29 January 2016

Reference: **Select Committee on Unconventional Gas Mining**

Dear Select Committee,

thank you for the opportunity to make a submission to the 'Select Committee on Unconventional Gas Mining'.

As one involved in recent years in environmental surveys in the Western Darling Downs, I had opportunity to observe and meet with rural landowners impacted by the CSG industry (Annexes A, B). I soon formed the view that, the scale and pace of this industrialisation of the rural Murray-Darling Basin (MDB) landscape, is without precedent in Australian history. Given its geographical extent and extraction density, the CSG industry in the Downs is a huge 'gas refinery', comprised of a vast, pressurised, leaking, below-ground 'tank farm', and an labyrinthine, gas gathering and purifying network above-ground.

However, despite this extensive and intensive terrestrial 'footprint', the CSG industry literally 'mushroomed' in Queensland, with little to no commitment to the precautionary principle. A 5-year, pilot CSG-extraction lease was not awarded, and consequently there was no research and monitoring of such before any up-scaling 'go/no go'. In fact, I am unaware of any phased, developmental, 'go/no go' criteria being applied to this industry. Further, to my knowledge, there was little to no air, soil and water benchmarking done with environmental surveys tailored to the already known inputs and outputs of this imported industry. Even today, I believe the surface atmosphere impact of this industry is still unknown, as one is unaware of any monitoring of the gaseous and particulate plumes over the Downs. Again, without hesitation, hydraulic fracturing was quickly brought up from the conventional Oil & Gas "deeps" into the unconventional "shallows" of the eastern lip of the Surat Basin, noted for its discontinuous, heterogeneous, incompetent, transmissive, strain-relaxed, lithologies. Such is evident in the CSG well completion report core logs and photos, that typically tell a different geological story to the simplistic 'block lithology cartoons' that appear in the same reports.

The appeal to surface-spreading of co-produced water, and to the venting and burning of unwanted gases, within the fragile MDB, has been simply 'breath-taking'. 'Dilution is the solution to pollution' is, at best, an half-truth. As 'pollution', by definition, is the 'dilution' of surficial soil, water and air quality with non-beneficial chemical species, 'dilution is the solution to dilution' does not make sense - only more 'dilution. For example, the Sodium Adsorption Ratio (SAR) is the ratio of soluble sodium to soluble calcium and magnesium, and consequently it can highlight the difference between natural surface and subterranean water chemistries with their different elemental ratios (Annex C). Water and air energies and gradients, plumes, earth-moving, fine dusts, etc., are some of the mechanisms that redistribute the exhumed, non-beneficial elemental ratios into the natural terrestrial environment, thereby adding to any 'dilution' that is really 'pollution'. Every single unit increment of the SAR has an impact on fragile soils, surface waters and hence vegetation - near and far, up and down, - the rural and agricultural MDB. The subject here is natural surface geochemistry 'tipping points', and how close we now are to them.

One aspect of CSG industrialisation is the concentration and disposal of many, natural and industrial, oxidised and unoxidised, low to high molecular weight, organic and inorganic, wanted and unwanted, solid-liquid-gas chemical species. Society provides little to no guidance, thresholds or value judgements on the combined impact of these many, often 'bit players', on environmental and human health. The aggregation of many minor quantities of many chemicals, like SMOG, requires on-going, broad-spectrum, environmental survey and assessment. Even at today's advanced stage of CSG development, this does not appear to have been done.

For over 100 years, mining in Australia has a self-evident history of resource 'rushes' with ensuing hasty development, degraded landscapes, human losses and derelict sites. One surely could be forgiven for hoping we had learnt to do it better.

Sincerely,
John Polglase

**Annex A**

**Darling Downs Field Trip**
**1-4 April 2013**

J. Polglase

27 April 2013

The groundwater quantity and quality, test and sample field trip covered an area bounded by Condamine, Chinchilla, Dalby and Moonie. During the trip it was learnt that:

1 Landowners are being offered treated and untreated water 'co-produced' with CSG mining, hereafter called 'waste water'.

2 The landowners response to the 'waste water' being offered by the CSG companies is varied. Most are cynical but at the moment have little understanding of just what this water is. Some do not see it as 'waste water'. To them it is water and they want it.

3 This 'waste water' has not undergone waste classification, and thus the handling, transport, treatment, mixing and storage requirement of this waste is unknown.

4 This 'waste water' comes with a disclaimer of any liability to the CSG company supplier.

5 This 'waste water' is not guaranteed wrt volume or quality.

6 This 'waste water' is being marketed as a 'product' to irrigator, farmer, grazier, stock and domestic users, but it has no specification. It is said to be 'fit-for-purpose' but 'fitness' and 'purposes' are not defined.

7 This 'waste water' may have a fee attached. In some cases a penalty for not taking the 'waste water' has been applied, with a fee per ML far greater than the market cost of water.

8 The purchaser of this 'waste water' is responsible for any non-beneficial outcomes or harm to the environment on his own property.

9 One reason why CSG companies do not favour re-injection is that they will similarly bear the risk of any non-beneficial outcomes or harm to the environment.

10 Unconventional CSG mining falls under the petroleum and conventional gas production acts. "The Petroleum and Gas (Production and Safety) Act 2004 and Petroleum Act 1923 authorises petroleum tenure holders to undertake activities related to the exploration for, and production of, petroleum and gas. This authorisation also includes the right to take or interfere with groundwater. However, the Water Act 2000 establishes responsibilities for petroleum tenure holders to monitor and manage the impacts caused by the exercise of these groundwater rights, including a responsibility to make good impairment of private bore water supplies. Those provisions exist because water is found in association with petroleum and gas and it is not practicable to manage the water separately." [Surat Underground Water Impact Report (UWIR), p. ix, www.dnrm.qld.gov.au/ogia].

11 The Surat UWIR modelled that over the long term, 528 registered water bores are predicted to be affected [refer UWIR Summary]. However, as the model needs to be updated over time, this estimate may change.

12 The QLD Government permits the CSG companies to 'cap and abandon' privately-owned groundwater bores that are / will be degraded in volume and quality by CSG mining. This effectively removes the registration of the groundwater bore.

13 CSG companies have removed pump fit-outs and filled casings with concrete.

14 The QLD Government is making no recompense for the loss of these groundwater supplies.

15 The so-called 'make good' provisions are for degraded bores, not for the degraded aquifer that supplied them.

16 The 'make good' provision is based on a designated drop in Standing Water Levels, not on a loss of water quality.

17 As of late 2012, no 'make good' agreements had been lodged with the QLD Government.

18 The land-owner may build a 'stock and domestic' bore into a deeper aquifer at own expense. However, there is a moratorium on further licensing such from GAB.

19 New deeper bores will typically cost more to pump, and their quality and quantity may be inferior to the previous bore supply. The quality and quantity of this deeper ('older') groundwater will vary with geology and location.

Opinion: CSG 'extraction' or 'production' is technically a 'mining' activity, and CSG formation water is technically a 'mining waste', as it is not the targeted economic resource. What is happening in QLD is effectively 'waste dumping'. Further, it is the substitution of a 'natural' groundwater supply with an unreliable and generally inferior one.

# Annex B

## Degradation of Rural Environments and Life-styles by Escalating CSG Industrialisation: Some Key Factors

J. Polglase
7 July 2013

### A Political Bias

1 The extent of the political, legal and fiscal primacy of subterranean mineral and fossil fuel resources over terrestrial, 'life-sustaining', environments and catchments and their inhabitants.

2 The extent of the political, legal and fiscal primacy of subterranean mineral and fossil fuel resources over good, sustainable groundwater resources.

3 The lack of time and funding made available for detailed submissions, independent scientific research, and legal recourse.

4 The disingenuous use of 'Commercial-in-Confidence' and of arbitrary and non-scientific 'Terms and Conditions' to keep local communities uninformed.

[Examples: only monitoring the quality and level of groundwater bores within an arbitrary one surface kilometre 'stand-off' from a fraccing well; only monitoring the quality and level of groundwater bores within an arbitrary 200m vertical distance from a fraccing horizon; unexplained forced capping and abandonment and de-registration of degraded or to-be-degraded groundwater bores (note groundwater bores are degraded - not aquifers).]

### B Operational Compliance

5 The absence of adequate compliance and environmental monitoring of CSG activities by Government agencies and independent scientists, beginning with exploration.

6 Over-reliance by Government agencies on CSG self-monitoring and related public statements made without the provision of supporting scientific data.

7 The gap between sweeping, generic and imprecise environmental impact and risk management statements and documents, and the day-to-day activities of CSG field operations in localised environments and geologies.

8 The lack of monitoring and enforcement of appropriate drilling and well-construction certification and worker experience.

9 The inconsistency of drilling and well-construction procedures across CSG operators.

10 The legality and impact of lateral drilling and mass extraction under private or public property.

11 The lack of prosecution and exaction of penalties for non-compliance.

### C Scientific Data

12 The profound absence of transparency and paucity of scientific data.

13 The unavailability of adequate scientific data.

14 The absence of background, on-lease and off-lease, environmental surveys of air, soil, rain water, surface water, and groundwater in both consolidated and unconsolidated material in the geological column (the 'shallows', <650m); antecedent to lease awards.

15 The lack of scientific data for localised, interconnected, strain and pressure systems in the 3-D geological column (the 'shallows', <650m).

16 The failure to monitor off-site / off-paddock / off-lease, up- / down-gradient, air and catchment impacts of CSG activities by Government agencies and independent scientists .

17 The failure to monitor solid-liquid-gas phases in-cage / on-property / on-lease, and make such data publicly available.

**D Environmental Impact**

18 The injection and loss of known, or suspected, toxic chemical contaminants and aggregates of same in sub-surface water systems via drilling, fraccing and waste disposal.

19 The voluminous disposal of highly saline fluids and solids onto roads, into waterways, and onto soils in rural localities, and the lack of information re. same.

20 The venting and flaring (high temperature combustion) of untested and unquantified gaseous and particulate wastes into the atmosphere.

21 The absence or lack of evidence of solid-liquid-gas radionuclide and radiation monitoring and handling.

22 Air pollution via gaseous and ultrafine particulate matter from fugitive gases, venting, flaring, diesel combustion engines, and vehicle movements. The creation of smog and acid rain locales.

23 The volume, temperature and chemistry of manual and automated gas flaring resulting in chemical compounds and accumulations of known or suspected toxicity.

24 The consumption of atmospheric molecular oxygen via the exhumation and emission of reduced and reactive solid-liquid-gas elements and chemicals. The creation of oxygen-depleted locales.

25 The exhumation, oxidation, concentration and liquid-air mobilisation of non-beneficial trace elements.

26 Ultrafine silicate etc. dusts from intensive earth moving, drilling, fraccing and vehicle movements.

27 The contamination of rain and rainwater collection systems (gutters, tanks and sediments), soils, dams and streams.

28 The alerting, measurement and monitoring of seismic shock waves from fraccing, and the subsequent damage to groundwater bores and surface structures and infrastructures.

29 The lack of scientific monitoring of - and data on -, the impact of seismic shock waves on groundwater systems.

30 Unprecedented groundwater bore draw-downs and de-pressurisation due to dense, localised well drilling, fraccing and mass (solids, groundwater) extraction.

31 The sudden or gradual long-term degradation of groundwater bore quality.

32 The absence of measurement and monitoring of sound and infra-sound impacts on living organisms (eg. from seismic surveys, fraccing, large diesel engines and generators).

**E Waste Management**

33 The absence of 'as-you-drill' or 'well-completion' solid-liquid-gas waste classification and concomitant waste management.

34 The lack of available information concerning the handling, transport, storage, processing and disposal of drilling, well-stimulation, production and water treatment solid-liquid-gas wastes.

35 The lack of available information concerning the usage, transport, storage, exhumation and fate of specific chemical compounds of known toxicity.

36 The lack of disclosure concerning terminal (ultimate) solid-liquid-gas waste disposal.

37 The discharge of untested and unquantified liquid and particulate wastes onto roads and into water ways.

**F Human Health**

38 The failure to comprehensively research and monitor the human health complaints of both the local community and CSG workers.

39 The psychological stress and ensuing illness from duress over legal, property and life-style matters; from CSG company pressure and visitations over property access, road access to property, property sale, etc.; from the ubiquitous secrecy and physical presence of the CSG companies.

# Annex C

## Queensland CSG Co-produced Water Salinity

J Polglase
1 Oct 2015

Reference:

Shaw, M. 2010. Stream ecosystem health response to coal seam gas water release: Hazard characterisation. Department of Science, Information Technology, Innovation and the Arts (DSITIA), Brisbane, 37pp.

https://www.dnrm.qld.gov.au/__data/assets/pdf_file/0012/106104/stream-ecosystem-health_hazard-characterisation.pdf. Downloaded 01/10/2015.

Hereafter, the 'DSITIA report'.

Wrt p 10 in the DSITIA report, QLD CSG co-produced water is characterised by:

Na min. = 721 mg/L
Na max. = 2683 mg/L

Cl min. = 370 mg/L
Cl max. = 2793 mg/L

Further, wrt to pp 18, 27, aggregated QLD CSG co-produced water b/n 2018 and 2027 (9 years) is estimated to be an average ~130 GL p.a. [1GL = 1 billion litre = 1,000,000,000 L].

As one appreciates, NaCl = $Na^+$ plus $Cl^-$. That is, a simple 1:1 ratio of sodium and chlorine atoms achieves the natural electronic balance for this 'the commonest of salts'.

However, given that the standard atomic weights of Na (22.99) and Cl (35.45) are not equivalent, 1 g of molecular NaCl is comprised of approximately 0.3934 g of Na and 0.6066 g of Cl. That is, 39.34 %wt of Na and 60.66 %wt of Cl.

If we assume that nearly all the Cl is bound to the more abundant Na in the form of highly ionic and water soluble NaCl:

NaCl mg/L min. = 370 mg/L Cl + 240 mg/L Na = 610 mg/L = 0.610 g/L
NaCl mg/L max. = 2793 mg/L Cl + 1811 mg/L Na = 4604 mg/L = 4.604 g/L

That is, the NaCl wt. in 130 GL of QLD CSG co-produced water is approximately:

NaCl min. = 0.610 g/L x 130,000,000,000 L = 79,300,000,000 g = 79,300,000 kg = 79,300 ton p.a.
NaCl max. = 4.604 g/L x 130,000,000,000 L = 598,520,000,000 g = 598,520,000 kg = 598,520 ton p.a.

Of course, one must multiply these totals by 9 or more years [DSITIA report, pp 18, 27].

In evaluating such quantities, it must be noted that:

a. the calculations rely upon minimal data and forward estimates provided by some vested-interest companies;

b. the calculations are chloride limited and do not deal with the remainder of the Na (whether adsorbed onto negatively-charged particulate and crystal surfaces, or compounded as bicarbonate, sulphate, fluoride, bromide, etc.), ie:

Na balance min. = 721 mg/L minus the above 240 mg/L = 0.481 g/L = 62,530 ton of 'other' Na p.a.
Na balance max. = 2683 mg/L minus the above 1811 mg/L = 0.872 g/L = 113,360 ton of 'other' Na p.a.;

c. whatever the amount of NaCl and other salts terrestrially aggregated by CSG extraction, all are ADDITIONAL to pre-existing locality or regional salt budgets / loads; and

d. given our continent's pre-disposition to salinisation, the Australian Sodium Adsorption Ratio (SAR) has a very fine 'tipping point'.

One measure of salinity in water and soil solution is the Sodium Adsorption Ratio (SAR). It is simply an atomic charge and weight normalised ratio of sodium to calcium and magnesium. These three cations belong to the four major metal cations found in natural waters (potassium being the fourth). The SAR derived from the data on pp. 13, 23 are min. = 92 and max. = 187. When one considers the tens of millions of public monies spent over decades educating and assisting agricultural land-holders etc. in practices that control and reduce salinisation of our low-energy landscapes - to keep the SAR below 20 and ideally below 10 -, sustained additional amounts of NaCl as calculated will retard and limit agricultural options up and down the Murray-Darling Basin (MDB).

The DSITIA report's forward estimates, based on 'earlyish' industry data, inform us that the worst is ahead for the MDB. The amount of 'common salt' (NaCl) involved is significant when compared to the aggregated contribution of all the other natural and introduced chemicals dissolved or suspended in the co-produced waters. Elevated quantities of saline liquid and solid aerosols from storage ponds, ephemeral waterways and shallow soils, with time will have a insidious deleterious or even desertification effect on already fragile and marginal landscapes, up and down, the MDB - and beyond. Australia, of all the Continents, already battles salinisation and desertification - CSG waste water, surficially stored and distributed, will in time make it demonstrably worse.

All this helps explain the growing push for re-injection.