Submission NT fracking enquiry #2, October, 2017.

Dear commission of Enquiry, as part of my work in the groundwater Industry in the NT, I see many exploration company groundwater appraisals. A common factor in most of these proposals is that there is little detailed background hydrogeological data and that most mining company's see this as of no concern. Why is it that most exploration companies (thankfully there are some exceptions) will dutifully drill multiple holes, only 1 to 2 hundred metres apart, to prove up a mineral resource but is happy to drill only a handful of holes to "*prove* " a groundwater supply of several Giga Litres a year that underpins the whole viability of their project; let alone provide a series of monitoring bores to gauge impacts and provide pre mining impact background data? No doubt a lack of regulation, perceived low value of water (free in NT) and ignorance all play a part. So amongst the many issues you have to consider I would like the panel to consider recommending that a thorough, independently reviewed, hydrogeological appraisal accompany any fracking proposal put before the NT. Such a review could take a form similar to the IESC recommendations for Large coal seam gas projects, that some members of the panel would already be aware of, as shown below.

John Wischusen

BSc, (geol) Grad dip appl. Sci, MSc, PhD (hydrogeology)

.

Suggested elements of groundwater and surface water Terms of Reference for major mining projects (sourced from the IESC:

http://www.iesc.environment.gov.au/system/files/resources/9eac190b-0a52-43cb-a75d-7e5d449ca5f9/files/iesc-advice-water-trigger.pdf)-

A. A description of the proposal

An overall description of the proposal that will give insight into its purpose, character, scale and the means by which it is likely to have a significant impact on water resources.

B. Background data and modelling

Provide a detailed description of baseline water resources, including critical water dependent values of concern that are supported by those resources. This description should include, but not be limited to:

1. Identification of water related assets (aquatic ecosystems, terrestrial ecosystems, drinking water supply and human health, irrigation water supply, surface infrastructure, industry, regional communities, aquifers), including:

* fauna, flora and species habitat surveys as they relate to dependence on water resources;

* location of springs and other groundwater dependent ecosystems;

* identification of the geological formation/ aquifer to which springs and groundwater dependent ecosystems are connected; and

* an estimation of the ecological water requirements of identified springs and groundwater dependent ecosystems.

2. A description of the water resources of the site and region, including maps of all surface water and groundwater resources, relevant to the project.

3. Descriptions of geology and hydrogeology at an appropriate level of spatial and vertical resolution (i.e. at both site and regional scale). Definition of the geological sequence in the area with names and descriptions of the formations from youngest to oldest, with accompanying surface geology and cross sections.

4. Descriptions of hydraulic characteristics (for example, hydraulic conductivity and storage characteristics) for each aquifer. The map and map legend should use appropriate symbols and names, describe all formations and structures according to geological convention and clearly indicate the bore holes from which data are derived. Definitions of any geological structures (for example, faults) in the area and evidence for the influence of the structures on groundwater, in particular groundwater flow or recharge.

5. Presentation of data to demonstrate the varying depths to the aquifers and associated standing water levels or potentiometric heads and hydraulic characteristics.

6. Definition of the likely recharge sources for each aquifer, details of discharge from the aquifers, direction of groundwater flow and contours of groundwater elevations for all aquifers likely to be impacted by the proposed development.

7. Assessments of the extent of hydrological interactions between water sources including surface water/ groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.

8. Surface hydrology resources including hydrographs, raw data and any records of seasonal and historic annual variations in level, quality and date of measurement, along with elevations of the reference points from which water levels were measured.

9. Surface water and groundwater hydrochemical data assessments and modelling, including water quality parameters (such as relevant organic chemicals, heavy metals, radionuclides and other potentially harmful chemicals).

10. A numerical groundwater model that is calibrated to baseline conditions and enables a probabilistic evaluation of potential future scenarios. The groundwater modelling should:

a) outline the model conceptualisation of the aquifer system or systems, including key assumptions and model limitations;

b) represent each aquifer, storage and flow characteristics of each aquifer, linkages between aquifers, if any, and the existing recharge/discharge pathways of the aquifers and the changes that are predicted to occur upon commencement of the development activities;
c) incorporate the various stages of the proposed development and provide predictions of water level/pressure declines in each aquifer for the life of the project and beyond;
d) provide information on the time to maximum drawdown and the time for drawdown equilibrium to be reached;
e) identify the volumes predicted to be dewatered on an annual basis with an indication of the proportion supplied from each aquifer;
f) provide information on potential water level recovery rates and timeframes in each aquifer for the life of the project and until equilibrium is expected to be achieved; and
g) include recommendations, a program for review and an update of the model as more data and information become available.

11. Relevant information generated by a bioregional assessment that can indicate the baseline conditions of the proposed development area. Where a bioregional assessment has not yet been completed, best available information should be used in describing the existing state of water-related ecosystems and processes at the regional scale. This information can include publicly available information from nearby or adjacent developments (for example, information from Environmental Impact Statements).

12. An assessment of the quality of, and risks inherent in, the data used in the background data and modelling.

C. Water and salt balances

A site specific water balance and a site specific salt balance, complemented by regional balances for both water and salt covering the larger area of potential impact, should be developed and applied based on the results of numerical modelling.

Information is required about the water and salt balances for the whole system, the set of water and salt stores within the system boundary and the flow of water and salts between those stores. The proposal needs to assess the change to any store or flow of water and salts in the system arising from the development.

Specific flows and changes that need to be identified include:

1. Any changes that occur to the salt loads of the ground water and surface water systems as a result of the proposed operation.
2. Aquifer storage properties and groundwater flows and pressures resulting from the mining operations.
3. Water infiltration from surface stores.
4. An estimation of the flow/exchange of water between overlying and/or underlying aquifers for all major aquifers over the project area.
5. Waste water from the operation, including brine treatment processes, disposal methods and volumes.

6. All volumes and quality of water intended for injection.
7. Volumes and quality of water used during mining, including within the mine itself (for example, ore washing, dust suppression) and for other associated activities (for example, cooling or other industrial processes).
8. Any water that is not available from within the extraction and treatment loops that must be imported from elsewhere. This water may be from surface, underground, or from another activity external to the system boundary.
9. All interactions and flows that exist that are part of the background (baseline) water flows of any given system. For example, each recharge and discharge for each aquifer/aquitard and seepage/recharge for each surface water store, rainfall interception and evaporation, and there is a shallow subsurface transition zone (hyporheic) where water may either pass through and recharge the underlying aquifers, or may be discharged directly to the surface water system.

D. Significant impacts on water resources and water related assets

The proponent should provide an assessment of the likely significant impacts on water resources and water related assets. The assessment should include but not be limited to:

1. An assessment of how the proposed development will change both local and regional water and salt balances.
2. In the case of underground mines, predictions of subsidence and effects from dewatering and depressurisation (including lateral effects) on surface topography, groundwater and movement of water across the landscape and possible fracturing of confining layers.
3. The aquifers that will be directly impacted by mining operations, including the aquifers that will be exposed/partially removed by open cut mining and/or underground mining.
4. The aquifers that will be dewatered or indirectly impacted by dewatering in connected aquifers.
5. The extent of impact on hydrological interactions between water sources including surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.
6. For open cut mines, predictions of the extent of the cone of depression and consequential impacts on water resources.
7. Impacts associated with surface water diversions.
8. Direct and indirect impacts on water related assets (groundwater and surface water aquatic ecosystems, terrestrial ecosystems, drinking water supply and human health, irrigation water supply, surface infrastructure, industry, regional communities and aquifers) with reference to the Australian Guidelines for Water Quality Monitoring and Reporting (www.environment.gov.au/water/publications/quality/nwqms-monitoringreporting.html)
9. Impacts on hydraulic properties of aquifer geology including potential for physical transmission of water within and between formations,
10. Estimates of the quality and quantity of operational discharges of water (particularly saline water) including potential emergency discharges due to unusual events, and the likely impacts on water related assets.
11. Indication of the vulnerability to contamination (for example, from salt production and salinity) and the likely impacts on the identified water assets.

12. Identification and consideration of landscape modifications, for example, voids, onsite earthworks, roadway and pipeline networks through effects on surface water flow including erosion and fragmentation of habitat of water dependent species and communities.
13. The cumulative impact of the proposal when all relevant developments (past, present and/or reasonably foreseeable) are considered in combination (see section on 'cumulative impacts' below).
14. Proposed mitigation actions for each identified impact.

E. Risk

The proponent should provide an assessment of risk that could be expected to address, but not be limited to, the following elements:

1. An identification of regional water related assets in the area of the proposal and changes to the regional water balance that might be vulnerable to the development proposal.
2. Identification of impacts on those assets likely to arise from activities associated with the proposal.
3. An assessment of the likelihood and consequence of identified impacts occurring and the consequential effect on water balance, water quality and water related assets.
4. An assessment of the magnitude or severity of impact in the event that the impact was to occur.
5. An assessment of the overall level of risk to those assets that might combine probability of occurrence with consequence or severity of impact.
6. An assessment of residual risk following the application of proposed mitigation measures.

F. Cumulative impacts

The proponent should provide an assessment of cumulative impacts taking into account all relevant developments (past, present and/or reasonably foreseeable) to determine the risks and impacts posed by a single new proposal, in combination with other developments.

A cumulative impacts assessment may require a qualitative or semi-quantitative approach, particularly for ecological risk assessment, if data is lacking. A cumulative impact assessment may also require consideration of interactive or synergistic impacts, as well as a more simple summation of individual proposals or impacts. Information should include but not be limited to:

1. Catchment and regional scale information provided through any available bioregional assessments (Geographic Information System (GIS) based water related assets, geophysical, hydrological, ecological information).
2. Total existing and planned licensed and extracted water for consumptive, industry and agricultural purposes in the surface catchment and groundwater basin within which the proposal is based.
3. Existing water quality guidelines, targets (i.e. salinity), environmental flow objectives and requirements for the ecosystems of the surface catchment and groundwater basin within which the proposal is based.

4. The proportional increase in water resource use and impacts as a consequence of the proposal.
5. The overall level of risk to water related assets that combine probability of occurrence with severity of impact of multiple actions.

G. Ongoing management and monitoring

The proponent should provide management and monitoring plans which focus in particular on mitigating, managing and monitoring risks and assets identified in the assessment of the project, and be capable of tracking changes against pre-development conditions.

Management and monitoring plans should address all impacts identified through the assessment where a management regime or intervention is required to mitigate the risk of a significant impact on water resources and ecological assets.

A groundwater monitoring network should be established such that there is sufficient data to assess background conditions, seasonal variations and recharge /discharge behaviours. The monitoring program should consist of dedicated groundwater monitoring bores and should not include uncased test holes or bore holes where there is no data on aquifers or a drilling log.

The groundwater monitoring program could be expected to satisfy the following criteria:

1. Clearly defined monitoring objectives are stated.

2. Maps to demonstrate location of bores, their purpose and screened hydrostratigraphic unit are provided.

3. Variables such as water level, electrical conductivity (salinity) and pH, are measured at monthly intervals or daily by data logger, to allow for the assessment of seasonal variations in storage and quality.

4. The methodology for the number, location and placement of monitoring bores and the outcomes the groundwater monitoring network can accurately describe for water quality and water levels over time.

5. The monitoring network should have adequate sites and spatial distribution to provide an understanding of groundwater gradients, flow directions, recharge processes, quality and water levels in each aquifer in both the project area and the surrounding areas where impacts to groundwater from project operations are likely to occur. The network should include shallow alluvial aquifers.

6. The monitoring network should extend beyond the predicted impact areas to demonstrate/confirm that impacts are not occurring beyond these areas.

7. A full chemical analysis covering all major ions should be undertaken at an appropriate periodicity. Parameters should be monitored that are relevant to ecotoxicology, human and animal health. Where the monitoring bore is located in an area vulnerable to groundwater contamination from mine impacts, additional parameters such as heavy metals should be monitored.

8. Drilling logs of all monitoring bores and accurate co-ordinates should be provided. Where vibrating wire piezometers are installed, depths of each piezometer should be provided.

9. All data supplied should be linked to the aquifer it is representing.

10. A proposed reporting program should be provided, which includes triggers for the review of the program, current and additional data, assessment, analysis and reporting requirements. Water quality monitoring should be managed in accordance with the relevant National Water Quality Management Strategy (NWQMS) guideline: Australian Guidelines for Water Quality Monitoring and Reporting (www.environment.gov.au/water/publications/quality/nwqms-monitoring-reporting.html)