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18 May 2017

The Honourable Justice Rachel Pepper
Hydraulic Fracturing Task Force
GPO Box 4393
Darwin NT 0801

The Honourable Justice Rachel Pepper

Re: Hydraulic Fracturing Inquiry – Information Request

Pursuant to your requests dated 28 April 2017, I enclose Santos' response below:

Email #1: RE: Economic Impacts of the Unconventional Gas Industry

1) Seeking a contact for the Inquiry and the economist (consultant)

Primary Contact: Tom Baddeley – Manager Public Affairs

Email #2: RE: Hydraulic Fracturing Inquiry – Information Request

Petroleum Resource Information

2) Up to date published estimates of potential shale and tight gas resources in the Northern Territory held by Santos

Santos has provided our estimate for the Velkerri B Shale (refer to Pg 34 of submission)

3) Professional advice from Santos as to estimates of which (if any) of the resources have the potential to be developed, the factors influencing this, and in what timeframe

Santos considers the Velkerri Shale as a prospective resource target (refer to Section 4.2.1 (Pg 32) of submission)

Influencing factors were included in the Santos submission and located at:
a. Refer to Section 3.2 and 3.2.1 (Pg 6) of submission
b. Refer to Section 4.3 (Pg 35) of submission
c. Refer to Section 4.3.1 (Pg 38) of submission

A time Frame for a conceptual development scenario is presented in Fig 21 of the Santos submission (refer to Pg 37 of submission).

4) Ranges of indicative gas volumes that could be developed and levels of confidence for these resources

The Santos conceptual development scenario is based on Velkerri B Shale. This is likely to be the 'best' quality shale in terms of total resource. Indicative gas in place volumes for the B shale are indicated in Section 4.2.1 (Pg 35 of submission).

If necessary, Santos can provide additional information to detail the A and the C shales. At this stage, these are not being considered for development..

In regards to confidence Santos provides the sensitivity assessments and assumptions (Table 1): Assuming a fixed well design: 2000m lateral w/ 34x fracture stages, recovering 0.425 Bcf/Stage = 14.45 Bcf Raw Gas / well

Table 1: McArthur Basin Development Concept Plateau Rate Sensitivity

Metric / Parameter	400 TJ/d Plateau Rate (146 PJ pa)		800 TJ/d Plataea Rate (292 PJ pa)	
Raw Gas / Well (Bcf)	14.45		14.45	
# Wells	326		652	
Well Spacing (acres)	240	480	240	480
Subsurface Area of Interest (km^2)	317	633	633	1267
# wells / pad	4	10	4	10
# pads	82	33	163	66

A further sensitivity can be studied which considers both higher and lower well deliverability (Table 2):

- *Low Case: 2000m lateral w/ 34x fracture stages, recovering 0.34 Bcf/Stage = 11.56 Bcf Raw Gas / well*
- *High Case: 2000m lateral w/ 34x fracture stages, recovering 0.6 Bcf/Stage = 20.4 Bcf Raw Gas / well*

Table 2: McArthur Basin Development Concept Well Deliverability Sensitivity

Metric / Parameter	400 TJ/d Plateau Rate (146 PJ pa)		800 TJ/d Plataea Rate (292 PJ pa)	
Raw Gas / Well (Bcf)	11.56		20.4	
# Wells	408		462	
Well Spacing (acres)	240	480	240	480
Subsurface Area of Interest (km^2)	396	793	449	897
# wells / pad	4	10	4	10
# pads	102	41	116	47

A further Field Development scenario may also be considered. In this case, fewer wells are required to fill a smaller production facility. Fewer wells and subsequently fewer well pads are required (Table 3).

Table 3: McArthur Basin Development Concept Smaller Field Development Scenario

Metric / Parameter	200 TJ/d Plateau Rate (73 PJ pa)		200 TJ/d Plataea Rate (73 PJ pa)	
Raw Gas / Well (Bcf)	11.56		14.45	
# Wells	204		163	
Well Spacing (acres)	240	480	240	480
Subsurface Area of Interest (km^2)	198	396	158	317
# wells / pad	4	10	4	10
# pads	51	21	41	17

5) All digital information relating to the boundaries of all potential shale and tight gas resources identified by Santos in the Northern Territory

Santos will provide shape files under a separate transmittal

6) All information relating to the geology and geochemistry of these prospective resources

Santos provided geological and geochemical in the submission.

- *Refer to Section 3.1.2 (Pg 5) of submission*
- *Refer to Section 4.1 (Pg 30) of submission*
- *Refer to Section 4.2.1 (Pg 32) of submission*

Please note that all Santos Tanumbirini-1 well data is open file and available from the NT Government. Please let us know if any specific information is required.

Petroleum Industrial Water Use Information

7) Estimates of water requirements for the life cycle of the industry, broken down into development stages i.e. exploration, drilling, production etc. (assumptions on likely development scenarios to be included)

Santos provided water use information in the submission. This included both the exploration and appraisal and the development phase. Please refer to Section 4.3 (Pg 35), Figure 21 (Pg 37) and Section 7.4.2 (Pg 96).

To break down into phases (which overlap) then it may be reasonable to assume:

- *Exploration and Appraisal Phase = 770ML (note already included in the submission scenario)*
- *Development Phase = 4.7GL (50% recycling) to 10GL (no recycling)*
- *Production Phase = 10 to 20 ML/year (based on operational experience)*

8) Likely source of water for potential developments in the Northern Territory

Likely sources of water were provided in the Santos submission. Please refer to Section 3.2.3.3 (Pg 16) and Section 7.4.3 (Pg 96) of the submission.

9) Estimates of volumes of waste water to be produced by potential development for the life cycle of the industry, broken down into development stages i.e. exploration, drilling, production etc. (assumptions on likely development scenarios to be included)

Estimated of volumes of waste water were provided in the Santos Submission. Please refer to Section 3.2.3.5 (Pg 25) and Section 3.2.3.6 (Pg 25) of the submission.

10) Likely economical recycle rates for wastewater reuse

Santos has not been able to obtain any data to assess the water / waste quality and are therefore unable to provide any site specific data or assessment (due to the moratorium coming into place before would could undertake the activity). Therefore we have provided an indicative range of 0% to 50% based on experience.

Please refer to Section 4.3 (Pg 35) & Fig 21 (Pg 37) and Section 7.4.2 (Pg 96) of submission.

11) Best estimates of likely discharges (controlled and uncontrolled) into the environment from a potential development detailing frequency, number quantity and quality.

No planned releases to the environment are planned or under consideration. Management controls focus on avoiding and then managing the risk unplanned releases. Any discharges would be reported to the regulatory authority.

12) List of the likely chemicals in waste waters and their individual and combined toxicity.

Santos has not undertaken hydraulic fracturing activities for shale gas in the Northern Territory and has not sufficiently progressed planning for such activities. This includes the selection of a hydraulic fracturing service provider and the evaluation of their potential fluid systems and associated chemical additives. Santos is therefore not in a position to provide potential development or location specific information.

Santos provided however references and associated links to our publically available hydraulic fracturing and chemical risk assessment for other Santos developments in the submission. These reports provide chemical additive disclosure and describe and assess the individual chemical additive and combined mixture toxicity including the source water and geogenic constituents in flowback.

These reports can be found at the following links:

- *Chemical Risk Assessment*
- *Compendium of Assessed hydraulic Fracturing Fluids (note multiple appendices)*

Santos also provided a scope of work for undertaking such hydraulic fracturing / chemical risk assessments in the submission (Refer to Appendix B) - should the moratorium be lifted and activities allowed to resume.

Please refer to the following sections of the Santos submission for further information:

- *Section 3.2.3.3 (Pg 16) of submission*
- *Section 7.6 (Pg 101) of submission*
- *Appendix B (Pg 207) of submission*

13) Details of storage, treatment and transport requirements by Santos for waste waters.

Santos provided information relating to the storage, treatment and transport in the submission. Please refer to the following:

- *Refer to Section 3.2.2.2 (Pg 8) of submission*
- *Refer to Fig 10 (Pg 22) of submission*
- *Refer to Section 3.2.3.5 (Pg 25) of submission*
- *Refer to Section 3.2.3.6 (Pg 25) of submission*
- *Refer to Section 7.4.2 (Pg 96) of submission*
- *Refer to Section 7.5.3 (Pg 99) of submission*

Land Access and Disturbance

14) Describe the typical access infrastructure (roads, culverts, fencing, pipeline easements etc.) required throughout the operational phase of any potential development. Include in this description, typical site selection process, policy on the utilisation of existing infrastructure, construction standards, maintenance requirements, runoff management, security.

Santos provided information relating to typical access infrastructure, location selection, construction standards, maintenance and run-off in the submission. Please refer to the following:

a. *Refer to Section 3.2.2 and 3.2.2.1 (Pg 7) of submission*
b. *Refer to Section 3.2.2.2 (Pg 8) of submission*
c. *Refer to Section 4.3 (Pg 35) of submission*

Santos seeks to utilise existing infrastructure such as road or access tracks where feasible.

Yours sincerely

Bill Ovenden
Executive Vice President – Exploration and Appraisal