CCC Meeting Presentation
Drilling and Completions: Design and Well Integrity

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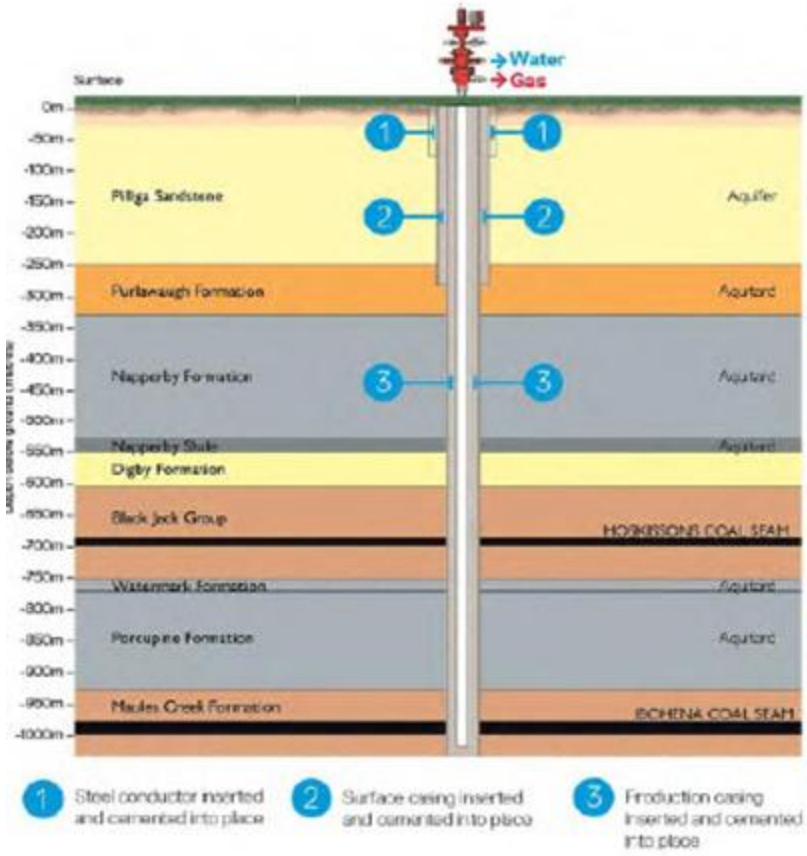
Pictures and information included within is indicative of recent or planned NSW operations but is not actual program information unless specifically stated.

Drilling with care

Local geology and Santos' high standards ensure natural gas is produced safely and groundwater is protected



- To produce gas, water is extracted from the coal seam, reducing the pressure and allowing the gas to flow
- Pilliga sandstone contains aquifers used for agriculture and community
- Coal seams in the Project area generally between 500m – 1000m below the surface
- Impermeable rock layers form a barrier between shallow aquifers and coal seams
- Layers of steel and cement isolate the aquifers and ensure well integrity
- Well design and construction codified within the NSW Code of Practice for CSG

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Typical Well Types

Depending on the objective there are many different well types that can be used to develop a project

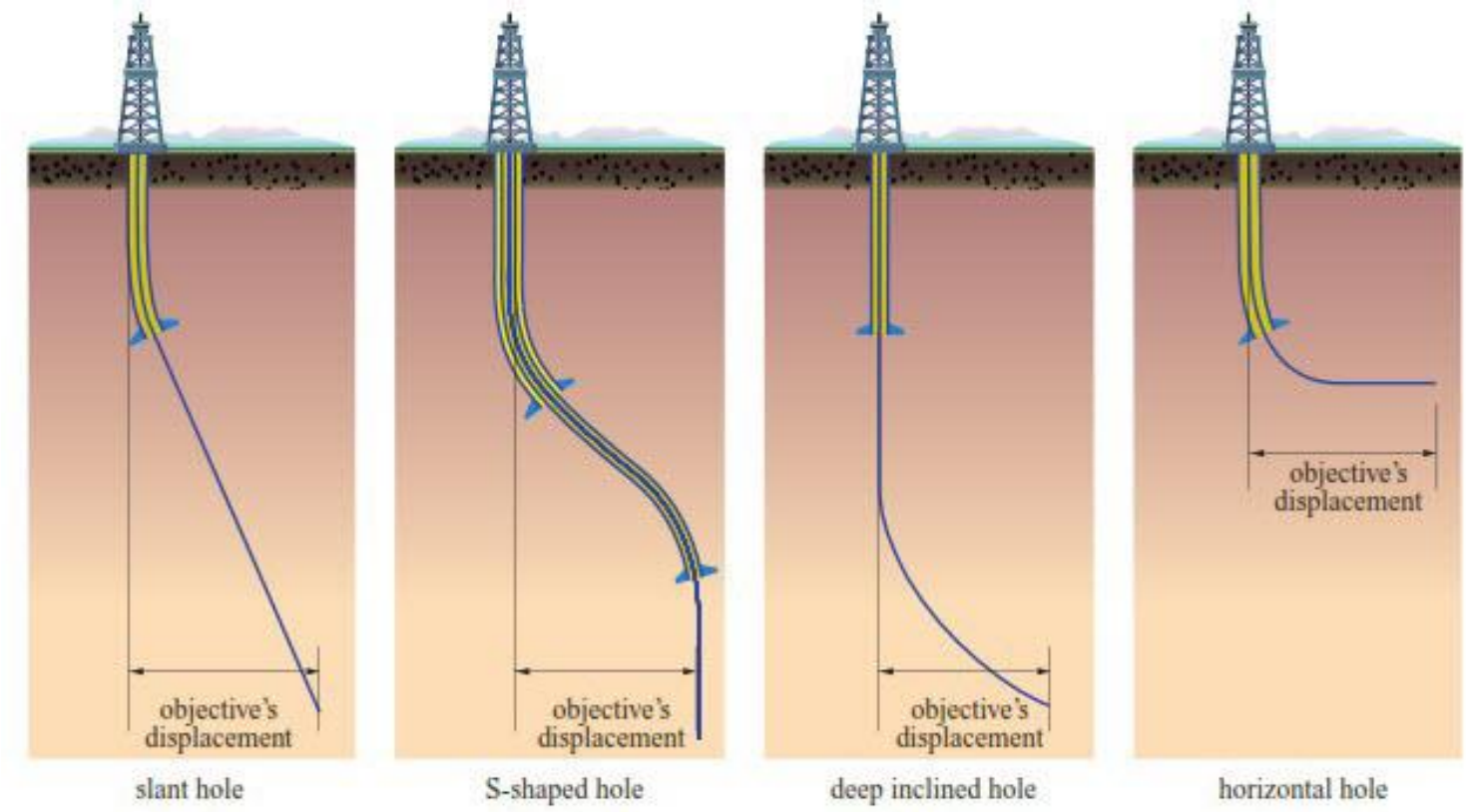

Fig. 1. Main configurations of a directional or horizontal well.

Source : Encyclopedia of Hydrocarbons

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Optimised Well Type

Surface to Inseam – Horizontal well with a vertical intercept well allows heel and toe production

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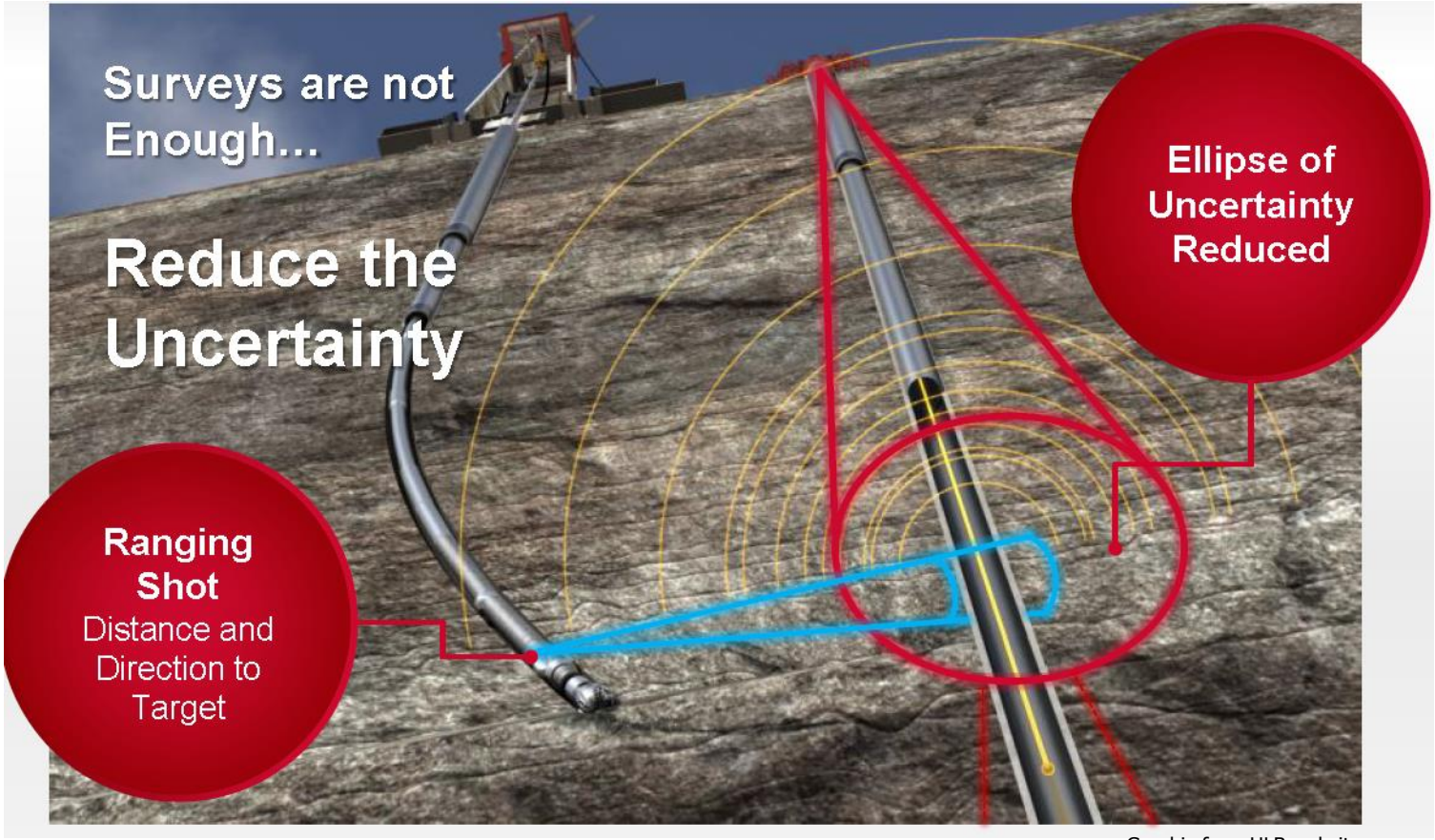
Horizontal Intercept Operations

Rotating Magnet Ranging System

Magnets in drill string used to locate rotating magnet in target well



Graphic from HLB website

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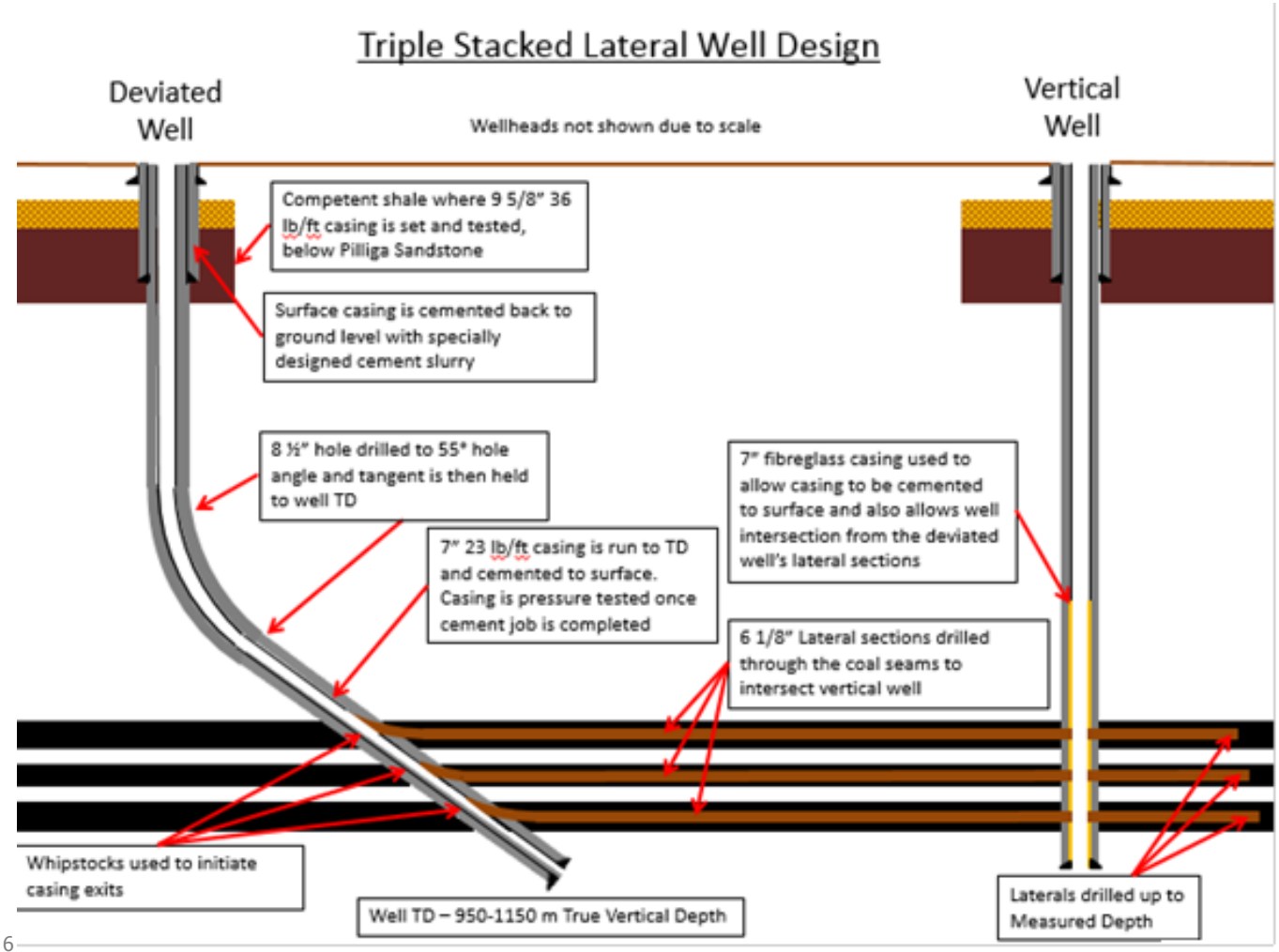
Current NGP Drilling Proposal

Multi-lateral well design with vertical intercept proposed as primary development scenario



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Drilling Fluid: Purpose and Design Introduction

Drilling fluid has many purposes including;

- Maintaining wellbore stability and well control
- Removing cuttings from the wellbore
- Cooling and lubricating the drill bit
- Transmitting hydraulic energy to downhole tools and the bit

Drilling fluid systems are designed based on reservoir conditions and are specifically based on pore pressure and rock properties.

Only water based drilling fluids using products approved for use in Australia will be used.

All drilling fluid products are tested to ensure they meet BTEX regulations.

Potassium Sulphate is one of the proposed drilling fluids to be used during the drilling operations.

Potassium ion assists with geological inhibition, preventing swelling and sloughing in shales and clays and assisting in wellbore stability.

A biocide, equivalent to those used in standard water well drilling operations is used to protect against bacteria forming downhole.

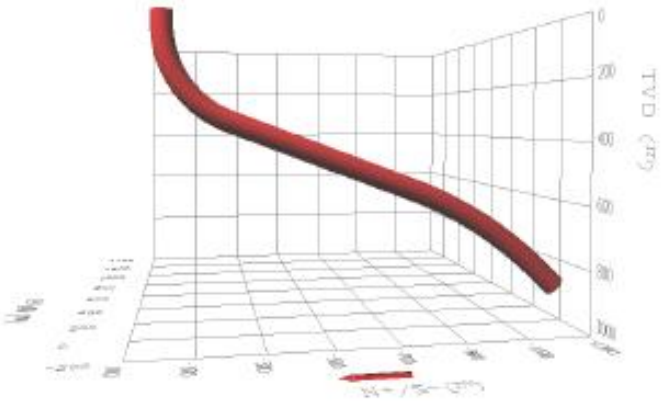
Well Design and Well Integrity Planning

Casing Centralisation: Simulations used to determine placement and frequency of centralisers in the casing string to achieve minimum required standoff from wellbore wall

T300
BOW SPRING

T346
TOP REACH GLIDER

RM09-31-3



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Well Design and Well Integrity Planning

Cement is engineered and laboratory tested with field samples taken to measure quality

Picture from Trican website

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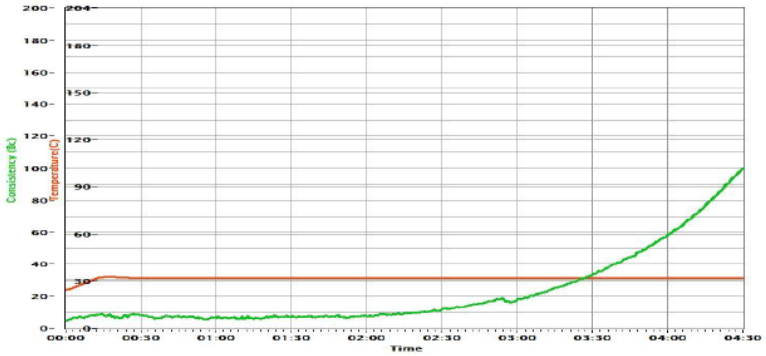
Well Design and Well Integrity Planning

Cement is engineered and laboratory tested with field samples taken to measure quality

Thickening Time

Consistency	40 Bc	70 Bc	100 Bc
Time (hr:mm)	3:39	4:09	4:29

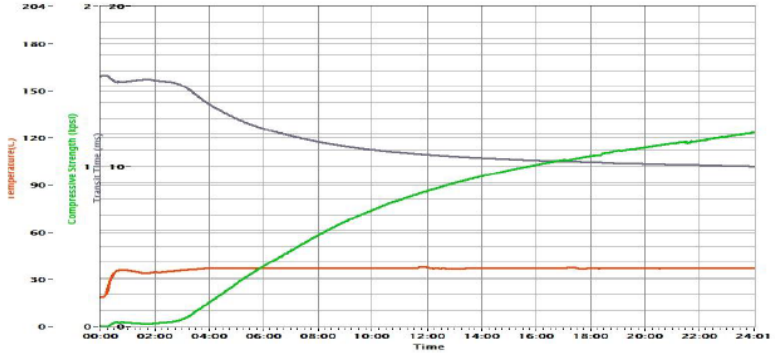
Figure 1 – 0611142 Surface Cement TT Graph



Ultrasonic Compressive Strength

Time (hr:mm)	7:17	12:00	24:00
Strength (psi)	500	850	1210

Figure 2 – 070314uca Surface Cement UCA Graph



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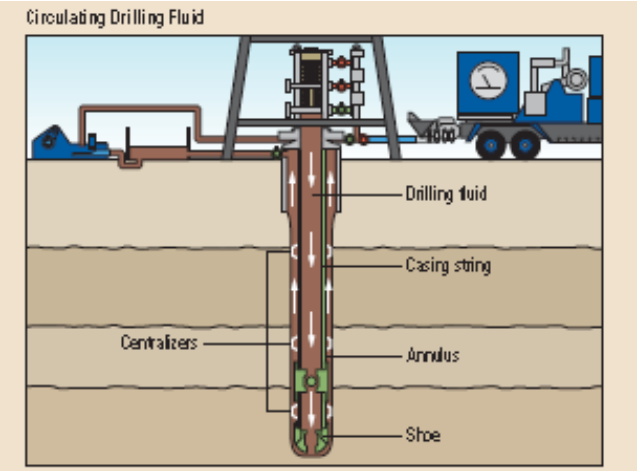
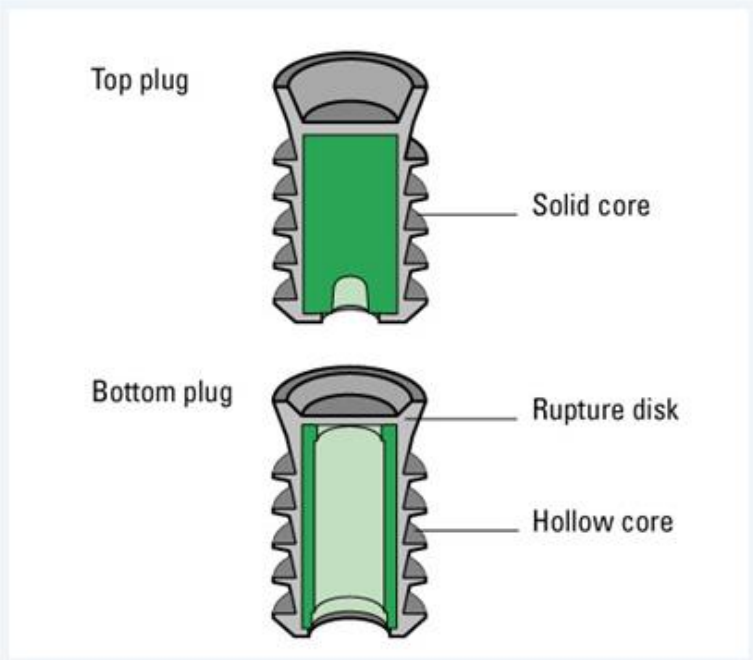
Additional Cementing Operations Information

- **Casing Hardware**
  - *Float Equipment*
  - *Centralizers*
  - *Wiper Plugs*
  - *Multi-stage tools*





Bottom and Top Plugs
Source: Schlumberger

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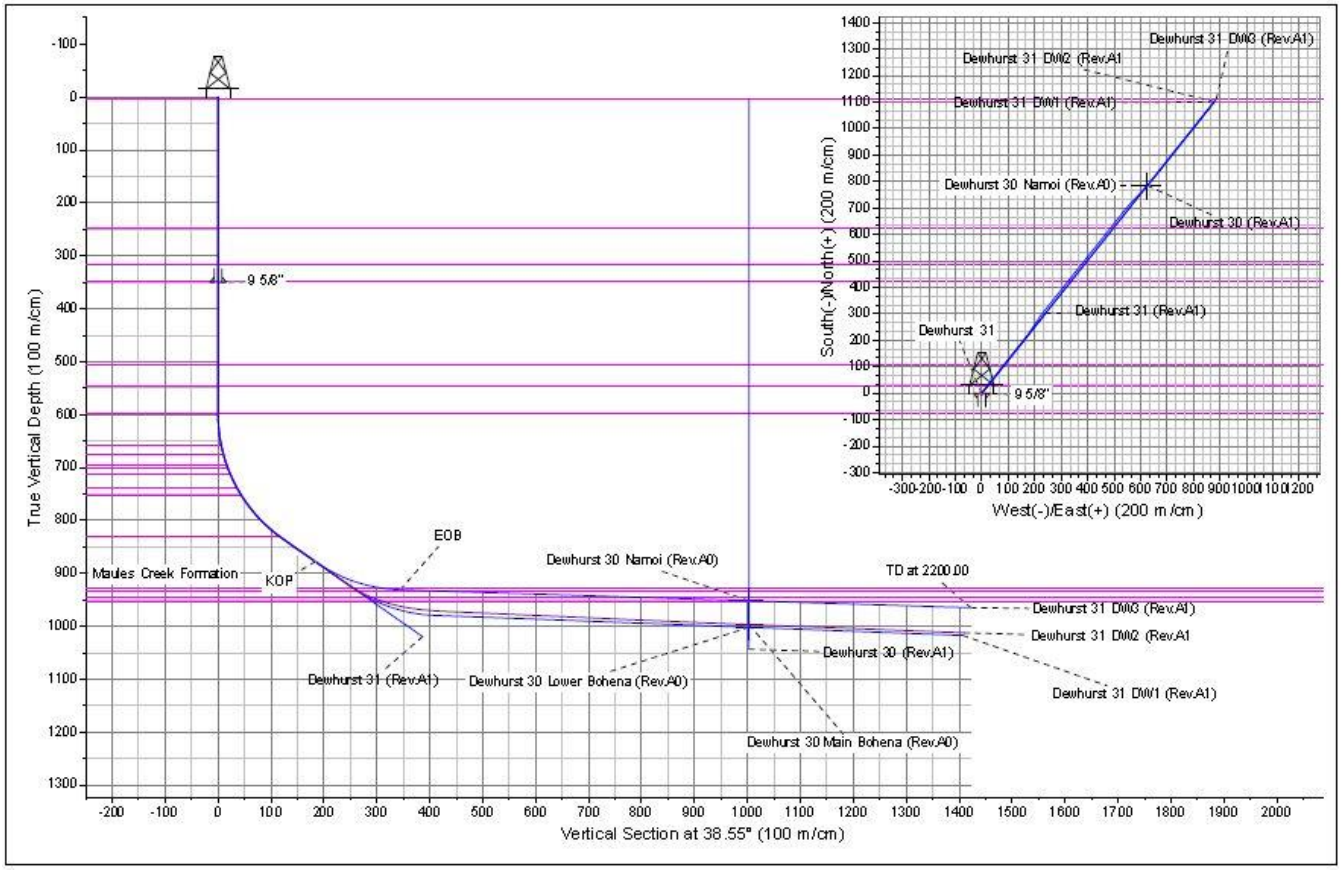
Well Design and Well Integrity Planning

Well planning includes detailed evaluation of kick off point and build rates at each depth interval to ensure drilling remains on target



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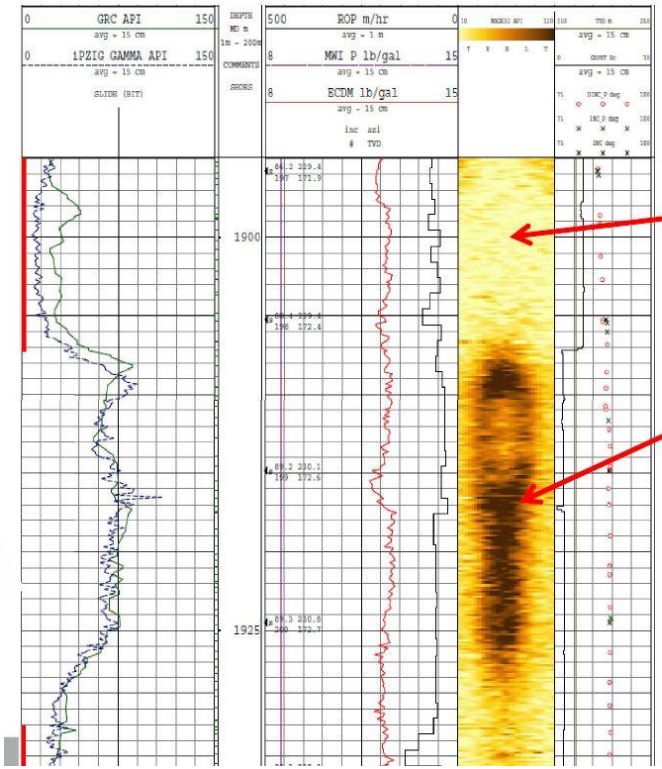
Well Design and Well Integrity Planning

Improving real time logging while drilling technology provides increased assurance of wellbore placement

Geosteering using near bit gamma ray tool

iPZIG – Real-time GR Images



Horizontal Coal well

"Clean" Coal

GR Image clearly shows best coal is above and need to gain in TVD

GABI log from tool provider website

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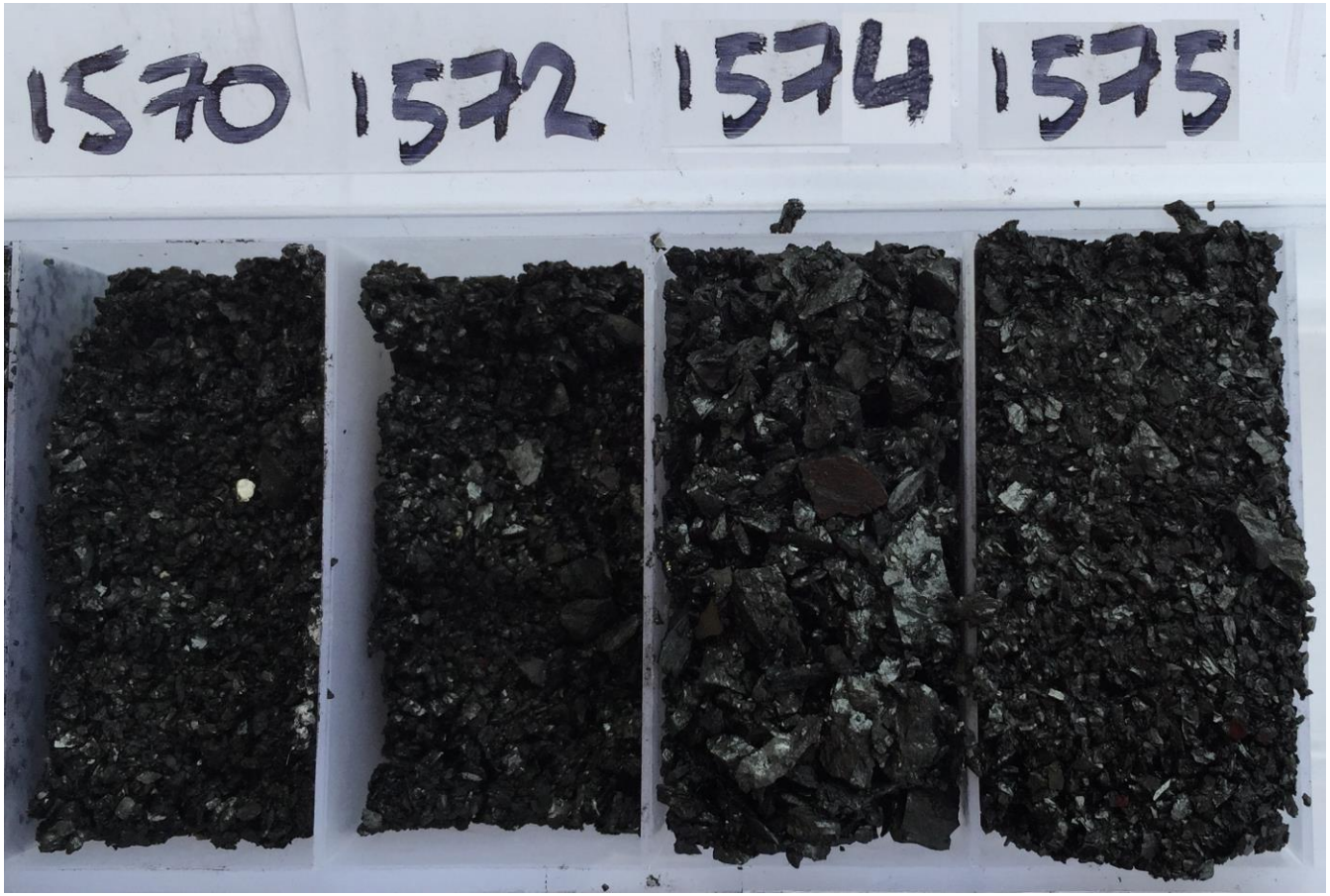

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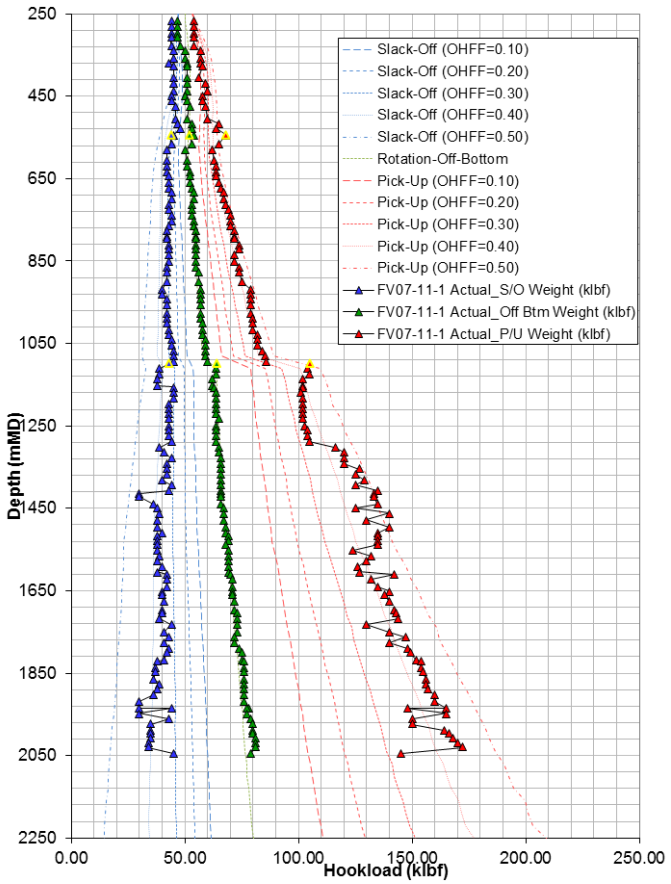
Well Design and Well Integrity Planning

Effective planning is the best way to ensure a successful outcome



Project Management

- Clear project objectives
- DWOP (office & field)
- Increased focus on lessons learned implementation & recording
- Increased integration with Asset Team
- Contingency planning based on offsets

Hole Cleaning & Wellbore Stability

- Torque and Drag modelling – controlled drilling parameters
- Staged drill out of 7” shoe & 6-1/8” hole

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Completion Designs

All wells will be equipped with bottom hole pumps. Typical designs include progressive cavity pumps and electric submersible pumps

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Well Monitoring

All wells included in a field monitoring plan including lease and wellhead inspections in addition to telemetrics.

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Thanks for your time

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