There are documents associated with this note relating to aspects of evidence and questions from my presentation to the Senate hearing on behalf of the Protect Country Alliance.

A summary of the corrosion issues is below noting the recent relevant Australian examples. It needs to be understood this is a physical reality not something that is unique to the NT circumstances.

The information relating to pressure from the federal government is in documents Evidence overview pressure re fracking and GST.docx and the Letter from Morrison to Manison re GST.pdf.

The documents relating to the issue regarding the poor FOI response from CSIRO in relation to the issues of corrosion is in document CSIRO FOI files.pdf.

There are no published baseline studies that predate the 2014 drilling of Tanumbirrini 1 and the discharge of approximately 21 million litres of drilling fluids. The document lr_PR20150029_Tanumbirini_1_basic-WCR.pdf is the copy of the Well completion report. All current exploration drilling is being done before the baselines are established.

Corrosion overview.

The preliminary water study (Rees et al)[1] confirms that Sulphate-reducing bacteria are present in the McArthur basin and colonising casings in water bores. The risks that these bacteria pose to the integrity of wells and the long term implications of this have very significant implications for the future and this needs to be factored into decision making. The presence of these bacteria greatly elevates risk assessment implications because these bacteria will cause corrosion issues with concrete and steel and eventually leaks.

It is the clear responsibility of the NT govt to regulate these risks and the stated policy that decisions in relation to petroleum and gas development will be guided by the principles of Ecologically Sustainable development (ESD) make it vitally important that the longer term view is taken. It is possible that the fracking companies will be gone from the region and the responsibility for managing the outcomes of this corrosion, if that is even possible, will fall on future NT governments and the consequences will be suffered by future generations of Territorians. The evidence from the Marcellus shale in the US shows that the problems with leaks keep growing with time and massive costs and impacts are thrown back on governments and communities.

This clearly needs to be a part of the final risk assessment mentioned in Pepper recommendation 4.6. There is a massive risk of future problems created by well failures and these problems seem to be unavoidable if the wells are proceeded with. This is a clear breach of ESD principles at it creates significant problems for future generations.

Sulfate-reducing bacteria (SRB) and sulfur-oxidizing bacteria (SOB) are in the Beetaloo[1] and are a massive risk to the long term viability of wells. These bacteria instigate processes that create

[1] Rees et al , Stygofauna and microbial assemblages of the Beetaloo Sub-basin, Northern Territory GISERA Surface and Groundwater Fact sheet December 2020

corrosion processes that impact on concrete and steel structures. Microbially induced concrete corrosion (MICC) caused by sulphuric acid attack is a major problem with concrete[2].

The Oil and Gas Industry can only control sulphide reducing bacteria (SRB) when it is on the inside of a well with biocides. The outside of the well is in a natural control until a gas or oil well goes through the environment where they are (mainly damp soil with organic material present or other bacteria which can provide a food source/or aquifers), this gas or oil well, if cement coated gives the SRB food and their numbers grow as the natural control (food) is no longer in short supply. As they consume the sulphates in the cement they exhaust Hydrogen Sulphide (rotten egg gas H_2S) which in the presence of water turns to acid (H_2SO_4).

This process is a problem in Australia such as at the MacIntyre-2H well where after recovering approximately one-third of the hydraulic stimulation fluid, traces of biogenic hydrogen sulfide gas, produced from naturally occurring organisms in the completion fluid, were detected and the well had to be suspended[3]

How long a well's external surface will last before it is broken down enough to allow cross contamination of the Aquifers, escaping gas, or fluids depends greatly upon the number of bacteria present, but this will eventually cause the connection between neighbouring aquifers to occur and leaks.

Reports show this corrosion is already a problem in QLD coal seam gas projects and it is a chemical/ physical process that is driving this, not operational factors.[4] Saltel Industries was approached in 2016 by one of Australia's leading natural gas producers, to tailor a solution for their unusual problem: in some of their CSG wells in Queensland, the 7in production casing must cope with severe and localized external corrosion, developing at shallow depth. These corrosion cases are suspected to be caused by bacteria growing under specific pressure and temperature environments.

"Microbiologically-influenced corrosion seems to be systemic in the region, and other operators might encounter similar issues in their CSG wells". Charles Albouy, Saltel Industries[2] There needs to be further study of this issue in the SREBA before these wells are allowed to proceed.

This information confirms that corrosion is an issue in the CSG areas of QLD and confirms our fears that this is going to cause wells to fail eventually and injected chemicals and related material released from the fractured rock layers, including the salt in the Moroak, will leach eventually into waterways.

This includes the Gum Ridge Aquifer, flows to the Roper River, Flora River, Katherine River, the McArthur River and other flows out of the catchments in the area both above and underground.

There are many examples of corrosion problems.
In 1998 the Adelaide River Bridge on the Arhnem Highway partially collapsed due to the impact of corrosive bacteria[5] on the concrete and steel.

---

[2] Hisashi Satoh , Mitsunori Odagiri, Tsukasa Ito, Satoshi Okabe, 2009, Microbial community structures and in situ sulfate-reducing and sulfur-oxidizing activities in biofilms developed on mortar specimens in a corroded sewer system, Water Resources 43(18):4729-39

[3] https://www.asx.com.au/asxpdf/20121031/pdf/429wskb4570t3n.pdf

[4] https://www.einpresswire.com/article/480473562/xpandable-patches-to-extend-the-life-of-corroded-csg-wells-in-queensland-australia

[5] NT News August 27th 1998.

The problem is extensive in the USA[6], An analysis of the root cause analysis of the 2015 Aliso Canyon blowout determined that surface corrosion on the outside of well casing was the immediate cause of the disaster. Prolonged contact with groundwater and microbes, most likely Methanogenic Archaea, was the underlying cause of the corrosion.

The impact of corrosive water on cementing and casing in the NT is provided by deep oil exploration wells (McDills and Dakota) drilled in the Perdika/Great Artesian Basin in the 1960s. (The Perdika Basin is one of the prospective unconventional shale gas areas of the NT. Now, some fifty years later, the steel casing had almost entirely corroded away, resulting in inter-aquifer contamination. This well required expensive rehabilitation work to stem artesian flow. This single bore cost the Territory and Commonwealth Governments $500,000 to plug (1960s prices) as the company responsible for the well was insolvent.

This example highlights the risks of operator insolvency due to the boom and bust cycles of oil and gas development which complicates efforts to hold liable parties responsible and provide for timely environmental reclamation.

The hypersaline nature of the deep aquifers and the high temperature further raises concerns about the integrity of the wells with both deep corrosion risks and closer to surface risks. There is a major concern among stakeholders that integrity failure will connect the hypersaline deep aquifers like the Moroak to the beneficial fresh water systems like the Gum Ridge aquifer. This poses a massive risk to the human and animal use of the region in the medium and long term and is clearly a breach of ESD principle for intergenerational equity.

Attempts to gather more detail of the risks and impacts of these microbial corrosion processes has led to an FOI application to CSIRO. The process was very poor with most of the documents redacted for what does not seem reasonable grounds and the result is being appealed. It is hard to understand why the heavy redaction was required other than trying hide information that might be highlighting risks to the community.

We have attached the relevant documents in the hope the inquiry may be able to get the detail of the information to inform the assessment of the corrosion risk.

All of these issues compound the risk. Corrosion leaks, chemicals, salinity, methane .

[6] Concerned Health Professionals of New York, & Physicians for Social Responsibility. (2020, December). Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction) (7th ed.). http://concernedhealthny.org/compendium/