RED HILL

WELL COMPLETION REPORT

ATP364

RH015

Comprised of:

RH015GL1V

RH015GL1A

Bowen Basin, Queensland

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Purpose

Arrow Energy Ltd is a Queensland based energy company focused on the development and commercialization of Australian coal seam gas resources.

Location

☐	**Blackwater** Blackwater (BW) is situated approximately 47km south from the township of Blackwater in Central Queensland and within the 'Bowen Basin'. Pilot drilling in the Blackwater region, comprised of ATP751 & ATP753, started in mid-2008.
☐	**Moranbah Gas Project** The 'Moranbah Gas Project' (MGP) is situated on the eastern flank of the township of Moranbah, two hours west of Mackay and within the 'Bowen Basin', Central Queensland. The project commenced development in August 2003 and is comprised of the three petroleum leases PL191, PL196 & PLA224 (ATP727P). The project is a joint venture between Arrow Energy Ltd and AGL Energy Ltd each holding a 50% stake. The Joint Venture is operated by Arrow Energy Ltd.
☒	**Red Hill** Red Hill (RH) is situated on approximately 40km north of the township of Moranbah, two hours west of Mackay and within the 'Bowen Basin', Central Queensland. Red Hill is a well field within ATP364. In early 2004, Arrow Energy commenced exploration in the area.
☐	**South Walker** South Walker (SW) is situated approximately 40km east of the township of Moranbah and within the 'Bowen Basin'. South Walker is a well field within ATP364. In mid-2004, Arrow Energy commenced exploration within South Walker.

Design

☐	**Frac-Well** A standalone vertical, drilled to 50m below the base of the deepest target seam, cased with steel to TD and then cemented into position. The steel casing overlying the target seam(s) is perforated and then high-pressure fluids are pumped into the seam causing it to fracture which in-turn increases the permeability of the coals surrounding the well.
☐	**Stand-alone Vertical (Under-Reamed)** Standalone vertical production well where the target seam(s) are under-reamed prior to the well being lined with slotted casing.
☒	**Surface-to-Inseam (SIS)** The vertical production well, is intersected by lateral wells. These lateral wells are produced using directional drilling techniques. (Appendix A - for a description of the various types of lateral well designs used by 'Arrow Energy').

Well Summary

Petroleum Lease	ATP364
Well Name	RH015
Comprised of	RH015GL1V RH015GL1A
Well Design	Single Lateral
Target Seam(s)	Moranbah Coal Measures - GL
Spud Date	04/08/2008
Release Date	20/09/2008

Maps

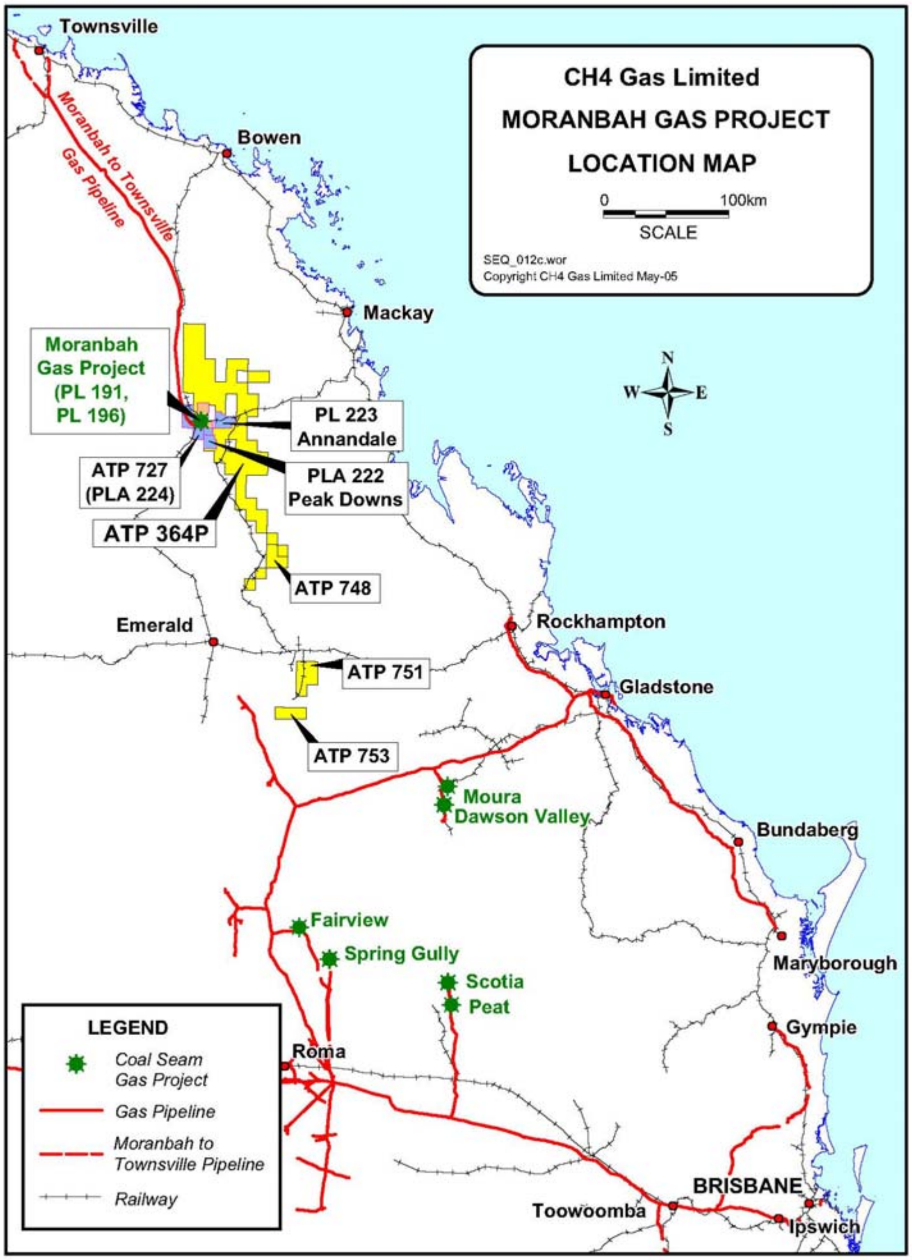


Figure 1 - Regional map

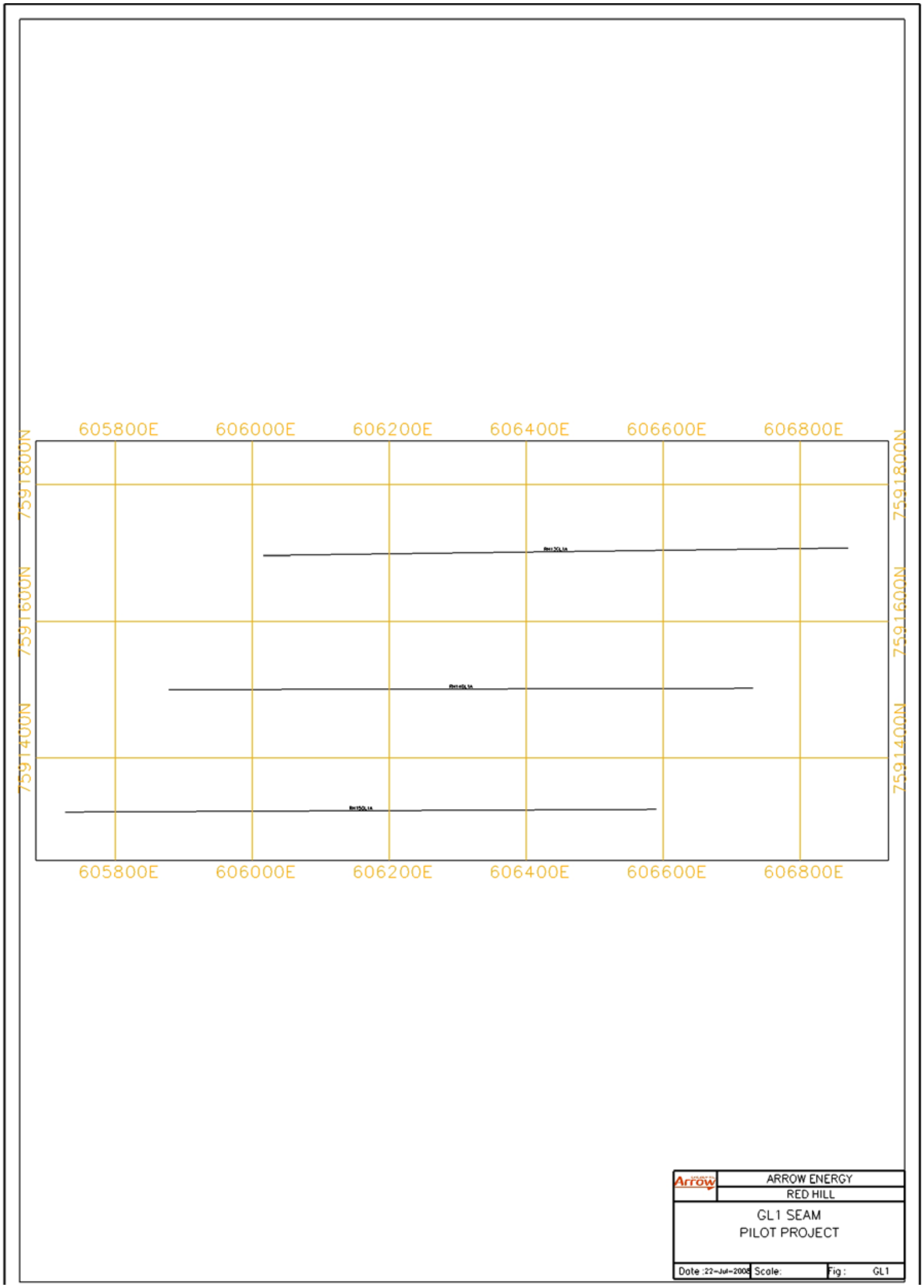


Figure 2: Location of well group in relation to the petroleum lease

Geology

Regional Geology

ATP364 is located on the north-western flank of the Permo-Triassic 'Bowen Basin'.

Formed in three distinct phases, the Bowen Basin overlies the Early-Palaeozoic metamorphic and sedimentary strata of the 'Drummond Basin' and 'Anakie Block'.

Commencing in the Early-Permian, a period of extension produced a series of isolated fault-bounded basins. In the case of the Bowen Basin, subsequent partial filling occurred in the form of volcanic (e.g. Lizzie Creek Formation) and sedimentary, Group I, (e.g. Reids Dome Beds) deposits. Secondly, after the period of rifting had ceased, thermal relaxation caused subsidence allowing for further deposition. This second phase, or Group II deposits, lasting until the Late-Permian, was dominated by a series of marine deposits including the 'Back Creek Group' and 'Tiverton Formation'. The final phase in the formation of the Bowen Basin was produced by the subsequent overtaking of the thermal relaxation by foreland loading. This transition occurred as progressive, Group III, deposits were laid down under conditions which varied from the marine-influenced deltaic environment of the German Creek Formation, to the dominantly fluvial flood plain environments of the Moranbah Coal Measures. A period of compression in the Middle to Late-Triassic terminated any further sedimentation within the basin.

Coal accumulations occur throughout the 3 phases and large volumes of 'Coal Bed Methane' (CBM) are known to be held within the Permian coals in the north of the basin.

Dominating the north of the Bowen Basin are two north-south trending depositional centres, the 'Denison Trough' to the west and the 'Taroom Trough' to the east.

The area is mantled by an irregular cover of poorly consolidated Tertiary sedimentary strata and basalt (fresh and weathered) of the Suttor Formation. The Tertiary cover overlies the sediments and main coal-bearing units of the Late Permian Blackwater Group (Table 1). The Blackwater Group is divided into three terrestrial units, namely the Rangal, Fort Coopers and Moranbah Coal Measures (RCM, FCCM and MCM).

Age	Formation	South	North
Triassic	Mimosa Group	Moolayember Formation	Moolayember Formation
		Clematis Sandstone	Clematis Sandstone
		Rewan Formation	Rewan Formation
Late Permian	Blackwater Group	Rangal Coal Measures	Rangal Coal Measures
		Burngrove Formation	Fort Cooper Coal Measures
		Fairhill Formation	
		MacMillan Formation	Moranbah Coal Measures
		German Creek Formation	
Middle Permian	Back Creek Group	Ingelara Formation	Blenheim Formation

Table 1 - Regional Stratigraphic Nomenclature of the Bowen Basin

Local Geology and Stratigraphy

Conformably lain above the 'Back Creek Group' and below the 'Mimosa Group' the 'Blackwater Group' forms the mainstay of Arrows CSG reserves in the Bowen Basin. On the north-western flank of the basin the seams generally dip east at between and 3° and 5°, although localised areas of steeper dip may occur in association with structural features.

Nearby volcanic activity, in the form of tuffaceous bands, is evident throughout the 'Blackwater Group'. Within the group there is a marked increase in the number and regularity of these tuff bands as one passes from the 'Moranbah Coal Measures' and into the 'Fort Coopers Coal Measures'. With their distinct gamma response these tuffs act as useful markers.

Rangal Coal Measures

The Late Permian 'Rangal Coal Measures' (RCM) conformably overly the 'Fort Coopers Coal Measures'. (It should be noted that in the southern part of the Bowen Basin the 'Fort Coopers is sub-divided into an upper 'Burngrove Formation' and the lower 'Fairhill Formation'). Throughout the Bowen Basin, the Triassic, 'Rewan Formation' conformably overlies the 'Rangal Coal Measures'.

Arrow Energy targets both the Northern and Southern 'Rangal Coal Measures' as a potential source of CBM.

The Rangal Coal Measures were deposited in a regressive marine to deltaic environment and are the most widely distributed measures in the Bowen Basin. They vary extensively in rank and quality, and are of major economic significance as a source of both coking and non-coking coal.

Fort Coopers Coal Measures

Conformably overlying the 'Moranbah Coal Measures', the 'Fort Cooper Coal Measures' (FCCM) are approximately 400m thick. Along with coal seams, sediments include sandstones, siltstones and mudstones. The 'Fort Cooper Coal Measures' are characterised by up to seven formations (6m-60m thick) rich in carbonaceous mud and thin coal seams. These formations are inter-bedded with 10m to 30m thick siltstone and sandstone sequences. The coal seams are distinguished by their high inherent ash ratios and abundant associated tuffaceous beds. Despite the seam's low gross to net coal ratio and poor permeability the FCCM represent a potential gas resource.

Moranbah Coal Measures

The 'Moranbah Coal Measures' form part of the Late-Permian 'Group III' coals deposited in the third and final phase of the formation of the Bowen Basin. 'Group III' coals deposited on the 'Collinsville Shelf' vary from the marine-influenced deltaic environment of the German Creek Formation in the south to the dominantly fluvial, flood plain environment of the Moranbah Coal Measures in the North. Most of the high grade coking deposits mined in Queensland is sourced from the 'Group III' coals from the 'Collinsville Shelf'.

The 'Moranbah Coal Measures' consist of coals, sandstones, siltstones and mudstones and average from 250m to 300m in thickness. They are characterised by several laterally persistent, relatively thick coal seams interspersed with several thin minor seams.

Target Seams of the Rangal Coal Measures

The 'Rangal Coal Measures' conformably overlie the 'Fort Coopers Coal Measures' and are overlain by the 'Rewan Coal Measures' of the 'Mimosa Group'. The Coal Measures have a thickness of some 100m. The top of the Rangal Coal Measures is regarded as the transition from carbonaceous sediments to the fluvial sequence of green coloured, non-carbonaceous siltstones and lithic sandstones of the Triassic Rewan Group.

Blackwater – Regional Seams

In the region of Blackwater, five seams dominate the Rangal Coal Measures. From youngest to oldest these are the Aries, Castor, Pollux, Orion and Pisces. Within the Blackwater region, all five seams can be all characterised by their frequent splitting and coalescence.

Coal rank generally increases to the northeast, with vitrinite reflectance increasing from about 1% at the Blackwater mine to 1.25% at the Leicchhardt Colliery. As a general rule the seams contain few stone bands and are very clean, with ash content ranging from 7-13%.

Aries

Within the Blackwater region the seam ranges in thickness from 0.2m to 5m+ and averages 1.5m. The seam splits in both the north and the south of the target area to form the upper Aries 1 and lower Aries 2 seams. The coalesced Aries seam is a targeted by the mines in the area as a mineable seam.

Gemini

Formed from the coalescence of the Castor and Pollux seams the Gemini seam is Arrows primary target seam. Estimations for methane per tonne of coal average 4-5m^3 (as estimated by BHP in 1980) to as a high 16m^3 (as estimated by the Leichhardt colliery between 1970 and 1982)

South Walker – Regional Seams

The two main target seams of the Northern 'Rangal Coal Measures' are the 'Leichhardt' (5m) and the Hynds (a.k.a. Vermont) (6m).

Leichhardt

Rank of the coal is moderately high, as is the gas content and the seam is generally free from stone bands. Ideal for coal seam gas production.

Hynds ◄► Vermont

The base of the Rangal Measures is generally clearly marked by the occurrence of the regionally persistent Hynds (a.k.a Vermont) seam. Averaging 7m in thickness the seam is divided into the 'Hynds Top' (1.5m) and the 'Hynds Bottom' (5m) by the half-meter thick 'Yarraby Tuff'. As a consequence of this, 'Surface-to-Inseam' drilling of the 'Hynds Seam' focuses on staying in the 'Hynds Bottom' and intersecting the 'Yarraby Tuff' as few time as possible. Minor siltstone, claystone and mudstone bands exist within the seam.

Target Seams of the Fort Cooper Coal Measures

The 'Fort Cooper Coal Measures' conformably overlie the Moranbah Coal Measures and are overlain by the 'Rangal Coal Measures'.

The measures are formed from a number of 20-40m inter-bedded zones of carbonaceous muds and silts. Volcanism, at the time of deposition, resulted in major outpourings of tuffaceous material; this contaminated much of the Fort Cooper Coal Measures and in particular the 'Fair Hill Formation'.

Due to the nature of the coal seams of the 'Fort Cooper Coal Measures' all wells targeting the Fort Coopers are of the stand-alone vertical design. Rather than target an individual seam the wells target multiple seams or coaly bands within the formation.

Girrah Seam

The Girrah marks the roof of the 'Fort Cooper Coal Measures' and is one of the few identifiable horizons. The seam is approximately 30m in thickness with numerous stone bands.

Fair Hill Formation

About 30 to 40m thick and rich in carbonaceous muds and stony bands the 'Fair Hill Formation' marks the base of the 'Fort Cooper Coal Measures'.

Fair Hill Seam

At about 2 to 4m thick the 'Fair Hill Seam' marks the floor of the 'Fair Hill Formation' and consequently the 'Fort Cooper Coal Measures'. The coal is rich in tuff beds and stony bands rendering it as an uneconomic seam to the local mines.

Target Seams of the Moranbah Coal Measures

Within the 'Moranbah Coal Measures', there are a number of seams from which Coal Bed Methane is either being produced from or are under investigation as potential target seams.

Q-seam

Throughout the 'Moranbah Gas Project' the Q-seam is split into three main plies, the QA1 (3.5m), QA2 (3m) and the QB (1.75m). Northeast of the town of Moranbah the QA2 seam thickens as it deepens. The QA2 ply is currently being tested for suitability as a target seam of the future.

Goonyella Upper (GU-seams)

Present in the 'Red Hill' gas field, the 'Goonyella Upper' can be directly related to the Q and P-seams of the 'Moranbah Gas Project. The formation is about 100m thick and has at least 5 identifiable coal seams ranging in thickness from less than 0.5m to 4.5m. One of these, the eldest and thickest GU0-seam has been marked as a potential source of economic coal seam gas.

P-seam

After the GM-seam the P-seam is the second most targeted source of Coal Seam Methane within the 'Moranbah Gas Project'. Formed of 3 plies, the GR (3m), PL1 (1.5m) and PL2(0.5m), the P-seam averages about 5m in thickness and is rich in tuff bands. North of latitude 757000 the seam starts to split and by 758000 is measured at about 25m in thickness from the roof of the GR to the floor of PL2. Currently none of the plies are categorised as target seams but investigation into the GR has shown some promising results.

P-Tuff

This is a regionally extensive marker bed, below the P-seam and above the GM-seam, and is an important unit for correlation due to its characteristically high natural gamma signature.

Goonyella Middle (GM-seam)

Currently the primary target seam within the 'Moranbah Gas Project'. The seam averages 5m in thickness but thins towards the southeast as a result of seam splitting. In the lower half of the seam are two tuff bands, the Penny and Tonstein bands. These act as useful marker in avoiding floor touches whilst drilling SIS wells.

Goonyella Middle Lower (GML-seam)

Like the QA2 seam, the GML-seam is currently being tested for suitability as a target seam of the future. In relatively small local pockets the seam can reach thicknesses of up to 6.5m. On average 40m-50m below the GM seam, evidence suggests that this inter-burden between the GM and GML seam is relatively rich in small, thin plies of coals and carbonaceous mudstones.

Well Fields

Blackwater Project

The ‘Blackwater’ is positioned on the eastern flank of the northerly trending ‘Comet Ridge’, which separates the western ‘Denison Trough’ from the eastern ‘Taroom Trough’ (aka Mimosa Syncline).

The predominant direction and angle of dip within the ‘Blackwater Project’ is East at about 3° to 5°, although there is a major easterly change in strike which occurs at the southern end of the ‘Blackwater Mine’ lease. This change in strike is a surface expression of a deep-seated basement boundary which subdivides the Bowen Basin into domains, in this case the Blackwater domain (or corridor) in the north and the Moura domain in the south.

The dominant structures in the region are compressional thrust faults and their associated folds and these follow two major trends, the first being a NNW-SSE and the second E-W. Average vertical displacement is less than 10m but displacements of over 30m are not uncommon.

Over most of the study are the Permian and Triassic beds of the Rangal and Rewan formations are unconformably overlain by approximately 5m of Cainozoic sands, clays and gravels, although up to 45m of cover, including Tertiary Basalt flows, occur in the southern part of the ‘South Blackwater’ and ‘Sirius Creek’ leases.

The ‘Rangal Coal Measures’ are the main target for coal seam gas production within the ‘Blackwater Project’. Feasibility studies have started on the seams of the upper ‘Burngrove Formation’.

<table>
<tr><th>Measure</th><th>Formation</th><th>Seam</th><th colspan="3">Plies</th></tr>
<tr><td>Mimosa Group</td><td>Rewan</td><td>Girrah</td><td></td><td></td><td></td></tr>
<tr><td>Rangal Coal Measures</td><td></td><td>Aries</td><td>Aries1</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>Aries2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Castor</td><td rowspan="2">Gemini</td><td rowspan="3">Taurus</td><td></td></tr>
<tr><td></td><td></td><td>Pollux</td><td rowspan="3">Argo</td></tr>
<tr><td></td><td></td><td>Orion</td><td></td></tr>
<tr><td></td><td></td><td>Pisces</td><td></td><td></td></tr>
<tr><td>Fort Coopers Coal Measures</td><td>Burngrove</td><td>Virgo</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Libra</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Leo</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Aquarius</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Scorpio</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Fair Hill</td><td></td><td></td><td></td><td></td></tr>
</table>

Moranbah Gas Project

The 'Moranbah Gas Project' is positioned upon the 'Collinsville Shelf', a stable tectonic easterly dipping environment situated on the western flank of the 'Taroom Trough'.

The predominant direction and angle of dip within the 'Moranbah Gas Project' is East-North-East at about 3° to 5°. Some minor folding is present as are relatively small numbers of significant thrust and normal faults. As a general rule thrust faults trend North East – South West are thrown down to the east and usually have a grater displacement than the East – West trending normal faults.

Within the area of drilling the 'Rangal Coal Measures' are cropped out. The 'Fort Coopers Coal Measures' sub-crop just to the west of the field. The 'Moranbah Coal Measures' are the main target for coal seam gas production within the 'Moranbah Gas Project'. The P-seam and GM-seam sub-crop a couple of kilometres to the west of the town of Moranbah.

Stratigraphy Of The Moranbah Gas Project

Measure	Formation	Seam	Plies		
Fort Coopers Coal Measures	FCCM7	Girrah			
	FCCM6				
	FCCM4				
	FCCM3				
	FCCM2				
	FCCM1				
	FHF	Fair Hill			
Moranbah Coal Measures		Q	QA	QA1	QA11
					QA12
				QA2	
			QB		
		P	GR		
			PL	PL1	
				PL2	
		GM		GMR	
				GM	
		GML			

Red Hill

Within the 'Red Hill' gas field, Arrow currently has very little data on both the Rangal and Fort Coopers coal measures. From the data supplied from outside sources there is evidence that the Vermont seam is present on the eastern flank of the field.

The 'Red Hill' gas field is structurally very similar to the 'Moranbah Gas Project'. The predominant direction and angle of dip within the 'Red Hill' gas field is East-North-East at about 3° to 5°. Few faults are well mapped in the area but evidence suggests, like the 'Moranbah Gas Project', both thrust and normal faults are present. In relation to SIS drilling, most of these faults are structurally insignificant.

The 'Moranbah Coal Measures' are the main target for coal seam gas production within 'Red Hill'. Many of the seams recognisable within the 'Moranbah Gas Project' have split into thin plies. Two seams with the 'Red Hill' well field are currently deemed as potential targets. These are the GU0-seam (5m) and the GM-seam (10m).

Stratigraphy Of The Red Hill Project

Measure	Formation	Seam	Plies		
Rangal		RV?			
Fort Coopers Coal Measures		FGI			
	GF2				
	GF0	Fair Hill?			
Moranbah Coal Measures		GU	GU5		
			GU3		
			GU2		
			GU0		
		GP	GP3		
			GP2		
			GP1		
			GP4		
			GP0		
		GM			
		GL	GL4		
			GL1	GM	
		GML			

South Walker

More structurally complex than either the 'Moranbah Gas Project' or 'Red Hill', the seams generally dip gently to both the east and west. A large North West - South East fault, thrown down to the west, runs through the centre of the gas field and exhibits the dominant directional trend of other more minor faults in the area.

The 'Rangal Coal Measure' is the main target for coal seam gas production within 'South Walker'. Typically 150m thick, both the 'Leichhardt' and the 'Hynds' seams are potential targets. Due to the density of thrust faults in the gas field, repeat sections are commonly logged in wells.

Currently not targeted within 'South Walker', the Girrah seam of the 'Fort Coopers Coal Measures' is often intersected at th e foot of vertical wells.

The 'Moranbah Coal Measures' are currently deemed to deep to be economical.

Stratigraphy Of The South Walker Project

Measure	Formation	Seam	Plies		
Rangal	**Leichhardt**		**MT**		
			MB		
	Hynds	**HY**	**HT**		
			YT		
			HB		
Fort Coopers Coal Measures	**Girrand**	**GR**			

Drilling Techniques

Hydraulically Fractured Vertical Well Drilling

The process of building a Hydraulically Fractured Vertical well is outlined below:

1. Large diameter hole drilled out to a depth of ≈1m below loose ground.
2. String of large diameter steel ‘Conductor Casing’ is concreted into well in order to hold back loose ground.
3. Concrete at base of ‘Conductor Casing’ is drilled out.
4. Drilling continues to ≈6m below base of Tertiary and into well consolidated Permian deposits.
5. String of ‘Tertiary Casing’ is run to TD and cemented in by displacement.
6. Concrete at base of ‘Tertiary Casing’ is drilled out.
7. Drilling continues to ≈50m below the deepest target seam.
    a. The added depth below the deepest target seam is designed to act as a sump, collecting any fines that are created by the process of pumping water out of the producing well and minimising the need for excessive working over during the well’s lifespan.
8. The drill string is pulled out of the hole and the well wireline logged using a minimum of:
    a. Calliper
    b. Gamma
    c. Long spaced density
    d. Short space density
    e. Verticality

    The resultant LAS file(s) provide a record of the wells path away from the vertical and accurate picks of the target coal seam(s)
9. Steel casing is run to TD and cemented into position by displacement
    a. Baffles are positioned within the casing string that allows the fracturing team to isolate each target seam.
10. A wireline cement bond log is conducted to verify that the cement job was conducted usefully.
11. In-turn, working from the bottom up, each of the target seams is fractured. This process involves;
    a. Perforation of the steel casing overlying the deepest seam that is to be fractured
    b. Fracturing the deepest seam
        i. High pressure water is forced through the perforation and into the target seam fracturing the seam
        ii. Sands are pumped into the seam holding fractures open once the pressure is released.
    c. Isolation of the seam from the seams above by means of a frac ball.
12. The well is complete once each of the target seams has been fractured.

Stand-alone Vertical (Under-Reamed) Drilling

The process of building a Stand-alone Vertical (Under-Reamed) well is outlined below:

1. Large diameter hole drilled out to a depth of ≈1m below loose ground.
2. String of large diameter steel 'Conductor Casing' is concreted into well in order to hold back loose ground.
3. Concrete at base of 'Conductor Casing' is drilled out.
4. Drilling continues to ≈6m below base of Tertiary and into well consolidated Permian deposits.
5. String of 'Tertiary Casing' is run to TD and cemented in by displacement.
6. Concrete at base of 'Tertiary Casing' is drilled out.
7. Drilling continues to ≈50m below the deepest target seam.
    b. The added depth below the deepest target seam is designed to act as a sump, collecting any fines that are created by the process of pumping water out of the producing well and minimising the need for excessive workovers during the well's lifespan.
8. The drill string is pulled out of the hole and the well wireline logged using a minimum of:
    a. Calliper
    b. Gamma
    c. Long spaced density
    d. Short space density
    e. Verticality

    The resultant LAS file(s) provide a record of the wells path away from the vertical and accurate picks of the target coal seam(s)
9. Each of the target coal seams is under-reamed
10. The well is flushed clean of cuttings
11. Liner casing is run to TD
    f. Within the casing string slotted casing is placed in positions that coincide with the under-reamed target seam(s).
12. Depending on the type of completion the annulus of the liner casing is either left open or a gravel pack is floated into position in order to maintain well integrity whilst at the same time providing a high permeability medium.

Surface to Inseam Drilling

The directional drilling technique employed by Arrow Energy involves two distinct phases. Firstly a vertical well is drilled which intersects the target coal seam(s). Secondly a series of lateral in-seam holes are drilled which intersect the vertical well. The in-seam holes provide a clear path for both gas and water to permeate towards the vertical well where the water is pumped and the gas free flows to surface.

A number of well designs are employed throughout the field. The choice of well design at each location is governed by a number of factors. These including but are not exclusive to:

- the presence of known or suspected fault(s)
- a significant or severe roll(s) within the area to be drilled
- depth to target seam(s)
- coal permeability
- cost
- the presence or not of seams which have been declared as mineable

The predominant design used for production wells is the 'chevron' whilst for pilot projects the common design is of a single lateral well intersecting a vertical well. Where possible the laterals are drilled down an apparent dip to the vertical well.

In all cases the aim is to create an evenly spaced, relatively dense, pattern of clear pathways through the coal to the vertical well(s) from which to draw off the 'Coal Bed Methane'.

Vertical Well Design

The process of building a Surface-to-In-Seam Vertical well is outlined below:

1. Large diameter hole drilled out to a depth of ≈1m below loose ground.
2. String of large diameter steel 'Conductor Casing' is concreted into well in order to hold back loose ground.
3. Concrete at base of 'Conductor Casing' is drilled out.
4. Drilling continues to ≈6m below base of Tertiary and into well consolidated Permian deposits.
5. String of 'Tertiary Casing' is run to TD and cemented in by displacement.
6. Concrete at base of 'Tertiary Casing' is drilled out.
7. Drilling continues to ≈50m below the deepest target seam.
    c. The added depth below the deepest target seam is designed to act as a sump, collecting any fines that are created by the process of pumping water out of the producing well and minimising the need for excessive workovers during the well's lifespan.
8. The drill string is pulled out of the hole and the well wireline logged using a minimum of:
    g. Calliper
    h. Gamma
    i. Long spaced density
    j. Short space density
    k. Verticality

    The resultant LAS file(s) provide a record of the wells path away from the vertical and accurate picks of the target coal seam(s)
9. Production casing is run.

    Production casing solutions vary (Appendix B), but all have the same overriding principle of stabilising the hole.
10. The target coal seam(s) is under-reamed

    Providing a broader target area for the lateral well(s) to intersect.
11. The well is flushed clean of cuttings

12. The under-reamed section(s) is wireline logged using a 3-arm calliper in order to record the success (or not) of the under-reaming as well as define the size and shape of the area to be targeted by the lateral well.

Lateral Well Design

The process of building a Surface-to-In-Seam Lateral well is outlined below:

1. rig is set up on a pre-determined mast angle and azimuth
2. Large diameter hole drilled out to a depth of ≈1m below loose ground.
3. String of large diameter steel ‘Conductor Casing’ is concreted into well in order to hold back loose ground.
4. Concrete at base of ‘Conductor Casing’ is drilled out.
5. Drilling continues to ≈6m below base of Tertiary and into well consolidated Permian deposits.
6. String of ‘Tertiary Casing’ is run to TD and cemented in by displacement.
7. Concrete at base of ‘Tertiary Casing’ is drilled out.
8. A narrow gauge casing liner is installed.

   The casing liner is installed in order to maintain the high ‘up hole velocity’ of the drilling fluids and their cuttings during the next stage of the drilling of the radius bend
9. Radius bend is drilled out using directional drilling equipment to a pre-determined measured depth (usually intersection of the target coal seam) before being pulled out of the hole
10. The narrow gauge casing liner is removed
11. A ‘Hole Opener’ is used to expand the diameter of the hole in preparation for the ‘Radius Bend Production Casing’.

    ‘Radius Bend Production Casing’ solutions vary (Appendix C), but all have the same overriding principle of stabilising the hole and isolating the target seam from other seams.
12. ‘Radius Bend Production Casing’ is run to the base of the opened section of the hole.
13. ‘Radius Bend Production Casing’ is cemented into position by displacement
14. The cement plug is drilled out
15. Directional drilling equipment is run into the hole and a path is drilled from the base of the radius bend into the target coal seam and along to it’s vertical well
16. Once the lateral intersects with the vertical well the lateral well is flushed and the directional drilling equipment is pulled out of the hole.
17. Open rods are run into the hole back to the vertical
18. Slotted polyethylene liner is run through the rods from the surface of the lateral to its intersection with the vertical
19. The rods are pulled back out of the hole leaving the polyethylene liner leaving in place keeping the lateral hole open.

Well Card(s)

DRILLING WELL COMPLETION REPORT

VERTICAL PRODUCTION WELL HOLE NUMBER: **RH015GL1** HOLE TYPE: **V** HOLE NAME: **RH015GL1V**

COLLAR AND SITE PARTICULARS								
AMG Co-ordinates:		**AMG East**	**AMG North**	**RL (m asl)**	**Location**	**Surveying Company**		**Surveyor**
Datum:	AGD 84	606570.22	7591345.81	256.62	Red Hill	Bryant, Edmonston and Associates		Steve Bryant
Purpose Of Hole			**Total Depth m**	**Hole Type**	**Azimuth**	**Inclination (deg)**	**Target Seam**	**Drilling Company**
CBM drainage well targeting Goonyella Lower One seam			489.00	PV	360.00	-90.00	GL1	MDC
CONDUCTOR CASING DETAILS								
Rig	**Rig Type**		**Driller/s**		**Commenced**	**Completed**		
MDC132	Schramm 685		D. McBride		4 August 2008	5 August 2008		
Date From	**Date To**	**Drill From (m)**	**Drill To (m)**	**Bit Type**	**Hole Size (inch)**	**Total Depth (m)**	**Comments**	
4 August 2008	5 August 2008	0	18	Blade	12	18	Running sands	
Casing Type	**Length (m)**	**Size (inch)**	**Thread**	**From (m)**	**To (m)**	**Date**	**Cement (litres)**	**Weight (ppg)**
Steel	18	10 3/4	Butt Joint (welded)	0	18	5 August 2008	1634	13.44
TERTIARY CASING DETAILS								
Rig	**Rig Type**		**Driller/s**		**Commenced**	**Completed**		
MDC132	Schramm 685		D. McBride		6 August 2008	6 August 2008		
Date From	**Date To**	**Drill From**	**Drill To**	**Bit Type**	**Hole Size (inch)**	**Total Depth (m)**	**Comments**	
6 August 2008	6 August 2008	18	39	Hammer	10	39	Good displacement of cement	
Casing Type	**Length (m)**	**Size (inch)**	**Thread**	**From (m)**	**To (m)**	**Date**	**Cement (litres)**	**Weight (ppg)**
Steel	37.1	8 5/8	VAM	0	37.1	6 August 2008	1100	13.44
PRODUCTION CASING DETAILS								
Rig	**Rig Type**		**Driller/s**		**Commenced**	**Completed**	**Comments**	
MDC132	Schramm 685		D. McBride		7 August 2008	17 August 2008	Blockages from 160m to 200m meant we ha	
Date From	**Date To**	**Drill From**	**Drill To**	**Bit Type**	**Hole Size (inch)**	**Total Depth (m)**	**Drilling Method (air, mud,u/b)**	
7 August 2008	7 August 2008	32	39	Hammer	7 7/8	39	DOC - Air	
7 August 2008	10 August 2008	39	489	Hammer	7 7/8	489	Air	
Geophysical Company		**Logger**	**Date**	**Logging Suite**		**Verticality OK?**	**Max DLS (Deg)**	**Max Deviation**
Geoscience		G. Offer	12 August 2008	Density, Caliper, Gamma, Deviation		Yes	0.429	2.3
Casing Type	**Length (m)**	**Size (inch)**	**Thread**	**From (m)**	**To (m)**	**Date**	**Cement (litres)**	**Weight (ppg)**
Steel	365.70	6 5/8	SFJ	0	365.70	16 August 2008	5389	13.4
XOs, Subs & Short	3.49	6 5/8	SFJ	365.70	369.19	16 August 2008		
Fibreglass	9.74	6 5/8	modified SFJ	369.19	378.93	16 August 2008		
XOs	0.43	6 5/8	SFJ	378.93	379.35	16 August 2008		
Steel	49.99	6 5/8	SFJ	379.35	429.34	16 August 2008		
Centralisers Used		**Spacing**	**Casing TD**	**Bump Plug**	**Bump Pressure**	**Pressure Held**	**Time Held (min)**	**Pressure Tested**
yes		1,16,30,50,67	429.34	Yes	400	yes	10	no
PRODUCTION ZONE DETAILS					***CONSUMABLES USED DURING DRILLING OF WELL***			
Target Seams	**GM**	**From (m)**	**To (m)**	**Thickness (m)**	**Product**	**Size Package**	**Amount Used**	**Total**
GM Seam Density Log Depth		370	377.7	7.7	Aus Plug	8 kilogram		0
GL1 Seam Density Log Depth		431.10	437.80	6.7	Bentonite	25 kilogram		0
GM Under Ream (U/R) Section		n/a	n/a	n/a	Aus Gel	8 kilogram	16	128
GL1 Under Ream (U/R) Section		431.10	437.80	6.7	Clay Coat	25 litre	1	25
U/R Size (inch)		16			Drill Foam	20 litre		0
Caliper Log Completed On		not done			Hammer Oil	25 litre	8	200
Geophysical Company		Geoscience			KCl	25 kilogram		0
Logger		G. Offer			Liquid Polymer	20 litre	5	100
Sump Depth (metres)		51.20			Soda Ash	25 kilogram		0
COMPLETION					FSF2000	20 litre		0
Wiper Trip	**Date**	**Blockages**	**From**	**To**	Poly Plus	20 litre		0
Yes	18 August 2008	None	N/A	N/A	Super foam	25 litre	7	175
Demobilised	**Well Capped**	**Equipment Left Down Hole**			Drill Plex	20 kilogram		0
Yes	yes	None			Star Gel	20 kilogram	2	40
WATER QUALITY INFORMATION					AMC XXX	15 kilogram		0
SWL	**Water Flow**	**Volume**	**pH**	**TDS**	Hi Seal	15 kilogram		0
N/A	N/A	N/A	N/A	N/A				

SUMMARY OF STRATIGRAPHY

Stratigraphy	Formation	From (m)	To (m)	Thickness (m)	Comments
Alluvium (Sands), sand (running)		0.00	18.00	18.00	
	Base of Tertiary	21.00	21.00	0.00	
sandstone and siltstone		21.00	20.00	-1.00	
	Base of Weathering	21.00	21.00	0.00	
sandstone, siltstone, mudstone		21.00	92.00	71.00	
coal, carb mudstone	**GF2**	92.00	182.50	90.50	Base of FCCM
mudstone		182.50	192.50	10.00	
Coal	**GF0**	192.50	195.30	2.80	QA11?
sandstone, mudstone		195.30	246.60	51.30	
Coal	**GU5**	246.60	248.10	1.50	QA21
siltstone		248.10	248.50	0.40	
Coal	**GU3**	248.50	250.50	2.00	QA22
sandstone		250.50	291.77	41.27	
Coal	**GU2**	291.77	293.00	1.23	QB
mudstone		293.00	311.80	18.80	
Coal	**GP3**	311.80	312.30	0.50	GR-split
mudstone		312.30	320.60	8.30	
Coal	**GP2**	320.60	321.30	0.70	GR-split
siltstone		335.10	335.70	0.60	
Coal	**GP1**	321.60	322.00	0.40	P-split
siltstone		322.00	322.30	0.30	
Coal	**GP4**	322.30	323.00	0.70	P-split
sandstone		323.00	324.70	1.70	
Coal	**GP0**	324.70	325.30	0.60	P-split
sandstone		325.30	370.00	44.70	
Coal	**GM0**	370.00	377.70	7.70	GM
sandstone		377.70	403.90	26.20	
Coal	**GL4**	403.90	405.80	1.90	GML-split
		405.80	431.10	25.30	
coal	**GL1**	431.10	437.80	6.70	GML-split
		437.80	489.00	51.20	

DRILLING WELL COMPLETION REPORT

VERTICAL PRODUCTION WELL	TARGET SEAM:	GL1	LATERAL:	A	HOLE NAME:	RH015GL1A

COLLAR AND SITE PARTICULARS

AMG Co-ordinates		AMG East	AMG North	RL (m asl)	Location	Surveying Company	Surveyor
Datum	AGD 84	605729.27	7591361.598	256.514	Red Hill	Bryant, Edmondston and Associates	Steve Bryant

Purpose Of Hole	Total Depth m	Hole Type	Azimuth	Inclination (deg)	Target Seam	Drilling Company
CBM drainage well targeting Goonyella Lower One seam	1034.53	PL	91.80	-60.00	GL1	MDC

CONDUCTOR CASING DETAILS

Rig	Rig Type	Driller/s	Commenced	Completed
MDC 110	UDR 1200	T. Hoffman, D. Carlon	11 September 2008	11 September 2008

Date From	Date To	Drill From (m)	Drill To (m)	Bit Type	Hole Size (inch)	Total Depth (m)	Comments
11 September 2008	11 September 2008	0	18	Blade	12	18	hand mixed

Casing Type	Length (m)	Size (inch)	Thread	From (m)	To (m)	Date	Cement (litres)	Weight (ppg)
Steel	18	10 3/4	Butt Joint	0	18	11 September 2008	563.4	Not recorded

TERTIARY CASING DETAILS

Rig	Rig Type	Driller/s	Commenced	Completed
MDC 110	UDR 1200	T. Hoffman	12 September 2008	12 September 2008

Date From	Date To	Drill From	Drill To	Bit Type	Hole Size (inch)	Total Depth (m)	Comments
12 September 2008	12 September 2008	18	31.97	Rock Roller	9 7/8	31.97	

Casing Type	Length (m)	Size (inch)	Thread	From (m)	To (m)	Date	Cement (litres)	Weight (ppg)
Steel	30.97	8 5/8	Ozcon	0	30.97	12 September 2008	1481	13.3

RADIUS BEND CASING DETAILS - NOTE: ONLY CASED TO BELOW P SEAM INTERSECTION

Rig	Rig Type	Driller/s	Commenced	Completed	Well Spooned
MDC 110	UDR 1200	T. Hoffman, D. Carlon, G. Weaver	12 September 2008	17 September 2008	No

Date From	Date To	Drill From (m)	Drill To (m)	Bit	Diameter (inch)	Total Depth	Drilling Method (air, mud,u/b)
12 September 2008	12 September 2008	23.05	31.97	Rock Roller	7 7/8	31.97	DOC, mud
12 September 2008	12 September 2008	31.97	33	Rock Roller	7 7/8	33	Steerable motor, Mud
12 September 2008	14 September 2008	33	597.53	PCD	4 3/4	597.53	Steerable motor, Mud, GL1 Seam entry @ 582.7m
14 September 2008	16 September 2008	33	410.91	Hole Opener	7 1/4	410.91	Mud

Geophysical Company	Logger	Date	Logging Suite	Verticality OK?	Max DLS	Max Deviation
N/A	N/A	N/A	N/A	N/A	N/A	N/A

Casing Type	Length (m)	Size (inch)	Thread	From (m)	To (m)	Date	Cement (litres)	Weight (ppg)
Steel	390.48	5 9/16	SFJ	0.00	390.48	17 September 2008	5981	12.6
Fibreglass	17.69	5 9/16	SFJ	390.48	408.17			

Centralisers Used	Spacing	Casing TD	Bump Plug	Bump Pressure	Pressure Held	Time Held (min)	Pressure Tested
Yes, 6 @ joints 1, 49, 56, 61, 66, 77	See left	410.17	Yes	350	Yes	10	No

IN SEAM SECTION DETAILS - NOTE: INCLUDES FINAL SECTION OF RADIUS BEND TO GM INTERSECTION

Rig	Rig Type	Driller/s	Commenced	Completed
MDC 110	UDR 1200	T. Hoffman, G. Weaver	17 September 2008	19 September 2008

Date From	Date To	Drill From	Drill To	Bit	Diameter	Total Depth	Comments
17 September 2008	17 September 2008	391.38	410.91	Rock Roller	4 7/8	410.91	DOC, mud
17 September 2008	19 September 2008	597.54	1034.53	PDC	4 3/4	1034.53	GL1 seam entry @ 588.7m , Intersected vertical @ 1034.53m

Branch	From MD	To MD	Type	Reason	Pull back metres
1	957.53	1059.40	Branch	Ranging	101.87
2			Branch	Intersect on Branch 2 — **Total Pullback (m)**	101.87

PRODUCTION ZONE DETAILS

Poly Run Information	From (m)	To (m)	Length (m)
In Seam Depth (SIS)	588.70	1034.53	445.83
Poly Length (metres)	0.00	1034.00	1034.00

Poly Inside Diameter (mm)	38	Poly Liner Run	Yes
Poly Outside Diameter (mm)	45	Poly to Surface	Yes
Poly Slot Type and Spacing	No data	Poly to TD	Yes
Dart Used (type)	Steel	Mud Used	Yes
Pump Pressure Start (psi)	no data	In Seam Fluid	n/t
Pump Pressure End (psi)	no data	Poly Joiner	Yes, steel (at 4m)

PRODUCTION ZONE SUMMARY

Production Seam	From (m)	To (m)	Length (m)
GM - Goonyella Middle Seam	394.70	408.70	14.00
GL1 - Goonyella Lower One Seam	588.70	1034.53	445.83

COMPLETION

Wiper Trip	Date	Blockages	From	To
Yes	19 September 2008	None	n/a	n/a

Demobilised	Well Capped	Equipment Left Down Hole
20 September 2008	Covered	None

WATER QUALITY INFORMATION

SWL	Water Flow	Volume	pH	TDS
No data	No data	N/A	N/A	N/A

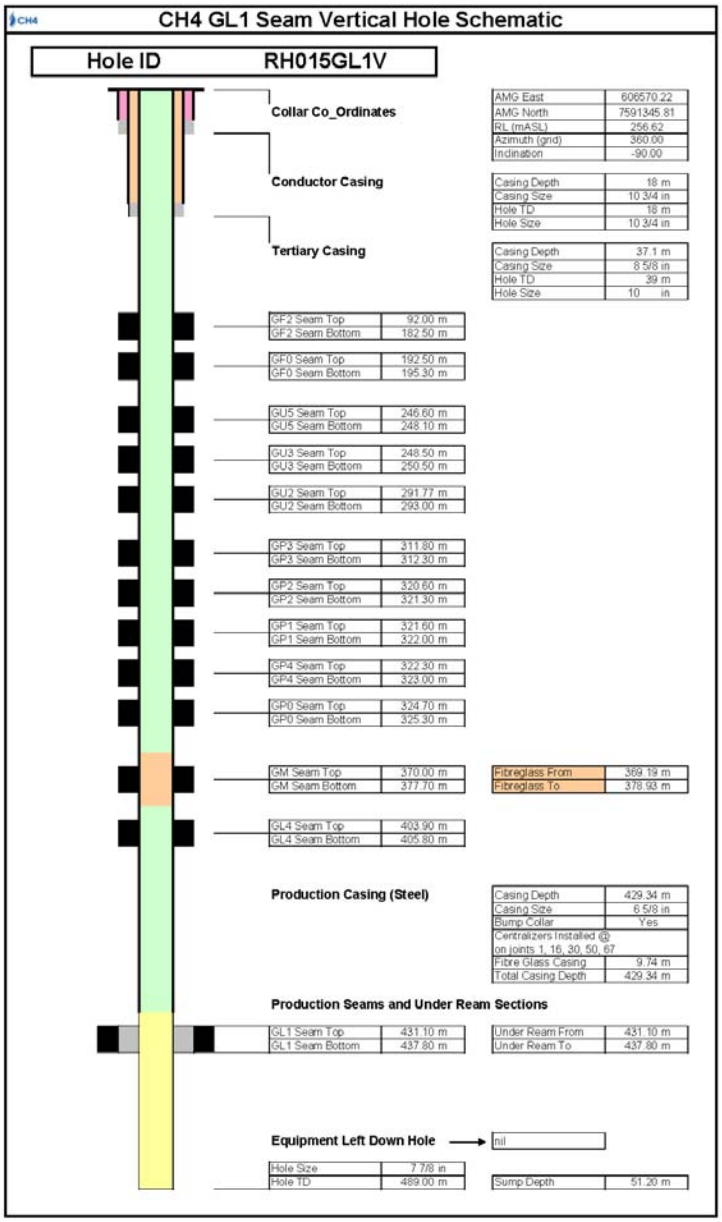
CONSUMABLES USED DURING DRILLING OF WELL

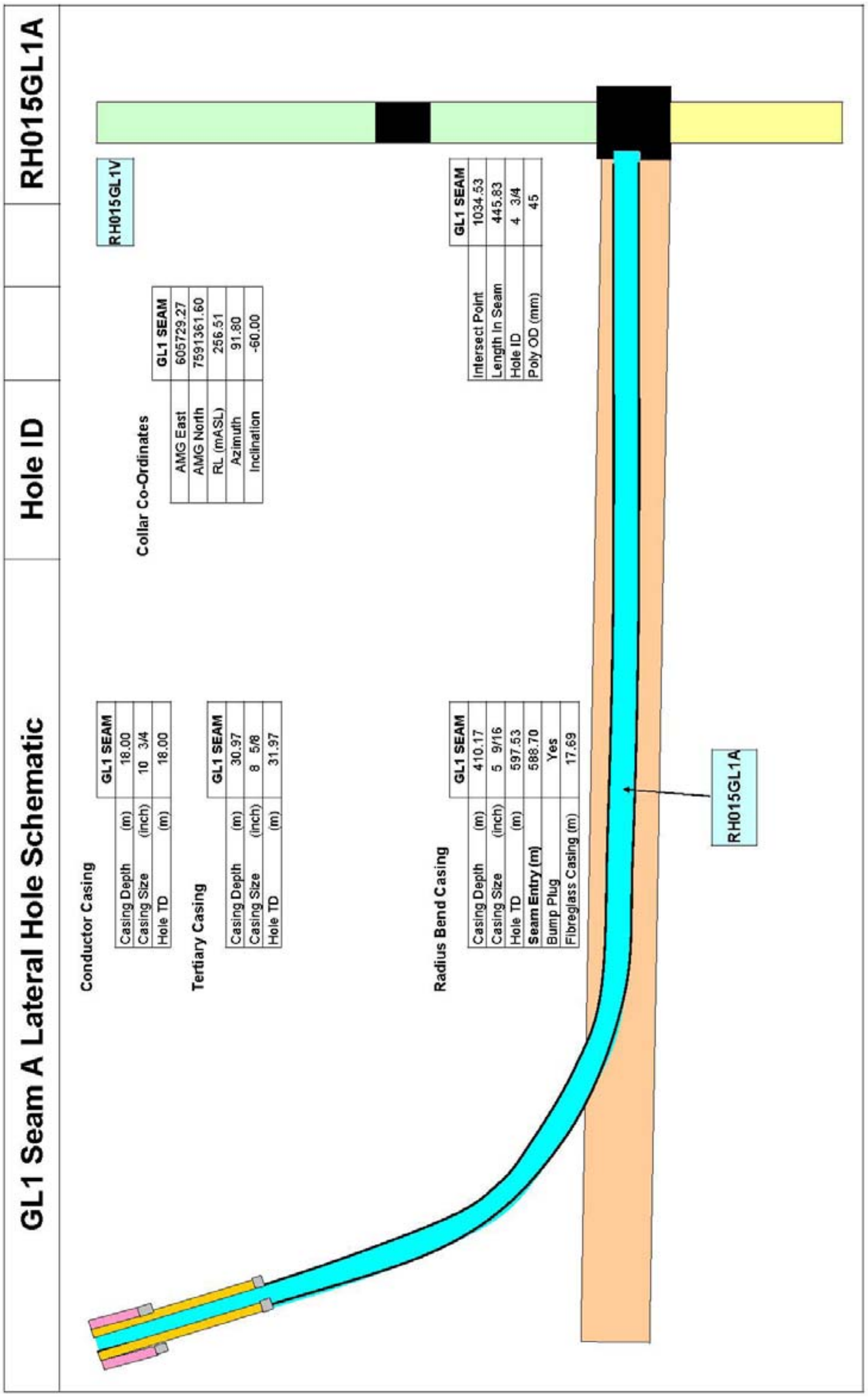
Product	Size	Amount	Total
Well Clean		4	
Xan Bore		6	
Aus Gel	8 kilogram	25	200
Clay Coat	20 litre	1	20
Drill Foam	20 litre		0
Hammer Oil	20 litre		0
KCl	25 kilogram		0
Liquid Polymer	20 litre	11	220
Soda Ash	25 kilogram		0
FSF 2000	20 litre		0
Poly Plus	20 litre		0
Super foam	20 litre		0
Drill Plex	20 kilogram		0
Liquid Pac	20 kilogram		0
AMC XXX	15 kilogram		0
Safe Lube	20 litre		0
Pac HV	25 kilogram		0
Hi Seal	15 kilogram		0
Star Gel	25 kilogram		0
XCD	25 kilogram		0

SUMMARY OF STRATIGRAPHY

Stratigraphy	Formation	From (m)	To (m)	Thickness (m)	Comments
Oxidised clays and sands		0.00	22.00	22.00	
	Base of Tertiary	22.00	22.00	0.00	
Sandstone & siltstone		22.00	34.00	12.00	
	Base of Weathering	34.00	34.00	0.00	
sandstone, siltstone, mudstone		34.00	92.00	58.00	
coal, carb mudstone	**GF2**	92.00	160.00	68.00	Base of FCCM
Sand/silt/ carb mudstone & coal		160.00	242.00	82.00	
coal, carb mudstone	**GUS/3**	242.00	248.00	6.00	GA2-1/2-2
Mudstone, carb mudstone & tuff		248.00	404.00	156.00	
Coal	**GM0**	394.70	408.70	14.00	GM - corrected to PVSR
Mud/ carb mudstone, tuff & coal		408.70	446.00	37.30	
coal, carb mudstone	**GL4**	446.00	458.00	12.00	GML-split
Mud/ carb mudstone, tuff & coal		458.00	586.00	128.00	
Target seam	**GL1**	588.70	1034.53	445.83	GML-split - corrected to PVSR

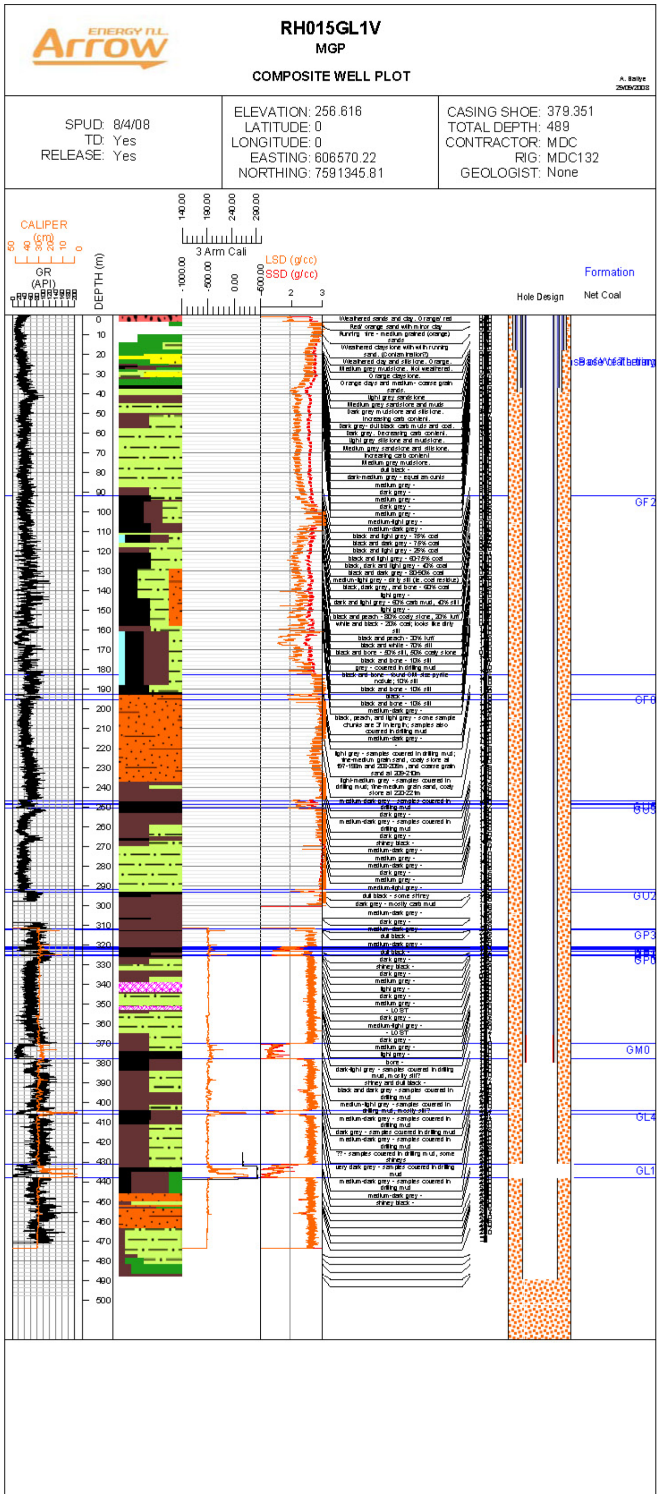
Well Schematic(s)





GL1 Seam A Lateral Hole Schematic
Hole ID
RH015GL1A
Conductor Casing
GL1 SEAM
Casing Depth (m) 18.00
Casing Size (inch) 10 3/4
Hole TD (m) 18.00
Tertiary Casing
GL1 SEAM
Casing Depth (m) 30.97
Casing Size (inch) 8 5/8
Hole TD (m) 31.97
Radius Bend Casing
GL1 SEAM
Casing Depth (m) 410.17
Casing Size (inch) 5 9/16
Hole TD (m) 597.53
Seam Entry (m) 588.70
Bump Plug Yes
Fibreglass Casing (m) 17.69
Collar Co-Ordinates
GL1 SEAM
AMG East 605729.27
AMG North 7591361.60
RL (mASL) 256.51
Azimuth 91.80
Inclination -60.00
GL1 SEAM
Intersect Point 1034.53
Length In Seam 445.83
Hole ID 4 3/4
Poly OD (mm) 45
RH015GL1V
RH015GL1A

Vertical Well Composite Log



Verified Survey Report

SURTRON TECHNOLOGIES

CH4 OPERATIONS - MORANBAH GAS PROJECT

Drillhole Survey - Verified Data

Hole Number: RH015GL1A B03

Date Drilled: Dec-08

Vertical Section Azi - Entry to Intersect: 91.20 degrees

Displacement along Section @ Intersect: 836.09 m

MD	Dip.	Azi.	TVD	North	East	DLS	VS	OFFSET	AMG N	AMG E	RL	Comments
0.00	30.04	91.22	0.00	0.00	0.00	0.00	0.00	0.00	7591361.60	605729.27	256.51	Collar
41.19	28.04	91.74	36.01	-0.51	19.99	1.47	19.99	0.10	7591361.08	605749.26	220.50	Rotate
47.19	28.14	91.34	41.30	-0.59	22.81	1.07	22.82	0.11	7591361.01	605752.08	215.21	1m@ 330
53.19	28.64	91.14	46.58	-0.65	25.66	2.54	25.67	0.11	7591360.95	605754.93	209.93	Rotate
59.19	28.84	91.14	51.84	-0.71	28.55	1.00	28.56	0.11	7591360.89	605757.82	204.67	1m @ 0
65.19	29.34	90.94	57.09	-0.76	31.46	2.55	31.47	0.10	7591360.84	605760.73	199.43	Rotate
71.19	29.54	91.04	62.31	-0.81	34.41	1.03	34.42	0.09	7591360.79	605763.68	194.20	Rotate
77.19	29.54	91.34	67.53	-0.87	37.37	0.74	37.38	0.09	7591360.72	605766.64	188.98	1m @ 30
83.19	29.94	91.94	72.74	-0.96	40.35	2.49	40.36	0.11	7591360.64	605769.62	183.77	Rotate
89.19	30.14	92.24	77.93	-1.07	43.35	1.25	43.36	0.16	7591360.53	605772.62	178.58	Rotate
95.19	30.14	92.34	83.12	-1.19	46.36	0.25	46.37	0.22	7591360.41	605775.63	173.39	1m@ 270
101.19	29.84	91.34	88.32	-1.29	49.35	2.91	49.37	0.25	7591360.31	605778.62	168.19	Rotate
107.19	29.64	91.14	93.53	-1.35	52.33	1.12	52.35	0.25	7591360.25	605781.60	162.98	Rotate
113.19	29.54	91.04	98.75	-1.41	55.29	0.56	55.31	0.25	7591360.19	605784.56	157.77	1.5m @ 330
119.19	29.94	90.84	103.96	-1.46	58.27	2.06	58.29	0.24	7591360.14	605787.54	152.56	Rotate
125.19	29.94	90.74	109.16	-1.50	61.26	0.25	61.28	0.21	7591360.10	605790.53	147.36	Rotate
131.19	29.84	91.14	114.36	-1.55	64.25	1.12	64.27	0.20	7591360.05	605793.52	142.16	Rotate
137.19	29.54	91.14	119.57	-1.60	67.22	1.50	67.24	0.20	7591359.99	605796.49	136.94	1.5m @ 330
143.19	29.84	90.64	124.78	-1.65	70.20	1.95	70.21	0.18	7591359.95	605799.47	131.73	Rotate
149.19	29.64	90.34	129.99	-1.68	73.17	1.25	73.19	0.14	7591359.92	605802.44	126.52	Rotate
155.19	29.24	90.04	135.22	-1.69	76.12	2.13	76.14	0.09	7591359.91	605805.39	121.30	1.5m @ 345
161.19	29.74	89.74	140.44	-1.68	79.07	2.61	79.09	0.02	7591359.92	605808.34	116.07	1m @ 0
167.19	30.24	89.24	145.64	-1.65	82.07	2.79	82.09	-0.06	7591359.94	605811.34	110.88	Rotate
173.19	30.04	89.24	150.83	-1.61	85.09	1.00	85.10	-0.17	7591359.98	605814.36	105.69	1m @ 90
179.19	30.04	90.74	156.02	-1.61	88.09	3.75	88.10	-0.23	7591359.99	605817.36	100.49	Rotate
185.19	30.34	91.64	161.21	-1.68	91.11	2.71	91.12	-0.23	7591359.92	605820.38	95.31	1.5m @ 60
191.19	30.74	92.84	166.37	-1.80	94.15	3.65	94.17	-0.18	7591359.80	605823.42	90.14	Rotate
197.19	31.04	93.54	171.52	-1.97	97.23	2.34	97.25	-0.07	7591359.63	605826.50	84.99	1m@ 270
203.19	31.24	92.64	176.66	-2.13	100.33	2.53	100.35	0.03	7591359.46	605829.60	79.86	1m@ 270
209.19	31.24	91.44	181.79	-2.24	103.43	3.11	103.46	0.08	7591359.35	605832.70	74.73	1m@ 270
215.19	30.84	90.44	186.93	-2.30	106.53	3.26	106.55	0.07	7591359.30	605835.80	69.58	Rotate
221.19	30.44	90.24	192.09	-2.31	109.59	2.06	109.61	0.02	7591359.28	605838.86	64.42	Rotate
227.19	29.94	90.34	197.28	-2.33	112.60	2.51	112.63	-0.03	7591359.27	605841.87	59.24	Rotate
233.19	29.54	90.24	202.49	-2.34	115.58	2.02	115.60	-0.08	7591359.25	605844.85	54.03	Rotate
239.19	29.24	90.54	207.72	-2.36	118.52	1.67	118.55	-0.12	7591359.23	605847.79	48.80	1m @ 0
245.19	29.54	90.64	212.94	-2.39	121.47	1.52	121.49	-0.15	7591359.20	605850.74	43.57	1m @ 0
251.19	30.14	90.64	218.15	-2.43	124.45	3.00	124.48	-0.18	7591359.17	605853.72	38.37	1m @ 0
257.19	30.84	90.34	223.32	-2.45	127.50	3.58	127.52	-0.22	7591359.14	605856.77	33.20	Rotate
263.19	30.94	90.54	228.47	-2.48	130.58	0.72	130.60	-0.26	7591359.12	605859.85	28.05	1m @ 90
269.19	31.04	91.24	233.61	-2.53	133.67	1.87	133.69	-0.27	7591359.07	605862.94	22.90	Rotate
275.19	31.04	91.84	238.75	-2.61	136.76	1.55	136.78	-0.25	7591358.99	605866.03	17.76	Rotate
281.19	30.94	91.74	243.89	-2.70	139.85	0.56	139.87	-0.22	7591358.89	605869.12	12.62	Rotate
287.19	30.74	91.84	249.05	-2.80	142.92	1.03	142.95	-0.19	7591358.80	605872.19	7.47	1.5m @ 0
293.19	31.24	92.14	254.19	-2.91	146.01	2.62	146.04	-0.15	7591358.69	605875.28	2.32	1.5m @ 0
299.19	31.84	91.74	259.30	-3.01	149.15	3.18	149.18	-0.11	7591358.58	605878.42	-2.79	2m @ 0
305.19	32.64	91.94	264.38	-3.12	152.35	4.04	152.38	-0.07	7591358.48	605881.62	-7.86	2m @ 0
311.19	33.34	91.94	269.41	-3.23	155.61	3.50	155.64	-0.03	7591358.37	605884.88	-12.90	2.5m @ 0
317.19	34.14	91.74	274.40	-3.33	158.94	4.04	158.98	0.01	7591358.26	605888.21	-17.89	3m @ 0
323.19	35.34	92.54	279.33	-3.46	162.36	6.42	162.39	0.06	7591358.14	605891.63	-22.82	3.5m @ 0
329.19	36.74	93.04	284.18	-3.63	165.88	7.15	165.92	0.16	7591357.96	605895.15	-27.67	3m@ 330
335.19	38.04	92.74	288.95	-3.82	169.52	6.56	169.56	0.27	7591357.78	605898.79	-32.44	3.5m @ 330
341.19	39.54	91.94	293.63	-3.97	173.28	7.91	173.32	0.34	7591357.63	605902.55	-37.11	3m@ 330
347.19	40.84	91.34	298.21	-4.08	177.15	6.78	177.19	0.37	7591357.52	605906.42	-41.70	3.5m @ 330
353.19	42.14	90.84	302.70	-4.16	181.12	6.71	181.17	0.37	7591357.44	605910.39	-46.19	3m @ 0
359.19	43.74	90.54	307.10	-4.21	185.21	8.06	185.26	0.33	7591357.39	605914.48	-50.58	3m @ 0
365.19	45.24	90.34	311.38	-4.24	189.41	7.53	189.46	0.27	7591357.36	605918.68	-54.86	2.5m @ 0
371.19	46.84	90.24	315.54	-4.26	193.73	8.01	193.78	0.21	7591357.34	605923.00	-59.03	2.5m @ 0
377.19	47.94	90.34	319.60	-4.28	198.15	5.51	198.19	0.13	7591357.32	605927.42	-63.09	1.5m @ 0
383.19	48.94	90.64	323.58	-4.32	202.64	5.12	202.68	0.08	7591357.28	605931.91	-67.07	2m @ 0
389.19	49.94	90.64	327.48	-4.37	207.20	5.00	207.24	0.04	7591357.23	605936.47	-70.97	2m @ 0
394.70	50.95	90.92	330.99	-4.43	211.44	5.62	211.49	0.00	7591357.17	605940.71	-74.48	GM Roof
395.19	51.04	90.94	331.30	-4.44	211.82	5.59	211.87	0.00	7591357.16	605941.09	-74.79	2.5m @ 0
401.19	52.24	91.24	335.03	-4.53	216.53	6.11	216.57	-0.01	7591357.07	605945.80	-78.51	2m @ 0
407.19	53.34	91.54	338.65	-4.64	221.30	5.63	221.35	0.01	7591356.96	605950.57	-82.14	2m @ 0
408.70	53.62	91.62	339.55	-4.68	222.52	5.71	222.57	0.02	7591356.92	605951.79	-83.04	GM Floor
413.19	54.44	91.74	342.19	-4.78	226.15	5.52	226.20	0.05	7591356.82	605955.42	-85.68	2m @ 0
419.19	55.24	91.84	345.64	-4.94	231.05	4.02	231.11	0.10	7591356.66	605960.32	-89.13	1.5m @ 0
425.19	56.24	91.94	349.02	-5.10	236.01	5.02	236.06	0.16	7591356.50	605965.28	-92.51	2m @ 0
431.19	57.74	91.84	352.29	-5.26	241.04	7.51	241.09	0.22	7591356.33	605970.31	-95.78	2m @ 0
437.19	58.94	91.94	355.44	-5.43	246.14	6.02	246.20	0.28	7591356.16	605975.41	-98.93	2m @ 0
443.19	60.44	92.14	358.47	-5.62	251.32	7.55	251.38	0.36	7591355.98	605980.59	-101.95	2m @ 0
449.19	61.74	92.24	361.37	-5.82	256.57	6.51	256.63	0.45	7591355.78	605985.84	-104.85	2m@ 330
455.19	63.24	91.94	364.14	-6.01	261.88	7.62	261.95	0.53	7591355.59	605991.15	-107.63	1.5m @ 0
461.19	64.34	91.64	366.79	-6.18	267.26	5.66	267.34	0.59	7591355.42	605996.53	-110.28	2m@ 330
467.19	65.64	91.74	369.33	-6.34	272.70	6.52	272.77	0.63	7591355.26	606001.97	-112.81	2m @ 0
473.19	67.14	91.54	371.73	-6.50	278.19	7.56	278.27	0.67	7591355.10	606007.46	-115.22	1.5m @ 330
479.19	68.74	91.54	373.98	-6.65	283.75	8.00	283.83	0.71	7591354.95	606013.02	-117.47	1m @ 0
485.19	69.84	91.24	376.10	-6.78	289.36	5.68	289.44	0.73	7591354.81	606018.63	-119.59	1m@ 315
491.19	70.54	90.74	378.14	-6.88	295.01	4.22	295.09	0.71	7591354.72	606024.28	-121.62	1m @ 90
497.19	70.94	91.34	380.12	-6.98	300.67	3.47	300.75	0.69	7591354.61	606029.94	-123.60	1m @ 0
503.19	71.14	91.74	382.07	-7.14	306.34	2.14	306.43	0.72	7591354.46	606035.61	-125.55	1m @ 0
509.19	71.64	91.54	383.98	-7.30	312.03	2.67	312.11	0.77	7591354.30	606041.30	-127.47	1m @ 0
515.19	72.44	91.44	385.83	-7.45	317.73	4.03	317.82	0.80	7591354.15	606047.00	-129.32	1.5m @ 330
521.19	73.54	91.24	387.59	-7.58	323.47	5.58	323.56	0.81	7591354.02	606052.74	-131.07	1m @ 0
527.19	74.14	90.74	389.26	-7.68	329.23	3.84	329.32	0.79	7591353.92	606058.50	-132.74	2m @ 0
533.19	75.14	90.54	390.85	-7.75	335.02	5.09	335.11	0.73	7591353.85	606064.29	-134.33	2m @ 0
539.19	76.44	90.44	392.32	-7.80	340.83	6.52	340.92	0.66	7591353.80	606070.10	-135.80	2.5m @ 0
545.19	78.04	90.24	393.64	-7.83	346.68	8.06	346.77	0.57	7591353.77	606075.95	-137.13	1.5m @ 0
551.19	79.34	90.34	394.82	-7.86	352.57	6.52	352.65	0.48	7591353.74	606081.84	-138.31	Rotate
557.19	79.64	90.24	395.91	-7.89	358.47	1.58	358.55	0.39	7591353.71	606087.74	-139.40	Rotate
563.19	80.04	90.04	396.97	-7.90	364.37	2.23	364.46	0.28	7591353.69	606093.64	-140.46	Rotate
569.19	80.24	89.84	398.00	-7.90	370.28	1.40	370.37	0.15	7591353.70	606099.55	-141.49	1m @ 90
575.19	80.04	90.44	399.03	-7.91	376.20	3.12	376.28	0.04	7591353.69	606105.47	-142.51	Rotate
581.19	80.14	90.44	400.06	-7.96	382.11	0.50	382.19	-0.04	7591353.64	606111.38	-143.55	2.5m @ 0
582.70	80.47	90.36	400.32	-7.97	383.59	6.74	383.68	-0.06	7591353.63	606112.86	-143.80	Seam Entry
587.19	81.44	90.14	401.02	-7.99	388.03	6.64	388.11	-0.13	7591353.61	606117.30	-144.51	2.5m @ 0

	593.19	82.94	89.84	401.84	-7.99	393.97	7.65	394.05	-0.26	7591353.61	606123.24	-145.32	2m @ 0
	599.19	84.44	90.04	402.50	-7.98	399.94	7.57	400.01	-0.39	7591353.62	606129.21	-145.98	2m @ 0
	605.19	85.44	90.14	403.02	-7.99	405.91	5.02	405.99	-0.51	7591353.61	606135.18	-146.51	Rot
	611.19	85.94	90.04	403.48	-8.00	411.90	2.55	411.97	-0.62	7591353.60	606141.17	-146.96	1.5m @ 60
	617.19	86.34	91.04	403.88	-8.06	417.88	5.37	417.96	-0.69	7591353.54	606147.15	-147.37	1m @ 90
	623.19	86.64	91.54	404.25	-8.19	423.87	2.91	423.95	-0.68	7591353.41	606153.14	-147.73	Rot
	629.19	86.94	91.54	404.58	-8.35	429.86	1.50	429.94	-0.65	7591353.25	606159.13	-148.07	2m @ 180
	635.19	85.84	91.64	404.96	-8.52	435.84	5.52	435.93	-0.61	7591353.08	606165.11	-148.45	Rot
	641.19	85.44	91.64	405.42	-8.69	441.82	2.00	441.91	-0.56	7591352.91	606171.09	-148.90	Rot
	647.19	85.54	91.74	405.89	-8.87	447.80	0.71	447.89	-0.51	7591352.73	606177.07	-149.37	Rot
	653.19	85.64	91.44	406.35	-9.03	453.78	1.58	453.87	-0.47	7591352.57	606183.05	-149.84	1.5m @ 0
	659.19	86.24	91.34	406.77	-9.18	459.76	3.04	459.86	-0.45	7591352.42	606189.03	-150.26	Rot
	665.19	86.44	91.04	407.16	-9.30	465.75	1.80	465.84	-0.45	7591352.30	606195.02	-150.64	Rot
	671.19	86.74	90.84	407.51	-9.40	471.74	1.80	471.83	-0.48	7591352.20	606201.01	-151.00	1.5m @ 0
	677.19	87.34	90.44	407.82	-9.47	477.73	3.60	477.82	-0.53	7591352.13	606207.00	-151.31	1.5m @ 90
	683.19	87.34	90.44	408.10	-9.51	483.72	0.00	483.82	-0.61	7591352.09	606212.99	-151.59	2m @ 0
	689.19	87.94	90.64	408.35	-9.57	489.72	3.16	489.81	-0.68	7591352.03	606218.99	-151.84	2m @ 90
	695.19	88.14	91.14	408.56	-9.66	495.71	2.69	495.81	-0.72	7591351.94	606224.98	-152.04	Rot
	701.19	88.64	91.64	408.72	-9.81	501.71	3.53	501.81	-0.70	7591351.79	606230.98	-152.21	Rot
	707.19	88.84	91.34	408.86	-9.96	507.71	1.80	507.80	-0.66	7591351.64	606236.98	-152.34	Rot
	713.19	88.64	91.94	408.99	-10.13	513.70	3.16	513.80	-0.62	7591351.46	606242.97	-152.47	Rot
	719.19	88.54	92.24	409.14	-10.35	519.70	1.58	519.80	-0.53	7591351.24	606248.97	-152.62	1.5m @ 135
	725.19	87.64	93.24	409.34	-10.64	525.69	6.72	525.79	-0.36	7591350.96	606254.96	-152.82	Rot
	731.19	87.64	93.64	409.58	-11.00	531.67	2.00	531.78	-0.13	7591350.60	606260.94	-153.07	1m @ 0
	737.19	88.14	93.94	409.80	-11.40	537.65	2.91	537.77	0.14	7591350.20	606266.92	-153.29	Rot
	743.19	88.44	93.84	409.98	-11.80	543.64	1.58	543.77	0.42	7591349.80	606272.91	-153.47	Rot
	749.19	88.74	93.74	410.13	-12.20	549.62	1.58	549.76	0.69	7591349.40	606278.89	-153.62	2m @ 225
	755.19	88.74	93.14	410.26	-12.56	555.61	3.00	555.75	0.93	7591349.04	606284.88	-153.75	Rot
	761.19	87.54	92.84	410.46	-12.87	561.60	6.18	561.75	1.12	7591348.73	606290.87	-153.94	2m @ 225
	767.19	86.14	91.94	410.79	-13.12	567.58	8.32	567.73	1.24	7591348.48	606296.85	-154.27	Rot
	773.19	85.84	91.54	411.21	-13.30	573.57	2.50	573.72	1.30	7591348.29	606302.84	-154.69	1.5m @ 0
	779.19	86.74	91.34	411.60	-13.45	579.55	4.61	579.71	1.32	7591348.14	606308.82	-155.08	Rot
	785.19	86.74	90.74	411.94	-13.56	585.54	3.00	585.70	1.31	7591348.04	606314.81	-155.42	Rot
	791.19	87.14	90.64	412.26	-13.64	591.53	2.06	591.69	1.25	7591347.96	606320.80	-155.74	1.5m @ 180
	797.19	86.24	90.44	412.60	-13.69	597.52	4.61	597.68	1.18	7591347.91	606326.79	-156.09	1.5m @ 135
	803.19	85.34	91.64	413.04	-13.80	603.50	7.49	603.66	1.17	7591347.80	606332.77	-156.53	Rot
	809.19	85.54	92.54	413.52	-14.02	609.48	4.60	609.64	1.26	7591347.58	606338.75	-157.01	Rot
	815.19	85.94	93.04	413.97	-14.31	615.46	3.20	615.62	1.43	7591347.29	606344.73	-157.45	Rot
	821.19	86.44	93.14	414.37	-14.63	621.44	2.55	621.61	1.62	7591346.97	606350.71	-157.85	1.5m @ 0
	827.19	87.24	92.94	414.70	-14.95	627.42	4.12	627.59	1.82	7591346.65	606356.69	-158.18	Rot
	833.19	87.44	92.54	414.97	-15.24	633.41	2.23	633.59	1.98	7591346.36	606362.68	-158.46	1.5m @ 210
	839.19	86.54	92.34	415.29	-15.49	639.39	4.61	639.58	2.11	7591346.11	606368.66	-158.78	Rot
	845.19	86.44	92.14	415.66	-15.73	645.38	1.12	645.56	2.22	7591345.87	606374.65	-159.14	Rot
	851.19	86.54	92.24	416.02	-15.95	651.36	0.71	651.55	2.32	7591345.64	606380.63	-159.51	Rot
	857.19	86.84	92.34	416.37	-16.19	657.35	1.58	657.54	2.43	7591345.40	606386.62	-159.86	2m @ 210
	863.19	85.74	92.54	416.76	-16.45	663.33	5.59	663.53	2.56	7591345.15	606392.60	-160.24	Rotate
	869.19	85.34	92.34	417.23	-16.70	669.30	2.23	669.51	2.69	7591344.89	606398.57	-160.71	1.5m @ 330
	875.19	85.94	91.54	417.68	-16.91	675.28	4.99	675.49	2.77	7591344.69	606404.55	-161.17	Rotate
	881.19	86.94	90.94	418.05	-17.04	681.27	5.83	681.48	2.77	7591344.56	606410.54	-161.54	1m @ 255
	887.19	86.54	89.94	418.40	-17.08	687.26	5.38	687.47	2.69	7591344.52	606416.53	-161.88	1m @ 180
	893.19	85.24	89.74	418.83	-17.06	693.24	6.58	693.45	2.55	7591344.53	606422.51	-162.31	Rotate
	899.19	85.14	90.04	419.33	-17.05	699.22	1.58	699.43	2.42	7591344.54	606428.49	-162.81	Rotate
	905.19	85.44	90.44	419.82	-17.08	705.20	2.49	705.41	2.32	7591344.52	606434.47	-163.31	1.5m @ 15
	911.19	86.64	90.64	420.24	-17.13	711.19	6.08	711.39	2.25	7591344.46	606440.46	-163.72	Rotate
	917.19	87.14	90.44	420.56	-17.19	717.18	2.69	717.38	2.18	7591344.41	606446.45	-164.05	Rotate
	923.19	87.24	90.44	420.86	-17.24	723.17	0.50	723.37	2.10	7591344.36	606452.44	-164.34	2m @ 150
	929.19	85.94	91.44	421.21	-17.34	729.16	8.20	729.36	2.07	7591344.26	606458.43	-164.70	Rotate
	935.19	85.34	91.94	421.67	-17.51	735.14	3.90	735.35	2.12	7591344.09	606464.41	-165.15	Rotate
	941.19	85.44	92.34	422.15	-17.74	741.12	2.06	741.32	2.22	7591343.86	606470.39	-165.64	1m @ 180
	947.19	84.24	92.44	422.69	-17.98	747.09	6.02	747.30	2.35	7591343.61	606476.36	-166.18	Rotate
3	953.19	83.84	92.64	423.31	-18.25	753.05	2.23	753.27	2.48	7591343.35	606482.32	-166.80	Lip cut B03
	959.19	81.94	92.54	424.06	-18.52	759.00	9.51	759.22	2.63	7591343.08	606488.27	-167.54	3m @ 270
	965.19	80.74	91.74	424.96	-18.74	764.92	7.19	765.15	2.73	7591342.86	606494.19	-168.45	3m @ 330
	971.19	81.14	90.84	425.90	-18.87	770.85	4.87	771.07	2.74	7591342.73	606500.12	-169.39	3m @ 330
	977.19	81.94	89.74	426.79	-18.90	776.78	6.75	777.01	2.64	7591342.70	606506.05	-170.27	3m @ 330
	983.19	82.84	88.34	427.58	-18.80	782.73	8.27	782.95	2.42	7591342.79	606512.00	-171.07	2m @ 0
	989.19	83.94	87.44	428.27	-18.58	788.68	7.09	788.90	2.07	7591343.01	606517.95	-171.76	Rot
	995.19	84.04	86.94	428.90	-18.29	794.64	2.54	794.85	1.66	7591343.31	606523.91	-172.39	2m @ 90
	1001.19	84.04	87.54	429.52	-18.00	800.60	2.98	800.80	1.24	7591343.59	606529.87	-173.01	Rot
	1007.19	83.94	87.84	430.15	-17.76	806.57	1.57	806.76	0.88	7591343.83	606535.84	-173.64	3m @ 90
	1013.19	83.94	89.44	430.78	-17.62	812.53	7.96	812.72	0.61	7591343.98	606541.80	-174.27	Rot
	1019.19	83.84	90.34	431.42	-17.61	818.50	4.50	818.69	0.48	7591343.99	606547.77	-174.91	Rot
	1024.19	83.84	90.44	431.96	-17.64	823.47	0.60	823.66	0.41	7591343.95	606552.74	-175.45	5m @ 270
	1036.70	83.84	88.01	433.30	-17.48	835.90	5.80	836.09	-0.02	7591344.12	606565.17	-176.79	intersection

Drilling Summary

RH015GL1V

The well was drilled without incidence.

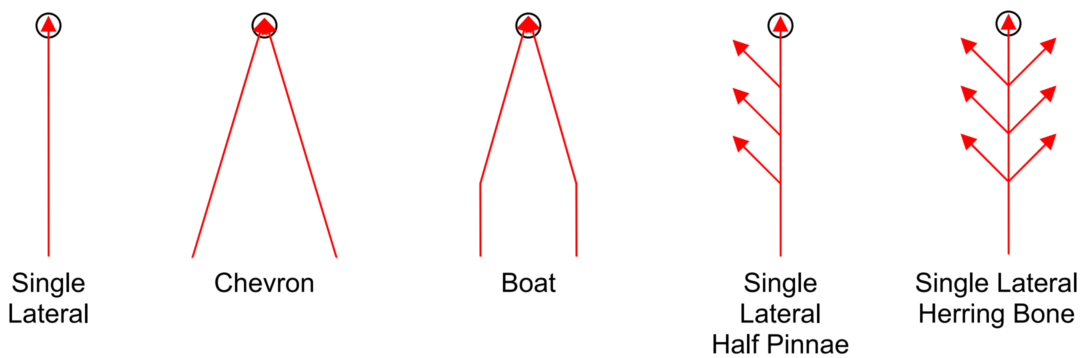
RH015GL1A

The well was drilled without incidence.

Appendix

Appendix A - Diagram of lateral well designs

Lateral well design to be applied: Single Lateral



Appendix B – Casing designs for SIS Vertical Wells

There are a number of vertical casing strategies applied by Arrow Energy. These are:

- **SIS - Cased to target seam (non mineable seam)**
  - The well is cased with steel to within 400mm of the target-seam roof.
- **SIS - Cased to target seam (mineable seam)**
  - The well is cased to within 400mm of the target-seam roof.
- **SIS - Cased to target seam (mineable seam) – F'glass sections**
  - The well is cased to within 400mm of the target-seam roof.
  - Fibreglass sections of casing are run through any non-target seams which have been deemed mineable
- **SIS - Multiple target seams (open)**
  - The well is cased with steel to within 400mm of the shallowest target-seam roof.
  - The well is barefoot from this point to TD
- **SIS - Multiple target seams (milled)**
  - The well is cased to within 400mm of the deepest target seam.
  - Casing covering shallower target seams is often fibreglass
  - Casing covering shallower target seams is milled out.
  - Any casing near mine-able seams is also fibreglass
- **Stand-alone vertical - Slotted Liner (no gravel pack)**
  - The well is drilled to TD
  - The target seams and coal bands are under-reamed
  - The well is lined with steel casing; slotted sections of casing are aligned with the under-reamed zones.
- **Stand-alone vertical - Gravel Packed**
  - The well is drilled to TD
  - The target seams and coal bands are under-reamed
  - The well is lined with steel casing, slotted sections of casing are aligned with the under-reamed zones.
  - Gravel is placed in the annulus, between the well and the liner providing stability to the well whilst maintaining a high porosity.
- **Stand-alone vertical – Frac**
  - The well is drilled to TD
  - The well is cased to TD
  - In turn, the casing in-front of each target seam is perforated and the seam hydraulically fractured.

Casing plan to be applied: SIS - Cased to target seam (mineable seam) – F'g

Appendix C – Casing designs for SIS Lateral Wells

There are 3 radius bend casing strategies applied within the MGP. These are:

- **Non mineable seam radius bends**
  Steel casing is set to either just above or just within the seam.
- **Mineable seam radius bends**
  Steel casing is set well above the target seam
- **Mineable seam radius bends - fibreglass sections**
  Steel casing is set well above the target seam
  Fibreglass sections of casing are run through any non-target seams which have been deemed mineable
- **Mineable seam radius bends (high)**
  Steel casing is set to just below the seam directly above the target seam.
- **Mineable seam radius bends (low)**
  Steel casing is set to 1m TVD above the target seam.

Casing plan to be applied:

RH015GL1A	**Mineable seam - fibreglass sections**
	[No Selection Made]
	[No Selection Made]
	[No Selection Made]

Appendix D – Daily Drilling Reports

On agreement with the DNRM the ‘Daily Drilling Reports’ are not attached as they have already been submitted to 'Andy.Kozak@nrm.qld.gov.au'.