SPE 166146
Environmental Regulation of Hydraulic Fracturing

David Campin
Queensland Department of Environment and Heritage Protection
Outline

• State and scale of Australian unconventional resources

• Current Queensland environmental regulatory regime and recognised entity report

• Environmental impacts of hydraulic fracturing

• International regulatory analysis

• Residual environmental risks

• Proposed environmental regulatory framework
Environmental Regulation of Hydraulic Fracturing in Queensland

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Environmental Regulation of Hydraulic Fracturing in Queensland

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State and scale of Australian unconventional resources
Australian Shale Resources

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Queensland Gas and Petroleum Basin Locations

Galilee Basin
Prospective shale developments close to existing basins of supply

Bowen Basin
Arrow LNG project

Surat Basin
Majority of CBM resources for LNG projects

Cooper Basin
Exploration by Santos & QGC shale and tight gas

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# Current CBM/LNG Projects in Queensland

<table>
<thead>
<tr>
<th>Project</th>
<th>Partners</th>
<th>Initial Capacity</th>
<th>First LNG</th>
<th>Capex</th>
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<tbody>
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<td>Queensland Curtis LNG</td>
<td>BG – 75%</td>
<td>Stage 1 – 8.5 mtpa</td>
<td>2014</td>
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<td>CNOOC – 25%</td>
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<td>Galdstone LNG</td>
<td>Santos - 30%</td>
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<td>KOGAS – 15%</td>
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<td>ConocoPhillips – 37.5%</td>
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<td>Sinopec – 25%</td>
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<td>Arrow LNG</td>
<td>Shell &amp; PetroChina</td>
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Stratigraphic Model of CBM Resources and Aquifers in the Surat Basin

CBM resources

Economic aquifers
CSG and petroleum wells
Current Queensland environmental regulatory regime and recognised entity report
Principal Current State Regulations

• *Petroleum and Gas (Production and Safety) Act*
  – Gas resources vested in the Crown (split estate)
  – Tenure granted by the state, giving access to resources
  – Gas field construction requirements
  – Restriction on BTEX (no addition allowed)

• *Environmental Protection Act*
  – Environmental permit attached to tenure
  – Bespoke conditions, outcome focused, inconsistencies
  – 247 Permits permitted to frac, 36 with specific conditions
  – Hydraulic fracturing environmental risk assessment at regional scale
  – Baseline bore assessment
  – Recognised Entity Report for retrospective application
Queensland Environmental Regulation Evolution

1. Setting the standards
2. Applying the standards
3. Monitoring performance
4. Responding to performance

Focus of previous regulatory framework
Focus of new regulatory strategy

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Stimulation Types Addressed Under Recognised Entity Report

- **Resources**
  - CBM, shale, conventional oil and gas, tight sands, basin centered gas, and geothermal – excludes in-situ mining

- **Methodology**
  - Stimulation below formation fracture pressure
  - High energy gas fracturing
  - High pressure hydraulic fracturing

- **Process**
  - Low viscosity fluids
  - High viscosity fluids
  - Energized fluids
  - Foams
  - Gas fracturing
  - LPG
  - Cryogenic
  - Metallic ion cross-linked
Hydraulic Fracturing Recognised Entity Report

- Introduction
- Environmental effects from hydraulic fracturing
- Review of current and recent investigations into hydraulic fracturing
- Cross jurisdictional legislative analysis
- Current risk assessment and environmental constraints
- Analysis of risk and regulatory rules
- Mitigations measures
- Proposed revised regulatory framework
- Detailed legislation
Environmental impacts of hydraulic fracturing
Environmental Impacts Of Hydraulic Fracturing

- Site locality impacts
- Neighbourhood impacts
- Noise
- Visual impacts
- Land clearance and stormwater impacts
- Feed water sourcing impacts
- Feed water storage impacts
- Transportation impacts
- Well integrity
- Groundwater impacts
- Flowback water quality, management and storage impacts
- Sourcing proppant
- Hydraulic fracturing equipment, intensity and scheduling
- Chemical releases at well pad
- Geologic and hydrologic issues
- Human induced seismicity
- Atmospheric emissions
- Waste management
International regulatory analysis
Hydraulic Fracturing - Regulatory Regimes Reviewed
Target Locations for Regulatory Analysis

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Residual environmental risks
## Groundwater Impact Residual Risks

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<thead>
<tr>
<th>Impact vector</th>
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# Surface Water Impact Residual Risks

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## Landform and Geological Impact Residual Risks

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# Biodiversity Impact Residual Risks

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<th>Flaring methane</th>
<th>Vehicle activity</th>
<th>Flowback storage</th>
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## Community Impact Residual Risks

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<th>Impact vector</th>
<th>Site selection and development</th>
<th>On-road vehicle</th>
<th>Water storage</th>
<th>Casing and cementing</th>
<th>Use of water</th>
<th>Perforation</th>
<th>Well integrity</th>
<th>Chemical storage</th>
<th>Supply of proppant</th>
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* ATCE 2013

Environmental Regulation of Hydraulic Fracturing in Queensland
SPE 166146
David Campin
Proposed environmental regulatory framework

Currently heading to consultation phase
Principles for Hydraulic Fracturing in the Queensland Context

- A risk assessment and management program addressing
  - The nature of the stratigraphy, faults, linear features, hydraulic conductivity, porosity, seismic risk and groundwater dependent assets
  - Understanding of the impacts of applied stresses and connectivity of surrounding aquifers
- The presence of vertically impermeable formations between the fractured zone and other aquifers
- Installation of a multi-barrier casing string isolating hydrocarbon bearing formations from aquifers (proof of MIT)
- Low toxicity injection fluids, with no persistent bio-accumulating constituents
- Use of advanced process control
- Initiate and maintain communication with the groundwater users, the public and government
### Environmental Authority Requirements

#### General

- Geospatial proximity limits
- Water resource protection
- Stormwater and nuisance
- Protection of freshwater from pollution
- Prohibition of aquifer connectivity
- Biodiversity protection
- Waste management
- Site rehabilitation
- Contingency planning
- Volatile organic compounds destruction
- Chemical storage and spill protection
- Hydrocarbon addition prohibition
- Records retention

#### Specific to stimulation

- Plant lighting
- Flowback
- Seismic limits
- Communication to landholders and residents
- Traffic access management
Proposed Concepts for Environmental Regulation of Stimulation

- Codified expectations
- Well focus not field focus
- Avoidance of information duplication
- Risk proportionate requirements
- Stimulation methodology differentiation
- Use of *suitably qualified person* for information analysis, assembly and design
- Use of statements of compliance
- Streamlined assessment by EHP
- Third party assessment of stimulation products
- Audits of documentation
- Systematic compliance program: on notice or unannounced
Stimulation Product Selection

• Selection option for holder of environmental authority

  • First option –
    • disclosure to government, detailed risk assessment (interactions and toxicology) and
    • extensive flowback sampling and analysis

  • Second option –
    • pre-assessment through independent party, including trace contaminants, toxicology and ecotoxicology. Verified products list on web site – no new disclosure requirement,
    • limited flowback sampling
Compliance and Enforcement

S 430  Contravention of condition of environmental authority

- Wilful contravention - $1,100,000 or 2 years imprisonment
- Contravention - $915,750

S 451  Administering authority may require relevant information
Acknowledgements / Thank You / Questions

Acknowledgements to the Queensland Government