

Regulation of Petroleum in the NT

Energy Division
11 March 2017

Scientific Inquiry into Hydraulic Fracturing in the Northern Territory

DEPARTMENT OF PRIMARY INDUSTRY AND RESOURCES

Brief

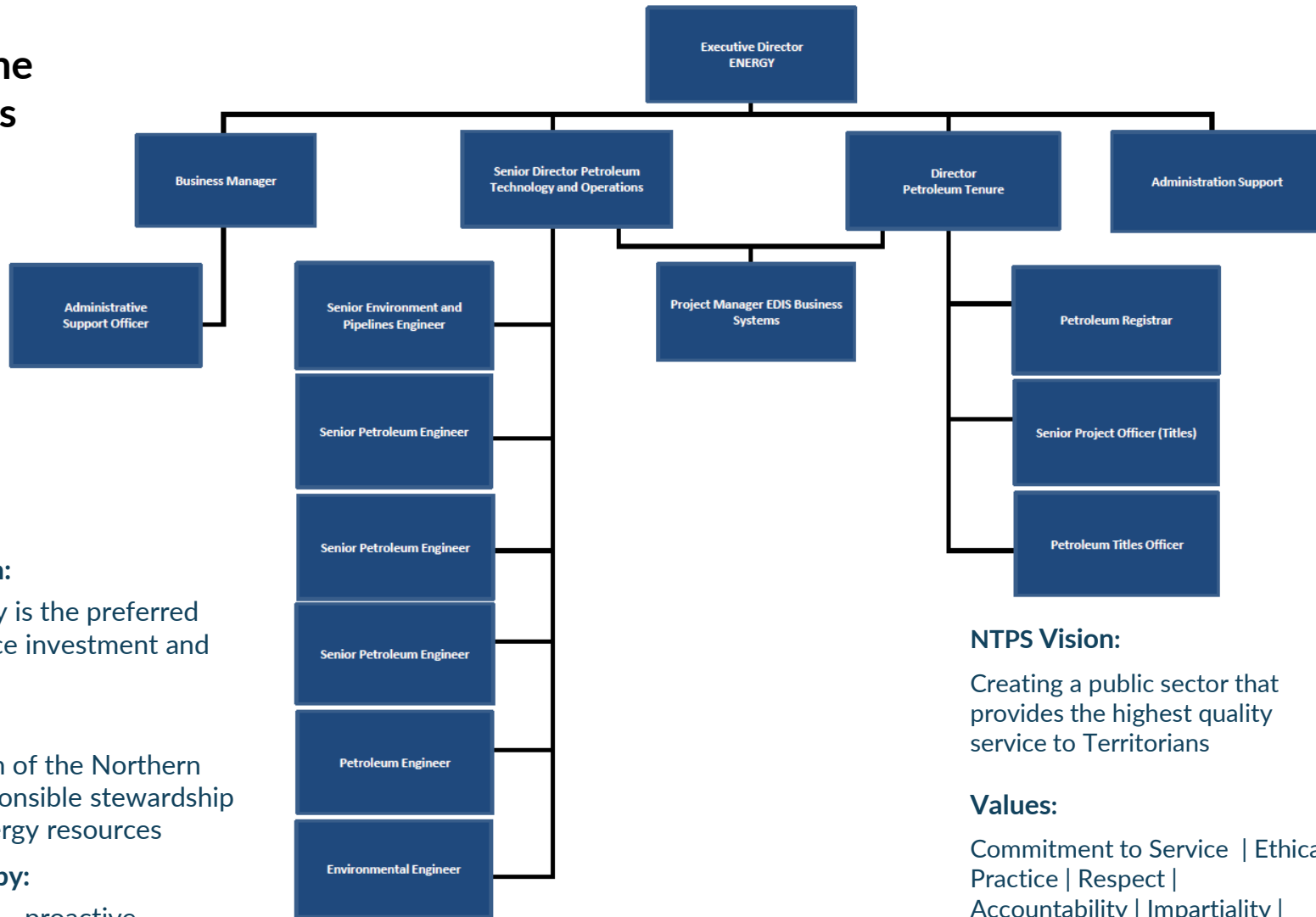
- How and by whom are exploration/production licences sought and obtained?
- Who/where and how are approvals and licences challenged?
- How are the conditions attached to either determined, especially in respect of water consumption?
- How is access to land regulated with pastoralists? TOs? Others?
- Can this be challenged and if so by whom, how and where?
- Who monitors compliance with conditions? Is this entity independent and transparent? How is it resourced?
- What happens if the conditions are breached?
- How is the drilling and fracking process (including the process of disposing of waste water) regulated?
- How is this monitored and what if there is a breach?
- What happens at the end of the well/project's life? Who is responsible for rehabilitation/remediation?
- What happens if a company goes bankrupt and cannot pay for rehabilitation/remediation?
- What are the critical points/ zones of potential leaks of liquids and gases, including both on-site (production) and off-site (gathering and processing, and transmission)?
- What are examples of leading practices/codes/regulations for the effective management of these critical areas
- Opportunities to achieve further, and cost-effective, reductions in leaks and emissions, such as the voluntary USA EPA NG STAR program and other programs?
- There are examples of leading regulation/practice invoked in some states in the USA and provinces in Canada.

Contents

- Energy Division
- Objective of the Petroleum Act
- Current oil and gas industry
- Acreage release, objections and negotiation processes
- Award of Exploration Permit
- Pastoral land access
- Title conditions
- Environmental assessment processes
- Current regulatory framework and reform
- Compliance and enforcement
- Petroleum activity application process
- Environmental regulations
- Regulating well integrity & hydraulic fracturing
- Decommissioning and rehabilitation
- Suggestions for improving the current regulatory framework
- Online resources - links

Energy Division – Organisation Chart

15 full-time employees



Mines & Energy Vision:

The Northern Territory is the preferred destination for resource investment and development

Our Mission:

To enhance the wealth of the Northern Territory through responsible stewardship of its minerals and energy resources

We aim to be viewed by:

Resource Industries as - proactive, consistent, accountable and innovative

Our Colleagues as - cooperative and knowledgeable

Our Critics as - rational, decisive and honest

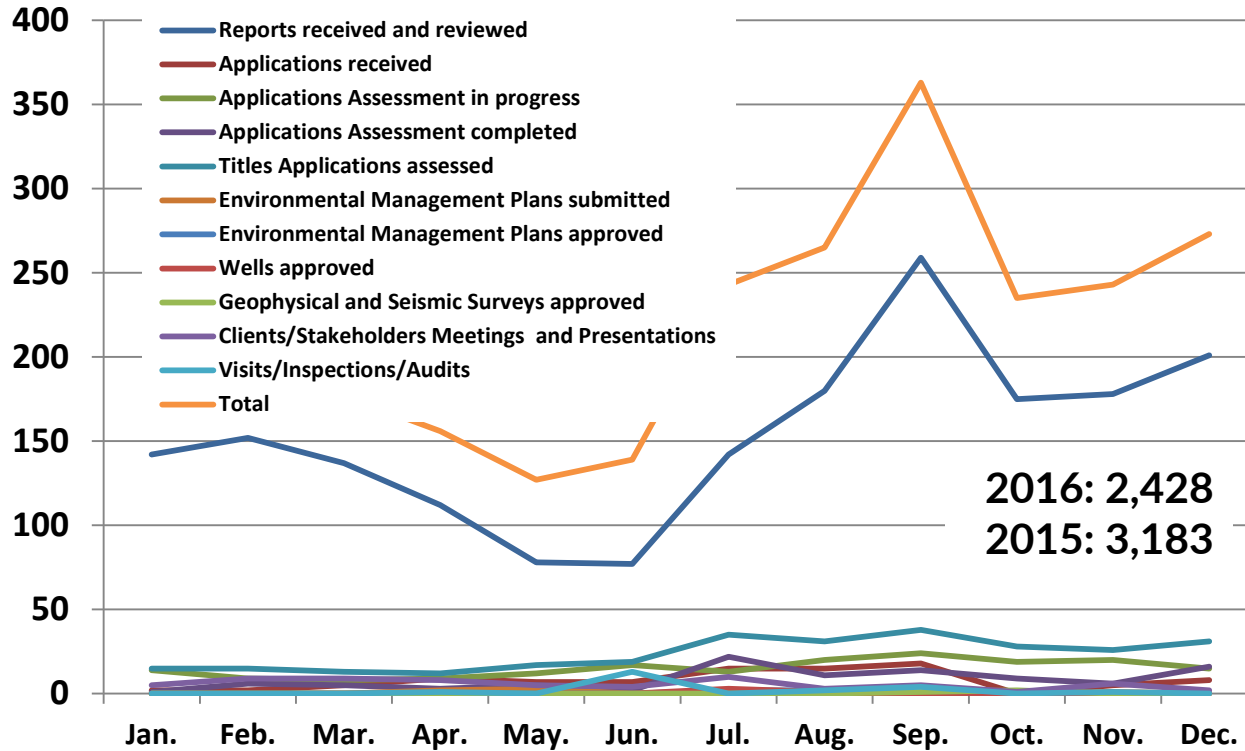
NTPS Vision:

Creating a public sector that provides the highest quality service to Territorians

Values:

Commitment to Service | Ethical Practice | Respect | Accountability | Impartiality | Diversity

Energy Division Regulatory Activities 2016



The energy division manages title administration and the assessment, compliance and enforcement of legislation associated with petroleum activities in the Northern Territory.

Activities are typically conducted during the dry season from May to October.

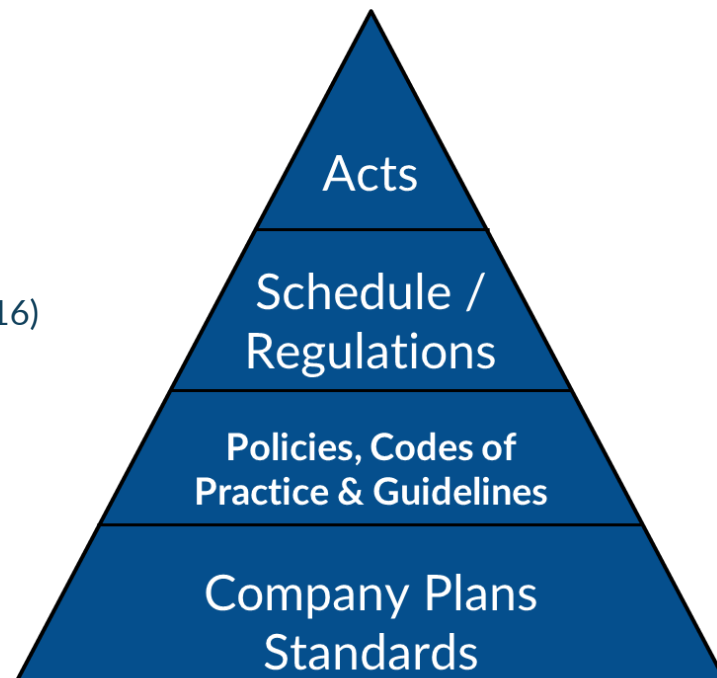
NT Legislation for Upstream Petroleum Activities

Under direct Administration

- *Energy Pipelines Act*
- *Petroleum Act 2016* (under review)
- *Schedule of Onshore Petroleum Exploration and Production Requirements 2016* (current)
- *Petroleum (Environment) Regulations 2016* (enacted July 2016)

Legislation affecting Petroleum Operations

- *Environmental Assessment Act*
- *Environmental Offences and Penalties Act*
- *Environmental Protection and Biodiversity Conservation Act*
- *Work Health and Safety (National Uniform Legislation) Act*
- *Waste Management and Pollution Control Act*
- *Water Act*
- *Weeds Management Act*
- *Sacred Sites Act*
- *Information Act*
- *Heritage Act*
- *Pastoral Lease Act*
- *Native Title Act*
- *Aboriginal Land Rights (NT) Act*
- *Control of Roads Act*
- *NT Wildlife Conservation Act*
- *Transport of Dangerous Goods*
- *Soil Conservation Act*



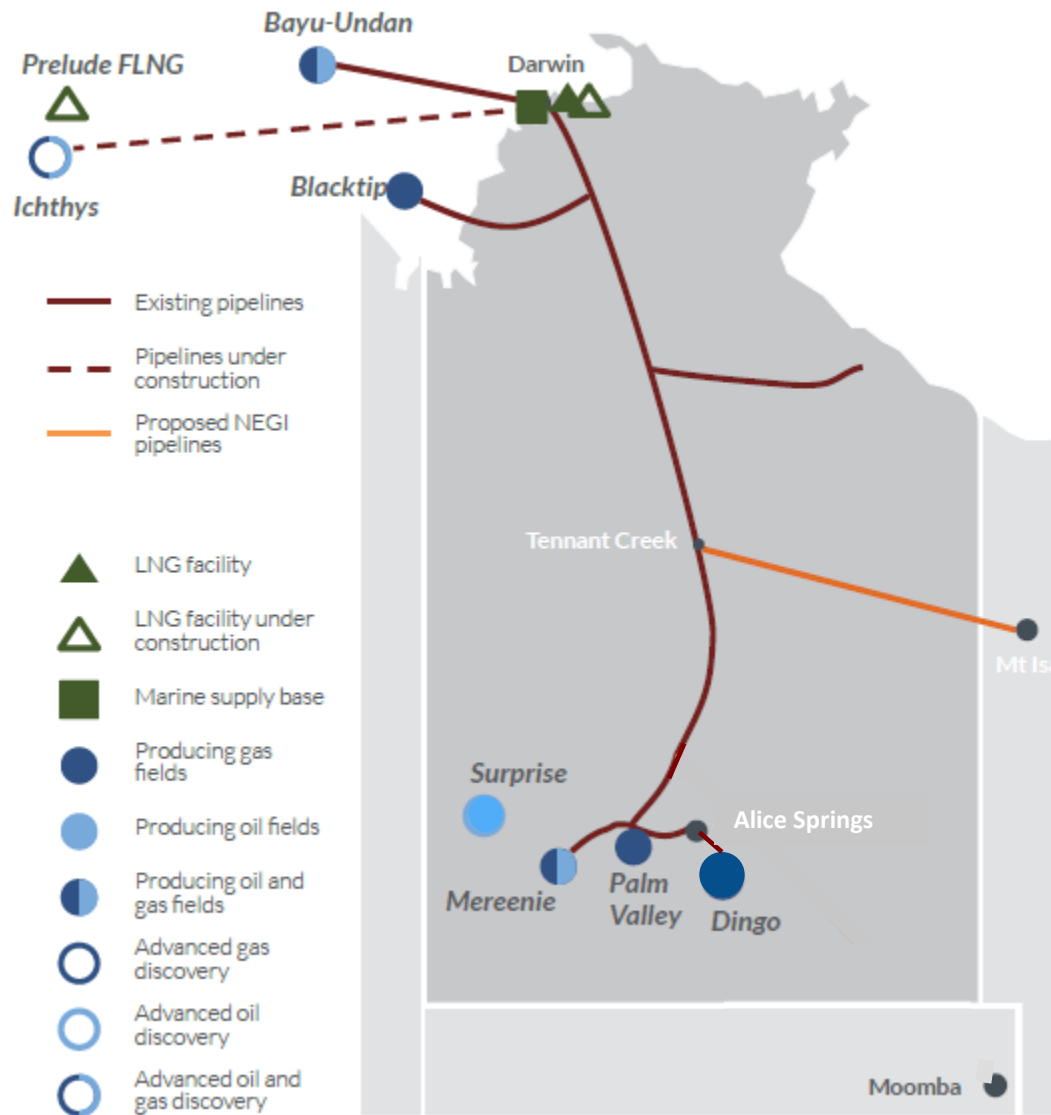
S3 Objective of the *Petroleum Act*

- The objective of this Act is to provide a legal framework within which persons are encouraged to undertake effective exploration for petroleum and to develop petroleum production so that the optimum value of the resource is returned to the Territory.
- The legal framework provides for the following:
 - the granting of petroleum interests and renewal or transfer;
 - the promotion of active exploration for petroleum, and of the development of petroleum production if commercially viable;
 - the assessment of proposed technical works programmes and of the financial capacity of interest holders;
 - the reduction of risks, so far as is reasonable and practicable, of harm to the environment;
 - the collection and the dissemination of information;
 - the efficient administration of this Act and collection of royalties.

Why Regulate Petroleum Activities?

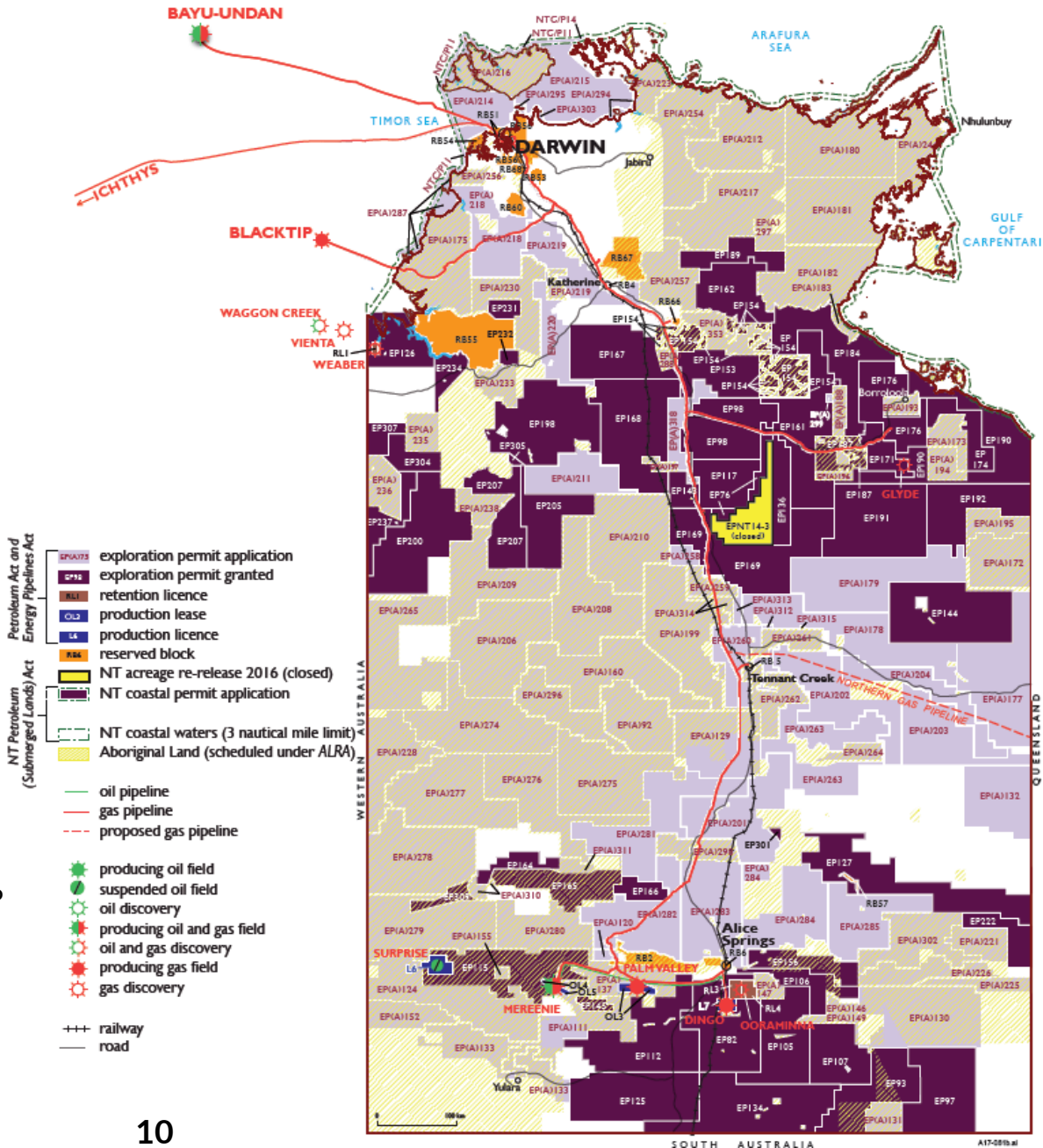
- S6 Petroleum property of Crown
 - all petroleum on or below the surface of land within the Territory, whether that land is alienated in fee simple or not so alienated from the Crown, is and shall be deemed always to have been the property of the Crown.
 - the property in petroleum produced from a well in a production licence area passes to the production licensee at the wellhead.
- Ensure that the optimum value of petroleum resources (through royalties or otherwise) is returned to the Territory
- Builds community and investor trust and confidence
- Provides a “level playing field”
- Correct market imbalance:
 - Environmental performance
 - Safety
 - Information asymmetry

Current NT Oil and Gas Industry

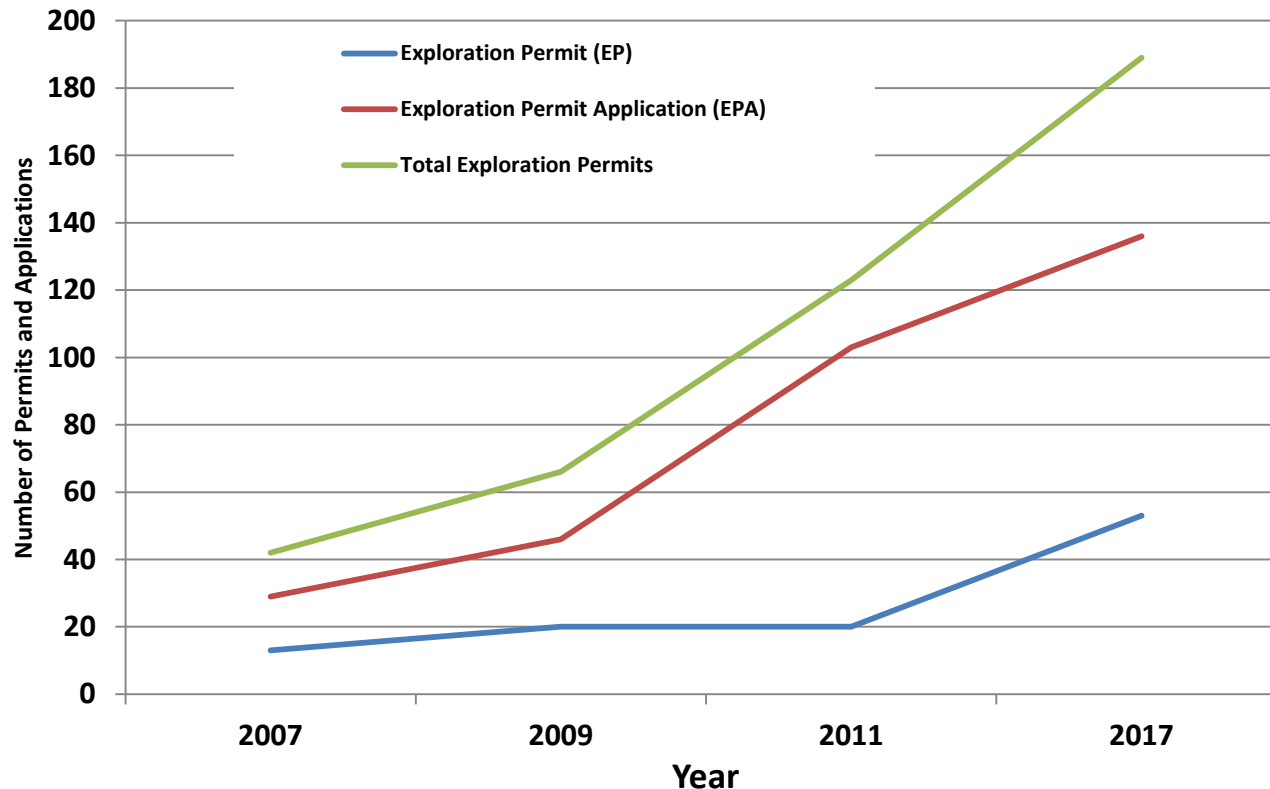


Energy Titles & Excluded Areas

- 53 granted exploration permits
- 3 retention licences
- 5 production licences
- 26 pipeline licences
- 1 pipeline permit
- 135 exploration permit applications
- 13 Reserved Blocks:
 - RB2 West MacDonnell NP
 - RB4 Town of Katherine
 - RB5 Town of Tennant Creek
 - RB6 Town of Alice Springs
 - RB51 Port of Darwin
 - RB53 Marrakai Dam
 - RB54 Bynoe Harbour
 - RB55 Bradshaw
 - RB56 Greater Darwin Area
 - RB57 Dulcie Range NP
 - RB60 Warrai Dam
 - RB66 Eley NP
 - RB67 Nitmiluk (Katherine Gorge) NP
 - RB68 Darwin River Dam
- 2 World Heritage listed Parks
 - Kata-Tjuta NP (Uluru)
 - Kakadu NP



Increased uptake of acreage following shale boom in the US since 2007

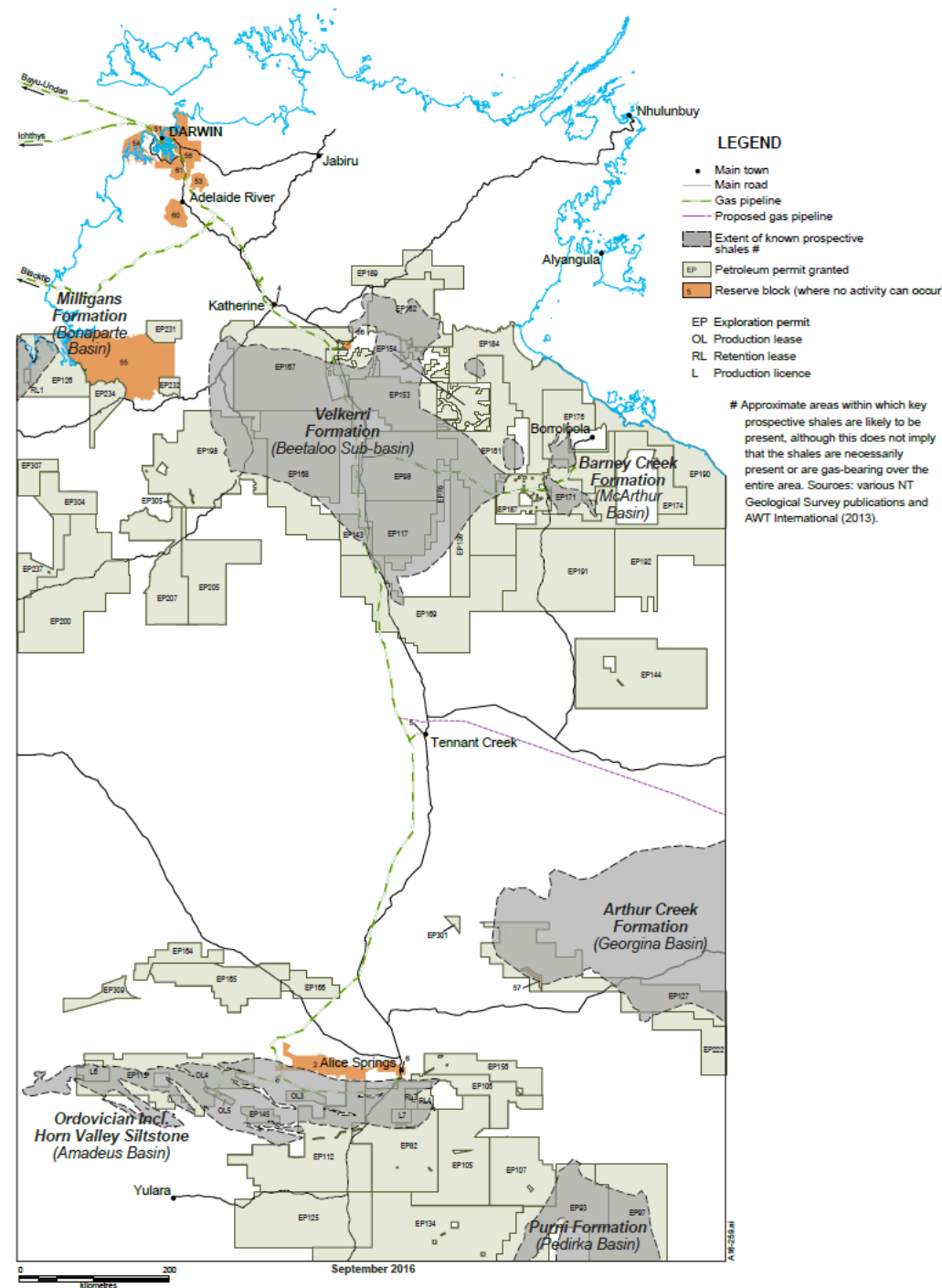


The NT has experienced an immense uptake of acreage for petroleum exploration since 2007 under an over-the-counter system which was replaced with an acreage release system in 2014.

By then, a significant amount of acreage had already been released

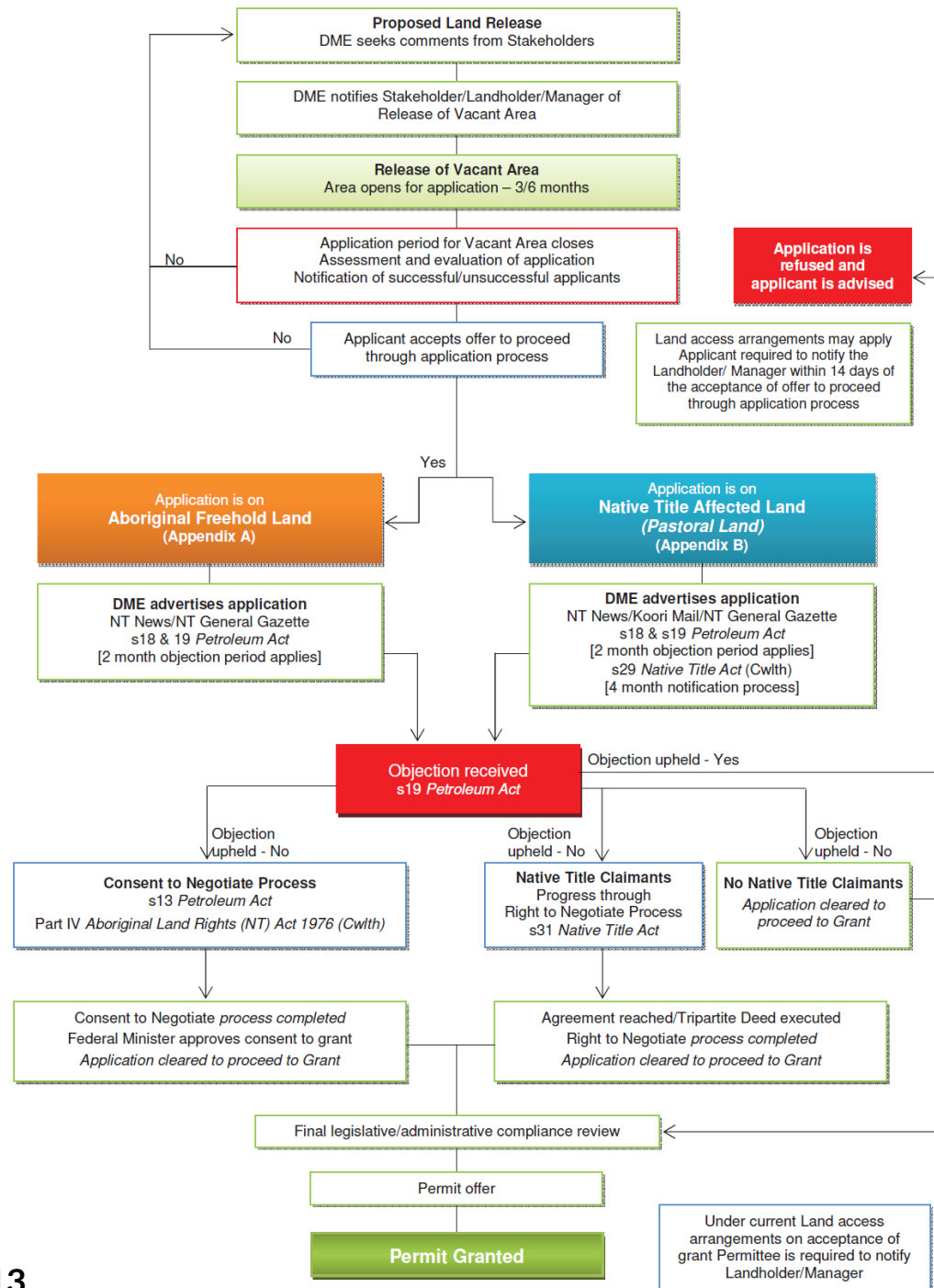
NT Operators

- Origin Energy Resources
- Santos QNT Pty Ltd
- Central Petroleum
- Armour Energy
- Pangaea
- Beach Energy
- Hancock Prospecting
- Mosman Oil and Gas
- Imperial Oil and Gas
- Paltar/Nation Energy
- Blue Energy/Wiso
- Baraka
- TriStar
- Tamboran
- Advent Energy



Acreage Release to Grant of Permit

- Native Title:
 - Pastoral land
 - Right to Negotiate (RTN)
 - Tripartite Agreement
- ALRA:
 - Aboriginal freehold
 - Consent to Negotiate (CTN)
 - Deed
- Engagement with pastoralist/land holder throughout the RTN process (NTA)
- On 1 January 2014 Petroleum Amendment Act 2013 introduced an 'Acreage Release Regime'
 - Before 2014, over the counter applications
 - Only two areas have actually been released through this process



Acreage Release for Petroleum Exploration

Acreage Release

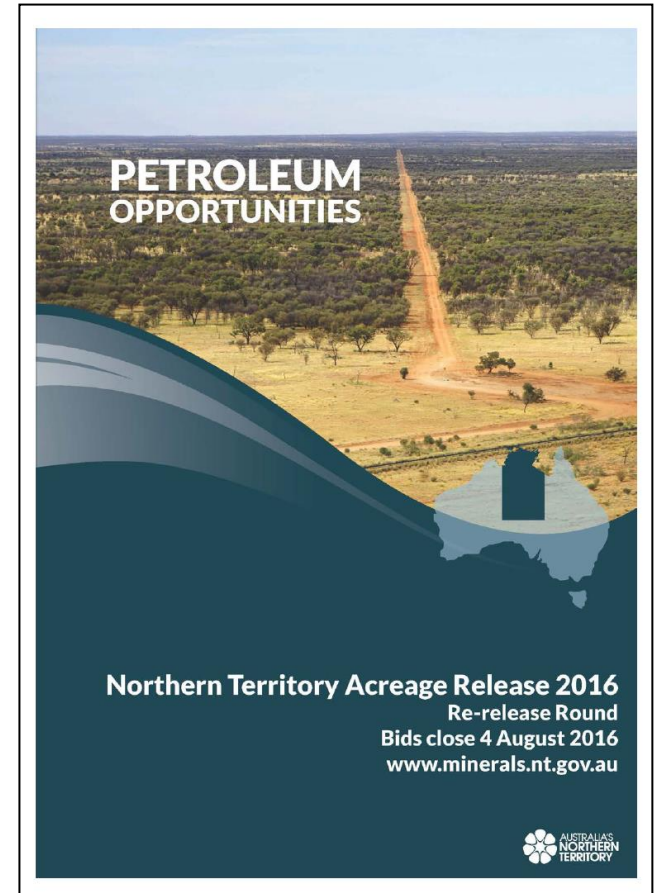
- Prospectus prepared and generally announced at a major conference (i.e. NAPE/APPEA or SEAAOC)
- Published in NT General Gazette and DPIR website
- Bidding round open for 6 -12 months
- Supported by Guidelines in accordance with the *Petroleum Act*;
 - Petroleum Exploration Permit Application and Conditions

Bid Preparation and Assessment Criteria

- Compliance with s16(3) of the Act
- Demonstrated capacity to undertake proposed work program:
 - Financial and technical resources
 - Ongoing access to resources to meet work commitments
 - Future viability of any consortium lodging an application,
 - Evidence of a satisfactory Joint Operating Agreement
 - Past performance in the NT or elsewhere

Assessment

- Assessment must be undertaken according to the Petroleum Exploration Permit Application and Conditions:
 - “Criteria for Assessment Petroleum Exploration Applications” and the *Petroleum Act*
- To ensure transparency, there are strict receipting and processing procedures
- Applications are assessed by:
 - Petroleum Assessment Committee (PAC): Technical/Financial
 - Petroleum Advisory Board (PAB): Review of process and final recommendation to Chief Executive and Minister or Delegate
 - Oversight of process is provided by an independent probity officer



Advertising, Notification and Objection

- Following acceptance of an offer of an exploration permit application, the application will be advertised in the NT News, NT General Gazette and/or notified in the Koori Mail
- A person who has an estate or interest in relation to land subject to an application has two months to lodge an objection with the Minister
- The Minister must provide copies of the objection/s and a notice to the applicant.
- The applicant may lodge replies or other comments within 30 days after the date of the notice

Native Title Act

- A four month notification period applies under NTA on pastoral land and runs concurrent with the two month objection period above.
- The Minister will consider all objections and submissions in making his or her decision on an application

Energy Titles – ALRA & NTA Negotiation Process

Native Title

- All EPAs over pastoral leases must proceed through the Native Title Act (NTA) Right to Negotiate process.
- Process starts after applicant confirms their intention to proceed with application.
 - EPA advertised in NT News, Koori Mail and General Gazette under s18(1)(e) *Petroleum Act* and s29 *Native Title Act*
 - EPA begins four month notification period - allows Native Title claimants/interested parties to register, lodge objection to the grant with the National Native Title Tribunal (NNTT).
 - two month objection period s18(1)(e) *Petroleum Act* (runs concurrently) to allow persons who have an estate or interest in area to lodge written objection to the grant.
 - Tri-Partite Deed must be executed prior to grant of EPA - between applicant, NT Government, relevant Land Council and any registered Native Title claimants.
 - Six to twelve months to reach agreement but in most cases is much longer.

ALRA

- All EPAs over aboriginal freehold land must proceed through the Aboriginal Land Rights (NT) Act (ALRA) Consent to Negotiate process.
- Process starts after applicant confirms their intention to proceed with application.
 - EPA advertised in NT News and General Gazette under s18(1)(e) *Petroleum Act*
 - EPA begins two month objection period s18(1)(e) *Petroleum Act* to allow persons who have an estate or interest in area to lodge written objection to the grant.
 - Minister (delegate) issues Consent to Negotiate (CTN) under Part IV ALRA
 - Within three months of CTN applicant is required to lodge 'exploration application' with Land Council. It must contain details of proposed exploration activities etc.
 - When deed is signed and approved (by Commonwealth Minister) DPIR will then grant title
 - Process can take many years, 3-5 year is standard, however can be longer.

Land Access & Stakeholder Engagement

Stakeholder Engagement

- At the start of the permit application process, the successful applicant must maintain regular contact with pastoralists/land managers regarding planned exploration activities and land access requirements
- Specific negotiation process apply for Aboriginal freehold or pastoral lease affected by native title

Notifying the landholder

- At a minimum, the pastoralist/land manager must be informed by the applicant:
 - within 14 days of nomination
 - At grant of the exploration permit
 - A minimum of 14 days prior to the start of any work

Reconnaissance activities

- Reconnaissance includes aerial and surface surveys, inspections and other activities that don't disturb land or vegetation
- The pastoralist must be notified at least 14 days prior but no access agreement is required

Land access agreement for exploration program

- An exploration program includes activities which require approval such as seismic surveys and drilling
- On pastoral leasehold, an agreement with the pastoralist/land holder about access to exploration sites is mandatory
- Proof of an agreement must be submitted to the department, such as a letter signed by both parties

If no agreement can be reached

- An agreement must be reached within 60 days of starting negotiations. Either party can refer to an arbitration panel
- The panel is made up of industry representatives and the chief executives of the following departments:
 - Department of Primary Industry and Resources
 - Department of Environment and Natural Resources
 - Department of Infrastructure, Planning and Logistics
- The panel must make a recommendation to the department about access and conditions within 21 days
- Both the explorer and the pastoralist/land holder can ask the civil court to review the recommendation

Petroleum Titles

Grant of an EP

Once ALRA or NTA agreements have been signed by the relevant parties the title can be granted.

An EP is granted for five years and can be renewed twice.

A typical exploration work program will consist of:

	Minimum Work Commitment
Year 1	Geological / Geophysical Studies (G&G)
Year 2	Seismic Survey
Year 3	Drill slim-hole well
Year 4	Drill & Test exploration well
Year 5	Evaluation of well results

Petroleum Titles

Change in permit conditions

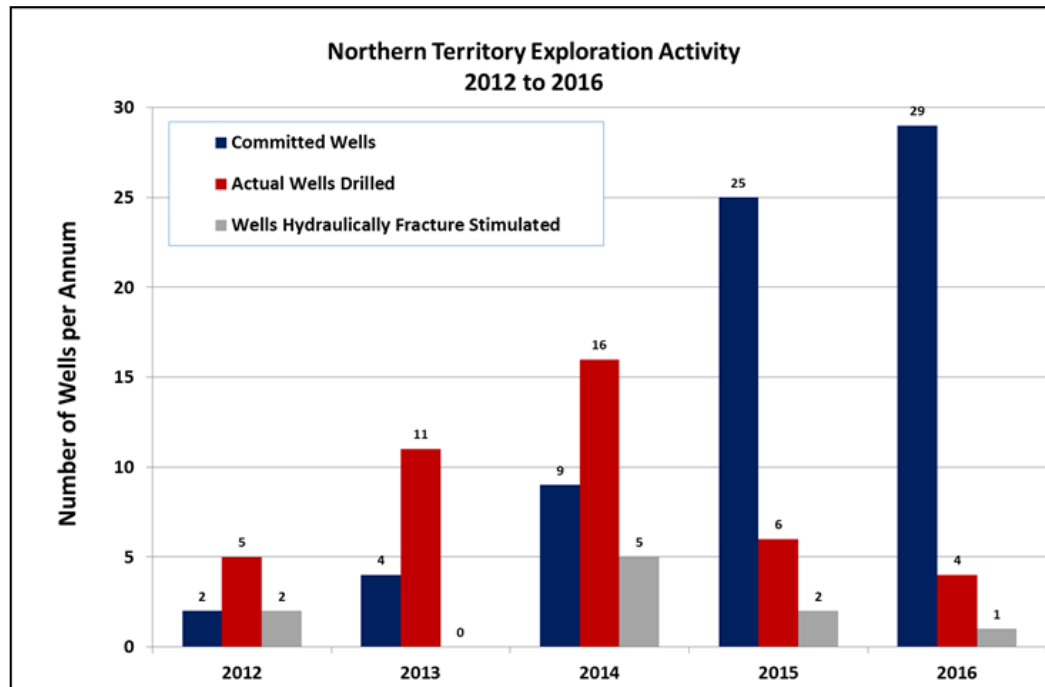
Companies may request suspension, extension and or variation of work programs and must apply to do so in accordance with s28 of the *Petroleum Act*.

Therefore the length of an initial first five year work program can extend out by several years, especially if there are a number of applications through the period.

When a discovery is made the company may apply for:

- Retention Licence – 5 year term
- Production Licence – 21 or 25 year term

In all cases there are annual reporting requirements.



Minimum work commitments on exploration permits can be exceeded or not carried out. Therefore predicting level of activity is dependent on many factors such as oil price and political factors

S58 General Conditions on a Petroleum Title

- Payment of annual fees and royalties (royalties on production licences);
- Conduct all operations, with reasonable diligence and in accordance with:
 - good oilfield practice; and
 - the approved technical works programme;
- To cause as little disturbance as practicable to the environment and comply with directions by the Minister;
- Prevent unplanned or unauthorised escape or release of any petroleum except in the interest of safety or in accordance with good oilfield practice;
- Conduct the technical works programme and other activities in such a way as to not interfere with existing infrastructure;
- Comply with directions of the Minister for the protection of the environment;
- Not erect a permanent structure or facility area unless approved;
- If on Aboriginal land, inform his employees, agents and contractors of:
 - the relevant provisions of the *Aboriginal Land Rights (NT) Act* and other Acts relating to conduct upon Aboriginal land; and
 - the principal provisions of any agreement relevant to the activities of his agents, contractors and employees he has reached with the relevant Land Council; and
- Conduct his operations and activities in such a way as to not interfere with the lawful rights or activities of any other person

Special Conditions - Water

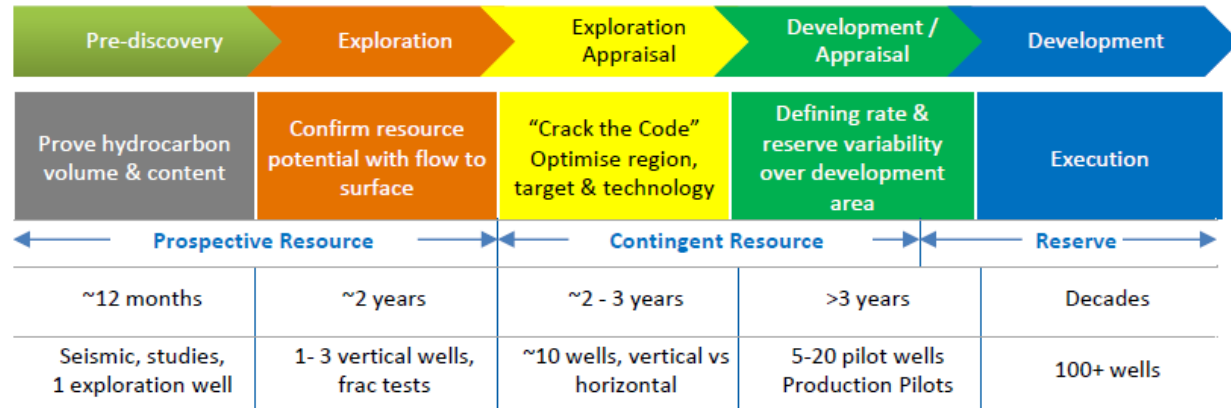
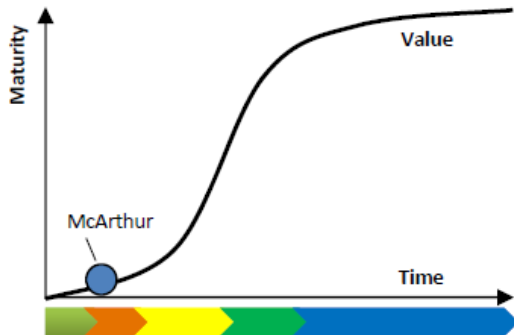
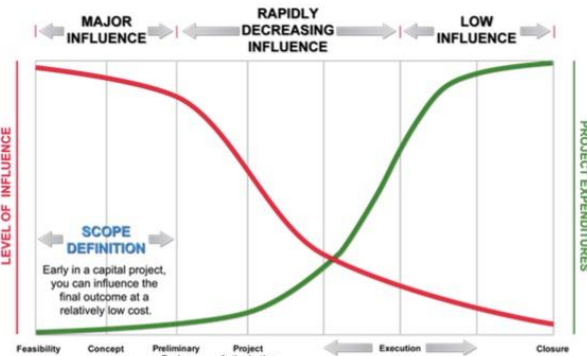
- Mining and petroleum activities are currently exempt from certain sections (Ss 7&15) of the *Water Act* (ie. obstruction of a waterway)
- Rights conferred by an exploration permit (not a production licence) include use of the water resources in the permit area for petroleum activities
- The Minister may put conditions on a permit or licence as (s)he thinks necessary
- If the petroleum activity is subject to environmental assessment under the *Environmental Assessment Act* and the assessment report contains recommendations, the Minister may include those recommendations as conditions of the licence
- Otherwise permit and licence holders are subject to all NT and Cth laws and will be required to provide the NT Government with an indemnity against any environmental harm
- Permit and licence holders must also abide by their agreements with traditional owners

Typical Project Life Cycle

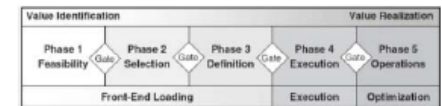
With recent discoveries of significant accumulations of petroleum in the McArthur Basin, the maturity of development is now at the appraisal stage. Continued appraisal will be subject to lifting the moratorium on hydraulic fracturing

Commercialisation Approach

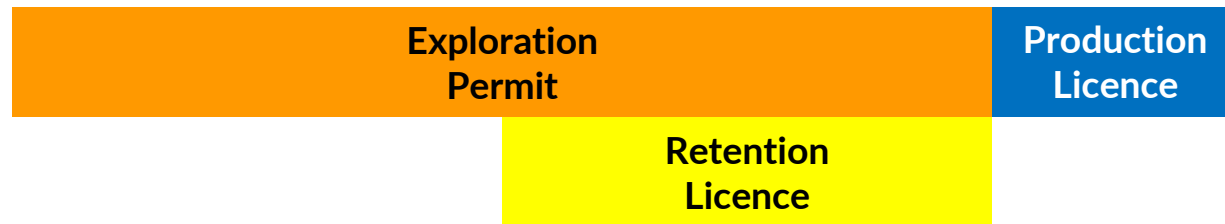
- > Involves long time frames and is capital and activity intense
- > Materiality & scale critical to underpin commerciality



Major Project Staged Gating Process



2017



Environmental Approvals & Independent Oversight

Environmental Assessment

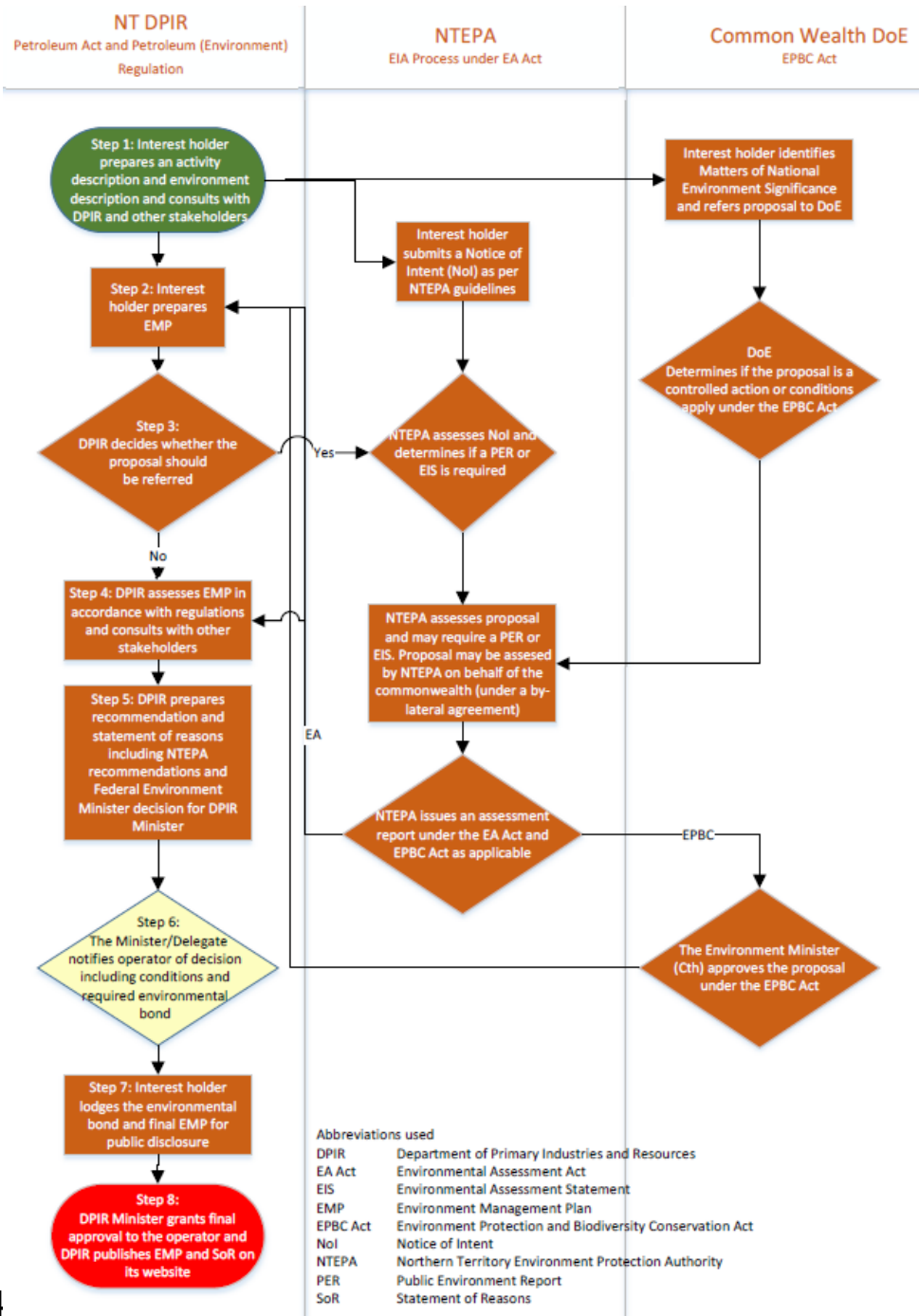
- All petroleum activities must comply with petroleum legislation and other relevant territory and commonwealth legislation
- Projects that trigger criteria for a notice of intent are assessed by the **NT EPA** to follow an EIA process
- Projects that trigger matters of national environmental significance are assessed under the EPBC Act by the **Commonwealth**

Legislation	Petroleum (Environment) Regulations	Environmental Assessment Act	EPBC Act
Small Project (Exploration)	✓		
Medium Project (Pilot Project)	✓	✓	
Large Project (Full field development)	✓	✓	✓

DPIR

NT EPA

Dept. of the Environment and Energy



Current NT Regulatory Framework

DPIR responsible for:

- Administration of *Petroleum Act*
- Resource management and promotion
- Assessment, compliance and enforcement
- Engages with other departments on weeds, water, wildlife, transport and infrastructure

WorkSafe responsible for:

- *Work Health and Safety Act*

NT EPA responsible for:

- Environmental Assessment
- *Waste Management and Pollution Control Act*

	Assessments	Approvals	Compliance & Enforcement
Resource Management (PA)	DPIR	DPIR	DPIR
Work Health & Safety (WH&S)	Work Safe	Work Safe	Work Safe
Process Safety (Schedule)	DPIR	DPIR	DPIR
Environment (Regulations)	DPIR	DPIR	DPIR
Environmental Impact Assessment (EA)	NTEPA	DPIR	DPIR
Matters of National Environmental Significance (EPBC)	DoEE/ NTEPA	DoEE	DPIR

DPIR = Department of Primary Industry & Resources

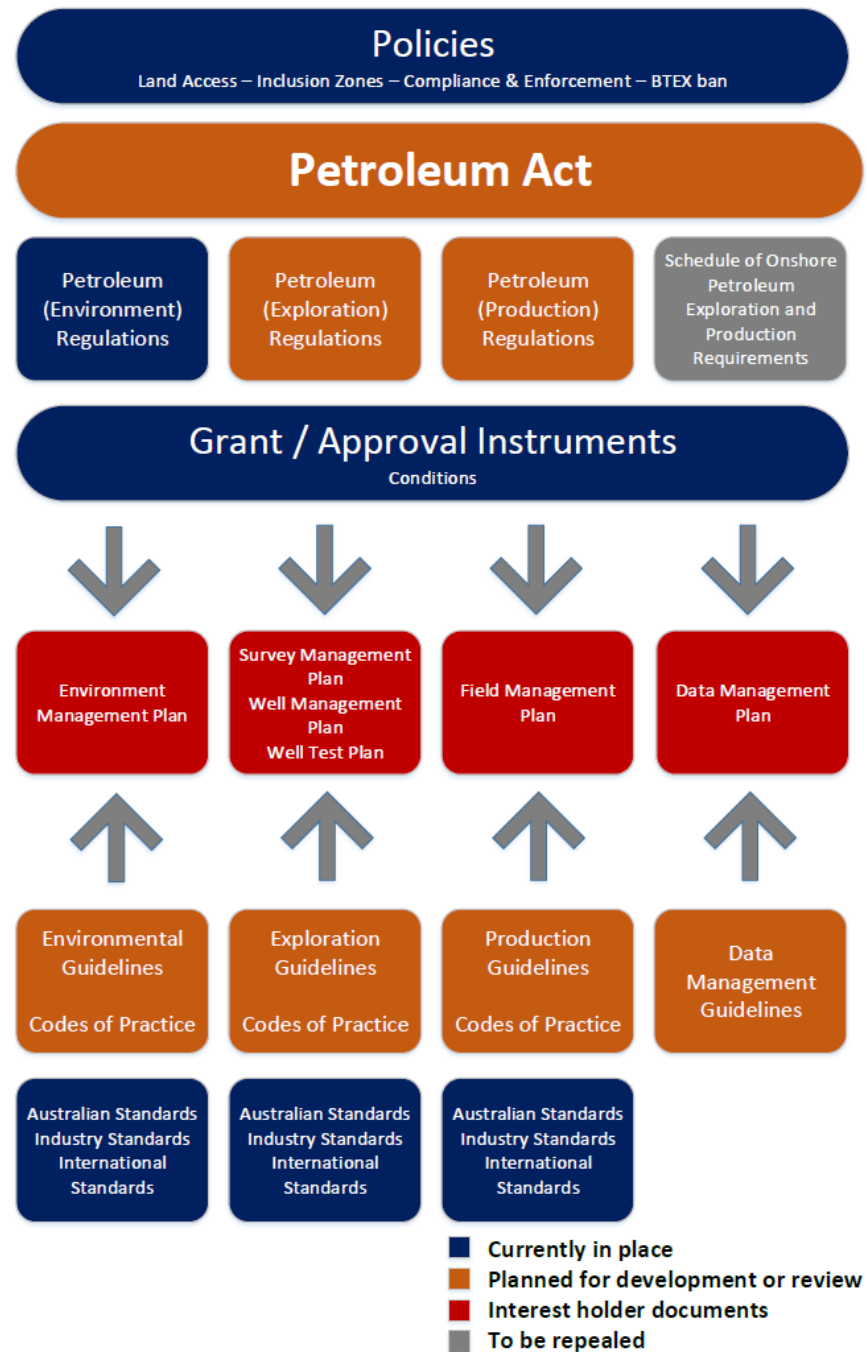
NTEPA = Northern Territory Environment Protection Authority

DoEE = Department of Environment and Energy (Cth)

WorkSafe = NTWorkSafe

Petroleum Regulatory Reform Framework

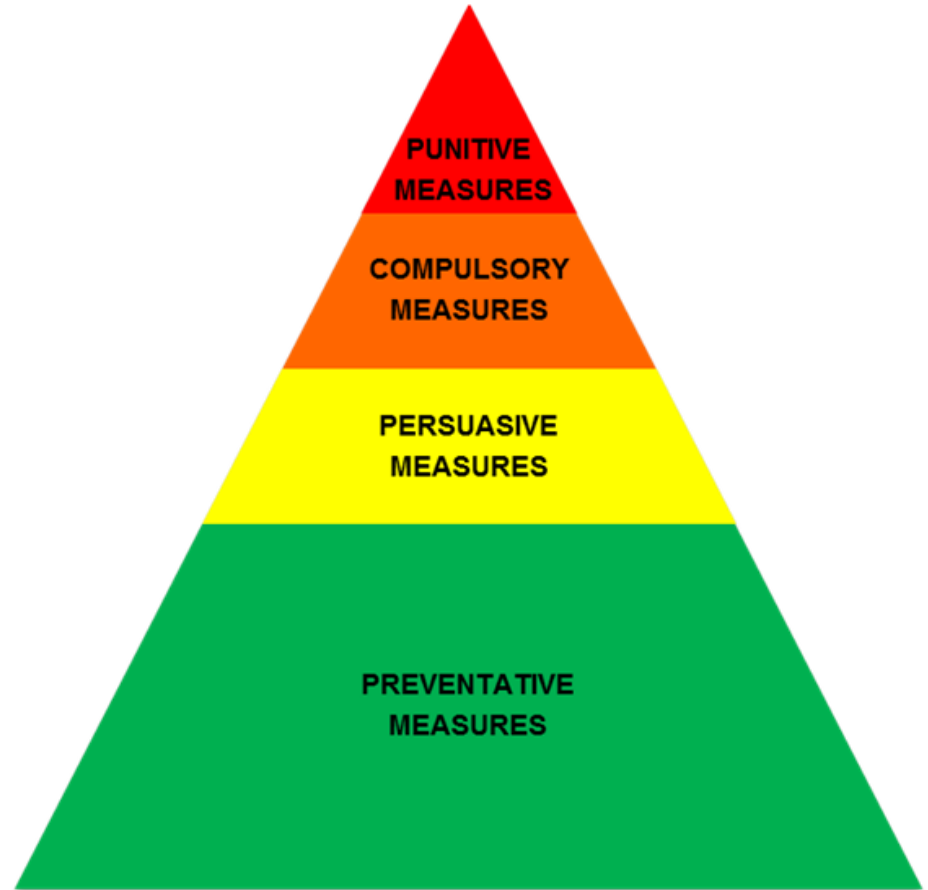
- A Risk/Outcome focussed model
- DPIR is the lead agency with effective reporting and accountability to other government agencies
- Health & Safety (WH&S Act): Safety Management Plan
- Environment (PER): Environment Management Plan
- Exploration (PEXR): Survey, Drilling or Testing Management Plan
- Production (PPrR): Field Management Plan
- Supported by Guidelines/Codes of Practice, plans must comply with guidelines and become legally binding documents, grant/approval instruments with conditions are legally binding and all are enforceable
- All plans must include decommissioning and rehabilitation provisions
- The framework is supported by adequate resourcing, competent well-trained staff, effective processes and procedures, business systems, performance management and auditing
- Regulation should be focussed on prevention of non-compliance and minimise the risk of incidents at the lowest cost to the community and industry



Compliance & Enforcement

- Risk-based and outcome focussed
- Principles:
 - Certainty
 - Openness
 - Targeted
 - Transparent
 - Proportionate
 - Practical
 - Efficient
- Focus on compliance and prevention of environmental harm
- Penalties and infringements for non-compliance with EMPs under the Regulations
- Penalties for environmental harm under the *Petroleum Act*

Energy Division is developing guiding material to ensure the plans submitted meet the objectives of the Regulations and are enforceable



Powers of Inspectors

- Inspectors may, at all reasonable times and, if requested:
 - enter and remain in an exploration permit or licence area;
 - inspect and test equipment that, in his or her opinion, has been or is being used in an area in connection with operations for petroleum exploration or operations for the recovery of petroleum; and
 - require a permittee or licensee to produce or provide him or her with access to documents in the permittee's or licensee's possession or control relating to the permittee's or licensee's operations and may inspect, take extracts from and obtain copies of any of those documents.
- A person who is the occupier or person in charge of a building, structure or place shall provide an inspector with all reasonable facilities and assistance for the effective exercise of his or her powers.
- Where an inspector is satisfied that there are reasonable grounds for suspecting that an offence against this Act has been, is being or is about to be committed, he or she may, without warrant, and with such assistance as he or she thinks necessary, on an exploration permit or licence area or otherwise:
 - seize or secure any thing which he or she believes, on reasonable grounds has been, is being or is about to be used in connection with the commission of that offence or proposed offence; and
 - take such other action as is reasonably necessary to prevent the commission of an offence against this Act.
- A person shall not, without reasonable excuse, obstruct or hinder an inspector or a person assisting an inspector in the exercise of his or her powers or, being a permittee or licensee, refuse or fail to provide the documents or provide the access
- Department Inspectors are certified level 4 Government Investigators

Definitions Environmental Harm s117AAB *Petroleum Act*

Material environmental harm means environmental harm that:

- is not trivial or negligible in nature;
- consists of an environmental nuisance of a high impact or on a wide scale;
- results, or is likely to result, in not more than \$50,000 being spent in taking appropriate action to prevent or minimise the environmental harm or rehabilitate the environment; or
- results in actual or potential loss or damage to the value of not more than \$50,000

Serious environmental harm means environmental harm that is more serious than material environmental harm and includes environmental harm that:

- is irreversible or otherwise of a high impact or on a wide scale;
- damages an aspect of the environment that is of a high conservation value, high cultural value or high community value or is of special significance;
- is likely to result in more than \$50,000 being spent in taking appropriate action to prevent or minimise environmental harm or rehabilitate the environment; or
- results in actual or potential loss or damage to the value of more than \$50,000

Environmental Offences and Penalties Act (1 unit = \$154)

Level 1

- An individual:
 - minimum \$59,290 and maximum \$592,900; or
 - imprisonment for maximum 5 years
- A body corporate: minimum \$296,296 and maximum \$2,962,960

Level 2

- An individual: minimum \$23,716 and maximum \$237,160
- A body corporate: minimum \$118,580 and maximum \$1,185,800

Level 3

- An individual: minimum \$11,858 and maximum \$118,580.
- A body corporate: minimum \$59,290 and maximum \$592,900

Level 4

- An individual: maximum \$11,585
- A body corporate: maximum \$59,290

Penalties/Imprisonment under the Act & Regulations

- Penalties are five times higher for body corporates than for individuals
- Individuals may incur prison terms between 6 – 24 months
- Low level (\$15,400/\$77,000)
 - Fail to comply with Direction, Notice or the Act
 - Fail to submit reports
 - Hindering or obstructing an Inspector
 - Fail to provide information (6 month prison false or misleading information)
- High level (\$61,600/\$385,000)
 - Commence exploration/extraction without permit/licence
 - Fail to give notice prior to exploration (2 years prison)
 - Provide false information to the Registrar (2 years prison)
 - Interfere with permittee or licensee access rights (2 years prison)
- Up to \$30,800/\$154,000 for offences under Environment Regulations

Summary of Onshore Petroleum Incidents Since 2008

YEAR	INCIDENT	
2008	10 - 15 m ³ of liquid hydrocarbons and water spill, due to sump overflowing in heavy rain	Environment: limited to lease, cleanup by operator
2010	Crude transfer pump leak, volume unknown	Environment: limited to lease, cleanup by operator
2012	Casing failure, frac fluid "(pre flush) 25,000 ltr (157 bbls) spill <100 ltr chemical	Environment: limited to lease, cleanup by operator
2014	Uncontrolled hydrocarbon release (150 litres of liquid hydrocarbons and approx. 6,250 m ³ gas) due to failed insulation gasket on flowline.	Environment: limited to lease, cleanup by operator
2014	Pipeline not fully isolated and was missing the flange. As a result approximately 6,000 ltr oil and a large amount of gas was released on pad.	Environment: limited to lease, cleanup by operator
2014	Unauthorised release of mast guy wire led to mast collapse. Well integrity was not compromised at any time before, during or after the incident.	Safety: high potential incident, well made safe, operations discontinued
2015	Rig mast loose bolt incident	Safety: high potential
2015	Diverter failure while drilling surface hole	Safety: high potential
2016	Incorrect design of mud sumps and inadequate monitoring led to overflow of sump. 30,000 ltr water spilled on well pad.	Environment: limited to lease, water only

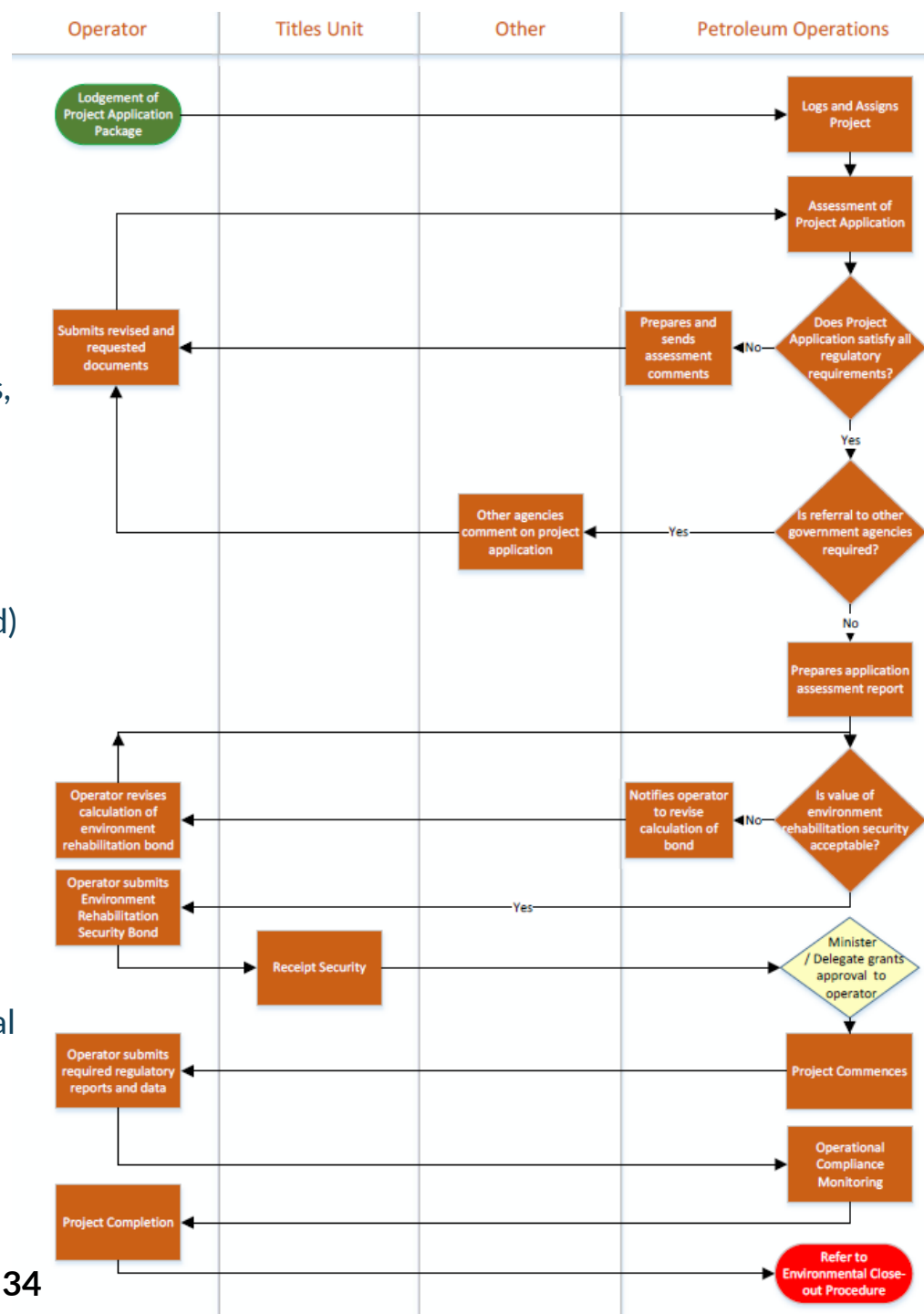
Project/activity applications

- Application is submitted by proponent (90 days)
 - Application letter, work program and Environment Management Plan (EMP)
- Energy Division formally assesses work program and EMP and consult with:
 - Weeds branch
 - Water branch
 - NT EPA
 - Department of Transport and Infrastructure
 - NT Parks and Wildlife
- Refer compliant EMP to NTEPA under a Notice of Intent (NOI)
- Additional supporting documents collected and reviewed
 - Certificates of Currency (adequate insurance cover)
 - Safety Management Plan (SMP) – assessed and approved by NT WorkSafe
 - Spill Contingency Plan (SCP)
 - Emergency Response Plan (ERP)
 - Cultural clearances (or evidence of consultation)
 - Evidence of stakeholder consultation
 - Assessment and Lodgement of Rehabilitation Security (bank guarantee)
 - Implementation of Baseline Ground and Surface Water Testing and ongoing monitoring
 - Submission of MSDS for public disclosure
 - Submission of EMP Summary for public disclosure - full disclosure under new regulations
 - Independent rig certification prior to spud

Assessment & Approval Process for Petroleum Activities

Energy Division:

- Assessment of program/plan revisions – Compliance with Act, Schedule, Guidelines, standards and Checklists
- Facilitates implementation of conditions/requirements of NT EPA and other agencies (e.g. DENR)
- Negotiate and receipt security (rehab bond)
- Verify land access arrangements
- Recommends approval to commence and carry out activity to Minister/delegate
- Carries out Compliance Monitoring of activity
- Assesses and approves subsequent Operational Applications
- Closes out Project with submissions of final reports (production, suspension or decommissioning & rehabilitation)

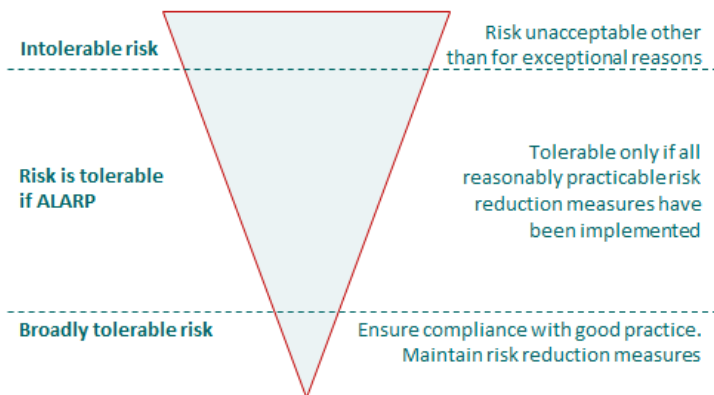


Objectives of the Petroleum (Environment) Regulations

- onshore oil and gas activities are carried out in a manner consistent with the principles of **ESD** and
- environmental impacts and risks are reduced to a level that is **ALARP** and **acceptable**.
- **affected stakeholders** are **engaged** during the development of environment management plans throughout the activity including decommissioning and full rehabilitation
- environmental management and decision making is **transparent**, focussed on **outcomes** and based on managing **key risks**

ALARP, as low as reasonably practicable, means that a risk reduction measure must be adopted unless the sacrifice involved in implementing that measure is grossly disproportionate to the reduction in risk.

Edward vs National Coal Board [UK 1949]

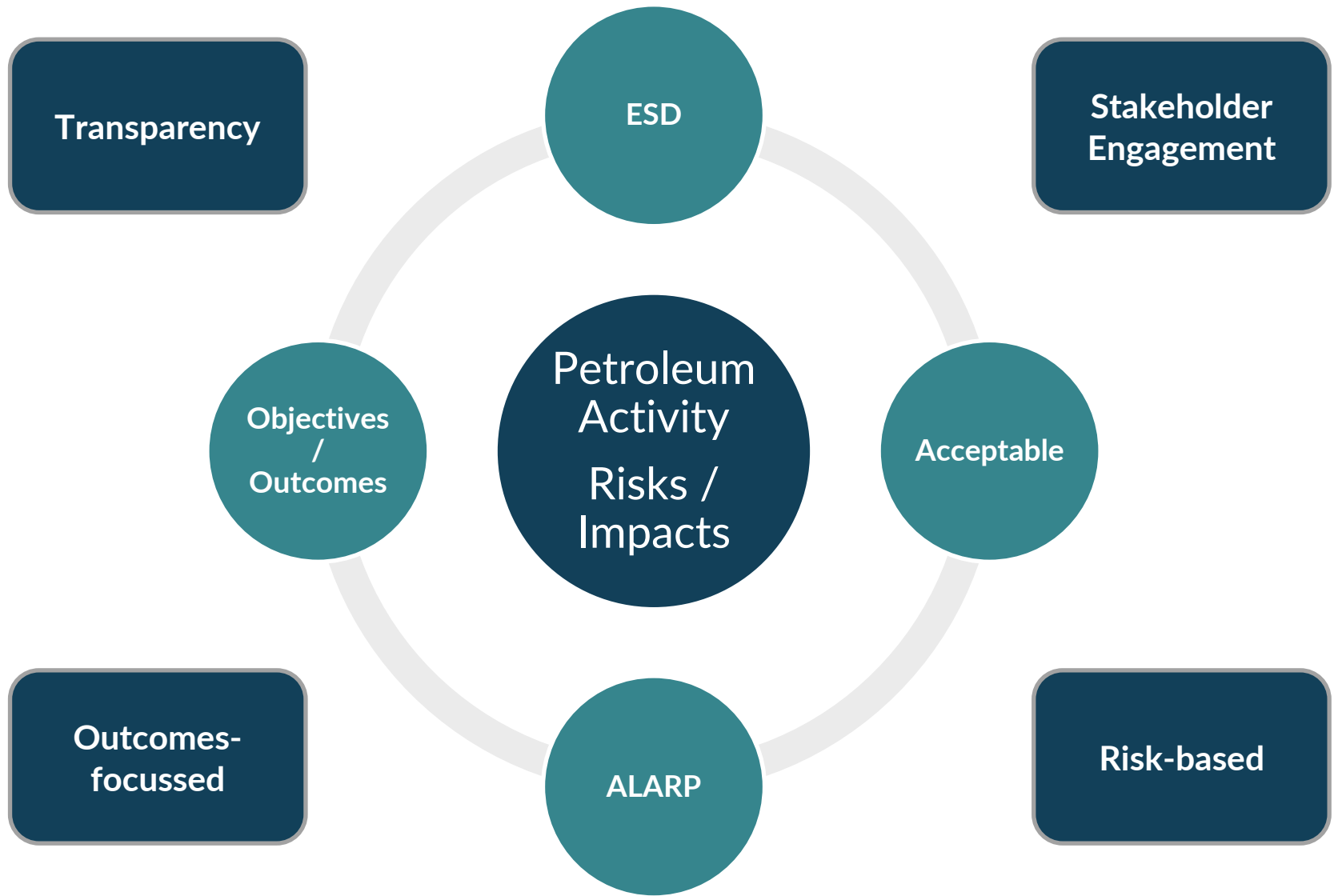


> Petroleum (Environment) Regulations

An Explanatory Guide

6 July 2016



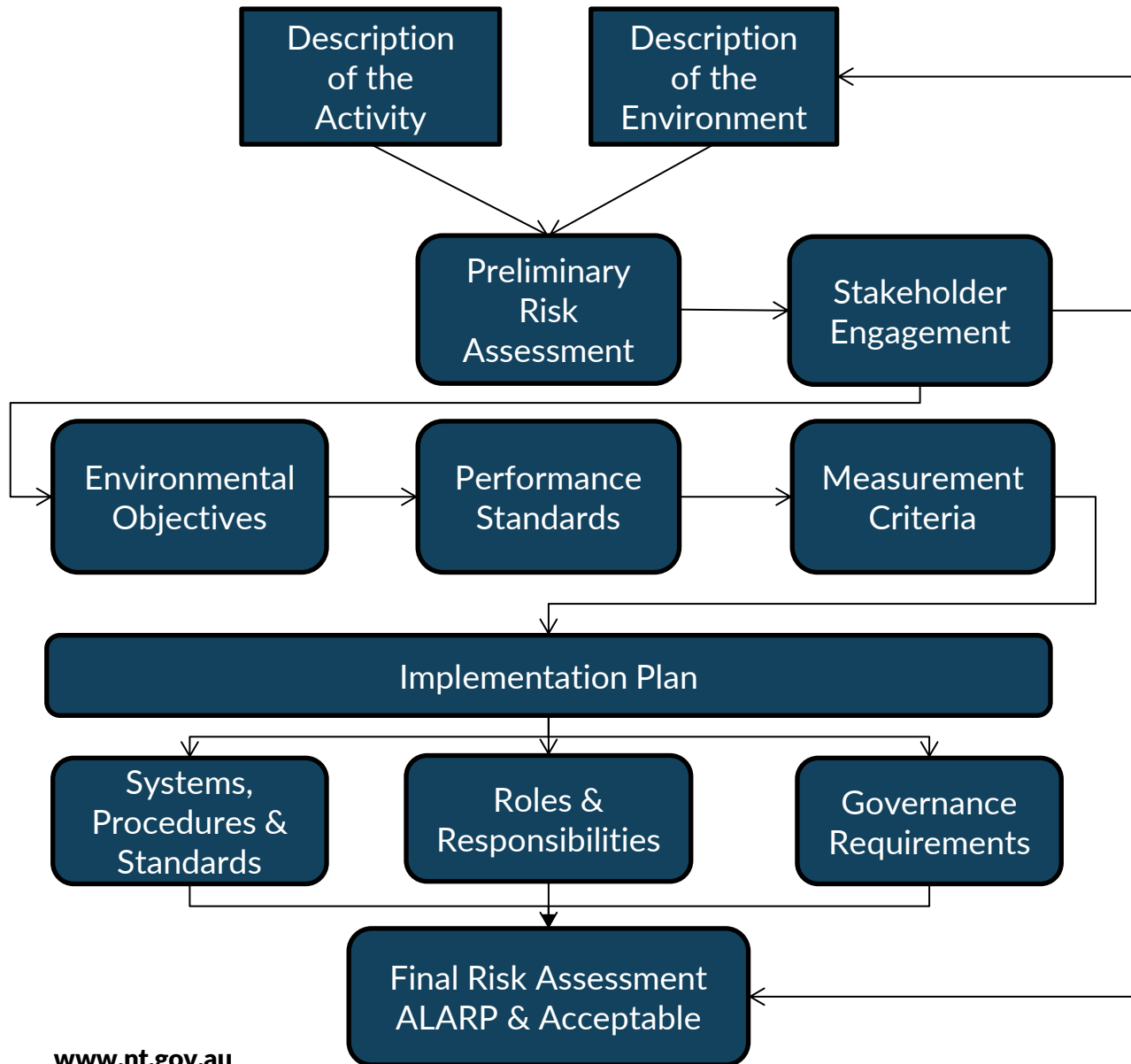




Principles of Ecologically Sustainable Development

- (a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
- (b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- (c) the principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
- (d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making; and
- (e) improved valuation, pricing and incentive mechanisms should be promoted.

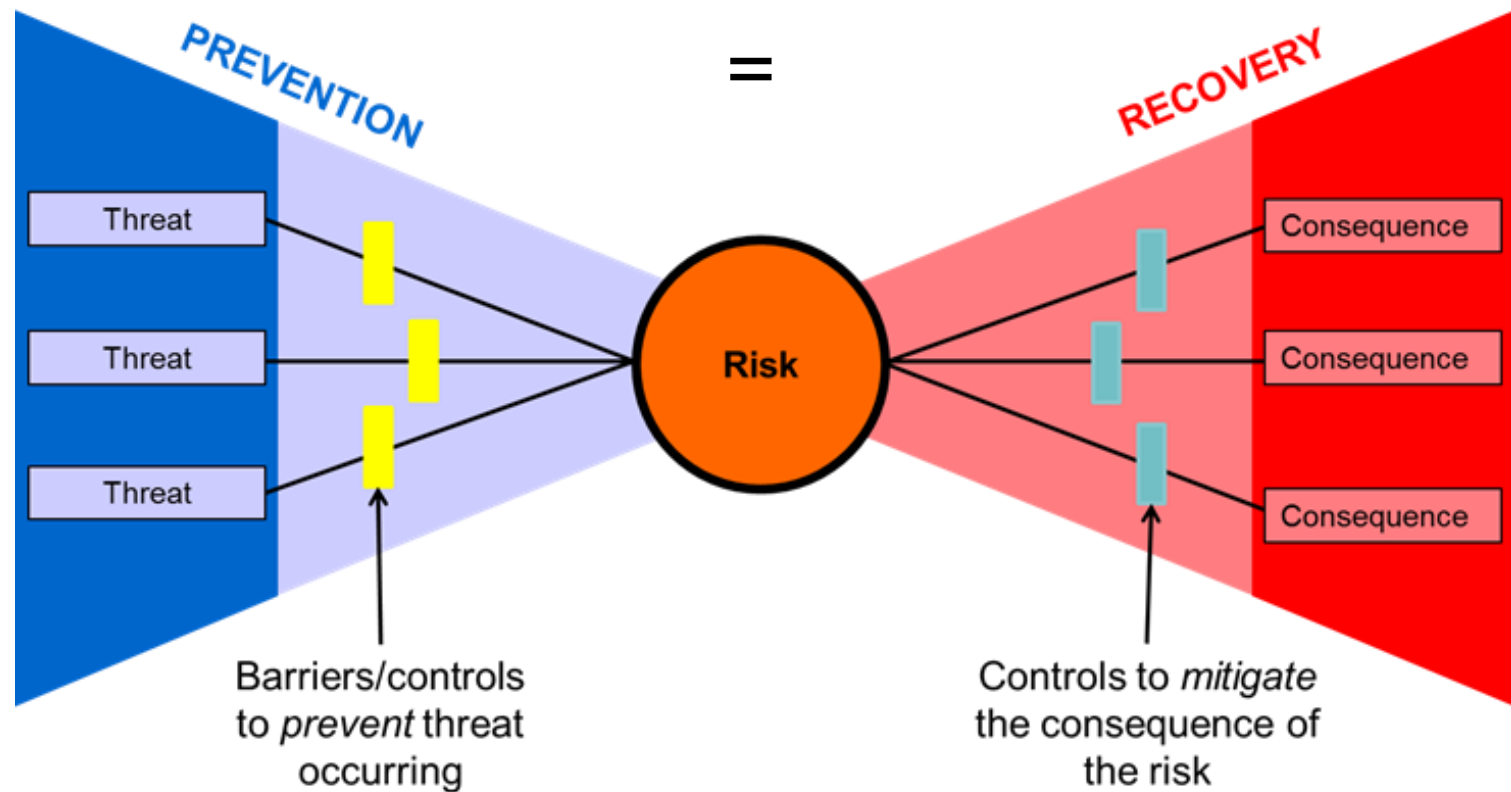
Conceptual Risk Assessment Process



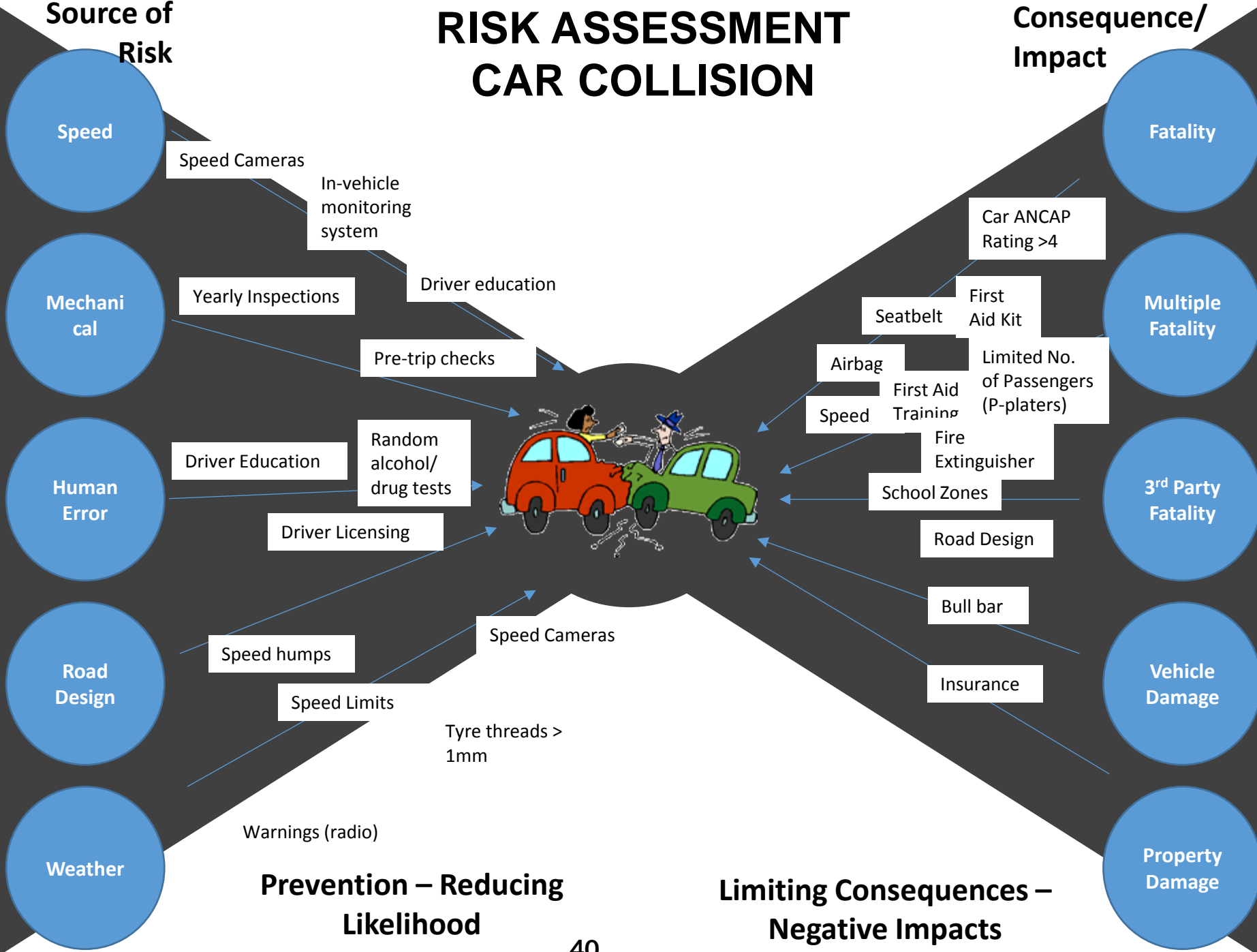
- Environmental Data:**
- Flora & Fauna
 - Water resources
 - Cultural heritage & Sacred Sites
 - Environmental Receptors
 - Ecologically sensitive areas
 - Social and economic
 - Meteorological
 - Geotechnical

Bowtie Analysis

Likelihood x Consequence



RISK ASSESSMENT CAR COLLISION



Source of Risk

Consequence/ Impact

Speed

Mechanical

Human Error

Road Design

Weather

Fatality

Multiple Fatality

3rd Party Fatality

Vehicle Damage

Property Damage

Speed Cameras

In-vehicle monitoring system

Yearly Inspections

Driver education

Pre-trip checks

Driver Education

Random alcohol/ drug tests

Driver Licensing

Speed humps

Speed Cameras

Speed Limits

Tyre threads > 1mm

Warnings (radio)

Car ANCAP Rating >4

Seatbelt

First Aid Kit

Airbag

First Aid Training

Limited No. of Passengers (P-platers)

Speed

Fire Extinguisher

School Zones

Road Design

Bull bar

Insurance

Prevention – Reducing Likelihood

Limiting Consequences – Negative Impacts

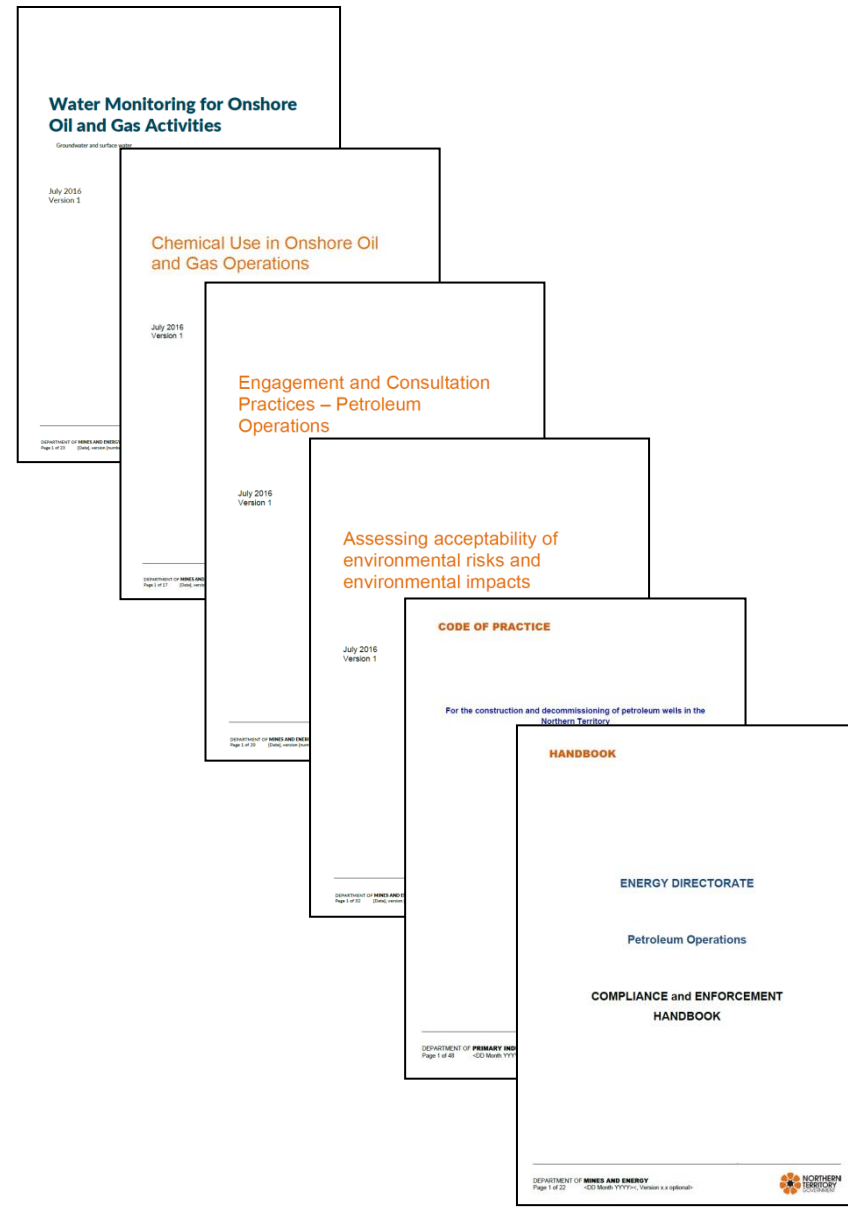
Stakeholder Engagement

- As with any new industry, community engagement and understanding is important
- Energy Division is committed to proactively working with government, industry and the community to identify and address opportunities and concerns arising from the development of onshore oil and gas resources.
- Officers call in to pastoralists when on field visits



Guidelines under Development

- Water Monitoring Guideline
- Chemical Assessment and Disclosure Guideline
- Stakeholder Engagement Guideline
- Environment Plan Assessment Terms of Reference – ESD & ALARP
- Compliance and Enforcement Handbook
- Code of Practice for Petroleum Wells (construction, lifetime & decommissioning)
- A total of 52 guidelines identified to be developed or updated



Baseline Water Monitoring

- Baseline monitoring is required for a number of environmental aspects such as biodiversity, air quality and water quality and availability
- Any project requiring hydraulic fracturing must have a baseline water monitoring study in consultation with a qualified hydro geologist
- During and after petroleum operations water quality must be monitored carefully to demonstrate that no contamination has occurred
- Any incidents such as spills or leaks must be reported to Energy Division as soon as practical
- A draft guideline has been developed to assist industry in complying with requirements under the *Petroleum (Environment) Regulations*
- The guideline was developed by incorporating best practices in Western Australia and Queensland and has been reviewed by DLRM and CSIRO

Water Monitoring for Onshore Oil and Gas Activities

Groundwater and surface water

July 2016
Version 1

DRAFT

DEPARTMENT OF MINES AND ENERGY
Page 1 of 23 [Date], version [number]



Chemical Use and Disclosure Requirements

- All chemicals used are assessed by NICNAS, the National Industrial Chemicals Notification and Assessment Scheme and
- Must have a Chemical Abstract Service (CAS) number.
- Energy Division retains copies of all chemicals used including Material Safety Data Sheets (MSDS) which must also be available on site.
- At the completion of any hydraulic fracturing operations Energy Division requires a reconciliation report with all chemicals actually pumped including concentrations and actual quantities.
- The operator is responsible for fluid testing which is done at two independent laboratories.
- A draft guideline, that will be issued for public comment, has been prepared to support the industry in complying with requirements.
- BTEX and Oil Based fluids are banned.

Chemical Use in Onshore Oil and Gas Operations

July 2016
Version 1

DRAFT

Well Integrity – Mandatory Requirements as per Schedule

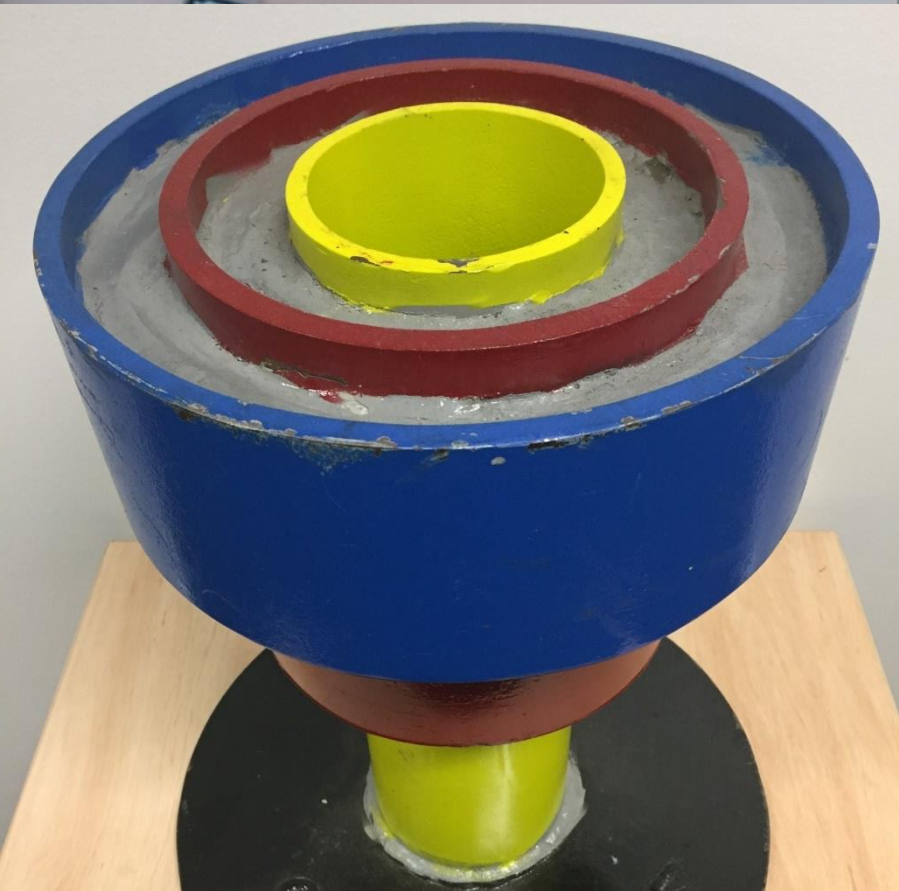
Well Integrity management is the application of technical, operational and organizational solutions to reduce risk of uncontrolled flow of fluids throughout the life cycle of a well and beyond

Well Construction (Drilling of the well)

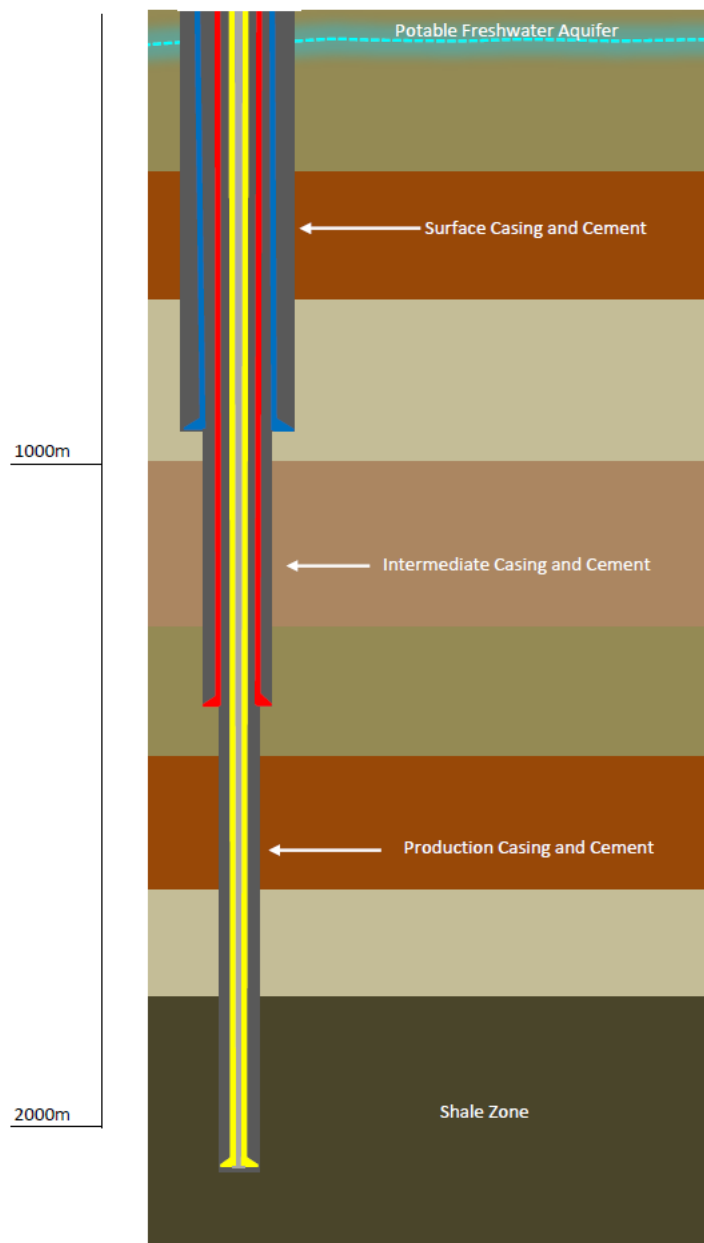
- Only water or synthetic based drilling fluids (drilling mud) or air drilling
- Oil based muds will not be accepted (BTEX is banned in NT)
- Cement to surface - all casing strings (unless expressly exempted)
- All casing strings, including surface casing, set in competent formation
- Validation of ALL barriers (placement and integrity): pressure tests, cement bond logs, volumetric confirmation
- Isolation of aquifers

Hydraulic Fracture Stimulation:

- Baseline water assessment and ongoing monitoring and testing
- Demonstrated understanding of natural fracture network and potential fault activation based on seismic interpretation and geomechanical studies
- Safe separation between natural aquifers and the fracture zone (aquifers and ductile formations)
- Cement Bond Log or equivalent demonstrating well cement integrity
- Pressure test of casing up to maximum working pressure in accordance with API standards or equivalent

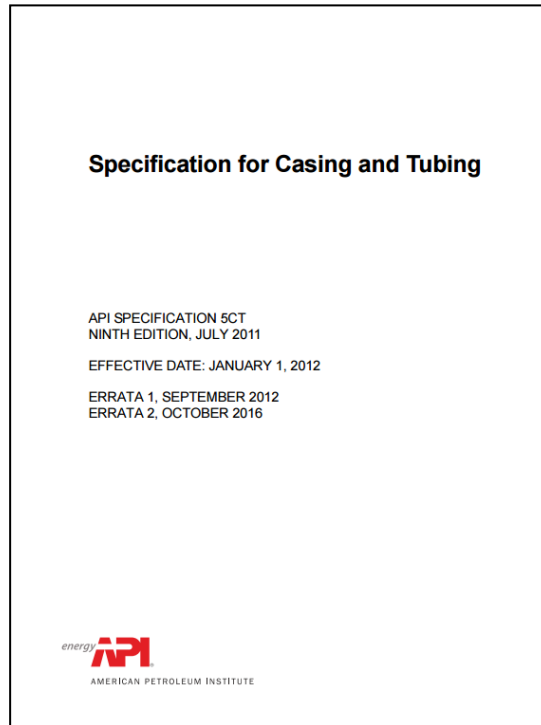


BASIC WELL DESIGN



Casing Design – Well Integrity

- Specific Casing Selected in Well Design
- Collapse Pressure
- Burst Pressure
- Tension
- Connections (Premium)



API Recommended Properties
of Casing

OD	Weight	Grade	ID	Collapse Resist.	Pipe Body Yield	Pipe Body Internal Yield
in	lbm/ft		in	psi	lbm	psi
7.000	23.00	C/T-95	6.366	4140	632000	7530
7.000	26.00	J-55	6.276	4330	415000	4980
7.000	26.00	K-55	6.276	4330	415000	4980
7.000	26.00	M-65	6.276	4810	491000	5880
7.000	26.00	L-80	6.276	5410	604000	7240
7.000	26.00	N-80	6.276	5410	604000	7240
7.000	26.00	C-90	6.276	5740	679000	8140
7.000	26.00	C-95	6.276	5890	717000	8600
7.000	26.00	C/T-95	6.276	5890	717000	8600
7.000	26.00	P-110	6.276	6230	830000	9960
7.000	29.00	M-65	6.184	6100	549000	6630
7.000	29.00	L-80	6.184	7030	676000	8160
7.000	29.00	N-80	6.184	7030	676000	8160
7.000	29.00	C-90	6.184	7580	760000	9180
7.000	29.00	C-95	6.184	7840	803000	9690
7.000	29.00	C/T-95	6.184	7840	803000	9690
7.000	29.00	P-110	6.184	8530	929000	11220
7.000	32.00	M-65	6.094	7360	606000	7360
7.000	32.00	L-80	6.094	8600	745000	9060
7.000	32.00	N-80	6.094	8600	745000	9060
7.000	32.00	C-90	6.094	9380	839000	10190
7.000	32.00	C-95	6.094	9740	885000	10760

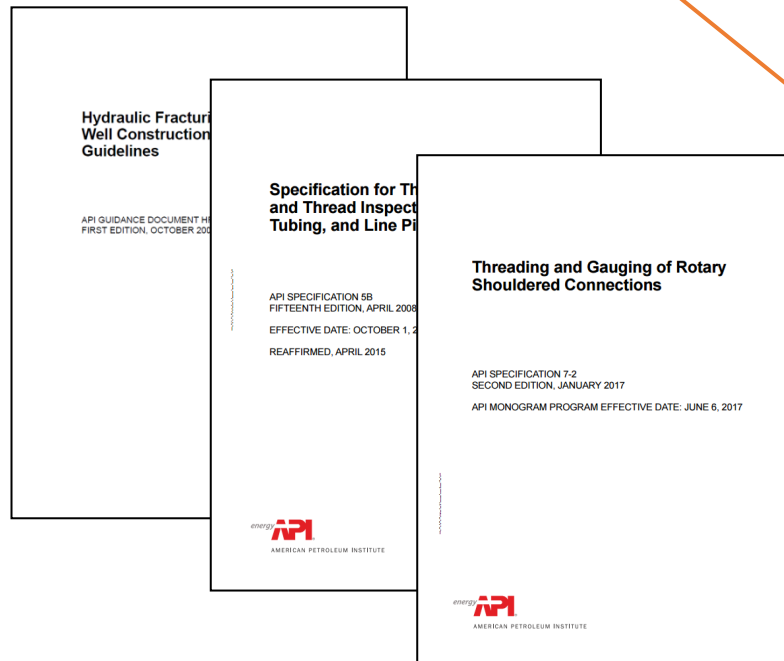
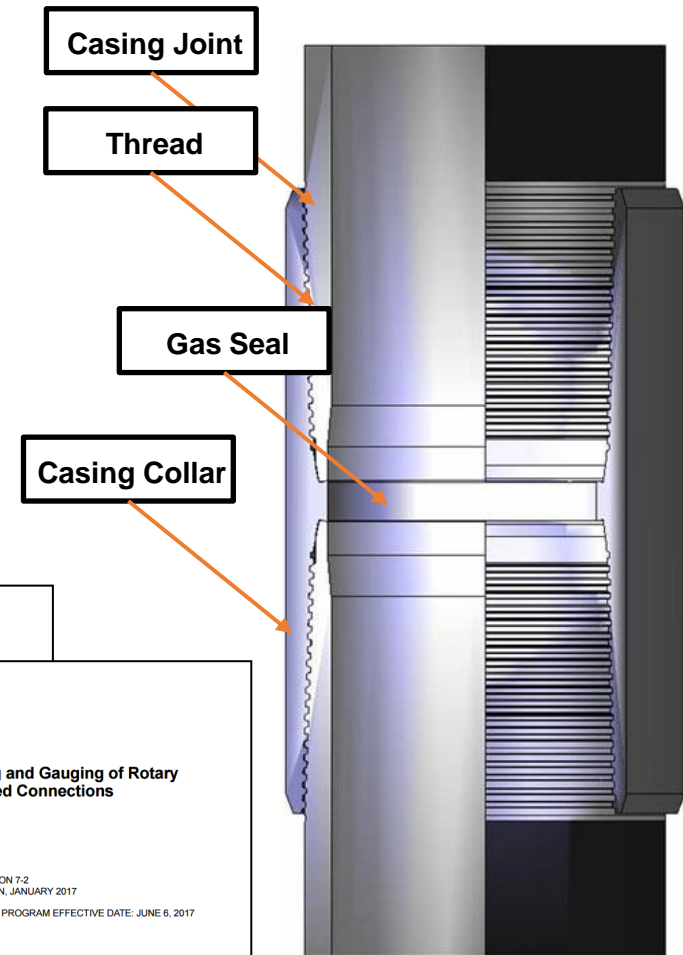
Ref.: SPE166142, Environmental Risk Arising from Well Construction Failure, Differences Between Barrier and Well Failure and Estimates of Failure Frequency Across Common Well Types, Locations and Well Age, King & King 2013



OCTG and Well Integrity

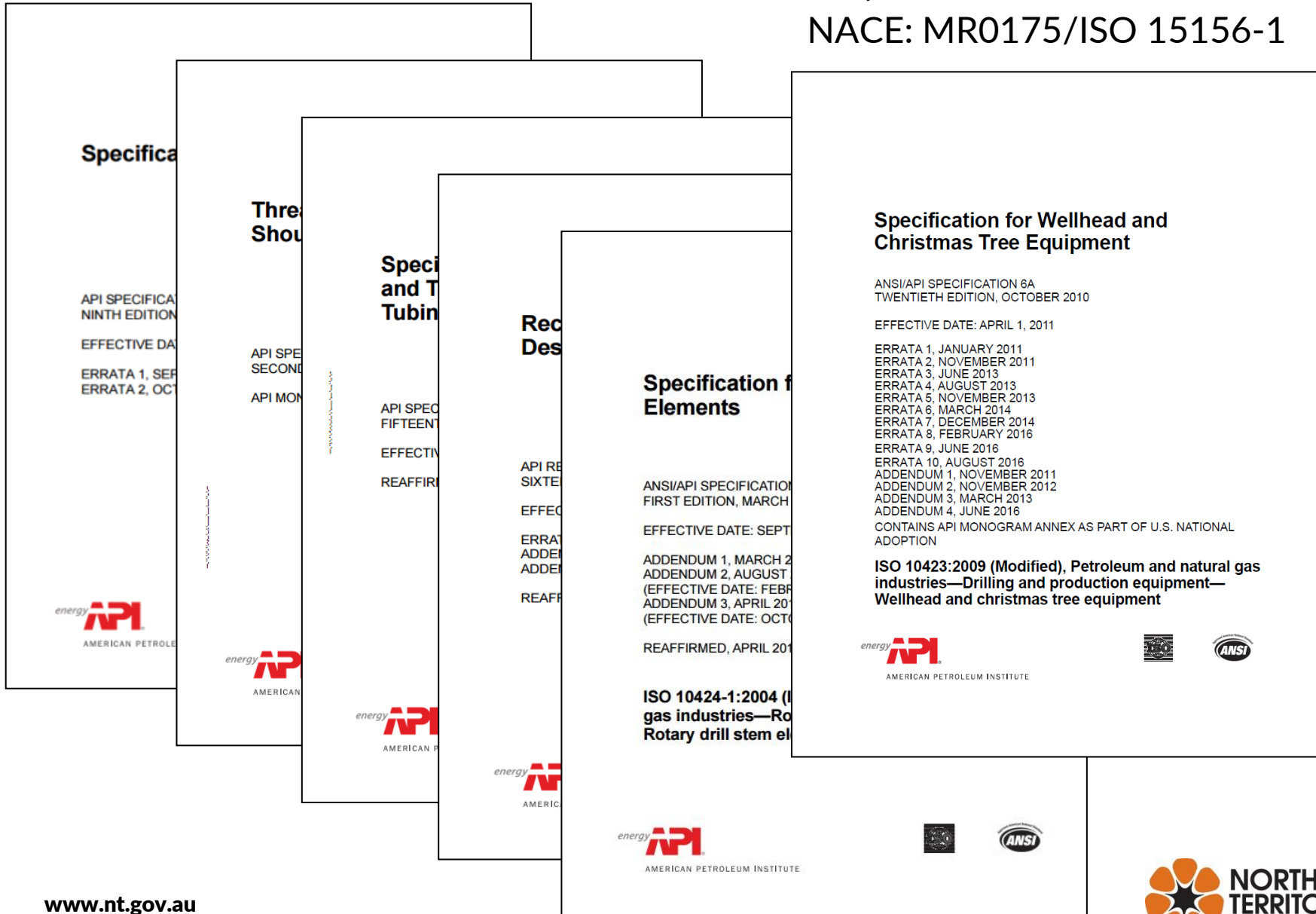
Oil Country Tubular Goods (OCTG) includes all drill pipe, casing and tubing used in petroleum wells

- API 5CT and API 5B are the main industry standards used for the manufacture and repair of API OCTG
- Premium threads are used in gas well application which include gas seals and tight tolerances

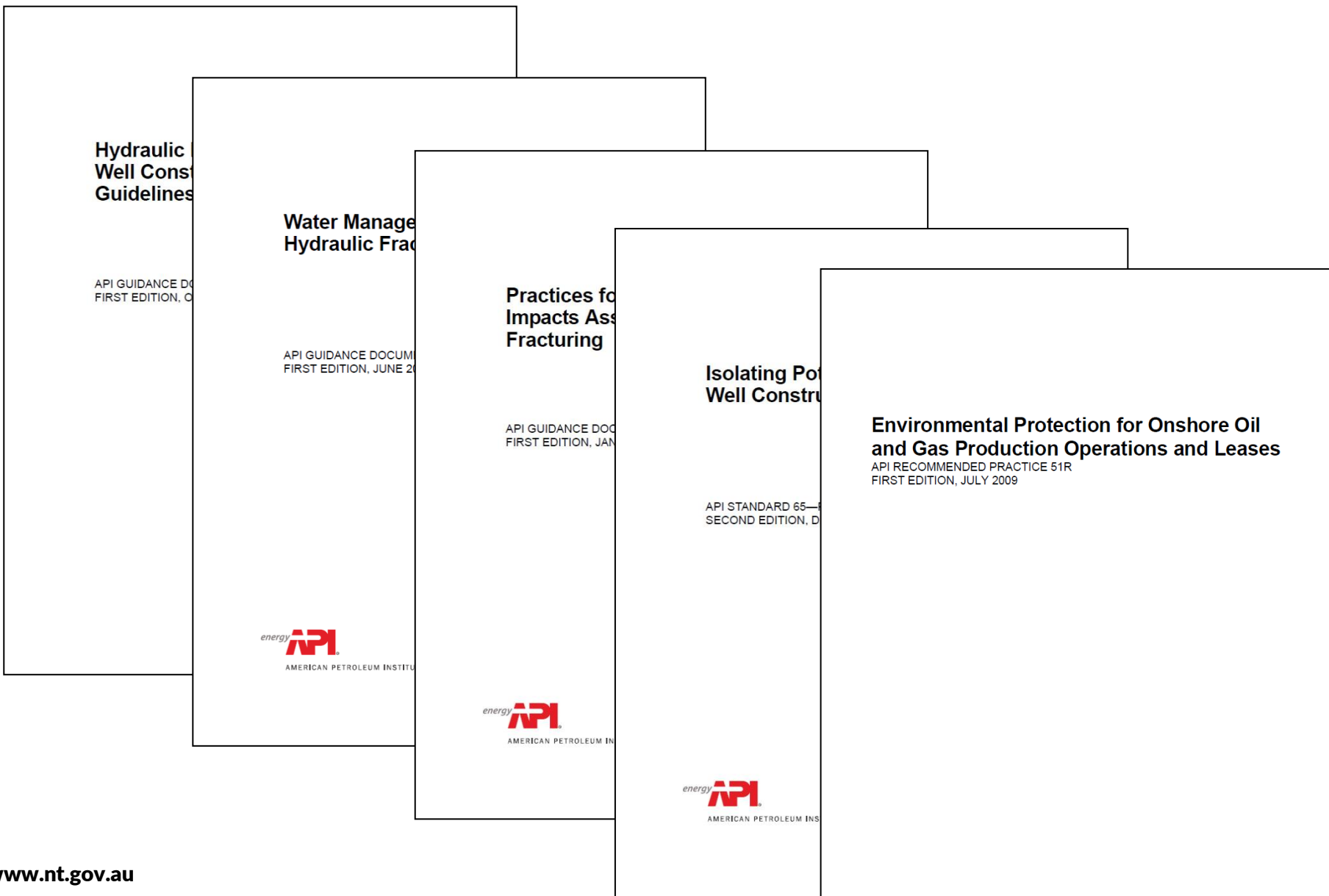


API Standards for Drilling

NORSOK: D-010 Revision 4
ISO/DIS 16530-1
NACE: MR0175/ISO 15156-1



API Standards Relating to Hydraulic Fracturing



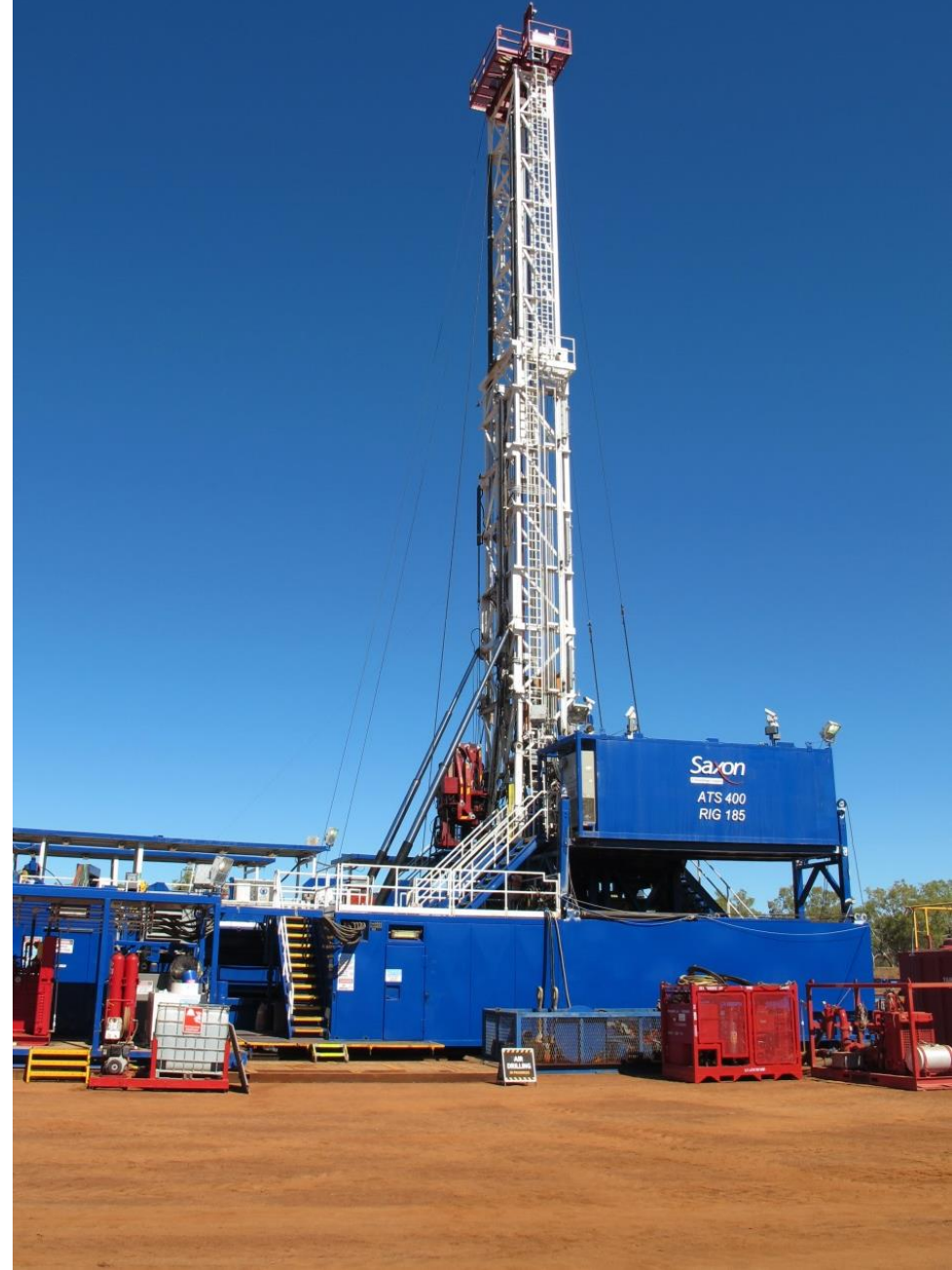
Reporting Requirements

DAILY REPORTS (before midday)

- Daily Drilling Report (DDR) and/or Daily Completions Report (DCR)
- Daily Geology Report (DGR)
- Daily Testing Report (DTR)

PER EVENT OR UPON REQUEST

- Wireline logs
- Well integrity reports (Mud logging, casing tallies, pressure recording, cementing, cement calculations)
- Rig contractor's report (IADC Report)
- Monthly Incident/HSE reports
- Reportable and Recordable reports
- Well Completion Reports



Example – Daily Drilling Report



DAILY DRILLING REPORT # 7
Amuneee NW-1
13.09.2015



DAILY DRILLING REPORT # 7
Amuneee NW-1
13.09.2015



DAILY DRILLING REPORT # 7
Amuneee NW-1
13.09.2015

Daily Operations	Ground Elevation (m)	200.63	LTI Free (days)	81.00	APE Amount (tGsd)	8,168,000
Country	AUSTRALIA ONSHORE					
Field Name	BETAALOO NORTH	Original KBRT Elevation (m)	265.68	Casing OD (in)	16	APE No.
Contractor	SAVON ENERGY SERVICES	End Depth TMD (mKB)	139	Set Depth TMD (mKB)	118	Daily Cost (Cost)
Rig	RIG 185	Set Depth TVD (mKB)		Cumulative Cost (Cost)		8,014
Well Long	Datum GDA 94	24 Hr Progress (m)		Leak Off Density (lb/gal)		4,053,473
Latitude (°)	16° 20' 38.172" E	Planned Depth (TMD) (mKB)		Cum Time Log Days From Spud (days)		
Longitude (°)	133° 53' 2.757" E	Planned Depth (TVD) (mKB)		Cum Time Log Days (days)		

Operations @ 0600hrs
Rigging up to air mist drilling
Last 24hr Summary
Washed on cement to cure. Cut 10" conductor and laid out same. Installed 21-1/4" RCH. Prepared 14-3/4" (TC) G25W(CPS) BHA and ran in hole.
24hr Forecast
Drill out cement and show track. Total losses at 118 mRT. Air mist drill from 112 to 139 mRT. Air mist drill surface hole from 130 mRT.
General Remarks
00:00 - 00:30 Continued to run in hole from 76 to 116.91 mRT. 00:30 - 01:00 Tagged cement. Installed tarps around cellar to keep mud going into cellar. 01:00 - 04:00 Washed and reamed cement and shoe track from 116.91 to 119 mRT, washed and reamed from 119 to 122 mRT. Tagged shoe at 117.34 mRT. Total losses at 118 mRT. 04:00 - 06:00 Pulled back into 10" casing shoe. Prepared mud pump #2 and air package to proceed with air mist drilling. Installed bearing assembly to RCD. Rearranged DC and HWDP on racks.

Date	Type	Description	Des	Day	Ops to Next Check (hrs)	Comments
13/09/2015	Weekly Safety Meeting	Weekly		Tue		Held weekly safety meeting - Statistics for the Week, - 52 Cards in total. Cards from yesterday not included. 3rd Party 9 Cards. Total cards open in system = 11 from over 720 cards since commencement of project. 7 Stop the job this week. Excellent result. WellSite Rep discussed - Lifesaver # 5, Barriers and signage, barrier incidental from deck. Safety Award - Graham Hartwig (Strive 11/6/15 re isolations). Air drilling operators and barrier/signage requirements.
13/09/2015	Fire Drill	Fire Drill		Day		Scenario bush fire near camp. Alarm sounded 2:30 minutes for muster. Debriefed personal on drill. P.JSM. Discussed installing and ripling up 7-11/16" valve on RCD, also raised permits for job.
13/09/2015	Pre-Job Safety Meeting	P.JSM		Day		AAR. On cementing with Halliburton, Well Site Representatives and Drilling Superintendent. P.JSM. Discussed picking up and making 14-3/4" bit and stabilizers, running in hole with BHA.
13/09/2015	After Action Review	AAR		Day		Origin life saving rule # 1 - always wear a seatbelt. Discussed, tripping, handling BHA, drilling program, mud checks.
13/09/2015	Pre-Job Safety Meeting	P.JSM		Night		
13/09/2015	Pre-Tour Meeting	PTSM		Night		

Start Time	End Time	Start (mKB)	End (mKB)	Phase	Op Code	Activity Code	Time P-N	Tri Class	Tri Class	Vendor	Operation
00:00	03:30	3.50	139.0	CONDT	CEMENT	WOC	P				Washed on cement to cure. Rough out 10" conductor and laid out, broke out 16" swellage and laid out, cleaned rig floor out 16" running equipment, rigged down and moved catwalk.
03:30	08:30	3.00	139.0	CONDT	CEMENT	RURD	P				Made final out on 10" conductor, position 21-1/4" RCH in cellar and aligned diverter for welding. Welding 21-1/4" RCH to 10" conductor casing. Function tested air package, tested primary and secondary jet.

Page 1

Printed on 14/09/2015

Start Time	End Time	Start (mKB)	End (mKB)	Phase	Op Code	Activity Code	Time P-N	Tri Class	Tri Class	Vendor	Operation
11:30	12:30	1.00	139.0	CONDT	CEMENT	SFTY	P				Held weekly safety meeting - Statistics for the Week, - 52 Cards in total. Cards from yesterday not included. 3rd Party 9 Cards. Total cards open in system = 11 from over 720 cards since commencement of project. 7 Stop the job this week. Excellent result. WellSite Rep discussed - Lifesaver no 5, Barriers and signage, barrier incidental from deck. Safety Award - Graham Hartwig (Strive 11/6/15 re isolations). Air drilling operators and barrier/signage requirements.
12:30	14:00	1.50	139.0	CONDT	CEMENT	RURD	P				Continued to weld on 21-1/4" RCH to 16" conductor casing. Held P.JSM. Discussed installing and ripling up 7-11/16" valve on RCD, also raised permits for job.
14:00	14:30	0.50	139.0	CONDT	CEMENT	SFTY	P				Nippled up 7-11/16" valve on RCD, installed blow line, reinstalled catwalk and raised v-door, reinstalled pipe arms.
14:30	18:00	3.50	139.0	CONDT	CEMENT	RURD	P				Conducted rig service. Loaded pipe racks with BHA, strapped and cleaned. Held P.JSM. Discussed picking up and making 14-3/4" bit and stabilizers, running in hole with BHA. Picked and made up 14-3/4" (TC) G25W(CPS) and ran in hole from surface to 76 mRT.
18:00	18:30	0.50	139.0	CONDT	CEMENT	SVRG	P				
18:30	19:30	1.00	139.0	CONDT	CEMENT	RURD	P				
19:30	20:00	0.50	139.0	CONDT	CEMENT	SFTY	P				
20:00	00:00	4.00	139.0	CONDT	CEMENT	RH	P				

BOPs		
Use of Last Test	Description	
Daily Mud Costs		
Daily Mud Total Cost (Cost)	Cumulative Mud Cost (Cost)	10,378.04

Depth (mKB)	Time	Type	Density (lb/gal)	Vis (cP)	Get (150) (bbl/100ft)	Get (10m) (bbl/100ft)	Get (30m) (bbl/100ft)
139.0	18:00	Water Base	8.30	27			
		Vis 300rpm		2			
		Vis 200rpm		1			
		Vis 100rpm		1			
		Vis 50rpm		1			
		Vis Spm		1			

Parameter	Value	Unit
pH	7.5	
API Calc (bbl/100ft)	0	
T Flowline (°C)	21.0	
OR Content (%)	1	
Water Content (%)	100.0	
Sand Content (%)	0.0	
LOG (%)	0.0	
RSS (%)	1	
API Filtrate (cc/30)	0.00	
Chlorides (mg/L)	300	
Calcium (mg/L)	300	
Magnesium (mg/L)	300	
Source	Seawater	
HTHP Depth (mKB)	API Calc (102)	Electric Slab (m)
HTHP FC (152)	Mud Engineer (Budi Mulyanto)	Active Mud Volume (bbl)
		Mud Lost to Surface (bbl)
		Mud Lost to Hole (bbl)

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Formation Name	Prog Top MD (mKB)	Prog Depth Top 50 (m)	Prog Bot MD (mKB)	Drill Top MD (mKB)	Drill Top TVD (m)	Prog Drift Top TVD - Act (m)	Prog Drift Top TVD - Plan (m)	Thickness (m)	Com
Undifferentiated Oolitic	0.00	279.35	75.00			5.35		544.33	94.95
Anthony Lagoon Beds	75.00	203.00	112.00	70.00				468.98	21.50
Gum Ridge Formation	112.00	166.00	237.00	91.50				431.98	-125.00
Antrim Volcanics	237.00	41.00	392.00					-156.00	
Bukakara Sandstone	392.00	-114.00	397.00					-5.00	
Upper Chambers River Mudstone	397.00	-119.00	794.00					-397.00	
Upper Chambers River Mudstone	794.00	-518.00	809.00					-15.00	
Lower Chambers River Mudstone	809.00	-531.00	809.00					-80.00	
Bukakara Sandstone	869.00	-591.00	957.00					-86.00	
Upper Kyalla Mudstone	957.00	-679.00	1,160.00					-233.00	
Kyalla Sandstone	1,160.00	-912.00	1,245.00					-55.00	
Lower Kyalla Mudstone	1,245.00	-697.00	1,365.00					-150.00	
Morak Sandstone	1,365.00	-1,117.00	1,870.00					-475.00	
Upper Velken Member	1,870.00	-1,592.00	2,090.00					-220.00	
Middle Velken Member	2,090.00	-1,512.00	2,090.00					-610.00	
Lower Velken Member	2,600.00	-2,322.00	2,600.00					-300.00	
Bessie Creek Sandstone	2,600.00	-2,622.00							

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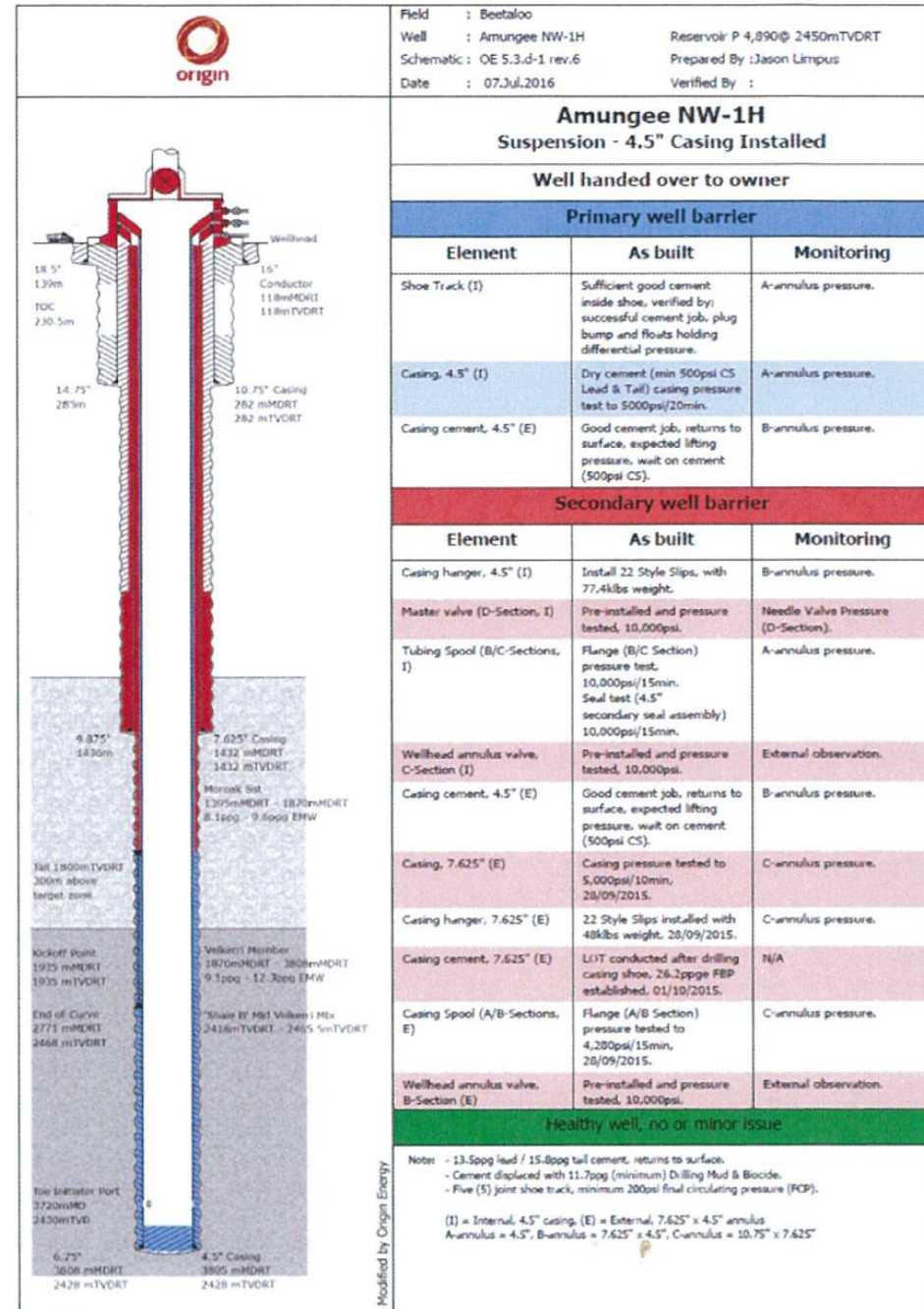


Compliance & Monitoring

Desktop audits provide holistic picture of the entire well construction process

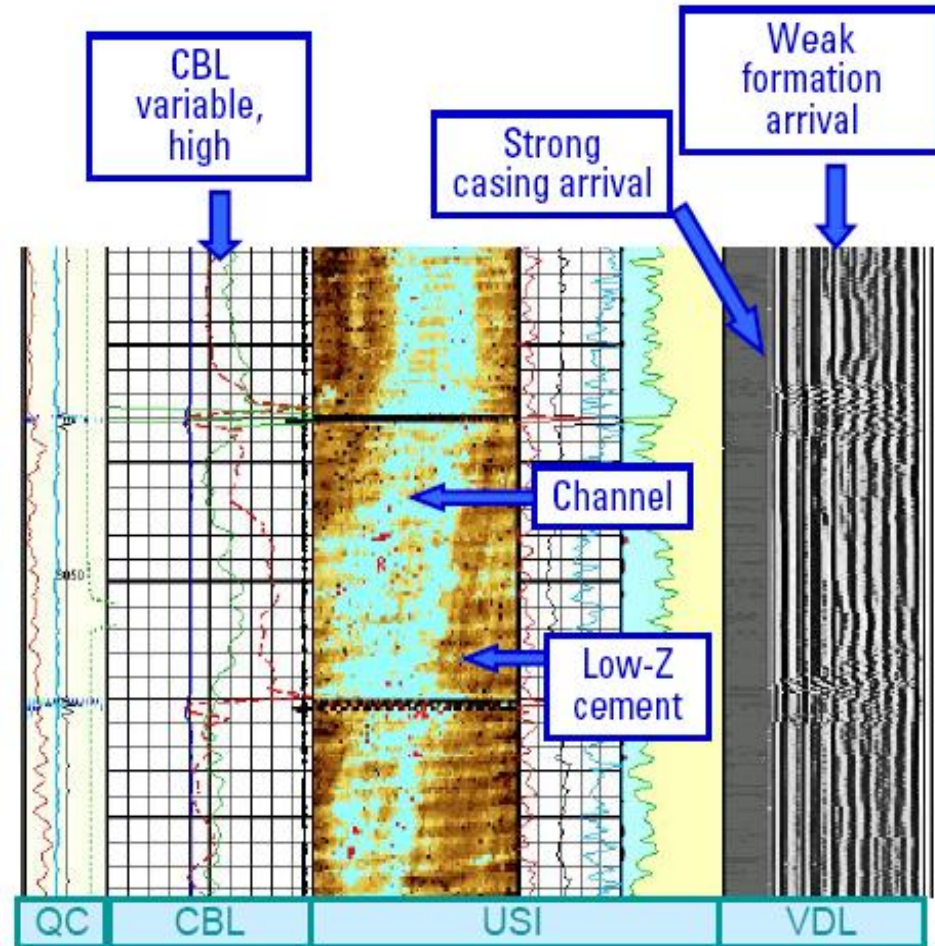
Reports record the installation and validation processes of every barrier

- Daily Drilling Report
- IADC report (Rig contractor's report)
- Pressure recording charts
- Cement Operator's pumping chart
- Wireline Logs
- Geological reports
- Mud Logger's report
- Casing tallies
- Cement volume calculations
- Etc.



Tools to Demonstrate Wellbore Cement Integrity

- Cement is laboratory engineered based on wellbore conditions
- Volume calculations, pressure tests and monitoring of cement movement, temperature logs and:
- Cement bond logs – detect areas where cement is thin or non-existent for risk assessment and remedial action if required
- All casing strings are pressure tested pre-commencing next phase per industry standards and government regulations
- The production casing is tested before any hydraulic fracturing operations to full maximum allowable operating pressure in accordance with strict performance standards



Source: Crain's petrophysics

Well Integrity Assessment and Verification Spreadsheet



PETROLEUM OPERATIONS

WELL INTEGRITY CHECK - PRE-HYDRAULIC FRACTURING

Well: Amungee NW-1H Re-entry
 Operator: Origin Energy Resources Limited
 Permit: EP98
 Rig Name: Rig 185
 Rig Contractor: Saxon Energy Services
 Spud Date: 28-Oct-15
 Well Rig Release Date: 24-Nov-15
 Well Re-entry Rig Release Date: 11-Jul-16



- Summary of Operations:**
- * 20" conductor hole was drilled to depth of 139 meters with 16" Conductor Casing set to 118 meters.
 - * 14 3/4" hole was drilled from 139 meters to 285 meters with 10 3/4" casing set to 282 meters.
 - * 9 7/8" hole was drilled from 285 meters to 1436 meters with 7 5/8" casing set to 1432 meters.
 - * 6 3/4" hole was drilled from 1436 meters to 2609 meters TD.
 - * 6-3/4" vertical hole section was plugged back to 1328 mRT before sidetracking to drill horizontal.
 - * 6-3/4" horizontal hole section was drilled to total measured depth of 3808 meters RT (2428 TVDRT)
 - * The well was then re-entered and the 4.5" production casing was set to 3799 meters.
 - * Well was then suspended and then re-entered again for hydraulic fracturing

Well Integrity Check:

Construction

Hole Size (inch)	Casing Size (inch)	Hole TD (m)	Sho Depth (m)	Lead Cement Volume Pumped (bbl)	Tail Cement Volume Pumped (bbl)	TCC - Lead-DOR Actual (m)	TCC - Tail-DOR Actual (m)	Pit Gain as expected?	Comments - Pit Gain	Pit	Plug Bumped?	Comments - Plug Bumping	Casing Pressure Test (psi)	Cement job performed as per approved program. Issues raised in DOR.	Comments - Cement Job/Issues in DOR	Leak Off Test Results or FIT Results for Non-Production Casing
20	16	139	139	55	Top up	Surface	Surface	n/a	n/a	n/a	n/a	n/a	n/a	Yes	Pumped 11 batches of top up 8 bbl of 16ppg cement. 2 bbls returns observed.	n/a - Conductor Casing
14 3/4	10 3/4	285	285	88.7	51.1	Surface	180	Yes	Yes	Yes	Yes	Bumped plug 700 psi	1000	Yes	Pressure tested casing to 1000 psi for 8 minutes. Observed 1 bbl to surface.	Performed LOT to 10.2 ppg EMM. Maximum surface pressure of 1431 psi.
9 7/8	7 5/8	1438	1438	200	33	Surface	1286	Yes	Yes	Yes	Yes	Plug bump ok	5000	Yes	Pressure tested casing to 500 psi for 10 min low and 5000 psi for 10 min high.	FIT = 1330 psi. EMM = 15 ppg
6 3/4	4 1/2	3808	3799	224.3	181	Surface	1800	Yes	Yes	Yes	Yes	Plug bumped	5000	Yes	Pressure tested casing to 5000 psi.	n/a - Production Casing

Suspension

Barrier	Type	Date Set	Type of Hole	Hole Diameter (inch)	Bottom Depth (m)	Top Depth (m)	Barrier Height (m)	(To Validate) - Tag (lbs)	Comment on Tagging	(To Validate) - Pressure (psi)	Comment on Pressure
10K C-Section of Wellhead	Mechanical	11/07/2016	Surface	Surface	Surface	n/a	n/a	n/a	n/a	10,000	Pressure tested 5-3/8" MV and C-Section 500psi for 5 mins low and 10000 psi for 15 mins high.
4.5" Casing	Mechanical	9/07/2016	Cased	6 3/4	3799	Surface	3799	n/a	n/a	5000	Pressure tested the 4 1/2" production casing to 5000 psi.
Heavy Weight WBM	Fluid	9/07/2016	Cased	6 3/4	3799	Surface	3799	n/a	n/a	n/a	Heavy weight fluid - 11.7 ppg WBM inside 4.5" production casing.
Shoe track	Cement	8/07/2016	Cased	6 3/4	3808	3799	9	n/a	n/a	n/a	Verified by successful cement job, plugs bumped and floats holding differential pressure.

Pre-Hydraulic Fracturing / DPT

Barrier	Type	Date Set	Type of Hole	Hole Diameter (inch)	Bottom Depth (m)	Top Depth (m)	Barrier Height (m)	(To Validate) - Tag (lbs)	Comment on Tagging	(To Validate) - Pressure (psi)	Comment on Pressure
4.5" Casing	Mechanical	9/07/2016	Cased	6 3/4	3799	Surface	3799	n/a	n/a	10000	As per DCR # 10 from Origin Energy, pressure tested to 7000 psi for 5 mins, repeated 4 times pressure tested to 9000 psi for 20 mins, pressure tested to 10000 psi for 20 mins, repeated 3 times. All OK, no shift.

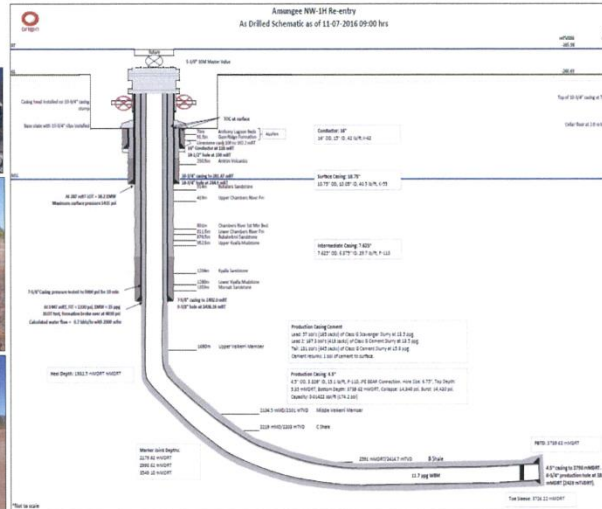
Was approval granted to conduct hydraulic fracturing? **YES** **NO**

Integrity Check by: Gibson Porkime
 Position: Senior Petroleum Engineer
 Date: 22 / 08 / 2016

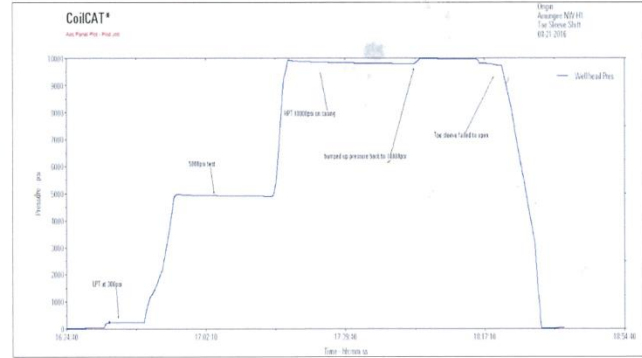
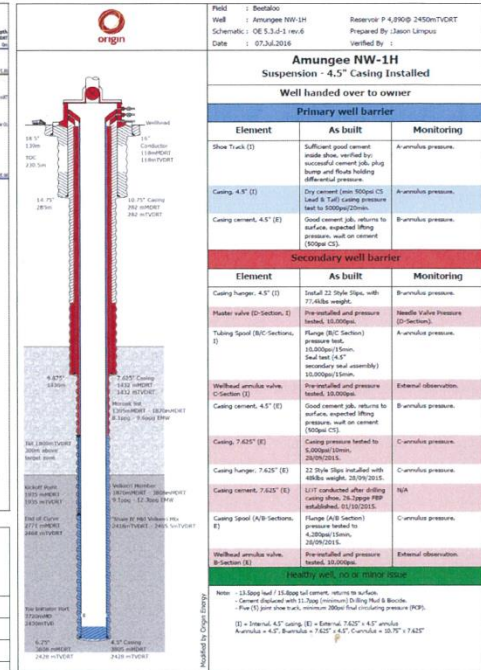
Reviewed by: Dominic Marozzi
 Position: Senior Petroleum Engineer
 Date: 22 / 08 / 2016

Approved by: Jop van Hattum
 Position: Senior Director Petroleum Technology and Operations
 Date: 22 / 08 / 2016

Well Schematic - Basic Well Completion Report



Well Schematic - Well Close-out Report



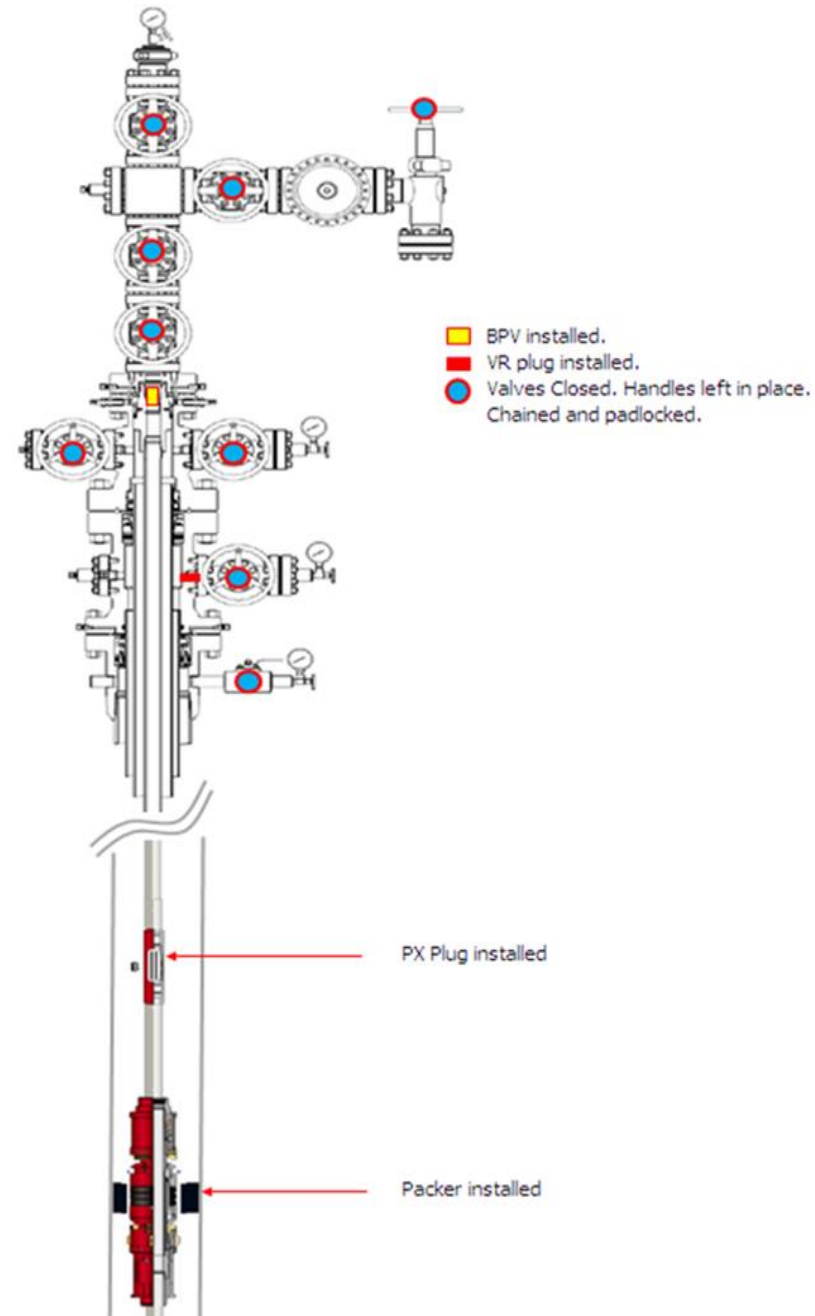
Compliance & Monitoring

Limitations of Onsite Inspections

- A constant presence will **NOT** provide a “visual of the workmanship”
- Not practical/feasible/affordable to be onsite 24/7
- Inspections will **NOT** provide a guarantee of well certification (like desk top audits)

Important benefits of Onsite Inspections

- Excellent idea of overall and general safety and environmental standards and issues
- Can build a better rapport with the operator
- Rig contractor and service companies
- Opportunity to assess and discuss their processes/procedures/concerns on their patch
- Reinforcing regulatory oversight
- Improves understanding of practicality of regulatory requirements



Well Certification/Independent Validation and Verification

Pros

- Provides an additional layer of protection
- Paid for by proponent
- Brings industry expertise to the process

Cons

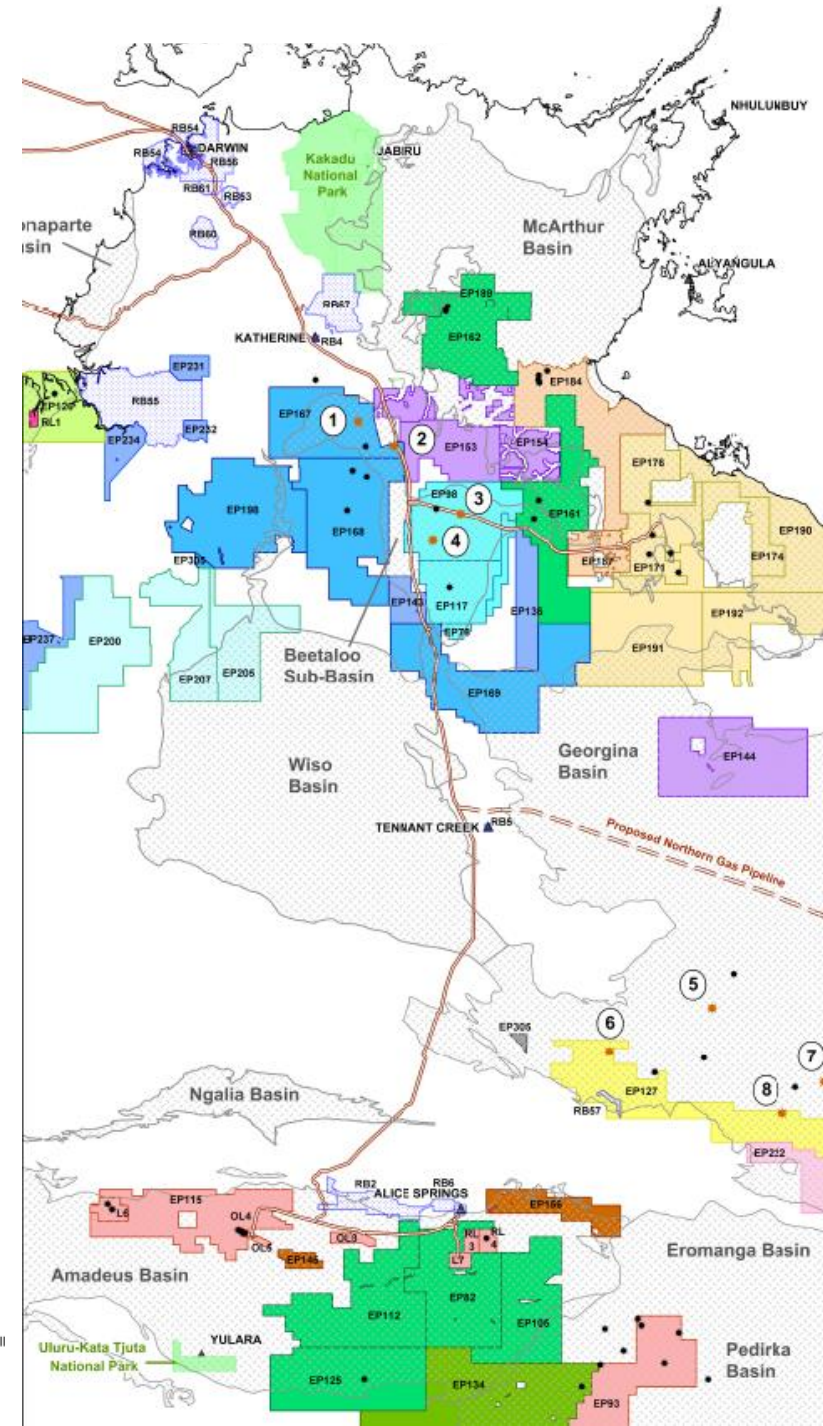
- Does not substitute for regulatory oversight
- Adds cost (to industry)
- Erodes regulator competency

The Schedule of Onshore Petroleum Exploration and Production Requirements currently provides for a mechanism to require independent validation of design and verification of as built well construction

Hydraulically Fractured Shale Gas Wells in the NT

1. Wyworrie-1 (Pangaea)
2. Birdum Creek-1 (Pangaea)**
3. Amungee NW-1H (Origin)***
4. Shenandoah-1A (Falcon)*
5. OzDelta-1 (Statoil)
6. MacIntyre 2H (PetroFrontier)
7. Owen 3H (PetroFrontier)
8. OzBeta-1 (Statoil)

* Gas show in 2011
 ** Discovery in 2015
 *** Discovery in 2016



Hydraulic Fracturing Regulatory Requirements

Regulated under the Schedule of Onshore Petroleum Exploration and Production Requirements

- Technical Works Program describing all aspects of hydraulic fracturing operations must include:
 - Status of the well prior to the operations;
 - Pressure testing of the well;
 - Interpretation of cement evaluation log(s);
 - Perforations details;
 - Design and stages of the hydraulic fracturing program;
 - Procedures of hydraulic fracturing operations;
 - Mechanical properties of the casing;
 - Geological hazards;
 - Geomechanical hazards;
 - Modelling of the fracture propagation;
 - Details of all aquifers;
 - Analysis of hydraulic fracturing operations including fracture gradient, half-length of fracture, propped half-length of fracture, fracture height, average fracture width, conductivity, maximum pumping pressure and estimated return volume of fluid;
 - Returned fluid management plan;
 - Details of Frac Tree;
 - The monitoring program, such as Tilt meter survey, MicroSeismic Monitoring or use of tracers; and
 - Such other information as the Minister requires.
- BTEX compounds must not be added to hydraulic fracturing fluids and any presence of BTEX in flowback fluids must be reported to the Minister without delay.
- Specific information regarding chemicals used must be released to the department and the general public.
- Hydraulic fracturing operations shall conform to API.
- Daily operations report shall be submitted to the minister before noon Australian Central Standard Time (ACST).
- If the operator has the plan to conduct micro-seismic monitoring, for the purpose of the drilling of monitoring well it shall submit an application under Clause 301.
- For monitoring operations, a weekly report shall be submitted to the Minister.

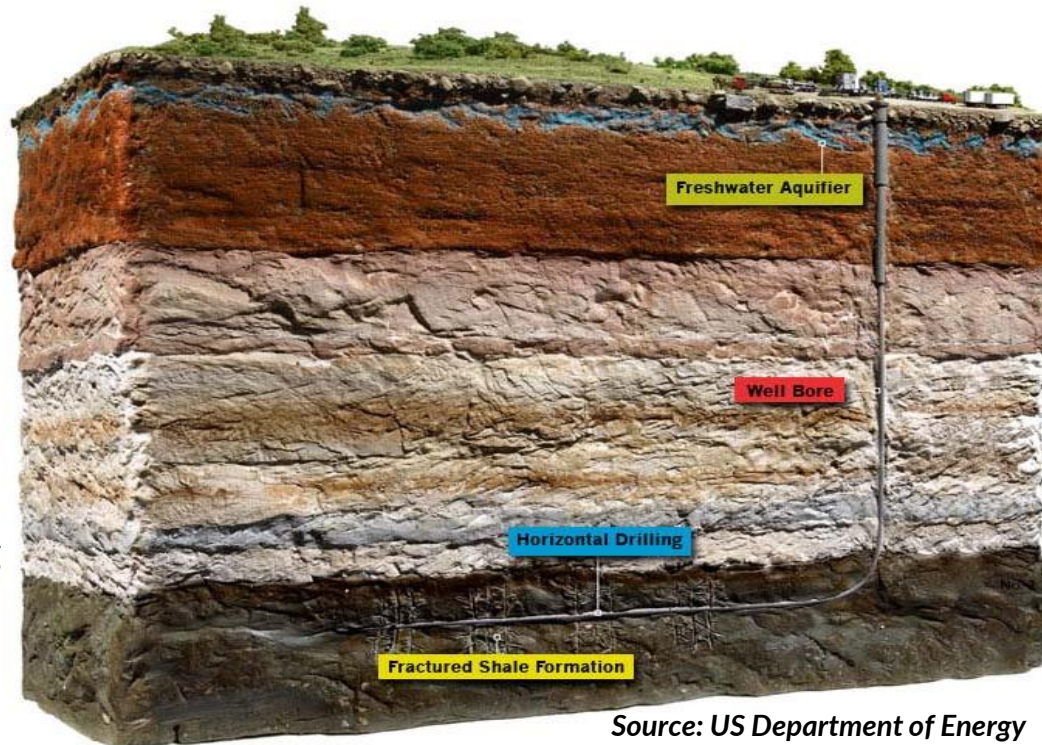
Hydraulic Fracturing Regulatory Requirements

Regulated under the Petroleum (Environment) Regulations

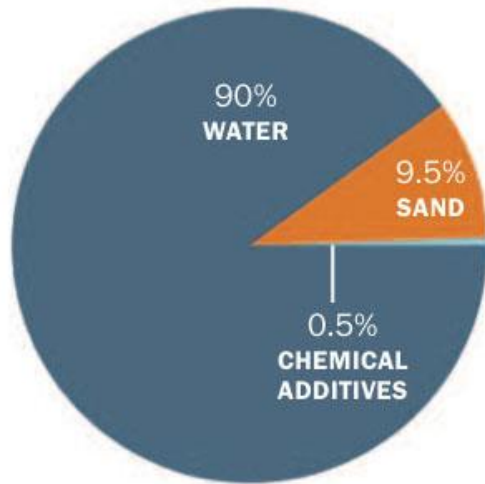
- Detailed description of the activity
- Detailed description of the environment
- Identification and assessment of environmental risks and impacts
- Baseline and ongoing monitoring of ground and surface water
- Disclosure of specific chemicals used their concentration in the fluid mix and toxicity
- Full disclosure of the environment management plan
- Arrangements for the containment of flowback fluids and disposal in accordance with the *Waste Management and Pollution Control Act*
- Flowback fluids may be retained in lined evaporation ponds
- Fluids removed from site must be disposed of at a licences waste treatment facility and evidence of acceptance by the treatment facility must be submitted to DPIR
- Reporting requirements and ongoing monitoring requirements

Pre-requisites for Safe Hydraulic Fracturing

- Baseline monitoring of surface water and aquifers
- Assessment of water availability
- Detailed understanding of geology:
 - Pore pressure
 - Fracture gradients
 - Expected formation breaking strength
 - Lithology
 - Natural fractures
 - Geomechanics/stress
- Data acquired through:
 - Geological studies
 - Offset wells
 - Seismic surveys
 - Drilling, logging and coring
 - Diagnostic Fracture Injection Testing (DFIT)
 - Fracture propagation modelling



Chemical Additives Used in Hydraulic Fracturing



Note: BTEX additives are banned in the NT

Compound	Purpose	Common application
Acids	Helps dissolve minerals and initiate fissure in rock (pre-fracture)	Swimming pool cleaner
Sodium Chloride	Allows a delayed breakdown of the gel polymer chains	Table salt
Polyacrylamide	Minimizes the friction between fluid and pipe	Water treatment, soil conditioner
Ethylene Glycol	Prevents scale deposits in the pipe	Automotive anti-freeze, deicing agent, household cleaners
Borate Salts	Maintains fluid viscosity as temperature increases	Laundry detergent, hand soap, cosmetics
Sodium/Potassium Carbonate	Maintains effectiveness of other components, such as crosslinkers	Washing soda, detergent, soap, water softener, glass, ceramics
Glutaraldehyde	Eliminates bacteria in the water	Disinfectant, sterilization of medical and dental equipment
Guar Gum	Thickens the water to suspend the sand	Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces
Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice
Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair coloring





Disclosure & IP Protection

Chemical disclosure includes exact chemical components and maximum concentrations and volumes used. Confidentiality is limited to exact concentrations in products (F112 etc.) only

Client: Origin
 Well: Amungee NW-1H STAGE 1
 Basin/Field: Northern Territory
 State: Northern Territory
 County/Parish: _6896332
 Case: Post-Job
 Disclosure Type: 8/26/2016
 Stage Completed: 9/6/2016 1:06 PM
 Date Prepared: RPT-44406
 Report ID:

Fluid Description(s)	
Slickwater and Gel Flush	191,940 Gal Contains: Water, Surfactant F112, Acid H015, Gelling Agent J580, Friction Reducer J609W, Scale Inhibitor L065, Clay Control Agent L071, Bactericide M275, Propping Agent S012, Fluid Loss Additive S100

The total volume listed in the tables above represents the summation of water and additives. Water is supplied by client.

CAS Number	Chemical Name	Mass Fraction	Mass (kg)	Volume (L)	Volume
-	Water (Including Mix Water Supplied by Client)*	93.14867%	724,450.44	724,449.62	97.10031%
57-13-6	Urea	0.00064%	4.98	5.79	0.00078%
64-02-8	Tetrasodium ethylenediaminetetraacetate	0.00002%	0.16	0.12	0.00002%
67-48-1	2-hydroxy-N,N,N-trimethylethanaminium chloride	0.14004%	1,089.14	990.13	0.13271%
67-63-0	Propan-2-ol	0.00016%	1.24	1.58	0.00021%
79-06-1	2-Propenamid (impurity)	0.00003%	0.23	0.21	0.00003%
107-21-1	Ethylene glycol	0.01005%	78.16	87.92	0.01178%
111-46-6	2,2'-oxydiethanol (impurity)	0.00010%	0.78	0.48	0.00006%
540-97-6	Dodecamethylcyclohexasiloxane	0.00001%	0.08	0.04	0.00000%
541-02-6	Decamethyl cyclopentasiloxane	0.00001%	0.08	0.04	0.00000%
556-67-2	Octamethylcyclotetrasiloxane	0.00001%	0.08	0.04	0.00000%
1310-73-2	Sodium hydroxide (impurity)	0.00005%	0.39	0.18	0.00002%
2682-20-4	2-methyl-2h-isothiazol-3-one	0.00011%	0.86	0.68	0.00009%
7447-40-7	Potassium chloride (impurity)	0.00003%	0.23	0.12	0.00002%
7631-86-9	Non-crystalline silica (impurity)	0.00015%	1.17	0.49	0.00007%
7647-01-0	Hydrochloric acid	0.05413%	420.99	350.82	0.04702%
7647-14-5	Sodium chloride	0.00190%	14.78	6.83	0.00091%
7757-82-6	Sodium sulfate	0.00015%	1.17	0.59	0.00008%
7758-98-7	Copper(II) sulfate	0.00001%	0.08	0.04	0.00001%
7783-20-2	Ammonium sulfate	0.01328%	103.28	102.26	0.01371%
7786-30-3	Magnesium chloride	0.00035%	2.72	1.17	0.00016%
9000-30-0	Guar gum	0.00587%	45.65	65.22	0.00874%
10043-52-4	Calcium Chloride	0.00096%	7.47	5.22	0.00070%
10377-60-3	Magnesium nitrate	0.00071%	5.52	6.21	0.00083%
14464-46-1	Cristobalite	0.00007%	0.54	0.21	0.00003%
14808-60-7	Quartz, Crystalline silica	6.58792%	51,236.60	19,706.36	2.64131%
26172-55-4	5-chloro-2-methyl-2h-isothiazolol-3-one	0.00038%	2.96	2.36	0.00032%
31726-34-8	Polyethylene glycol monohexyl ether	0.01903%	148.00	144.82	0.01941%
38193-60-1	Acrylamide, 2-acrylamido-2-methylpropanesulfonic acid, sodium salt polymer	0.00980%	76.22	57.18	0.00766%
61789-77-3	Dicoco dimethyl quaternary ammonium chloride	0.00079%	6.14	6.14	0.00082%
63148-62-9	Dimethyl siloxanes and silicones	0.00001%	0.08	0.08	0.00001%
67762-90-7	Siloxanes and silicones, dimethyl, reaction products with silica	0.00001%	0.08	0.10	0.00001%
91053-39-3	Diatomaceous earth, calcined	0.00353%	27.45	58.41	0.00783%
129898-01-7	2-Propenoic acid, polymer with sodium phosphinate	0.00940%	73.11	28.12	0.00377%
136793-29-8	Polymer of 2-acrylamido-2-methylpropanesulfonic acid sodium salt and methyl acrylate	0.00105%	8.17	4.19	0.00056%
		100%			100%

* Mix water is supplied by the client. Schlumberger has performed no analysis of the water and cannot provide a breakdown of components that may have been added to the water by third-parties.

* The evaluation of attached document is performed based on the composition of the identified products to the extent that such compositional information was known to GRC-Chemicals as of the date of the document was produced. Any new updates will not be reflected in this document.

Flowback Fluid Management

- Fracing can be done using salty, fresh or bore water
- Up to 80% of the fluid can be recovered from the well after hydraulic fracturing
- Flowback fluid is stored in lined ponds and re-used in future operations or evaporated and disposed in accordance with the *Waste Management and Pollution Control Act*
- Residual fluid remains isolated within the rock formation
- Tracking of fluids and an acceptance certificate from a licenced waste treatment facility (currently in Mt. Isa) is required



Petroleum Resource Management

Assessment of petroleum resource management regulatory requirements:

- Petroleum Reserves/Resources estimates reports
- Petroleum discovery notification and assessment reports
- Reservoir Management Plans

Maintaining a petroleum resource estimate database

- In accordance with Society of Petroleum Engineers Petroleum Resource Management System (SPE-PRMS)

Technical assessment of titles applications and reports

- Acreage Release bids
- Renewal and exemptions from relinquishment applications of exploration permits
- Suspension and extension and variation application of technical work program
- Annual reports of exploration permits and retention licences

Maximising value from Petroleum Resource

- Reservoir and resource management
- Production reporting

Closure / Well Decommissioning

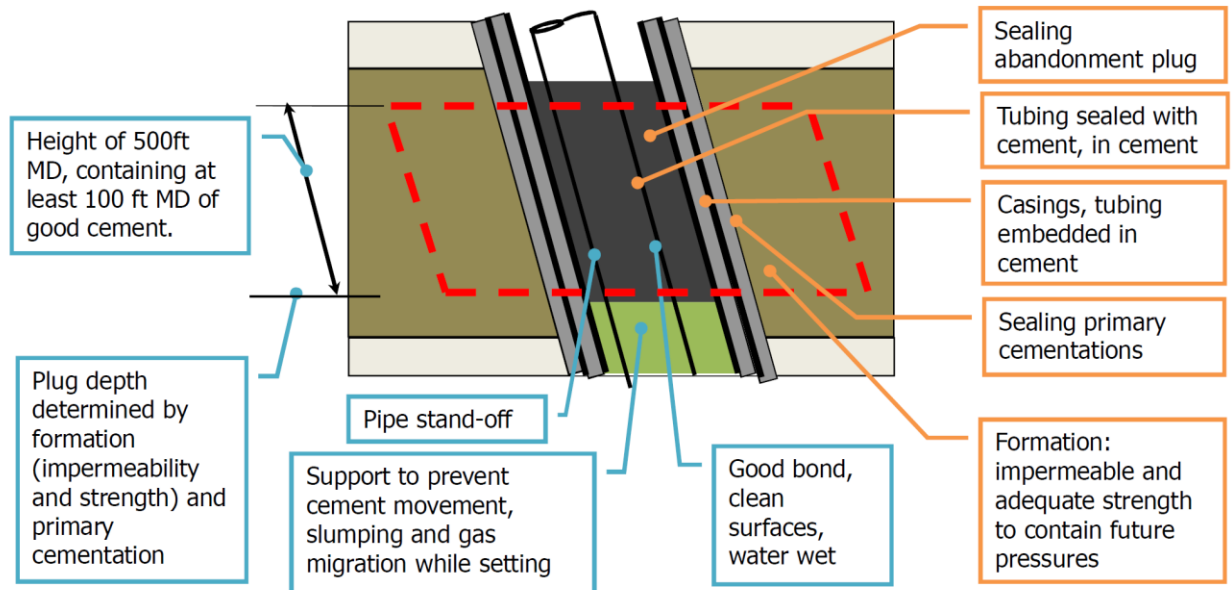
- When the well is ready to be closed, the petroleum company must plug the well with cement in accordance with regulations to prevent any future flows of gas, oil or water.
- Cement plug across hydrocarbon formation and minimum 50 metres above the highest perforations.
- Cement plug across any fresh water aquifers.
- All cement plugs must be appropriately pressure tested

Permanent Abandonment Barrier (red dashed envelope)

"Restoring the caprock"

Best practices

Barrier elements



Schedule of onshore petroleum exploration and production requirements 2016

DEPARTMENT OF PRIMARY INDUSTRY AND RESOURCES
Page 1 of 64 08 December 2016



Environment - Rehabilitation

Proponent must

- Remove all site equipment
- Respread topsoil over site
- Monitor vegetation regrowth on site
- Land owner may request some infrastructure to remain (e.g. tracks)

Site condition following suspension 2016



Drilling of Birdum Creek-1 2015



Site condition after rehabilitation 2017

Petroleum Act Rehabilitation Provisions

S73 Surrender & S74 Cancellation: Rehabilitation

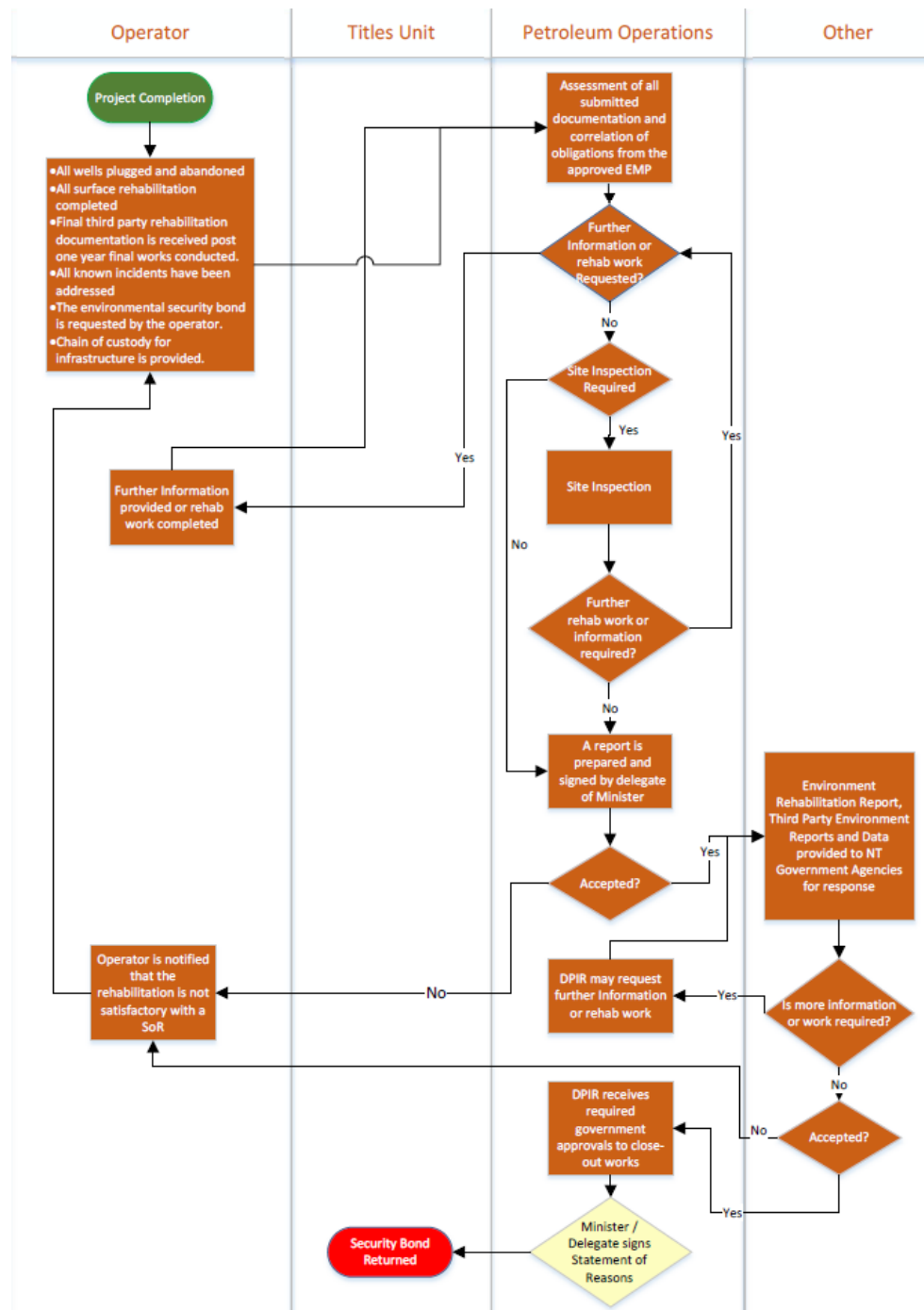
- Minister must be satisfied that land being surrendered is restored and rehabilitated
- Minister may as an alternative to prosecution cancel a permit or licence whole or in part

S77 Removal of property, decommission wells etc.

- Minister may direct person whose permit is surrendered or cancelled to:
 - Remove or make other arrangements with respect to property
 - Decommission all wells
 - Restore the surface and rehabilitate the environment

Environmental Closeout Procedure

- All work has been undertaken and 1 year of post operations rehabilitation has concluded
- All documentation has been reviewed
- Environmental site inspection, and landholder conversations are incorporated into Energy Division's report
- Energy Division shares written report with other NT Government Agencies and incorporates feedback
- Statement of reasons is drafted
- Final advice is provided to Executive Director Energy
- Environmental bond is returned




Rehabilitation Security Assessment

Assessment categories

- Mobilization / Demobilization of Equipment
 - Movement of Camps, Drill Rigs, Graders etc.
- Disposal of Wastes
 - Domestic wastes, septic tanks, chemical wastes, testing of site, removal of drilling and fracturing related wastes
- Removal of Equipment
 - Removal of onsite facilities, mobile plants, tanks etc.
- Restoration of Infrastructure
 - Fencing, access roads, restoration of hard stand areas etc.
- Land Rehabilitation
 - Camp workshop areas, seismic lines and access tracks, other areas such as temporary bores or staging areas
- Remedial Maintenance,
 - contaminated areas/spill sites, pest and weeds management, drainage and erosion control, consultant services, etc.
- Post Clean up Monitoring
 - Erosion, contaminated sites, sampling, weeds

covers surface areas and the impacts that do or can occur at the surface of operations. This includes ongoing monitoring while the site is rehabilitating.

 DEPARTMENT OF MINES AND ENERGY www.nt.gov.au	
Last Revision: April 2015	
Petroleum Activity - Rehabilitation	
Security Calculation Form	
Calculation Summary	
Project	
Operator	
Operator Contact	
Date	
Management Areas	
Mobilization / Demobilization of Equipment	Calculated Cost (auto-filled from individual worksheets) \$0
Disposal of Wastes	\$0
Removal of Facilities and Equipment	\$0
Restoration of Infrastructure	\$0
Land Rehabilitation	\$0
Remedial Maintenance	\$0
Post Activity Monitoring	\$0
Sub-Total	\$0
CONTINGENCY @15%	\$0
TOTAL COST	\$0

FOR OFFICE USE	
Petroleum Operations Assessment of Operator's Calculation	
Assessing Officer	
Date	

Insurance Certificates

- Well insurance cover against uncontrolled release of hydrocarbons to cover workover of wells and remediation costs of environmental damage due to catastrophic well failure.
- Note, this does not cover single barrier failure or well leaks from maintenance backlog etc.

Legacy Mining Fund

- First implemented in Western Australia
- Allowed a significant fund in the NT for the remediation of mines and the establishment of a legacy mines unit
- May be a model for an orphan well fund or legacy petroleum fund (Canada)

Operator Lodging a cash security – EXAMPLE ONLY	
Current security lodged by operator	\$5,000,000
A 10% discount on this security reduces it to	\$4,500,000
Cash refunded back to operator	\$500,000
1% levy of the security retained and added to fund (non-refundable)	\$45,000

Consistency with Commonwealth Regulatory Practices and Objectives

- Consistency with Commonwealth reduces risk
- COAG Best Practice Regulation and initiative to reduce red tape is key to maintain a contemporary legislative framework
- Petroleum (Environment) Regulations were modelled on the WA regulations
- WA regulations were modelled on the Commonwealth environment regulations to the *Offshore Petroleum Greenhouse Gas Storage Act*
- Risk-based and outcome focussed, maintaining flexibility, encouraging innovation
- Consistency with Commonwealth legislation increases legitimacy



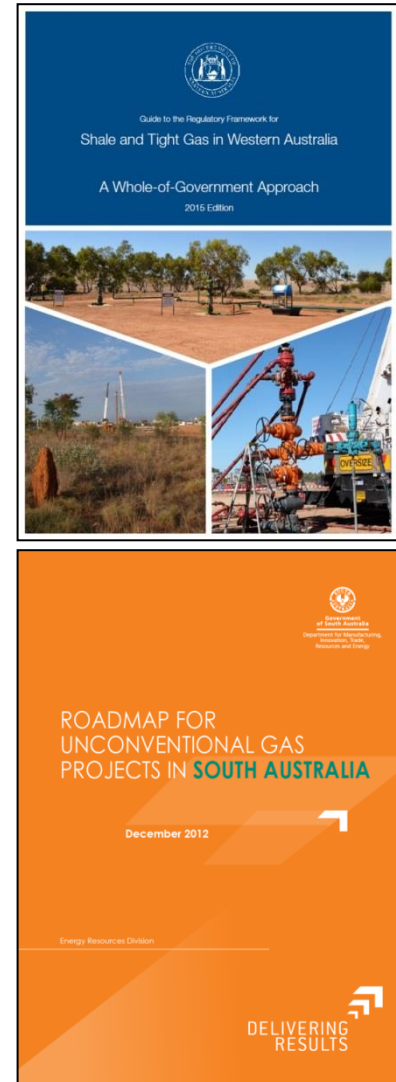
Learning from Other Jurisdictions

WA Whole of Government Framework

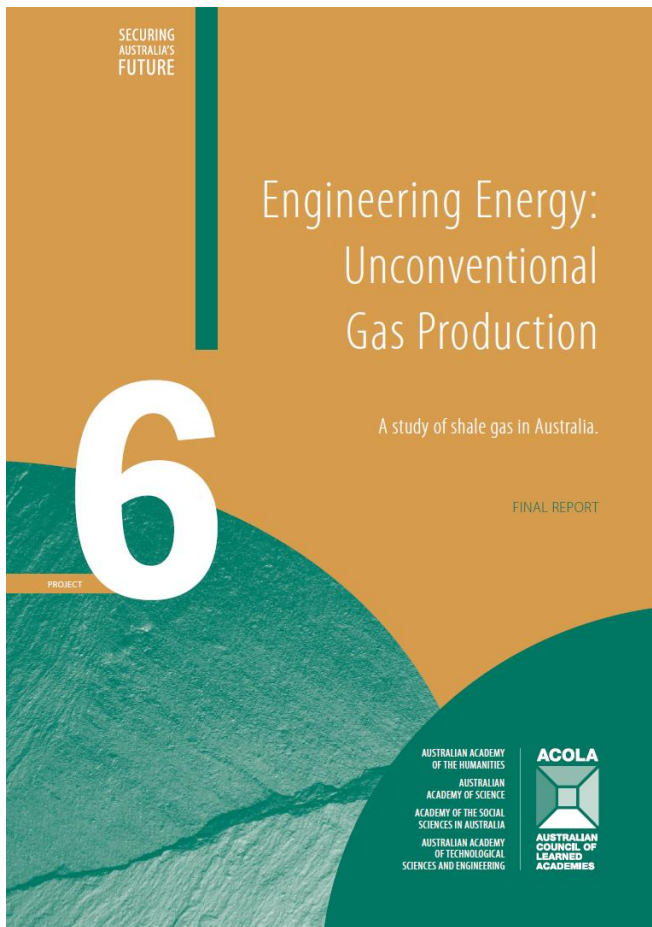
- Signed by all CE's
- Explicitly identifies roles and responsibilities of each agency
- Outlines a clear framework

Roadmap unconventional gas projects

- Round tables for discussion and identifying best practices/reducing roadblocks
- Cross-jurisdictional
- Invites stakeholder participation
- Identifies opportunities



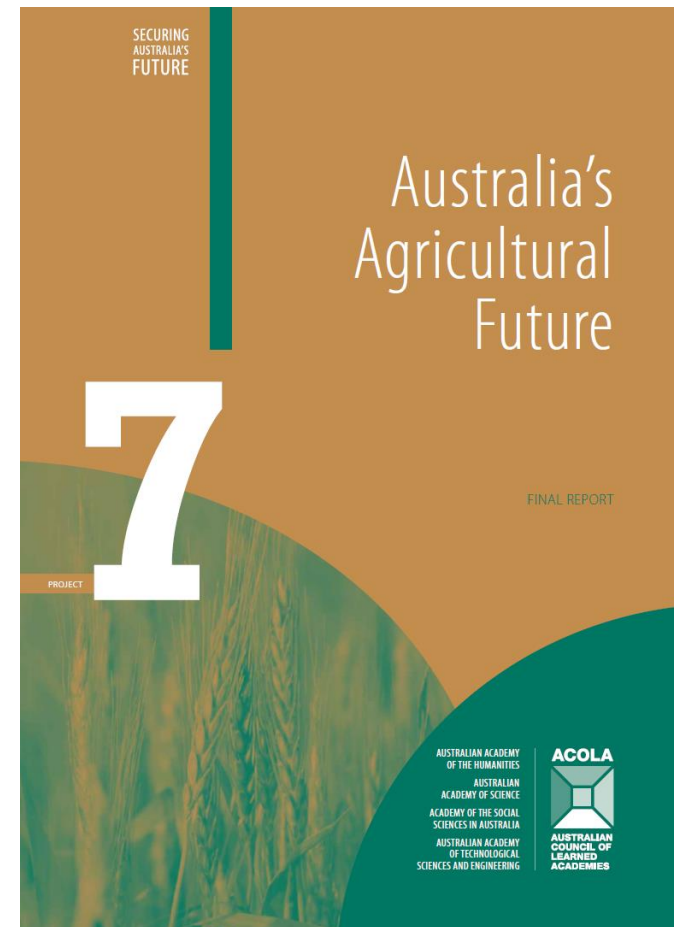
ACOLA Reports: Energy and Agriculture



- Engineering energy 2013
- Australia's agricultural future 2015



- A study of the synergies between unconventional gas production and agriculture may highlight potential benefits that should inform policy making



Examples of Efforts Focused on Best Practices

- Australian Academy of Technological Sciences and Engineering (ATSE)
- American Petroleum Institute “HF series” of best practices guidance documents for hydraulic fracturing
- Australian Petroleum Producers and Exploration Association (APPEA)
- Gas Industry Social Economic Research Alliance (GISERA)
- Interstate Oil and Gas Compact Commission (IOGCC)
- South Australia Round Tables for Oil & Gas (Working Group 1- 8)
- Onshore Petroleum Regulators Assembly Australia (OPRAA)
- Marcellus Shale Coalition
- Marcellus Center for Outreach and Research (MCOR)
- Barnett Shale Energy Education Council
- Appalachian Shale Water Conservation and Management Committee
- STRONGER state regulatory review of oil and natural gas environmental regulation
- International Petroleum Industry Environmental Conservation Association (IPIECA); now - global oil and gas industry association for environmental and social issues
- DNV Recommended Practice: Risk Management of Shale Gas Developments and Operations
- Secretary of Energy Advisory Board recommendations
- National Petroleum Council recommendations
- World Resources Institute recommendations
- Center for Responsible Shale Development (CRSD) Performance Standards

Online Resources

- [Homepage: Mining and Petroleum](#)
- [Disclosure of Petroleum Environment Reports](#)
- [Disclosure of Chemical Use in Petroleum Operations](#)
- [STRIKE: Tenure and Geoscience Information](#)
- [GEMIS: Geoscience Information System](#)
- [PEX: Petroleum Exploration Reports](#)
- [CORE: Creating Opportunities for Resource Exploration](#)
- [EnergyNT: Annual Summaries of Petroleum Activities](#)
- [Petroleum Facts and Figures](#)
- [DPIR Annual Report](#)

A significant amount of information is available on the department's website. However, some of the information may not always be easily found. The links on this page lead directly to information that is of interest to people concerned about onshore petroleum activities such as environment management plans and chemicals used in petroleum activities

Thank you