SCIENTIFIC INQUIRY INTO
HYDRAULIC FRACTURING
IN THE NORTHERN TERRITORY

STRATEGIC REGIONAL ENVIRONMENTAL AND BASELINE ASSESSMENT

15

15.1 Introduction

The lack of adequate pre-development assessment and environmental baseline data is routinely cited as being one of the biggest environmental regulation and management related issues associated with the rapid development of the shale gas industry in the US, and with the rapid development of the CSG industry in Queensland.[1]

The need for robust baseline data has been emphasised and echoed in many of the submissions received by the Panel, during the community consultation meetings, and in prior reports on hydraulic fracturing. Recommendation 4 from the 2012 Hunter Report specifically referred to the need for baseline water data,[2] while recommendation 15 from the 2015 Hawke Report was to: *"Strengthen long-term strategic land use planning so that environmental considerations and constraints - including threatened species impacts - are considered when strategic land use decisions are being made."*[3]

Without an adequate pre-disturbance baseline, the magnitude of any post-development change cannot be effectively predicted or its impacts assessed. Comprehensive regional baseline datasets are essential to underpin modelling of the possible impacts of any new industry and to inform the site specific quantitative impact risk assessments (for example, water quality or public health) that are being conducted by industry and being submitted to regulators for assessment.[4] The absence of a robust baseline also negatively affects the ability of industry, government, the community and affected landholders to be able to strategically plan for the rollout of any onshore shale gas industry, but also to identify any key sensitivities in the regional context and to openly and constructively investigate and resolve issues that may arise as a result.[5]

The lack of an integrated strategic and coordinated approach to data collection over large geographic regions in which multiple industry players are involved can also result in inconsistencies between datasets and, therefore, prejudice the subsequent usefulness of such data for developing region wide assessment and management models. An Australian example where this has been effectively addressed for water-related data is provided by OGIA in Queensland, which was established to develop and house an integrated groundwater model for the Surat Basin and to provide independent assessment of likely impacts.[6]

It has also been noted by the Panel (see Chapters 7 and 8) that there is generally poor spatial coverage of data on surface and groundwater characteristics and of both aquatic and terrestrial biodiversity in those regions of the NT most likely to be affected by any onshore shale gas industry. Based on evidence provided to the Panel, there is very limited understanding of the attributes and behaviour of surface waters and groundwater, or their relationship with aquatic or groundwater dependent/groundwater influenced ecosystems. Distributions of most species are known only in general terms, and there is very limited knowledge of geographic patterns of diversity and endemism and the dependence of that biodiversity on specific surface and groundwater resources. Such limited information on biodiversity assets and the locations within which they occur in prospective onshore shale gas development regions represents a significant knowledge gap, impeding the ability to properly assess the risks of any shale gas development (especially cumulative risk over large areas). It also reduces the ability to plan the location of infrastructure to avoid, or minimise, the risk of unacceptable impacts to local flora and fauna (both aquatic and terrestrial).

1 US EPA Report; Jackson et al. 2013; ACOLA Report; Queensland Gasfields Commission 2017.
2 2012 Hunter Report.
3 2015 Hawke Report
4 Department of the Environment and Energy 2017c.
5 Queensland Gasfields Commission 2017.
6 Queensland Gasfields Commission 2017, p 52.

15.2 Scope of strategic regional environmental and baseline assessment

Recommendation 15.1

That a strategic regional environmental and baseline assessment (SREBA) be undertaken prior to the grant of any production licence for onshore shale gas.

The inclusion of 'regional' in the title is a deliberate choice because onshore shale gas plays typically extend over large areas that often include whole aquifer systems and large sections of river catchments, together with multiple social and cultural contexts.

A regional assessment will provide the foundation for a planning framework for development that gives certainty to both industry and communities, and achieves better environmental outcomes by addressing the potential for cumulative impacts across broad regions.

Bioregional planning based on strategic assessment is widely recognised, including by the EPA,[7] as the most appropriate basis for limiting the impacts of regional development on biodiversity. It is formally recognised under the EPBC Act, including for *"large-scale industrial development and associated infrastructure"*.[8]

The SREBA framework recommended by the Panel is much broader than the scope of the bioregional assessment process that has been developed and applied by the Commonwealth Government for the assessment of regions affected, or potentially affected, by large coal mines or by the extraction of CSG.[9] Those bioregional assessments are limited to the assessment of water assets and water dependent ecosystems by virtue of constraints imposed by the 'water trigger' provision of the EPBC Act. Water related aspects of the extraction of shale gas are not included within the ambit of the EPBC Act, and only MNES that there may be a significant impact upon (for example, rare and endangered species or Ramsar wetlands) by any development are required to be assessed under that Act. Areas of high conservation significance by virtue of local assemblages of plants and animals are not specifically addressed by the provisions of the EPBC Act unless they are areas of habitat for rare and endangered species. In addition, the bioregional assessments completed to date have largely relied on existing datasets. This approach would be especially problematic in the NT where, as has been noted in Chapters 7 and 8, there is generally very poor survey coverage of biological assets.

A SREBA as proposed by the Panel would consist of the physical, biological, public health, social and cultural components outlined below, to address the key knowledge gaps identified in this Report and its associated recommendations.

7 EPA submission 417, p 3.
8 Australian Government 2011.
9 Barrett et al. 2013.

15.2.1 Water quality and quantity

A SREBA would address the following objectives with respect to water quality and water quantity:

- establish a baseline for groundwater and surface water hydrology over a period that is representative of the climatic cycles of the area and of the geological and geomorphological variation across the region;
- characterise the hydrostratigraphy of the region sufficient to identify and characterise the aquifer systems and any interconnectivity that could be affected by the extraction of water for shale gas development;
- quantify recharge rate (and where possible, recharge zones) and to establish the sustainable yield for potentially affected aquifer systems;
- develop a suitably calibrated groundwater-surface water flow model(s) to quantify the connectivity between groundwater and surface water systems to predict the likely impacts of hydrological perturbation as the result of potential shale gas development and production; and
- establish a baseline for water quality, including measuring vertical profiles of water quality parameters through potentially affected aquifers and surface waters, noting that this will need to be done at a number of locations across a region to inform the lateral variations in quality. In semi-arid and arid regions, particular attention should be paid to the water quality of perennial to near-perennial water bodies that are likely to provide dry season refugia for aquatic biota and drinking water sources for wildlife.

15.2.2 Surface aquatic and groundwater dependent ecosystems

A SREBA would address the following objectives with respect to surface aquatic ecosystems and GDEs:

- determine locations of ecologically important temporary waterbodies and dry season aquatic refugia;
- characterise the wet season surface water flow regime (including overland flow);
- characterise the dependency or degree of influence of ecosystems by groundwater, and their likely sensitivity to shale gas-related water abstraction; and
- characterise inter-annual and seasonal water quality variability, with particular focus on dry season aquatic refugia (see above).

15.2.3 Terrestrial ecosystems

A SREBA would address the following objectives with respect to terrestrial ecosystems:

- identify locations of high conservation value within affected IBRA bioregions[10] through systematic survey of vascular plants, vertebrates and selected invertebrate taxa;
- establish current distribution and densities of occurrence of weed species throughout the region; and
- determine if any threatened species are likely to be seriously affected by the cumulative effects of habitat loss and fragmentation that could accompany any onshore shale gas development.

15.2.4 Greenhouse gas emissions

A SREBA would address the following objectives with respect to GHG:

- establish a regional baseline for methane concentrations and fluxes; and
- identify any locations that have substantively higher emissions than the regional average and determine, where possible, the reasons for these anomalies.

10 Thackway and Cresswell 1995.

15.2.5 Public health

Baseline data needs to be obtained on the frequency and duration of the occurrence of symptoms commonly associated with irritant substances (for example, sore eyes, respiratory irritation, asthma).

15.2.6 Social impacts

The social impacts of any onshore shale gas industry must be assessed in accordance with the strategic SIA, as discussed in Chapter 12 (see Section 12.4).

15.2.7 Aboriginal people and their culture

Any assessment with respect to Aboriginal people and their culture should:

- be designed in consultation with Land Councils and AAPA; and
- engage traditional Aboriginal owners, native title holders and affected Aboriginal communities, and be conducted in accordance with world leading practice.

For further discussion see Chapter 11.

15.3 Guidance for undertaking a SREBA

While it is not the intention of the Panel to be overly prescriptive, there are a number of overarching issues that must be addressed when designing the framework and developing scopes of work for regional baseline assessments to ensure a robust outcome.

In particular, it needs to be implicitly recognised that much of the work that has been undertaken to date has been opportunistic (that is, used existing data collected for other purposes), or spatially restricted, rather than being regionally strategic for the purposes of providing the pre-development data required to underpin effective land use planning and to properly inform the environmental performance of any onshore shale gas industry. This situation is aptly described, using groundwater as an example, by the quotation below from a recent paper describing the status of monitoring (baseline and otherwise) for methane and other contaminants in relation to the industry the US:[11] *"Present-day monitoring efforts do not consider the groundwater resource in its entirety and involve only periodic sampling from existing sparsely located domestic wells, which serve as receptors at risk, rather than adequate monitors for groundwater impact evaluation."*

15.3.1 Water

The data collected for the regional assessment must be sufficient to inform the water supply, surface and groundwater interactions, and water quality components of the baseline assessment. Further, the data must add to the knowledge-base of these systems in the NT. Useful guidance for this process has been developed by the Victorian EPA[12] and the IESC[13].

15.3.1.1 Water supply

The key parameters are recharge rate, recharge mechanism, sustainable yield and flow velocity. As noted in Chapter 7, these four components are not well defined over much of the NT. Even for the most well characterised groundwater system in the Beetaloo Sub-basin, there is still missing data, especially in the southern part of the Sub-basin.

Recharge can be inferred from water balance models, but this is a relatively unsophisticated approach that is subject to considerable uncertainty,[14] especially for the case of stratified aquifer systems. Leading practice for measuring these parameters uses a combination of geochemical fingerprinting and stable isotope measurements.[15] Work of this type needs to be done regionally to determine the extent of heterogeneity in aquifer systems because sustainable yield in one part of a shale basin may be very different to other (lower rainfall) parts. Santos and Origin have recently commissioned CSIRO to undertake these measurements across their lease areas in the Beetaloo Sub-basin, including the southern Beetaloo area.[16]

11 Cahill et al. 2017, p 293.
12 Victorian EPA 2006.
13 IESC 2015.
14 Crosbie et al. 2010; Suckow et al. 2016.
15 Suckow et al. 2016; Suckow et al. 2017.
16 Santos submission 420, pp 10-11; Origin Energy Ltd, submission 469 (**Origin submission 469**), Attachment 1, p 12.

15.3.1.2 Surface and groundwater interactions

The regional assessment should identify locations where groundwater aquifers intersect with surface waters, and the extent, and importance, of any ecosystems dependent on, or influenced by, groundwater. In particular, the locations of groundwater fed springs and dry season aquatic refugia need to be identified and characterised, and the sensitivity of these assets to the abstraction of groundwater should be assessed.

For all relevant water resources and water dependent assets, a description of baseline conditions, and conceptual and/or numerical models of potential impacts of any onshore shale gas industry need to be developed. Numerical modelling should be undertaken to inform an understanding of potential impacts to a particular water resource. It should be constructed in accordance with the conceptual model, calibrated and verified with appropriate baseline data, and should explore the probability of a range of possible outcomes based on uncertainty analysis.[17]

15.3.1.3 Water quality

The standard suite of water quality parameters that that have been measured to date throughout the NT by the Power and Water Corporation have been focussed on those inorganic (salts and metals) and microbiological standards most relevant to assessing near surface systems for human drinking, stock watering, or agricultural uses.[18] There are no extended time series baseline datasets for those parameters that would be diagnostic of an industry that can potentially contaminate groundwater with natural inorganic (including NORM) and organic chemicals (methane and hydrocarbons) that originate from depth.[19]

It is only recently that a more comprehensive range of water quality measurements have been acquired from samples collected by consultants engaged by industry.[20] These measurements will need to be extended regionally, and made seasonally over several years to provide a robust baseline dataset.[21] The analytical detection limits (**DLs**) that are specified will also need to be fit for purpose. The lowest DLs appropriate for water quality assessments need to be used, noting that the DLs needed for environmental baseline assessments are generally lower than those required for human drinking water.

As stated in Chapter 7, methane will be a key water quality parameter as 'fugitive' methane is the most likely contaminant to be found in groundwater close to gas extraction wells. The baseline needs to determine both the concentrations and geologic origin ('thermogenic' - deep shale gas, or 'biogenic' - near surface microbiological origin) of measured methane.[22] This is a specialist field that uses a combination of isotopic ratio measurements and gas compositions. Establishing a reliable baseline for methane in water requires specialist expertise.[23]

A fundamental limitation on the rigour and usefulness of the water data acquired to date (and this includes the current CSIRO work) is that it has mainly come from bores constructed for the purpose of domestic supply or stock watering, with variable bore depths and screened intervals. While the groundwater quality data from these bores is adequate for a preliminary assessment, the data obtained to date is not sufficient to properly inform the development of a regionally extensive industry that has the potential to contaminate groundwater by salts or gas for the following reasons:

- first, aquifer systems can be vertically stratified with overlying younger water flowing across the top of the aquifer profile, with much older water residing below it. Therefore, measurements of groundwater age that do not specifically address this issue can yield estimates of recharge (and therefore sustainable yield) that are incorrect;[24]

17 Barnett et al. 2012.
18 Power and Water Corporation 2016.
19 For example, Appendix A in Department of the Environment and Energy 2017c.
20 Origin submission 153, Appendix 4.
21 See Jackson et al. 2013 for a comprehensive discussion of the issues and the extent of the monitoring required.
22 Currell et al. 2017.
23 Currell et al. 2017; Walker and Mallants 2014.
24 Suckow et al. 2017.

- second, the concentrations of dissolved oxygen through the aquifer need to be determined as this will inform the potential for degradation of fugitive methane in groundwater by aerobic or anaerobic microbial pathways (see Section 7.6.1), and the potential for the occurrence of stygofauna; and
- third, the baseline concentrations of major ions need to be established through the aquifer profile to provide a reference condition against which leakage of flowback water from a well, or a surface spill contaminating the groundwater, can be assessed.

Obtaining this information will require the targeted installation of multilevel piezometer arrays, screened across a number of discrete vertical intervals, to permit sampling through time conducted reliably and reproducibly at each horizon. In this context, the Panel also recommends that such multilevel bores be used for performance monitoring of installed shale gas extraction wells.

15.3.1.4 Collation of data and quality control of process

A central issue regarding the integrity of regional baseline assessments is the quality of the data being collected. Typically, multiple entities collect water samples and submit them for analysis to different commercial laboratories. This is currently the case in the Beetaloo Sub-basin, where different consultants are engaged by different gas companies to do their baseline work.

All of the data being collected for a regional assessment must be collated into a single repository database. Ideally, this collation should be done regularly to ensure that any identified issues are addressed as expeditiously as possible, including inconsistencies in analysis quality and achieved quantification limits. Adequate resourcing must be provided to ensure that the data are uploaded regularly and any problems immediately identified and rectified.

Ongoing attention to quality control is vital as variances in sampling methods, sample processing, and laboratory analysis procedure, can lead to significant systemic variation between datasets consisting of the same set of measured parameters.

To minimise the potential for problems, the Panel recommends that there be an annual field and laboratory evaluation component built into the work program for any consultants involved in the assessment program. Specifically, this should comprise samples collected (on an annual frequency at a minimum) from several bores nominated by the regulator, with the resultant field and laboratory data being compared and assessed by the regulator, or by an independent consultant engaged by the regulator. In this way, any bias or systemic issues can be identified at the earliest opportunity, and corrective action taken. If this is not done, then the possibility exists of having unexplained discrepancies between the datasets that are being obtained across a region.

The Panel recommends that the regulator play a role in auditing the data and the data collection process, not only to avoid discrepancies between datasets, but also to give the community confidence in its scientific independence.

This data quality control and review by the regulator, must apply to all components of the regional assessment.

15.3.2 Aquatic and stygofauna biodiversity

For surface water ecosystems, there are few generic protocols for assessment of biodiversity that will be equally applicable in all NT waters. The AusRivAS (Australian River Assessment System) models have been developed for some parts of the NT, and can be used to obtain generic river health biodiversity data for some systems in the Top End.[25] However, this approach only provides information on higher taxonomic level biodiversity of macroinvertebrates, which is only one component of biodiversity in the waters of the NT. More recently, Townsend et al. provided more general commentary on approaches to river health assessment in the wet-dry tropics,[26] but again, this was focussed on stream health assessment, and not on the development of a biodiversity baseline. For a SREBA, a broader range of taxonomic groups should be considered, including fish and other vertebrates, macroinvertebrates, macrophytes and algae, and microcrustaceans that can play dominant roles in the aquatic biodiversity of some NT waters.

The NT straddles a number of major Australian drainage divisions, including the Lake Eyre Basin, Tanami-Timor Sea, North Western Plateau and Carpentaria Coast,[27] and some spring systems associated with the Great Artesian Basin. The Carpentaria Coast drainage division is the current remnant of a previously much more extensive Lake Carpentaria catchment at lower sea levels[28] that connected what are current drainage divisions of the NT, Queensland and southern Papua New Guinea. Inundation of that catchment by sea level rise has resulted in patchy remnant populations of aquatic organisms that were formerly more widespread, with an example being the Finniss River Grunter,[29] which is only known to occur in one NT river, its nearest relative being in Papua New Guinea.

The fact that most surface waters of the NT have been poorly studied highlights the need for detailed surveys before development of the production phase of a regionally extensive industry such as onshore shale gas. Specifically, the aquatic biodiversity of the NT is not well known, the distributions of its species is uncertain, even for fish, and the locations of key refugia, sensitive assemblages, and isolated populations are poorly documented. The Panel finds that without detailed baseline data, it is not possible to understand the key sensitivities in any region proposed for any onshore shale gas industry, and planning to manage possible impact on aquatic ecosystems must therefore be based on application of the precautionary principle. Accordingly, assessing the risk to surface water aquatic ecosystems from the accidental release of shale gas wastewaters will need to be based largely on expert opinion. This is correct for not only Top End ecosystems, but also for the much less studied semi-arid and arid ecosystems.

In the inundated semi-arid and arid systems, baseline data collection is made especially difficult because planning for sampling is confounded by unpredictability. It is further complicated by the fact that in any one period of inundation, only part of the biodiversity may be apparent because of high variability in the development of assemblages of organisms between wetting-drying cycles and geographically within temporary water networks due to:

- stochastic recruitment effects on assemblage development;[30]
- in-built genetic variability in timing and triggers for ending aestivation within populations ('spreading the risk') and among different species;[31]
- physical and chemical constraints on assemblage successions and variability among years will require different benchmarking between inundation events. For example, the initial assemblage composition (and therefore process of ecosystem successional development) in salt lakes is contingent on the amount of inflow in the initial re-wetting of the ecosystem, with different taxa favoured by different salinities;[32]
- changes in the relative input of surface and groundwater flows (particularly to pools/refugia) at different phases of the wetting-drying cycle, with implications for water persistence and water quality; and

25 See https://ausrivas.ewater.org.au/.
26 Townsend et al. 2012.
27 BOM River Regions.
28 Reeves et al. 2008.
29 DENR 2006.
30 Vanschoenwinkel et al. 2010.
31 Simovich and Hathaway 1997.
32 Suter et al. 1995; Halse et al. 1998; Cale et al. 2004.

- the extent of connectivity between refugia and newly inundated habitats, geographically and temporally, strongly affecting recruitment opportunities and sequences and therefore the resultant biological interactions.[33]

Accordingly, it is essential that any SREBA is designed to include multiple-year sampling of aquatic ecosystems. As a general rule, in the Top End two to five years of baseline data will be required to achieve adequate coverage of inter-annual variability,[34] while in drier zones, a longer timeframe is required.

The timing of sampling will be dependent on the hydrological cycle of the water bodies of interest. For example, King et al. identified three phases of the seasonal flow regime for perennial and intermittent rivers in tropical savannah climates: the wet-dry transition, the dry season and the dry-wet season transition.[35] They identified these hydrological phases as each being ecologically important, albeit in different ways. However, Humphrey and Pigeon[36] have identified the recessional flow phase in the wet-dry transition as being the best period for sampling the macroinvertebrate assemblage in these seasonal tropics, because it represents the period of maximum biodiversity in an established assemblage. In systems with different inundation patterns and durations, the timing of sampling in each inundation cycle will need to be adapted, and optimal timing may differ for different taxonomic groups.

There is no specific guidance on measuring stygofaunal biodiversity in the NT, but guidance documents have been developed for WA, NSW and Queensland that are generally applicable to the NT.[37] The comments above concerning the limitations of using existing bores for characterising the groundwater quality baseline are equally applicable to establishing a baseline for stygofauna biodiversity, but bores developed for a regional assessment of groundwater quality can also be designed to be appropriate for stygofauna assessment.

Timing may be less critical for the assessment of surface GDEs than for non-groundwater dependent surface water ecosystems. However, access may be more difficult in the wet season in the wet-dry tropics, or immediately after the less predictable rainfall further south. Again, for these systems, a broad range of taxonomic groups should be considered, including fish and other vertebrates, macrophytes and algae. Microcrustaceans and terrestrial vegetation and associated fauna should additionally be considered.

Bameranji Waterhole, Hayfield Station 2017.

33 Sheldon et al. 2003; Sheldon et al. 2010.
34 Humphrey et al. 1995.
35 King et al. 2015, pp 747-753.
36 Humphrey and Pidgeon 2001.
37 WA EPA 2007; WA EPA 2016; Serov et al. 2012; Queensland DSITI 2015.

15.3.3 Terrestrial biodiversity

The Panel's assessment is that the risk of inappropriate location of any onshore shale gas development would be 'low' and acceptable provided that a SREBA of terrestrial biodiversity values is undertaken and applied to ensure that the development is excluded from any identified areas of high conservation value. These regional assessments should be comprehensive,[38] both in terms of space (covering all major vegetation types across the region) and biota (including all groups of vascular plants and terrestrial vertebrates, and representative terrestrial invertebrates).[39] The data should be assessed for patterns of species richness and endemism, and for the occurrence of threatened species.

The EPA has developed guidance for assessing impacts on terrestrial biodiversity. [40] The recommended assessment methodology utilises a combination of desktop assessments and field verification to identify and map vegetation communities, the presence of threatened flora and fauna under the Territory Parks and Wildlife Conservation Act, critical habitat, MNES, and the presence of weed and pest species.

While the EPA guidance provides a good starting point for what is required, it should be noted that across much of the NT there is insufficient coverage of survey data to be able to place a strong degree of reliance on existing mapping datasets. This applies especially to the coverage of ground data that will be required for a regional assessment of an industry with a potentially large footprint with a potentially significant cumulative impact, as distinct from an individual project assessment with a smaller total footprint (for example, a medium sized metal mine). Significant on-ground work will therefore be needed to comprehensively map the occurrence and distribution of terrestrial biodiversity assets of regions likely to be affected by the extraction of any onshore shale gas.

As noted above for water, it will be critical to ensure that verifiably consistent methods are being used by the different consultants engaged to undertake the baseline assessment for the gas companies that hold leases in prospective shale gas basins. If not, the integrity and usefulness of the regional assessment could be seriously compromised.

15.3.4 Greenhouse gas emissions

Establishing an appropriate methane baseline is important to provide an understanding of pre-existing pollutant sources, which are necessary to predict cumulative impacts from any proposed onshore shale gas development. In the Beetaloo Sub-basin, for example, there are a range of natural GHG emission sources likely to be contributing to the regional GHG (including methane) budget. These include biomass burning, ephemeral wetlands, termites, agriculture and pastoral activities. These emissions sources are likely to vary significantly both temporally and spatially, and therefore, a robust GHG baseline program is required.

Many of the technical issues involved with estimating fluxes of methane to the atmosphere have been addressed in Chapter 9 (Section 9.5), noting that such measurements are complex and require well developed expertise and specialist equipment. GISERA has undertaken detailed measurements of methane concentrations in the Surat Basin in Queensland over the last three years which provide a good reference for future monitoring programs.[41] It is noted that both Origin and Santos are in the planning phase of a baseline methane assessment in the Beetaloo Sub-basin.[42]

38 EDO submission 465, p 27.
39 ALEC submission 88, p 16; ALEC submission 238, p 12.
40 NT EPA 2013.
41 Day et al. 2013; Day et al. 2015; Etheridge et al. 2017.
42 Santos submission 168, p 110; Origin submission 433, p 58.

15.3.5 Public health

Section 10.2 references the community desire for adequate baseline data on public and environmental health to be collected ahead of any onshore shale gas development, so that future impacts of the industry can be reliably assessed. The Panel has recommended (***Recommendation 7.4***) the need to have completed a SREBA that includes baseline human health prior to approval being given for the production of any onshore shale gas in any of the prospective regions in the NT.

The Panel does not underestimate the difficulties of compiling this public health data. It is not known by the Panel what type of health data is held by regional hospitals or community health centres. Nor is it clear how accessible this data is, given the privacy issues surrounding its collation. Collection of public health data through community surveys of self-reported symptoms and health status may be one way of collecting it, but the utility and reliability of such survey data is problematic. Section 10.3.2.1 discusses some of the limitations of self-reported public health data in assessing the impacts of airborne pollutants sourced from any shale gas industry.

The sample size is likely to be small for people living in close proximity to sites of any unconventional gasfield development in the NT, and this is likely to compromise baseline health comparisons with larger regional or State-wide surveys. However, the Panel suggests that existing models for the assessment of such data, such as that used by the Menzies School of Health Research, may be useful. Such methods were successfully applied to the prospective assessment of birth outcomes in a relatively small Aboriginal birth cohort.[43]

An industry submission[44], while supporting the need for collation of baseline regional health data, suggests that some of this data already exist in State and Territory Health departments and that its collation should not be the responsibility of industry but a task for Government or an independent organisation such as GISERA. It was noted that such baseline health statistics were used in an analysis of the impact of CSG activities in Queensland.[45]

Another issue is drawing the boundaries for the public health component of a SREBA. The proximity of humans and livestock ('receptors' in the HHRA methodology) to the sources of emissions is an important factor in determining health risks. In the HHRA reports commissioned by industry (see Section 10.1.1.4), findings that credible exposure pathways leading to nearby residents, or people other than onsite workers, are 'incomplete' has led to the discounting of any potential health impacts on local communities.

In analysing all of the data on airborne and water-borne exposure pathways, the Panel has had difficulty in recommending suitable 'setback' distances between wellheads, processing facilities, pipelines, and local communities. If any onshore shale gas industry in the NT occurs in areas remote from established towns or local communities, the gathering of public health data from distant sites of habitation may be less useful. If there are isolated pockets of people living in closer proximity to any onshore shale gas development (for example, pastoral homesteads, or Aboriginal communities), the small numbers of people may compromise the meaningfulness of any data.

43 Menzies 2013.
44 Origin submission 433, p 63.
45 Werner et al. 2017.

15.3.6 Social impacts

As discussed in detail in Chapter 12, developing a baseline assessment of social and economic data for individual communities and regions has been deemed essential for monitoring and evaluating the impact of any onshore shale gas industry on the NT. Leading SIA practice suggests that such baseline data becomes a critical reference point, along with other benchmark values, against which potential impacts can be anticipated and change measured. Leading practice for SIA requires that the assessment is not undertaken as a component of an EIS but rather as a standalone assessment that also anticipates the monitoring of any cumulative impacts that may occur as a result of intersecting industries and/or activities.

To be successful, any SIA must include participation from a range of stakeholders that are likely to be affected by the industry. On-ground consultation means that each community or region can develop its own framework based on the natural, cultural, social, human, political, financial, built and institutional capitals. From this, key indicators can be developed that will take into account both historic trends, but also any regional aspirations for growth.

Issues important for any SIA undertaken in regions in the NT include impacts on housing and infrastructure, employment, business income, education and skills development, community cohesion, crime rates, transport, and the transient nature of the workforce.

Based on other Australian and international experiences, it will be critical to monitor the potential for cumulative impacts that may develop if multiple gas companies exist and are likely to operate across a common region. Any data gathered by individual gas companies must be shared openly and must be made available to the community to ensure that the greatest degree of transparency is afforded to any development. There must be a participatory regional monitoring and evaluation framework that includes an online open access database of all information arising from any monitoring.

15.3.7 Aboriginal people and their culture

An assessment of the cultural impacts of any onshore shale gas development must be included in the SREBA and, as discussed in Chapters 11 and 12, should:

- be undertaken by a suitably qualified and independent party;
- be designed to engage traditional owners and the affected Aboriginal communities to enable them to understand risks and opportunities associated with development of any onshore shale gas industry, including any risks to the maintenance of cultural continuity and community cohesion;
- utilise the expertise and knowledge held within the Land Councils and AAPA for both the design and implementation of the assessment;
- be conducted in accordance with world leading practice; and
- be completed and their findings made public before any onshore shale gas development (in particular, production) occurs.