.A., McDougall, L & Benson, D. (1999). Revised edition. *Rare Bushland Plants of Western Sydney*. Royal Botanic Gardens, Sydney.
- James, T.A. (2009) Threatened plant species of Baulkham Hills Shire – unpublished booklet for Baulkham Hills Shire Council.
- James, T.A. (2009) Vegetation communities of Baulkham Hills Shire – unpublished booklet for Baulkham Hills Shire Council.
- James, Teresa (2013) Flora of Cumberland Plain Woodland – an identification guide

Reports
List of unpublished species lists and reports over the last 15 years.

- Kodela, P.G., James, T.A., Coveny, R.G. and Hind, P.D. (1992). Reconaissance survey of the vegetation at Long Swamp, near Penrose, Central Tablelands, N.S.W. Royal Botanic Gardens, Sydney. Unpublished report.
- James, T.A. & Kodela, P.G. (1992). Species list for Little Cattai Creek and tributary creeks. Royal Botanic Gardens, Sydney. Unpublished species list.
- James, T.A. & Kodela, P.G. (1993). Plant species recorded from Butlers Swamp, Central Tablelands, N.S.W. Royal Botanic Gardens, Sydney. Unpublished species list.

- James, T.A. Coveny, R.G., Kodela P.G. and Hind, P.D. (1993). Plant species recorded from a wetland area on the northern side of Fitzroy Falls Reservoir, Central Tablelands, N.S.W. Royal Botanic Gardens, Sydney. Unpublished species list.
- James, T.A., Hind, P.D., Kodela, P.G. (1993). List of native species recorded for the Vale of Avoca Reserve. Royal Botanic Gardens, Sydney. Unpublished species list.
- Coveny, R.G. and James. T.A. (1993). Plant species recorded from the Dr. Charles McKay Reserve, Mt. Druitt, Western Sydney. Royal Botanic Gardens, Sydney. Unpublished species list.
- James, T.A. (1994) Native plant species recorded from Alpha Park Reserve, Greystanes. Unpublished report.
- James, T.A. (1994) Botanical Significance of the Lower Canal, Greystanes. Unpublished report.
- James, T.A. (2004 revised 2009). Rare and threatened plant species of Baulkham Hills Shire for Baulkham Hills Shire Council.
- Allen, CB, Benson, DH, James, T & Kelleway, J (2007). Vegetation map of the Sydney Harbour Foreshore, December 2006. Prepared for NSW Maritime and the Sydney Metropolitan CMA by Royal Botanic Gardens, Sydney.

Consultancies:

- James, T.A. (1992) Vegetation Survey of proposed pipeline and irrigation sites for Goulburn wool scour. Unpublished report for Gunninah Consultants.
- James, T.A. (1992). Survey of Vegetation along New Line Road at Cherrybrook. Unpublished report for Gunninah Consultants.
- James, T.A. (1993). Vegetation survey of the eastern section of the Australian Defence Industries site, St. Marys. Unpublished report for Gunninah Consultants.
- James, T.A. *et al.* (1994) Royal Botanic Gardens Assessment of the World Heritage Values of the Blue Mountains and surrounding plateaus.
- James, T.A & S. Mcune (1998a). Flora assessment for the proposed Highlands Resort development near Picton. Report prepared for DLWC.
- James, T.A. (1998b). Cumberland Plain Woodland Assessment, Claremont Meadows, Penrith. Report prepared for Biosis Research. Subsequent assessment of significance of Cumberland Plain Woodland at the site for Species Impact Statement (Dec. 1998).
- James, T.A. & S. Cook (1998d). Flora Survey of Domain Creek, Parramatta Park.
- Douglas, S.M. & James, T.A. (1998e). Report on the native flora and development potential of Lot72 DP661069 & Lot 75 DP 67236 Sirius Road, Voyager Point. Report to Liverpool City Council.
- James, T.A. (1999a). Species profiles and environmental impact assessment guidelines for the rare species *Epacris sparsa, Kunzea cambagei, Acacia baueri* subsp. *aspera, Euphrasia bowdeniae* and *Zieria covenyi.* Prepared for NSW NPWS.
- James, T.A. (1999b). 8 Part Test- proposed laying of underground electrical conduit at the Crest of Bankstown. Report to Bankstown City Council.
- James, T.A. (1999c). 8 Part Test for drainage works at the Crest of Bankstown. Report to Bankstown City Council.
- James, T.A. (1999d). Overview of vegetation and assessment of conservation significance at proposed Erskine Park Employment Area. Report prepared for Biosis Research.
- James, T.A. (1999e). Vegetation review and survey of Area 3, Chullora Industrial Estate. Report prepared for Mather & Associates and Business Land Group.
- James, T.A. (Sept 1999). Review of management plan for the Highlands Resort, Picton - report for DLWC.
- James, T.A. (Oct 1999). Field survey and 8-part test for *Acacia baueri* subsp. *aspera*. Report for the Illawarra Shooting Association.
- James, T.A. (Nov 1999). Flora assessment - proposed works at Oatlands Golf Course. Report to Oatlands Golf Club.
- James, T.A. (Dec 1999). Flora assessment - Bungarribee Creek, Blacktown. Report to Blacktown City Council.
- James, T.A. (Feb 2000). Norfolk Reserve, Greenacre - Plant Survey and 8 Part Test for proposed walking tracks. Report to Bankstown City Council.
- James, T.A. (March 2000). Flora survey along Clavering Road, Seaforth.
- James, T.A. (May 2000). Flora assessment and 8-part test for proposed high school development along York Road, Kellyville. Report to the Department of Public Works.
- James, T.A. (June 2000). Flora survey and assessment of remnant Cumberland Plain Woodland at Dr. Charles McKay Reserve, Mt. Druitt. Report to Dr. Charles McKay Reserve 271 Park Committee.
- James, T.A. (June 2000). Remnant bushland at Central Gardens, Merrylands - flora survey and assessment of conservation and educational values. Report to Holroyd City Council.
- James, T.A. (July 2000) Powell Park, Kurrajong Hills - flora survey and conservation assessment. Report to Hawkesbury City Council.

- James, T.A. (August 2000) Chullora Industrial Estate - bushland retention area (3) and adjoining lands - flora and fauna assessment and "eight part tests" of significance. Report to Business Land Group.
- James, T.A. (August 2000) Flora report for bushland along Ropes Creek, St. Marys with management guidelines. Report to National Trust.
- James, T.A. & S. Douglas (September 2000). Flora survey & 8-part test for Lower Prospect Canal.. Report to NSW NPWS.
- James, T.A. (November 2000). Flora inspection of proposed driveway across 181 Princes Highway, Sylvania.
- James, T.A. (November 2000) Preliminary flora & fauna survey - Arabella Street, Longueville - proposed subdivsion.. Report to City Plan Services.
- James, T.A. (January 2001) Flora survey and assessment for Dwyer Oval, Cabramatta for Liverpool City Council.
- James, T.A. (January 2001) Flora survey and assessment for Duncan Park, Seven Hills for Friends of Grantham
- James, T.A. & J. Anderson for Oculus Pty Ltd. (Feb-April 2001). Flora and fauna survey of reserves within Mosman Local Government Area for Mosman City Council.
- James, T.A. & J. Anderson (March 2001). Species Impact Statement - Lot 907 Narabang Way, Belrose. Report to Access Industrial Holdings Pty Ltd.
- (April-May 2001). Flora survey of Wingecarribbe Swamp. Field assistance provided to Sainty & Associates Pty. Ltd.
- James T.A. & Anderson, J. (May 2001). Preliminary flora and fauna survey for Public Reserve, Prestons. Report for Liverpool City Council.
- James, T.A. (March 2001). Species Impact Statement for Dendrobium Project (BHP) Woronora Plateau. Assistance provided to Biosis Research.
- James, T. A. (June 2001). Threatened flora assessment & survey – *Grevillea juniperina* subsp. *juniperina, Grevillea parviflora* subsp. *parviflora* and *Pultenaea pedunculata*. Report to NSW National Parks & Wildlife Service.
- James, T.A. & Anderson, J. (June 2001) Preliminary flora and fauna survey for Public Reserve south of Braidwood Avenue, Prestons. Report to Liverpool City Council.
- James, T.A. (July 2001). Flora survey - Scheyville National Park for NSW National Parks & Wildlife Service.
- James, T.A. (August 2001). 8 Part Test for proposed cycle track at Crest Reserve, Bankstown. Report to Bankstown City Council.
- James T.A. & Anderson, J. (August 2001). Preliminary flora & fauna survey of Chullora lands affected by proposed rail upgrade. Report to Rail Infrastructure Corporation.
- James, T.A. (Sept 2001). Inspection and assessment of current mowing/slashing activities at the St Marys ADI site. Report to Compliance and Enforcement Section, Environment Australia
- James, T.A. (Nov 2001). Flora survey for proposed drainage easement at Pleasure Point. Report to Liverpool City Council.
- Kodela, P.G., Bravo, F.J, James, T.A. & Sainty, G.R. (Dec 2001). Quantitative sampling of vegetation in Wingecarribee Swamp. Prepared for Sydney Catchment Authority.
- James, T.A. (March 2002). Moorebank Interchange - Threatened Flora Survey and Assessment. Report to Haliburton KBR and the Roads and Traffic Authority, New South Wales
- James, T.A. (March 2002). Clearing of native vegetation – Lots 1 & 4 Cowlishaw Street, Redhead. Report to NSWNPWS and Lake Macquarie City Council.
- James, T.A. (April 2002). Balmoral Road Land Release – Ecological assessment of Cumberland Plain Woodland. Report to Baulkham Hills Shire Council
- Kodela, P.G., Bravo, F.J, James, T.A & Olsen, A. (May 2002). Quantitative sampling for vegetation in Wingecarribee Swamp-Spring 2002 survey. Report for Sydney Catchment Authority.
- James, T.A. (May 2002). Post-fire survey for *Acacia baueri* ssp. *aspera* – proposed shooting range. Report to Illawarra Shooting Association.
- James, T.A. (May 2002). Eight-part test for Chullora siding proposal. Report to Rail Infrastructure Corporation.
- James, T.A. (August 2002). Ecological study of Castle Hill Cemetery. Report to Baulkham Hills Shire Council
- James, T.A. (August 2002). Flora survey and assessment for Precint A1, Judith Street, North Seaforth. Report to GHD for NSW Planning & RTA.
- James, T.A. (September 2002). Flora survey and assessment for Precint C North, Seaforth. Report to GHD for NSW Planning & RTA.
- James, T.A. (November 2002). Flora survey and assessment for proposed roadway and stormwater easement in vicinity of Clavering Road & Gurney Crescent, Seaforth. Report to GHD for NSW Planning & RTA.

- James, T.A. (December 2002). Flora survey and assessment for Lot 38A Boronia Lane, Seaforth. Report to GHD for NSW Planning & RTA.
- James, T.A. (January 2003). Flora survey and assessment (including 8 part-test) for proposed upgrade of Seaforth Oval. Report for Manly Council.
- James, T.A & Anderson, J. (February 2003). Flora and fauna survey and assessment (including 8 part-tests) for Lot 31 Muir Road, Chullora. Report to Landcom.
- James, T.A & Anderson, J. (February 2003). Flora and fauna survey and assessment for proposed re-zoning of creek-line in vicinity of 15-25 First Avenue, Hoxton Park. Report to Liverpool City Council.
- James, T.A. (March 2002). Flora survey of Heath Road Reserve. Report to Baulkham Hills Shire Council.
- James, T.A & Anderson, J. (April 2003). Review of Environmental Factors for proposed hazard reduction burn at the Kings School, North Parramatta.
- James, T.A & Anderson, J. (May 2003). Flora and fauna survey and assessment for Lot 11 Corner Hume Highway and Worth Street, Chullora. Report to Landcom.
- James, T.A. (June 2003). Chullora rail yard upgrade – targeted survey for Tadgell's Bluebell *Wahlenbergia multicaulis*, part of requirement for SIS. Report to Rail Infrastructure Corporation.
- James, T.A. (May-June 2003). Flora survey in Hunter district for NSW National Parks & Wildlife Service.
- James, T.A. (June 2003). Field survey in North West Sydney – for Eco Logical Australia and Planning NSW.
- James, T.A & Anderson, J. (September 2003). Flora and fauna survey of Caroll Park & surrounds, Casula. Report to Liverpool City Council.
- James, T.A. (October 2003). Flora survey in Nattai – Bargo district for NSW National Parks & Wildlife Service.
- James, T.A. (December 2003). Flora survey and assessment for rail corridor at Yagoona. Report to Report to Rail Infrastructure Corporation.
- James, T.A. (December 2003). Review of flora and fauna issues re proposed integrated housing development at Beames Road, Rooty Hill. Report to Dr. Charles McKay Reserve Committee.
- James, T.A. (February 2004). Flora survey and assessment for rail corridor at Birrong. Report to Report to Rail Infrastructure Corporation.
- James, T.A. (May 2004). Summary of flora surveys during 2003-4 in Dr Charles McKay Reserve, Mt. Druitt for Blacktown City Council.
- James, T.A. (May 2004). Conservation assessment of Cumberland Plain Woodland in Balmoral Road Land Release area, Kellyville. Report to Baulkham Hills Shire Council.
- James, T.A. (May-June 2004). Threatened flora assessment for proposed realignment of the Great Western Highway at Lawson. Report to Australian Museum Business Services and Roads & Traffic Authority.
- James, T.A. (July 2004). Yagoona cutting flora review. Report to Rail Infrastructure Corporation.
- James, T.A. & Anderson, J. (September 2004). Flora and fauna survey for proposed residential development at the Kings School, North Rocks. Shale Sandstone Transition Forest and threatened species. Report to the Kings School.
- James, T.A. (September 2004). Flora assessment for proposed construction of sewage effluent pipeline at Megarritys Creek, Warragamba. Report to Australian Museum and Sydney Water.
- James, T.A. (September 2004). Flora survey of Faulkland Crescent Reserve, Kings Park. Report to Blacktown City Council.
- James, T.A. (October 2004). Flora assessment for proposed construction of water quality basins at Henry Street and Waratah Street, Lawson. Report to Australian Museum and Roads & Traffic Authority.
- James, T.A. (October 2004). Clearing of native vegetation at Lot 102 DP 1027438, 238-258 Captain Cook Drive, Kurnell. Report to Dept. of Environment & Conservation.
- James, T.A. (November 2004). Review of flora and fauna assessment for proposed subdivision at Charcoal Road, South Maroota. Report to Baulkham Hills Shire Council.
- James, T.A. (January 2005). Birrong rail cutting - flora review. Report to Rail Infrastructure Corporation.
- James, T.A. (Feb 2005). Proposed construction of electricity transmission line west of Nowra – preliminary flora survey and assessment. Report to Parsons Brinckerhoff Australia Pty Ltd.
- James, T.A. & Anderson Ecological Surveys (March 2005). Amended Species Impact Statement for proposed development at 8 Narabang Way, Austlink Corporate Park, Belrose.
- James, T.A. (March 2005). Review of flora and fauna assessment for proposed subdivision at 48-52 Oratava Avenue, 11 Maralinga Place and 19-25 Timberline Avenue, West Pennant Hills. Blue Gum High Forest. Report to Baulkham Hills Shire Council.

- James, T.A. (May 2005). Flora assessment for proposed extensions at Chatswood High School. Report to NSW Dept. of Commerce (Government Architects Office).
- James, T.A. (September 2005). Review of flora and fauna assessment for proposed hotel complex at 314 Annangrove Road, Rouse Hill. Shale Sandstone Transition Forest. Report to Baulkham Hills Shire Council.
- James, T.A. (October 2005). Flora survey for proposed fire hazard burn at Lawson. Report to GIS Environmental Consultants.
- James, T.A. (November 2005). Flora survey and assessment of shale forest at Helensburgh. Report to J & Z. Erskine.
- James, T.A. (December 2005). Preliminary flora survey at 110 Hebron Road, Lower Portland.. Report to GIS Environmental Consultants.
- James, T.A. (February & March 2006). Flora surveys in BHP exploration areas (Appin district). Surveys undertaken for Biosis Research.
- James, T.A. (March 2006). Flora survey & assessment for proposed reconstruction of 32nd Avenue, Hoxton Park. Report to Liverpool City Council.
- James, T.A. (April 2006). Flora monitoring survey - Hartley Quarry. Survey for Biosis Research.
- James, T.A. (May 2006). Preliminary flora report – proposed Penrith Great River Walk. Report to Australian Museum Business Services for Penrith City Council).
- James, T.A. (May 2006). Autumn surveys in Dr Charles McKay Reserve, Mt. Druitt. Ongoing survey & monitoring for Blacktown City Council.
- James, T.A. (May 2006). Update of Species Impact Statement for proposed development at 8 Narabang Way, Belrose. Report to Access Industrial Holdings Pty Ltd.
- James, T.A. (May 2006). Review of Environmental Management Plan and site inspection for proposed stabilisation works along Birrong rail cutting. Advice to RailCorp.
- James, T.A. (July 2006). Flora investigation of alleged poisoning of vegetation on Lot 42 Warlands Creek via Blandford, Upper Hunter Valley. Report to Department of Environment & Conservation (Legal Branch).
- James, T.A. & Barker, C. H. (June-August 2006). Preliminary flora & fauna survey for Hyland Road Reserve (North), Greystanes. Report to Holroyd City Council.
- James, T.A. (September 2006) Threatened Flora Surveys – western Sydney. Targeted survey for Department of Environment & Conservation.
- James, T.A. (November 2006). Flora survey and assessment for proposed footbridge construction over Cabramatta Creek. Report to Liverpool City Council.
- November 2006. Targeted field survey for *Gentiana wingecarribiensis* at Wingecarribee Swamp, Southern Highlands. Assistance to Parsons Brincherhoff Australia.
- February-May 2007. Field survey of Sydney Metropolitan Catchment Management Authority area. Royal Botanic Gardens Trust and Sydney Metropolitan Catchment Management Authority.
- T.A. James (February 2007). Faulkland Crescent Reserve - flora survey and review. Report to Blacktown City Council.
- James, T.A. (April 2007). Upgrade of Great Western Highway at Wentworth Falls - proposed stockpile, compound and spill basin areas - Flora survey and assessment. Report to Australian Museum Business Services for RTA.
- James, T.A. (May 2007). Upgrade of Great Western Highway at Bullaburra – flora survey and assessment. Report to Australian Museum Business Services for RTA.
- BioBanking Pilot Program (May 2007). Field survey & assessment at three Sydney sites (Wilton, Camden & Cranebrook) to test draft assessment methodology. Undertaken with Australian Museum Business Services for Department of Environment & Conservation.
- James, T.A. (August 2007). Flora review – proposed re-zoning of land along Pacific Highway, Pymble with particular reference to Blue Gum High Forest. Report to Ku-ring-gai Council.
- James, T.A. & C. H. Barker (October 2007). Flora & Fauna Survey and Assessment – Castle Hill Cemetery. Report to Baulkham Hills Shire Council.
- James, T. A. (Nov 2007). Investigation of clearing of native vegetation at Lot 2 DP 559922, 280-282 Captain Cook Drive, Kurnell. Report to NSW Department of Environment & Climate Change (DECC).
- James, T.A. (Nov 2007). Review of flora assessment for proposed residential development at 216-220 New Line Road, Dural. Report to Hornsby Council.
- November 2007. Assistance to SMEC Australia with base-line ecological monitoring in Upper Nepean Special Area for SCA.
- James, T.A (Dec 2007-Feb 2008). Targeted survey for *Hibbertia superans.* Report to Indigenous Business Services.
- November 2007- January 2008. Targeted survey for *Gentiana wingecarribiensis* and *Prasophyllum uroglossum* at Wingecarribee and Hanging Rock Swamps. Report to NSW Department of Environment & Climate Change (DECC).

- March 2008. Flora survey for upgrade of Great Western Highway at Bullaburra. Report to nghenvironmental for RTA.
- James, T.A. (March 2008). Flora survey of Plumpton Park Reserve. Report to Blacktown City Council.
- James, T.A. (April 2008). Review of Water Street DA, Wahroonga. Report to Ku-ring-gai Council.
- James, T.A. (April 2008). Flora survey of Gum Tree Reserve, Guildford and Bolaro Avenue, Greystanes. Report to Holroyd City Council.
- May 2008-June 2009. Assistance to Ku-ring-gai Council to map and assess Blue Gum High Forest and Turpentine Ironbark Forest.
- James, T.A. (August 2008). Flora review of Species Impact Statement prepared for proposed industrial development at 37 Beaumont Road, Mt. Ku-ring-gai. Report to Hornsby Shire Council.
- James, T. A. (May 2009). Preliminary flora report for proposed residential development at 38-40 Grove Avenue, Narwee.
- James, T.A. & Barker, C. (2006-2009). Monitoring of flora and fauna at Hyland Road Reserve. Report to Holroyd City Council.
- James, T. A. (Sept 2009). Ecological issues relating to the Turramurra Deferred Area within Ku-ring-gai LGA. Report to Friends of Turramurra.
- James, T.A. (Sept 2009). Targeted survey for *Pimelea spicata* at Menangle Park. Assistance to GHD Pty Ltd.
- James, T.A. (Sept 2009). Investigation into land clearing of Shale Sandstone Transition Forest and Cumberland Plain Woodland - 561 Appin Road, Gilead. Report to Campbelltown City Council.
- James, T.A. (Nov 2009). Peer review of subdivision proposal at Kellyville. Shale Sandstone Transition Forest & threatened species present. Report to Hills Shire Council.
- James, T.A (2010). Field survey and ecological assessment for proposed park at Water Street, Wahroonga. Report to A. Parr.
- James, T.A. (March 2010). Survey of *Pimelea spicata* at Menangle Park for GHD.
- March-April 2010. Advice on threatened species for Growth Centres Strategic Assessment under EPBC Act to EcoLogical Australia.
- Lewis Ecological Surveys & James, T.A. (May –June 2010). Flora and fauna assessment for extension of Kirkwood Road, Tweed Heads. Report to Tweed Heads Shire Council.
- Lewis Ecological Surveys & James, T.A. (May –June 2010). Compensatory habitat assessment for the Kempsey to Eungai pacific highway upgrade.
- Joint project with Australian Museum (October 2010 - March 2011) – Flora & fauna survey for Stage 2 of the Narrabeen Lagoon Multi-use Trail.
- Joint project with Australian Museum (October 2010 - December 2011) – City of Sydney Biodiversity Survey & Strategy.
- James, T.A. (2011). Investigation into land clearing of Shale Sandstone Transition Forest and Cumberland Plain Woodland - 561 Appin Road, Gilead. Expert report to DECCW.
- James, T.A. (2011) Flora survey for three reserves in Holroyd LGA to document regeneration following the cessation of mowing. Report to Holroyd City Council.
- James, T.A. (2011) Flora survey of Grey Box Reserve, Greystanes. Report to Holroyd City Council.
- Douglas, S & James, T (2011) Review of listing advice and conservation advice for Shale Sandstone Transition Forest EEC under the EPBC Act – in progress.
- James, T.A. (2011) External Review of White Box – Yellow Box – Blakeley's Red Gum grassy woodlands and derived native grassland ecological community for the Mt. Pleasant Project (EPBC 2011/5795). Report to Dept. of Sustainability, Environment, Water, Population and Communities.
- Ecological advice to SMEC Australia (July-August, 2011). Impact assessment for *Pimelea spicata* – upgrade of Camden Valley Way, western Sydney.
- Ecological advice to SMEC Australia (August-September, 2011). Survey and assessment for Eastern Flame Pea – Trans Grid Dapto substation upgrade.
- Field assistance to SMEC Australia (February 2012) - Targeted survey for *Pimelea spicata* and general survey for RTA Camden Valley Way upgrade.
- PAS2 Expert Interviews for NSW threatened species with Office of Environment & Heritage (February-August 2012).
- Plot survey and ground verification of vegetation mapping within Hills Shire Council (June 2012).
- Threatened species management plans for several species prepared for Hills Shire Council (June 2012) – multi-species plan for Paulls Road (South Maroota), individual plans for *Persoonia hirsuta* and *Epacris purpurascens* at Fred Caterson reserve.
- Joint project with Australian Museum - Narrabeen Lagoon multi-trail (stage 2) Species Impact Statement (June 2012)
- Field assistance to SMEC Australia at Western Sydney Parklands vegetation monitoring for WSP Trust (July – August 2012).

- Biodiversity/conservation assessment for 12-14 Cabernet Circuit Orchard Hills. Unpublished report to Wayne Olling,of CCA (October 2012)
- PAS Reviews for selected NSW threatened species with Office of Environment & Heritage (November 2012).
- Vegetation Peer Review for the Northern Beaches Health Service Project. Report to Health Infrastructure (January 2013).
- Flora survey and assessment on private properties within the Balmoral Release Area, Kellyville (15, 16-20, 24, 26 & 28) for the Hills Shire Council (May-June 2013).
- Preparation of a Threatened Species Plan of Management for *Dillwynia tenuifolia* endangered population along Maquires Road, Maraylya for the Hills Shire Council (May-June 2013).
- Biobanking Assessment Report for the Northern Beaches Hospital Precinct development (a State Significant Development). July 2013. Report to SMEC Australia and Health Infrastructure.
- Threatened species roadside survey and verification of threatened ecological communities for Campbelltown City Council (September-October 2013).

NSW Land & Environment Court cases:

- Grand United Friendly Society v Minister for the Environment - 87A Hammers Road, Toongabbie**.** Land & Environment Court.Proceedings No. 40292 of 1997. Engaged as a consultant by NPWS. Issues relating to Cumberland Plain Woodland and Shale Sandstone Transition Forest.
- Australand v Penrith City Council, Erskine Park (Dec 1999-April 2000). Land & Environment Court Proceedings. Engaged as a consultant by Penrith City Council. Cumberland Plain Woodland and Sydney Coastal River-flat Forest.
- Penrith City Council v Norman Mathie & Others – 392-476 Luddenham Road, Luddenham. Land & Environment Court Proceedings No. 50080-82 of 1999. Engaged as a consultant by Penrith City Council. Issues relating to Cumberland Plain Woodland and Sydney Coastal River-flat Forest.
- Blacktown City Council v Megarry Excavations and Roadworks Pty Ltd. Land & Environment Court Proceedings No 40141 of 2000. Engaged as a consultant by Blacktown Council. Issues relating to Cumberland Plain Woodland and Shale Gravel Transition Forest.
- Mark Topic v Liverpool CityCouncil. North Liverpool Road. Land & Environment Court Proceedings No 0155 of 2000. Engaged as a consultant by Liverpool City Council. Issues relating to Cumberland Plain Woodland
- Australand v Liverpool City Council. Land & Environment Court Proceedings No 10374, 10375, 10376, 10377 of 2003. Engaged as a consultant by Liverpool City Council. Issues relating to Cumberland Plain Woodland and Sydney Coastal River-flat Forest
- Development Approval Managers v Liverpool City Council. Land & Environment Court Proceedings No. 10453 (Stage 3), No. 10455 (Stage 4) and No. 10454 (Stage 5) of 2003. Engaged as a consultant by Liverpool City Council. Issues relating to Cumberland Plain Woodland and Sydney Coastal River-flat Forest
- BGP Properties v Lake Macquarie City Council **-** Lots 1 & 4 Cowlishaw Street, Redhead. Land & Environment Court Proceedings No 10042 of 2003. Engaged as a consultant by Lake Macquarie City Council. Issues relating to Sydney Freshwater Wetlands and *Tetratheca juncea*.
- Bentley v Hugh Gordon, Bentley v BGP Properties, Bentley v Whet Investments - Lots 1 & 4 Cowlishaw Street, Redhead. Land & Environment Court Proceedings No 50069-80 of 2003. Engaged as a consultant by NSW National Parks & Wildlife Service. Issues relating to Sydney Freshwater Wetlands and *Tetratheca juncea*.
- Blue Mountains City Council ats Blaxland Park Pty Ltd**.** - 60 Winnicoopa Road, Blaxland. Land and Environment Court Proceedings No. 10033 of 2004. Court appointed expert. Survey, identification & assessment of *Eucalyptus sclerophylla* Bench Woodland and *Lomandra brevis* in Repsonse to Agreed Questions.
- Providence Projects Pty Ltd v Gosford City Council – Lot 17 Meacham Way, Woy Woy. Land and Environment Court Proceedings No. 11626 of 2004 & 10101 of 2005. Court appointed expert. Review of issues relating to the identification of Umina Coastal Sandplain Woodland.
- Liverpool City Council ats Muslim League of NSW – 264 Wilson Road, Green Valley. . Land & Environment Court Proceedings No 10394 of 2005. Engaged as a consultant by Liverpool City Council. Issues relating to Cumberland Plain Woodland.
- Liverpool City Council ats AV Jennings – Stage 24 Dalmeny Drive, Prestons. Land & Environment Court Proceedings No 10395 of 2006. Engaged as a consultant by Liverpool City Council. Issues relating to Cumberland Plain Woodland.
- Director General, Department of Environment & Conservation v Serenity Cove Business Park Pty Ltd – 238-258 Captain Cook Drive, Kurnell. Land & Environment Court Proceedings No 50003-5005 of 2006. Engaged as a consultant by the Department of Environment & Conservation. Issues relating to

Swamp Sclerophyll Forest on Coastal Floodplains (formerly Sydney Coastal Esutary Swamp Forest), Sydney Freshwater Wetlands & Kurnell Dune Forest.

- Sutherland Shire Council ats Rocla Pty Ltd. Land & Environment Court Proceedings No 10447 of 2005. Engaged by Sutherland Shire Council. Issues relating to Swamp Sclerophyll Forest on Coastal Floodplains and Sydney Freshwater Wetlands.
- Wollongong City Council ats Albert David Moulds. Land & Environment Court Proceedings No 10488 & 10563 of 2006. Engaged as Court Appointed Expert. Issues relating to Illawarra Subtropical Rainforest and *Cynanchum elegans*.
- Gerroa Environment Protection Society v Department of Planning and Cleary Bros. Pty Ltd. Land & Environment Court Proceedings No 10801 of 2007. Issues relating to Swamp Sclerophyll Forest, Bangalay Sand Forest and Littoral Rainforest.
- Ecological advice to Ku-ring-gai Council and Land & Environment Court in relation to proposed development at 1-9 Buckingham Road, Killara. Issues relating to Blue Gum High Forest.
- Kaligem Pty Ltd v Ku-ring-gai Council. Proceeding No: 10823 of 2008 Ecological advice to Ku-ring-gai Council and Land & Environment Court in relation to proposed development at 5-7, Lonsdale Avenue, Pymble. Issues relating to Sydney Turpentine Ironbark Forest.
- Proceedings No: 10496 of 2009 Ecological advice to Warringah Council and Land & Environment Court in relation to proposed development at Beacon Hill. Issues relating to threatened species & general environmental impact. Proceedings No 10973 & 10794 of 2009.
- Ecological advice to Ku-ring-gai Council and Land & Environment Court in relation to proposed development at 35 Billyard Avenue, Wahroonga. Issues relating to Blue Gum High Forest. Proceedings 10908 of 2009 (NSWLEC 1222).
- Expert advice to the Environmental Defenders Office and Land & Environment Court in relation to proposed development at Jordan Springs, St. Marys. Proceedings 40873 of 2011.
- Expert advice to the Office of Environment and Heritage and Land & Environment Court in relation to alleged clearing of endangered ecological communities (Cumberland Plain Woodland and Shale Sandstone Transition Forest) at Gilead, western Sydney. Proceedings 50604 of 2011.
- Expert advice to Ku-ring-gai Council and Land & Environment Court in relation to proposed development at Knox Grammar School, Warrawee. Issues relating to Blue Gum High Forest. Proceedings 10762 of 2011.