Mulka Bore decommissioning and replacement – Lake Eyre South Region

DEWNR Technical note 2016/27
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- Mulka Station
- Silver City Drilling
- Owen Oil Tools
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1. Introduction

This report discusses the decommissioning of the damaged and leaking artesian Mulka Bore, and the drilling and construction of its replacement on the Mulka pastoral lease. Both wells produce water from the Algebuckina Sandstone and Cadna-owie Formation aquifers of the Great Artesian Basin (Smerdon et al., 2012; Keppel et al., 2013).

The original Mulka Bore was drilled in 1907 and has been rehabilitated several times. Recently the 80 mm diameter fibreglass casing which had been used to reline the well disintegrated at the surface resulting in the headworks breaking off. The well flowed uncontrolled for some time before being temporarily repaired.

The replacement well (Mulka Bore No. 2) was successfully drilled adjacent to the original well in April 2016, targeting the Algebuckina Sandstone aquifer. The original well was perforated adjacent the confining beds and was successfully decommissioned by cementing the well and annulus in several stages.
Figure 1. Location of Mulka Bore and Mulka Bore No. 2
2. Construction of Mulka Bore No. 2

2.1. Background

Mulka Bore No. 2 (Unit number 6641-15) was drilled to replace the original Mulka Bore (Unit number 6641-6). Mulka Bore No. 2 was designed in accordance with the Minimum Construction Requirements for Water Bores in Australia (NUDLC, 2012). It contains three strings of casing to ensure proper control of the water being produced from the artesian aquifer.

All three strings of casing were to be cemented from the shoe to ground level. The well was completed with an 143 mm open hole production zone in the Algebuckina Sandstone.

The well construction diagram is given in Figure 2.

2.2. Well drilling and construction

The drilling contractor, Silver City Drilling (Alice Springs, Northern Territory), used a Schramm T130XD Rotadrill carrier-mounted drill rig (54 tonne GVM) (Figure 3) with a semi-automated rod handling system (Figure 4).

The hole was drilled using the rotary mud method, with several settling pits excavated on site for the mud circulation system. Tulsa TT-560 mud pumps were used. The mud consisted of the viscosifiers LIQUI-POL and XAN-BORE, potassium chloride for clay inhibition and weighting, and barites for weighting.

Casing was manufactured by Yantai Baosteel Pipe Co., Ltd to the American Petroleum Institute (API) 5CT specification’s K-55 grade, which is a standard carbon steel grade used in the petroleum industry (Figure 5).

Three strings of steel casing were used (Table 1):  
- Conductor casing – buttress threaded steel casing, 326.9 mm ID, wall thickness 10.95 mm.
- Artesian control casing – buttress threaded steel casing, 225.1 mm ID, wall thickness 9.65 mm.
- Production casing – buttress threaded steel casing, 161.7 mm ID, wall thickness 8.05 mm. Casing lengths were joined with an externally fitting threaded coupling with an outside diameter of 194.46 mm.

Table 1. Casing design of Mulka Bore No. 2

<table>
<thead>
<tr>
<th>Drillhole size (mm)</th>
<th>Casing string</th>
<th>Casing I.D. (mm)</th>
<th>Casing thickness (mm)</th>
<th>O.D. at joint (mm)</th>
<th>Clearance from drillhole to casing (mm)</th>
<th>Clearance between casing strings (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>444.50</td>
<td>Conductor</td>
<td>326.90</td>
<td>10.95</td>
<td>Welded</td>
<td>348.80</td>
<td>47.85</td>
</tr>
<tr>
<td>312.13</td>
<td>Artesian control</td>
<td>225.10</td>
<td>9.65</td>
<td>Welded</td>
<td>244.40</td>
<td>33.87</td>
</tr>
<tr>
<td>222.95</td>
<td>Production</td>
<td>161.70</td>
<td>8.05</td>
<td>Threaded external coupling</td>
<td>194.46</td>
<td>14.25</td>
</tr>
</tbody>
</table>
The well was drilled and constructed according to the following steps:

- A 444.5 mm polycrystalline diamond cutter (PDC) bit was used to drill to 12 m.
- The conductor casing string was set at 12 m and cemented by tremie line (see details below).
- A 312.13 mm PDC bit was used to drill to 106.07 m.
- The artesian control casing string was set at 104.07 m:
  - Steel 6-wing bowspring centralizers were installed every 12 m (Figure 6).
  - A drillable casing shoe with non-return valve was used.
  - The artesian control casing was pressure cemented by displacement through the shoe (see details below).
- A 222.95 mm PDC bit was used to drill to 1083 m.
- The production casing string was set at 1081.83 m:
  - Steel 4-wing bowspring centralizers were installed every 12 m (Figure 6).
  - A drillable casing shoe with non-return valve was used.
  - The production casing was pressure cemented by displacement through the shoe. Returns were not achieved and a top-up was attempted with a tremie line (see details below).
- The hole was mudded again and a 143.325 mm PDC bit was used to drill to 1112 m.
- After geophysical logging, drill rods were run to 630 m and then 850 m to displace drilling mud with water and artesian flow developed over 24 hours.
- The headworks were completed and the landowner's reticulation system from the original well was connected to the new well.

Appendix A contains further details of:

- The Drillers Well Construction Schedule 8 report.
- Details of the mud program and ingredients.
- Details of the drill bits used.

### 2.3. Cementing

The conductor casing was cemented using a tremie line, 46 x 20 kg bags of cement and 633 L of water. It was then topped up with 20 L of cement slurry.

On 11 April 2016 the artesian control casing was pressure cemented by displacement through the casing shoe by Silver City Drilling.

- 4387 L of 1.66 S.G. grout mix was pumped comprising:
  - 225 x 20 kg bags of cement.
  - 2955 L cool water from Mulka Bore.
- The mix was displaced through the shoe.
- Returns were observed.
- The well was left undisturbed for 24 hours to allow the grout to set.
- The Silver City Drilling report is attached in Appendix B.

On 17 April 2016 the production casing was pressure cemented by displacement with water through the casing shoe, by the contractor Wellpro (Roma, Queensland):
- 1590 L of water was pumped as a preflush spacer.
- 26,235 L (calculated to exceed the nominal annular volume by 60%) of 1.69 S.G. grout mix was pumped over 1 hour comprising:
  - 26866 kg Class A cement.
  - 17731 L water (from Pandi Pandi Bore).
  - 4% Bentonite.
  - 0.82% Retarder FR-3.
  - 0.275% Dispersant NC-S-1.
  - 0.2% Defoamer 7011D.
- 23,373 L of water was pumped to displace the grout through the casing shoe.
- Returns were not observed.
- The well was left undisturbed to allow the grout to set.
- The Wellpro report is attached in Appendix B.

Interpretation of cement bond logs run at setting times of 16 and 33 hours indicated the top of cement was at 188 m.
Figure 2. Construction of Mulka Bore No. 2

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Figure 3. Drilling rig used at Mulka Bore No. 2

Figure 4. Rod loading, blooey line and mud system used for Mulka Bore No. 2
Figure 5. Tags from artesian control and production casing

Figure 6. Centralizers used for artesian control casing (left) and production casing (right)
2.4. Geophysical logging

Downhole geophysical logs were run on four occasions:

1. On 16 April 2016 the open hole was logged with a caliper and temperature probe. The logging equipment then failed due to an electrical fault. After repeated attempts at running further surveys to determine exact lithological boundaries, logging was abandoned after continued electrical problems.

2. On 18 April 2016 the production casing was logged with a cement bond probe 16 hours after the cementing operation. The grout mix samples were not set at this stage, but the log was run to determine the extent to which sample setting affected the log interpretation.

3. On 19 April 2016 the production casing was logged again with a cement bond probe, 33 hours after cementing and after the grout mix samples had set, which indicated the top of cement was at 188 m (Figure 7).

4. On 21 April 2016, after drilling the production zone and 21 hours after the tremie top-up cement job on the production casing, two more runs were undertaken:
   - The production zone was logged with a caliper and temperature probe (1000-1112 m).
   - The top section of the production casing that was cemented by tremie line was logged with a cement bond probe (0-300 m).

All geophysical logs are shown in full in Appendix C.

Figure 7. Initial cement bond log results from 19 April 2016, which was 33 hrs Waiting On Cement (WOC). The top of cement was picked at 188 m based on coincident drops in AMP3FT, AMP5FT, and radial SECT receiver amplitudes. The regular drops in amplitude at 168, 178.5, 189.5, and 200 m are casing joints.
A tremie top-up cement job was then conducted by Silver City Drilling:

- A tremie line was run into the annulus to the maximum possible depth between the artesian control and production casing strings to 67 m.
- 2745 L of 1.65 S.G. grout was pumped through the tremie line.
- On 21 April a cement bond log was run from 0–300 m which confirmed the bottom of the tremie cement was at 67 m (Figure 8), and again confirmed the top of the displacement cement job was at 187 m.
- The Silver City Drilling report is attached in Appendix B.

Results:

- Calculations indicate that the freshwater pre-flush fluid should be in the annulus from 67–187 m.
- The interval from 67–187 m is not likely to be cemented:
  - This presents a risk to the long-term integrity of the production casing.
  - The risk is likely to be higher from 104 to 187 m, as this is below the artesian control casing shoe and formation water in this interval is in contact with the production casing.
  - In the short term the risk is minor due to the presence of pre-flush fluid (fresh water) in this annular space.

Figure 8. Initial tremie cement bond log results from 21 April 2016. The bottom of the tremie line cement job was picked at 67 m based on coincident rises in the AMP3FT, AMP5FT, and maximum radial (SECT) receiver amplitudes. The regular drops in amplitude at 168, 178.5, 189.5, and 200 m are casing joints.
2.5. Lithological logging

Cuttings were collected for lithological examination across the entire drilled depth. A sieve was used to catch cuttings and the samples described on site by a DEWNR hydrogeologist. A summary log is shown in Table 2, with more detailed descriptions given in Appendix D.

A tentative interpretation of the stratigraphy is shown in Table 2. The interface between Bulldog Shale and Cadna-owie Formation is unclear due to the absence of a natural gamma log. The interface between the Cadna-owie Formation and Algebuckina Sandstone was picked at 1059 m based on the increase in angular quartz sand in cuttings and a change in penetration rate at that depth. The bottom of the Algebuckina Sandstone was not reached before drilling ceased at 1112 m.

Table 2. Summary lithological log for Mulka Bore No. 2

<table>
<thead>
<tr>
<th>Sample depth (m)</th>
<th>Description</th>
<th>Tentative stratigraphic interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Top soil</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>White to grey sticky clay with fine sand/sandstone</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Grey/green clayey shale, sandy, traces of lignite</td>
<td></td>
</tr>
<tr>
<td>266</td>
<td>Grey shale, very soft, with fine quartz sand, interbedded</td>
<td>Bulldog Shale</td>
</tr>
<tr>
<td></td>
<td>with calcareous and carbonaceous shale</td>
<td></td>
</tr>
<tr>
<td>401</td>
<td>Grey shale interbedded with calcrite and lignite</td>
<td>Cadna-owie Formation</td>
</tr>
<tr>
<td>986</td>
<td>Shale interbedded with fine sandstone</td>
<td></td>
</tr>
<tr>
<td>1014</td>
<td>Quartz sandstone with gray clay</td>
<td></td>
</tr>
<tr>
<td>1059</td>
<td>Coarse quartz sand with gray clay</td>
<td>Algebuckina Sandstone</td>
</tr>
<tr>
<td>1071</td>
<td>Coarse quartz sand, much less clay</td>
<td></td>
</tr>
<tr>
<td>1091</td>
<td>Fine quartz sand with coarse quartz sand</td>
<td></td>
</tr>
</tbody>
</table>

2.6. Headworks

The well was completed with two steel 6 inch gate valves (Figure 9) and connected to the landholder’s reticulation pipework which was previously attached to the old well.

2.7. Flow testing

After development the well was left to flow under artesian conditions for 24 hours. The flow rate was estimated at 33 L/s using the time taken to fill a 1 m³ container.

On 4 August 2016 further testing was conducted by DEWNR. A 40 minute flow test resulted in a stable flow rate of 36 L/s and a stable (maximum) temperature of 85.6 °C which was reached after approximately 20 minutes (Figure 10). The electrical conductivity of the water was measured at 1496 µS/cm.

The valve was then shut over 5 minutes and a pressure shut-in test conducted for 35 minutes. The maximum pressure after shut-in was 515 kPa and no leakage was observed.
Figure 9. Headworks of Mulka Bore No. 2
Figure 10. Artesian flow of 36 L/s from Mulka Bore No. 2 during flow test on 4 August 2016
3. Decommissioning of Mulka Bore

3.1. Introduction

Mulka Bore (Unit number 6641-6) was originally drilled in 1907 by the cable tool method, and rehabilitation works were undertaken in at least 1957, 1959, and 1984:

- 1907: Bore drilled to 1050 m and completed with 8" steel casing to 593 m and 6" steel casing to 1046 m. The annulus was not cemented as the casing was driven into the ground by the cable tool drilling method.
- 1957: Unknown.
- 1959: Unknown.
- 1984: 80 mm FRP casing set at 283 m and 80 mm steel casing set from 283 m to 307 m.

The plan to decommission the well was based on perforating the original 6" casing in two points to ensure cement could be squeezed into the annulus over a confining layer. It was considered likely that the original casing strings had corroded significantly at multiple depths.

The well was then to be cemented in several stages.

3.2. Decommissioning activities

The well was decommissioned between 22–25 April 2016. Site supervision was provided by the DEWNR Drilling Inspector. The Drillers Well Construction Schedule 8 report is given in Appendix E. The well construction diagram is given in Figure 11.

- Flow from the well was controlled by pumping 9295 L of mud slowly through temporary wellhead works which would extend to a depth of at least 810 m.
- The well was geophysically logged to total depth at 1050 m with a 3-arm caliper, and a combination gamma, neutron and casing collar locator (CCL) probe (Appendix F).
- A cement bond log was run to 307 m, the depth to which the well had been relined (Appendix F).
- The well was explosively perforated in two successive runs over two depth intervals, 1015.5 m to 1018.5 m and 440.5 m to 443.5 m.
- Drill rods were run to 600 m (maximum available on site) and 3430 L of grout was pumped through the rods.
- After allowing for setting time when running the rods back to surface an obstruction was encountered at 273 m. A piece of FRP casing was subsequently found inside the drill rods. This indicates the FRP casing had probably degraded in parts down the hole.
- The top of grout was tagged at 489 m, indicating the cement plug spans the interval from 489 m to approximately 683 m. This means the lower perforated interval was not cemented due to the lack of rods on site.
The next stage of grout was done in two stages:
  \begin{itemize}
    \item 1980 L of 1.67 S.G. grout was placed from 364 m to approximately 476 m.
    \item 1980 L of 1.67 S.G. grout was placed from 364 m.
  \end{itemize}

After allowing for setting time grout was tagged at 78 m. A tremie pipe was then used to cement the well to surface.

Perforation and cementing reports are included in Appendix G.
4. Conclusions and Recommendations

4.1. Conclusions

Mulka Bore No. 2 was successfully drilled and constructed and is producing at 33 L/s. The old Mulka Bore was decommissioned successfully.

A cement bond log was successfully used to determine a missing section of grout from 67 to 187 m. This presents a risk to the long-term integrity of the production casing.

4.2. Recommendations

Cement bond log surveys that have been undertaken by DEWNR on a number of wells drilled in the Great Artesian Basin over the past two years have indicated that casing is not always being correctly grouted, with grout rarely returning to surface as required. This results in missing sections of grout in the annulus, which can result in casing being exposed to shallow formation fluids and being subject to a higher risk of corrosion than if the annulus were grouted.

In order to improve the outcome of cementing jobs, we recommend that:

- Two or more tremie lines be pre-installed on the production casing to depths of 100 m and 200 m (for example) to enable deeper placement of cement during top-up jobs, if required.
- The drilling or cementing contractor be aware of the fracture pressure of formations that have been drilled through and take steps to ensure mud and cement grout weights are suitable for these conditions.
- Depending on formation types and drilling conditions, consideration should also be given to increasing the volume of grout pumped as a percentage of calculated annular volume, for example up to 100% additional volume of grout. Materials should be on site to allow for this possibility.
Figure 11. Decommissioning of Mulka Bore
References


Appendices

A. Mulka Bore No. 2 Construction

This appendix contains:

- Drillers Well Construction Schedule 8 Report (1 page)
- Mulka Bore basic mud program (drilling fluids) (5 pages)
- Manufacturer data sheets for drill bits used (2 pages)
**DEWNR Technical note 2016/27**

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**GOVERNMENT OF SOUTH AUSTRALIA**  
**DRILLERS WELL CONSTRUCTION REPORT**  
**Natural Resource Management Act 2004**

**NAME OF DRILLER:** John L. Cliff  
**License No:** 218562

**CENTERS Phone:** 08 8471 750 800

**Date of Survey:** 28-04-2016  
**Surveyed by:** H. B.  
**Method:** GPS

**GPS COORDINATES AND DATUM USED:**  
**AGD 66/84:**  
**ZONE 52:** Q  
**ZONE 53:** Z  
**ZONE 54:** Q

---

**WELL NAME:** Mulka Bone Bore  
**REDEEMER**

**PERMIT NO:** 258255  
**Location:** Site

**PERMIT HOLDER or land occupier:** SHILLIGAN P.L.

**Postal Address:** MT. NEIL, P.O. BOX 1, SHILLIGAN.

**وعد ★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★★
MULKA BORE BASIC MUD PROGRAM (DRILLING FLUIDS)

- Top Section (Conductor Casing to 12mtrs)

Spud Mud  Liquipol @ 2 - 2.5kgs /1000

Using one (25,000 ltr) sump plus hole volume (1,200 ltrs) – rounded up Circulating Volume 26,000 ltrs

Liquipol required @ 2.5kgs/1000  65kgs (3 x 25kg Cubes)

- 12¼" Section to 600mtrs

Introduction of KCL @ 5% (50kgs/1000) to inhibit Bulldog Shale and Xanbore @ 1 -1.5kgs/1000 for hole cleaning purposes.

To be introduced across both 25,000 ltr sumps plus hole volume.

Sumps 50,000 ltrs plus hole volume 46,000 ltrs plus 20% dilution factor

Total volume to be conditioned 115,000 ltrs

KCL required @ 5% (50kgs/1000)  5,750kgs
Xanbore required @ 1.5kgs/1000  172kgs

At the end of this section the hole should be flushed as much as possible to evacuate as many cuttings as possible as the fluid in the hole will be utilised for the 8¼" section.

Once this section is completed the intial two sumps should be abandoned and two new sumps utilised.

- 8¼" Section to 900mtrs

Given that we will be utilising the fluid occupying the 12¼" hole for this section the amount of fluid to be conditioned will be 2 x 25,000 ltr sumps plus the extended hole volume (8¼" from 600 to 900mtrs).
Volume to be conditioned 50,000 ltrs (sumps) plus 12,000 ltrs hole volume plus 20% dilution rate = total volume of 75,500 ltrs.

KCL required @ 5% (50kgs/1000) 3,775kgs
Xanbore required @ 1.5kgs/1000 114kgs

Please note that additional Xanbore may be required to gain your desired viscosity.

- 6" Section to TD (1000mtrs)

Fluid from the second bank of sumps can remain in use as the Bulldog shale is still evident through this section.

An extra 2,000 ltrs of fluid plus a dilution factor of 20% will need to be conditioned to allow for the extended hole volume.

Extra fluid to be conditioned – 2,500 ltrs (Rounded up)

KCL required @ 5% (50kgs/1000) 125kgs
Xanbore required @ 1.5kgs/1000 3kgs

It is within this section that we encounter the pressurised Artesian Aquifer. The aquifer is pressurised at 150 PSI with the top of Aquifer being at 940mtrs.

Taking this into consideration our fluid needs to be weighted up to subdue the pressure. The fluid needs to be weighted approximately 20mtrs prior to intersection, and given the depth to top of aquifer and the PSI reading the fluid (which will be currently weighted at 1.065SG due to solids and KCL addition) will need to be weighted up to 1.132SG.

To enable this weight to be achieved Baryte was added at 99kgs/1000 ltrs. Extra addition of Xanbore will be required to enable the Baryte to stay in suspension.

The circulating volume to be weighted is as follows

<table>
<thead>
<tr>
<th>Sump Volume</th>
<th>50,000 ltrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hole volume (6&quot; to 1000mtrs)</td>
<td>18,750 ltrs</td>
</tr>
<tr>
<td>Total circulating volume</td>
<td>69,000 ltrs (rounded up)</td>
</tr>
<tr>
<td>Baryte required @ 99kgs/1000</td>
<td>6,831kgs</td>
</tr>
</tbody>
</table>
**Description**

LIQUI-POL is a liquid anionic polymer viscosifier with high molecular weight providing rapid viscosity without the problems associated with mixing, as is the case with most powdered polymers. It provides a complete drilling fluid system and mixes very rapidly in fresh or brackish water.

**Application**

LIQUI-POL can be used in diamond drilling or water well drilling:

- Produces rapid viscosity.
- Very cost effective - low concentration required.
- Reduces rod chatter and torque - increases core recovery.
- Inhibits water sensitive formations - improves borehole stability.

**Diamond Drilling Recommended Treatment**

Add 0.75 - 1.25 litres / 1,000 litres water for complete drilling fluid. Add 0.5 - 0.75 litres / 1,000 litres to stop rod vibration and reduce torque.

**Water Well Drilling Advantages**

- The polymer can be easily and economically broken down for the development of water wells after setting screens.
- Controls sticky clays and inhibits water sensitive, swelling formations.
- Promotes effective settling of drilling solids in surface pits.
- Cost effective and economical to transport.

**Water Well Drilling Recommended Treatment**

Add 1.0 - 1.5 litres / 1,000 litres for complete water well drilling fluid.

**Packaging**

25 kg plastic pail.
20 kg box.

*Several factors will dictate the most appropriate concentration rate. Please contact your nearest AMC representative for the best results.*

**With more than 20 years experience, AMC has enjoyed a successful history of supplying specialist drilling products to the mineral, oil & gas, water well, horizontal directional drilling, civil and tunnelling industries world wide. The success of AMC is due to its quality products and the dedication of its skilled team who offer on site support where and when customers need it.**

amc@imdexlimited.com    www.amcmud.com

**AMC Africa**  
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**AMC Asia Pacific**  
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**AMC Europe**  
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**AMC North America**  
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**AMC South America**  
T +56 (2) 589 9300
**Description**

XAN-BORE is a premium quality biopolymer powder designed to provide maximum solids suspension and hole cleaning in vertical and highly deviated wells as well as horizontal directional drilling applications. XAN-BORE is a distinctive product, able to produce a thixotropic shear thinning fluid. XAN-BORE also acts as a very effective mud filtrate viscosifier.

**Application**

XAN-BORE can be added to a pre-hydrated bentonite based fluid or can be used as a single viscosifying additive in fresh, brackish or saturated salt water.

XAN-BORE fluids are highly shear thinning which improves bit cleaning and ROP significantly. The fluid will revert to higher viscosities at low shear rates. This unique property provides many benefits in highly deviated wells and in HDD bores by providing excellent carrying capacity of coarse cuttings, sand and gravel.

In HDD drilling improved hole cleaning and cuttings transport allows for quicker and easier back reams and pull backs on longer bores.

In CBM drilling XAN-BORE’s highly thixotropic mud filtrate limits damage to coal seams and cleats.

**Advantages**

- Highly effective in low concentrations
- Mixes easily in all water types
- Maximises hole cleaning and suspension properties
- Improves lifting capacity with the only a small effect on ECD
- Improved hydraulics
- Stabilizes unconsolidated formations
- Prevents surging and swabbing
- Provides excellent lubricity
- Biodegradable and non toxic.

**Typical Properties**

Appearance: Cream coloured powder

pH (1% solution): 6.0 – 8.0

Specific gravity: 0.65

**Recommended Treatment**

Add 1 – 3 kg per 1000 litres of water through a mud hopper or a high shear mixer.

**Packaging**

5 kg plastic pail.

25 kg paper sack.
POTASSIUM CHLORIDE (KCI)
CLAY AND SHALE STABILISER /WEIGHTING AGENT

Description
POTASSIUM CHLORIDE (KCI) is a soluble salt that is an extremely efficient shale stabilizer when drilling hydro sensitive clays and shales. Inhibition is produced through exchange; the potassium ion enters between the individual clay platelets in the shale so that they are held together, thus eliminating entry of water from the drilling fluid.

Application
POTASSIUM CHLORIDE (KCI) can be added directly to a drilling fluid system to enhance its inhibitive quality, and can be used as a weighting agent ranging in densities from 1.005 S.G. (8.4 ppg) to 1.162 S.G. (9.7 ppg). POTASSIUM CHLORIDE (KCI) solution becomes saturated near 1.162 S.G. (9.7 ppg); the closer to saturation the less soluble the salt becomes.

Advantages
• Inexpensive and easily obtainable
• Benefits achieved at low concentrations
• Compatible with most drilling fluid additives
• Stabilizes water sensitive clays and shales
• Prevents issues resulting for shale instability
• Fast dissolving

Typical Properties
Physical appearance: White crystals or powder
pH Saturated aq. sl @ 15°C: 7.0
Solubility: 28.1g/100g of water @ 0°C
34.2g/100g of water @ 20°C
37.2g/100g of water @ 40°C
Purity: 95% min

Recommended Treatment
Normal use: 3.0 % (30 kg) – 8.0 % (80 kg) by volume (per 1000 litres).

Polymer such as EZEE-TROL, AUS-TROL, EZEE-PAC R & L, PACs CR-650 and LIQUI-POL can all be used in conjunction with POTASSIUM CHLORIDE (KCI). It is recommended the water be pre-treated and polymers mixed before adding POTASSIUM CHLORIDE (KCI).

NOTE: Environmental Sensitivities may exclude the use of POTASSIUM CHLORIDE (KCI) in certain areas, please contact your local AMC Representative to discuss alternatives.

Packaging
25 kg polypropylene sack.

Several factors will dictate the most appropriate concentration rate. Please contact your nearest AMC representative for the best results.

With more than 20 years experience, AMC has enjoyed a successful history of supplying specialist drilling products to the mineral, oil & gas, water well, horizontal directional drilling, civil and tunneling industries world wide. The success of AMC is due to its quality products, and the dedication of its skilled team who offer on site support where and when customers need it.

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DEWNR Technical note 2016/27 25
17 ½" (444.5 mm) IADC: S223 MD619HDXS

Product Specifications

<table>
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<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Type</td>
<td>Steel</td>
</tr>
<tr>
<td>Profile</td>
<td>Medium Parabolic</td>
</tr>
<tr>
<td>Cutter Size</td>
<td>19 mm / 13 mm</td>
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<tr>
<td>Total Cutter Count</td>
<td>78</td>
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<tr>
<td>Cutter Backup</td>
<td>Shock Studs</td>
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<tr>
<td>Blade Count</td>
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<td>Number of Ports</td>
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<td>Number of Nozzles</td>
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<tr>
<td>API Pin Connection</td>
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<td>Gage Length</td>
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<td>Gage Protection</td>
<td>T2A / PDC</td>
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<td>Blade Profile</td>
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Operating Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary Speed</td>
<td>Suitable for Rotary and PDM</td>
</tr>
<tr>
<td>Max Weight on Bit</td>
<td>62 klbs (28 t)</td>
</tr>
<tr>
<td>Flow Rate, Min - Max</td>
<td>600 - 1,300 gpm (2,270 - 4,920 l/min)</td>
</tr>
<tr>
<td>Max TFA</td>
<td>3.341</td>
</tr>
<tr>
<td>Make-Up Torque</td>
<td>64,800 - 66,200 ft-lb</td>
</tr>
</tbody>
</table>

Technical data and pictures for information only. Please contact us for recommendations for your individual well.
Sniper

These economical steel bodied bits are designed for sandstone and shale. These bits are specifically constructed to withstand higher impact force and are loaded with higher abrasion resistant cutters than competitors. Sniper bits can be designed with flushing holes or open center and include various blade and cutter size configuration options.

<table>
<thead>
<tr>
<th>BIT SIZE</th>
<th>BLADE COUNT</th>
<th>CUTTER SIZE</th>
<th>PIN SIZE</th>
<th>BODY</th>
<th>HYDRAULICS</th>
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</thead>
<tbody>
<tr>
<td>3 3/4&quot; - 3 7/8&quot;</td>
<td>3</td>
<td>1304</td>
<td>2 3/8&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>4&quot; - 4 1/2&quot;</td>
<td>4</td>
<td>1304/1308</td>
<td>2 7/8&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
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<td>4, 5</td>
<td>1308</td>
<td>2 7/8&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
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<tr>
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<td>1308/1613</td>
<td>2 7/8&quot; REG</td>
<td>Steel</td>
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<tr>
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<td>1308/1613</td>
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<td>4, 5</td>
<td>1308/1613</td>
<td>3 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>6&quot;</td>
<td>4, 5</td>
<td>1308/1613</td>
<td>3 1/2&quot; REG</td>
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<td>Flushing Holes/Open Center</td>
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<tr>
<td>6 1/2&quot;</td>
<td>4, 5</td>
<td>1308/1613</td>
<td>3 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>6 3/4&quot;</td>
<td>6</td>
<td>1613</td>
<td>3 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>7&quot;</td>
<td>6</td>
<td>1613</td>
<td>3 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>7 1/2&quot;</td>
<td>6</td>
<td>1613</td>
<td>3 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>7 1/2&quot;</td>
<td>6</td>
<td>1613</td>
<td>3 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>7 3/4&quot;</td>
<td>6</td>
<td>1613</td>
<td>4 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>8 1/2&quot;</td>
<td>5</td>
<td>1613</td>
<td>4 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>8 1/2&quot;</td>
<td>5</td>
<td>1613</td>
<td>4 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>8 3/4&quot;</td>
<td>6</td>
<td>1613</td>
<td>4 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>8 3/4&quot;</td>
<td>6</td>
<td>1613</td>
<td>4 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>9 7/8&quot;</td>
<td>5</td>
<td>1613</td>
<td>4 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>9 7/8&quot;</td>
<td>6</td>
<td>1613</td>
<td>4 1/2&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>11&quot;</td>
<td>5</td>
<td>1613</td>
<td>6 5/8&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
<tr>
<td>12 1/4&quot;</td>
<td>5</td>
<td>1613</td>
<td>6 5/8&quot; REG</td>
<td>Steel</td>
<td>Flushing Holes/Open Center</td>
</tr>
</tbody>
</table>

Call for Details

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B. Mulka Bore No. 2 Cementing reports

This appendix contains contractor reports with details of the different stages of cementing conducted at Mulka Bore No. 2:

- Artesian Control Casing Cementing Report (1 page, 11 April 2016, SCD)
- Production Casing Cementing Report (1 page, 17 April 2016, SCD)
- Annulus Grout Top Up Confirmation (1 page, SCD)
- Wellpro Cement Job Report (3 pages, 17 April 2016, Wellpro)
Control Casing Cementing Report

Mulka Bore Redrill - Mulka Station S.A.

Permit No. 258255

Date: 11-04-2016
Diameter of hole: 311.15 mm
Depth of hole: 106 m
Casing dimensions: 244.4 mm O.D. x 9.65 mm Wall, API 5L x42.
Casing shoe: Seated 2m above bottom at 104.07m
Centralised: Yes. Steel bow spring centralisers.
Type of grouting: Displacement cementing
Method of grouting: Displaced down the centre by a drillable plug by drilling mud through drillable casing shoe.
Grout makeup: 4387 L of 1.66 S.G. Grout comprising,
225 Sacks of cement (20kg).
2955 L cooled water from existing bore.
Distance grouted: Shoe to surface.
Return Observed: Yes.
Mixing time: 2 hours 40 mins
Pumping time: 15 mins. (00:45hrs)
Displacement Time: 15 mins. (01:00hrs)
Top Up: Yes. 11-04-2016, 20L.
Licensed Driller: John Laurence Dixon Lic.No. 218562
2nd Lic. Driller: Hamish Beach Lic. No. T.B.A.
Signed: Date: 12-04-2016

Date: 12-04-2016
Production Casing Cementing Report

Mulka Bore Redrill - Mulka Station S.A.

Permit No. 259255

Date: 17/04/2016

Depth of hole: 1086 m x (222.25 mm hole below control casing)

Casing dimensions: 177.8 mm O.D. x 163mm I.D. to 226.6 mm I.D. x 104.07 m control casing.

Casing shoe: Seated above the bottom at 1081.83 m B.G.L. Cement Head to shoe 1084.63m.

Centralised: Yes. Steel bowspring centralisers.

Type of grouting: Inter-casing.

Method of grouting: Displacement through a drillable float shoe.

Contractor: Wellpro - Roma Qld.

Grout makeup: 26235 L of 1.69 S.G. Grout. (See also Wellpro report)

26866 Kg of cement. (Calculated)

17731 L water, from existing Pandi Pandi bore.

0.82% BWOC FR-3 Retarder. 4% Bentonite etc. (See Wellpro cement job report.)

Distance to grout: Shoe to surface.

Displacement: 22578 L pumped.

Return Observed: No. Returns ceased during final displacement pumping.

Pre-flush Pumped: 1590 L of water. 16 mins.

Mixing time and Pumping Time: 56 mins.

Displacement time: 54 mins. (22578 L)

Cement Bond Log: Indicates grout top at 180 m BGL 33 hours after lock in. Confirmed 19-04-2016.


Final Top Up:

Licensed Driller: John Laurence Dixon Lic.No. 218562

2nd Lic. Driller: Hamish Beach Lic. No. T.B.A.

Signed: 21/4/16

Date: 21/4/16
Mulka Bore Redrill

Annulus Grout Top-Up Confirmation

Production to Control Casings Annulus

Data:

Control Casing I.D. 226.6 mm.

Depth of Control Casing. 104.07 m

Production Casing O.D. 177.8 mm

Depth of Calculation. 104.07 m to 180 m B.G.L.

Volume of Water Spacer. 10 bbl. or 1590 L.

Calculation:

@SUM((226.6-177.8)*(226.6+177.8)*0.0007854)*(180-104.07))

= 15.5 L/m * 75.93m = 1177 L

Length of Fresh water Spacer within the annulus = 1590 L / 15.5 L/m = 102.58 m.

Determination:

The fresh water spacer location, at final cement set following placement by Wellpro, is calculated as being from the top of the cement grout, which was located by the cement bond log at 180 m, to (180 - 102.58m) 77.42 m B.G.L.

Observations:

At commencement of the placement of the top-up grout, via tramie to the annulus, the first return to surface was observed to be clean water, and this continued as the only discharged fluid prior to the return to surface of the excess grout.

Signed: [Signature]

Lic. Class 3 Driller # 218562
CEMENT JOB REPORT

Customer: Silver city Drilling
Date: 17-4-2016
PO#: 
Service Supplied: P&A

Lease & Well No. Mulka Bore
Location: Mulka Station (South Australia)
Field Ticket No. 

Materials Furnished by WellPro
100% Class A Cement
0.2% Defoamer 7011D,
4% Bentonite,
0.275% Dispersant NC-S-1,
0.92% Retarder FR-3

Slurry WGT PPG 14.1 ppg
Slurry YLD L/SK 43.88
Water L/SK 29.5
Pump Time HR:MIN 165
BBL Slurry 92.5
BBL Water Mix 165

Available mix water (bbl): 140bbl
Available Displ. Fluid (bbl): 140bbl
Total: 280bbl

<table>
<thead>
<tr>
<th>Stage</th>
<th>Hole</th>
<th>Mix Water</th>
<th>Displacement Fluid</th>
<th>Well Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>% Excess</td>
<td>Depth</td>
<td>Size</td>
<td>% Excess</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>1084m</td>
<td>water 8.4</td>
<td></td>
</tr>
</tbody>
</table>

Pre cement jobs:
- PSV set and tested: Yes
- Lines and equipment Pressure tested: Yes
- Previous Cement plug pressure tested: N/A

Tools run, eg stingers, mule shoe, bit ect:
- Cement head, 7 inch casing

Explanation, Trouble setting Tool, pipe stuck ect

Total barrels pumped:
- Pre flush 10bbl
- Cement Slurry 165bbl
- Displacement 142bbl
- Wash up 21bbl

Post cement jobs:
- Cement to surface: No
- Cement squeeze conducted: N/A
- Cement weight at surface: N/A

Wellpro Rep:
Name: Jason Burns
Signature: [Signature]
Date: 17-4-16

Operating Company Rep:
Name: [Signature]
Date: 17-4-2016
# CEMENT JOB REPORT

<table>
<thead>
<tr>
<th>Time</th>
<th>Pressure - PSI</th>
<th>Rate BPM</th>
<th>Fluid Pumped (bbl)</th>
<th>Fluid Type</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>19:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19:15</td>
<td>2.5</td>
<td>10</td>
<td>water</td>
<td></td>
<td>TBM with all crew</td>
</tr>
<tr>
<td>19:30</td>
<td>4</td>
<td>165</td>
<td>slurry</td>
<td></td>
<td>Pump water spacer.</td>
</tr>
<tr>
<td>20:30</td>
<td>600</td>
<td>3</td>
<td>142</td>
<td>water</td>
<td>Start mixing and pumping 14.1ppg cement slurry</td>
</tr>
<tr>
<td>21:30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Displace with water. No cement seen at surface water flow out blooe line slowed down at 120bbl displacement.</td>
</tr>
<tr>
<td>21:45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Shut down pump shut in cement head and hold pressure on casing.</td>
</tr>
</tbody>
</table>

Wellspro Rep:  
Name: Jason Burns  
Operating Company Rep:  
Name: Jeremy  
Signature:  
Date: 4-17-18
## Wellpro Job Pump Sheet

**Date:** 17/05/2016

**Client:** Silver City Mining

**Well:** Meta

**Job Description:** 7" Production casing cement job

**Cement Required:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Sacks</th>
<th>Kilograms</th>
<th>Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>cement</td>
<td>581.00</td>
<td>250.00</td>
<td>0.09</td>
</tr>
<tr>
<td>retarder</td>
<td>50.1</td>
<td>28.1</td>
<td>0.03</td>
</tr>
<tr>
<td>dispersant</td>
<td>58.8</td>
<td>33.4</td>
<td>0.03</td>
</tr>
<tr>
<td>total</td>
<td>699.9</td>
<td>311.5</td>
<td>0.15</td>
</tr>
</tbody>
</table>

**Mix Water Required:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Barrels</th>
<th>Litres</th>
<th>Cubic Metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>mix water</td>
<td>167.00</td>
<td>23373.00</td>
<td>21.37</td>
</tr>
</tbody>
</table>

**Plugs:**

<table>
<thead>
<tr>
<th>Plug</th>
<th>From</th>
<th>To</th>
<th>MPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cased Section</td>
<td>8G</td>
<td>0</td>
<td>1.24</td>
</tr>
<tr>
<td>8.75&quot; Open Hole</td>
<td>1200</td>
<td>80</td>
<td>11.69</td>
</tr>
<tr>
<td>Shoe trat</td>
<td>12</td>
<td>0</td>
<td>0.25</td>
</tr>
</tbody>
</table>

**Total:**

- **Surface - 5-5/8" section**

  - **Sacks:** 102.60
  - **Kilograms:** 29.5
  - **Bbl:** 43.2

**Name and Signature (Wellpro):**

- **Jason Biles**

**Name and Signature (OCR):**

- **Jeremy Wardle**
C. Mulka Bore No. 2 Geophysical logs

This appendix contains copies of the geophysical logs run on Mulka Bore No. 2:

- Caliper and temperature probe, run on 18 April 2016 from 69 m to 1082 m
- Cement bond probe, run on 19 April 2016 from 7 m to 1074 m.
- Caliper and temperature probe, run on 21 April 2016 from 1052 m to 1109 m.
- Cement bond probe, run on 21 April 2016 from 18 m to 313 m.
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Tm:500m</th>
<th>DEGC</th>
<th>AMP3FT E2 291-330 us</th>
<th>SECT AMPMIN E2 231-285 us</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Client:** DEWNR/Silver City Drilling  
**Location:** Mulka  
**Purpose:** Cement evaluation  
**State:** SA  
**Project:** Mulka replacement  
**Longitude/Easting:** 0270154  
**Latitude/Northing:** 6861008  
**Date:** 18/04/2016  
**Bore name:** New Mulka Bore  
**UTM zone:** 54H  
**Sample interval:** 5 cm  
**Unit no.:**  
**Depth reference:** Top of casing  
**Vehicle:** XQ8449  
**Permit no.:**  
**Depth ref. elev.:**  
**Driller depth:** 1084 m  
**Fluid level:** 0 m  
**Depth ref. above G.L.:** 3.8 m (1 m above rig floor)  
**Logged depth:** 1081 m  
**Fluid type:** Follow on water  
**Casing depth range:** 0 m - 1084 m  
**Casing type:** Steel  
**Bit size:**  
**Operator:** KI & GK  
**Witness:** J. Wardle  
**Casing I.D.:**  
**Notes:** Cement curing time ~ 16 hrs
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>T Value</th>
<th>AMP3FT E2 291-330 us</th>
<th>SECT AMPMIN E2 231-285 us</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>35</td>
<td>DEGC</td>
<td>40 30 300 2500</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Notes: Cement curing time = 33 hrs
<table>
<thead>
<tr>
<th>Depth</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>490</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>67.12</td>
</tr>
<tr>
<td>510</td>
<td>57.92</td>
</tr>
<tr>
<td>520</td>
<td>67.10</td>
</tr>
<tr>
<td>530</td>
<td>67.44</td>
</tr>
<tr>
<td>540</td>
<td>57.68</td>
</tr>
<tr>
<td>550</td>
<td>57.85</td>
</tr>
<tr>
<td>560</td>
<td>58.01</td>
</tr>
<tr>
<td>570</td>
<td>58.18</td>
</tr>
<tr>
<td>580</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The diagram appears to show seismic data with depth (in cm) on the y-axis and time (in microseconds) on the x-axis. The data includes labels for AMP3FT E2 291-330 us, SECT AMPMIN E2 231-285 us, AMP3FT E1 354-399 us, and SECT AMPMAX E2 231-265 us.
### Mulka Bore No. 2 Lithology

This appendix contains a detailed lithological log from cuttings taken while drilling Mulka Bore No. 2.

Detailed lithological log for Mulka Bore No. 2

<table>
<thead>
<tr>
<th>Sample depth (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 2</td>
<td>Sandy top soil, fine quartz sand, clear to orange, red stained, well sorted, chips of iron stones, sample tending to sandy clay at 2 m</td>
</tr>
<tr>
<td>2 12</td>
<td>Sandy clay, fine quartz sand, well rounded, clear to orange red, tending to clay at base</td>
</tr>
<tr>
<td>12 15</td>
<td>Clay, white sticky plastic clay, fine grey quartz sand, poorly sorted, sub angular to angular</td>
</tr>
<tr>
<td>15 18</td>
<td>AS ABOVE, hard sandstone band 16–17m, sandstone well sorted, fine grey, well sorted grains</td>
</tr>
<tr>
<td>18 21</td>
<td>AS ABOVE, intermittent hard sandstone bar</td>
</tr>
<tr>
<td>21 24</td>
<td>White grey clay, plastic, sandy, quartz sand as above</td>
</tr>
<tr>
<td>24 27</td>
<td>White grey clay, mottled in part, red/yellow fine-medium quartz sand, iron stone stained, interbedded hard bars of sandstone</td>
</tr>
<tr>
<td>27 30</td>
<td>AS ABOVE - interbedded hard bars of sandstone</td>
</tr>
<tr>
<td>30 33</td>
<td>Grey sticky plastic clay</td>
</tr>
<tr>
<td>33 36</td>
<td>Mottled grey yellow weak clay, angular quartz sandstone chips, interbedded hard bars of sandstone</td>
</tr>
<tr>
<td>36 39</td>
<td>Grey clayey shale-moderately stiff, yellow mottling present</td>
</tr>
<tr>
<td>39 42</td>
<td>AS ABOVE</td>
</tr>
<tr>
<td>42 45</td>
<td>AS ABOVE, mottled yellow / grey interbedded black shale</td>
</tr>
<tr>
<td>45 48</td>
<td>Green/grey shale (glauconitic), stiff, some blebs of yellow shake evident</td>
</tr>
<tr>
<td>48 69</td>
<td>AS ABOVE</td>
</tr>
<tr>
<td>69 72</td>
<td>AS ABOVE, blebs of white clay evident</td>
</tr>
<tr>
<td>72 75</td>
<td>Highly glauconitic</td>
</tr>
<tr>
<td>75 78</td>
<td>Weak salty shale, gritty sand, fine, well rounded, clear to grey/black, carbonaceous material evident</td>
</tr>
<tr>
<td>78 81</td>
<td>AS ABOVE</td>
</tr>
<tr>
<td>81 84</td>
<td>Grey/green silty shale</td>
</tr>
<tr>
<td>84 87</td>
<td>AS ABOVE, stiff shale-highly glauconitic</td>
</tr>
<tr>
<td>87 106</td>
<td>AS ABOVE</td>
</tr>
<tr>
<td>106 180</td>
<td>Grey / green shale with poorly cemented fine grained sandstone in bands and traces of lignite</td>
</tr>
<tr>
<td>180 210</td>
<td>AS ABOVE - grey /green soft shale with fine sand</td>
</tr>
<tr>
<td>210 257</td>
<td>Grey /green soft shale</td>
</tr>
<tr>
<td>257 266</td>
<td>Grey shale, very soft</td>
</tr>
<tr>
<td>266 269</td>
<td>Calcareous gray shale with fine quartz sand</td>
</tr>
<tr>
<td>269 275</td>
<td>Grey shale, some sand</td>
</tr>
<tr>
<td>275 281</td>
<td>Brown lignite and grey shale</td>
</tr>
<tr>
<td>281 323</td>
<td>Carbonaceous grey shale</td>
</tr>
<tr>
<td>323 341</td>
<td>Calcareous grey shale</td>
</tr>
<tr>
<td>341 347</td>
<td>Grey shale, some fine sand, traces of lignite</td>
</tr>
<tr>
<td>347 353</td>
<td>Calcareous grey shale</td>
</tr>
<tr>
<td>353 365</td>
<td>Grey shale with fine quartz sand</td>
</tr>
<tr>
<td>Sample depth (m)</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>365</td>
<td>371 Calcareous grey shale</td>
</tr>
<tr>
<td>371</td>
<td>395 Grey shale, carbonaceous in parts, some fine sand</td>
</tr>
<tr>
<td>395</td>
<td>401 Grey shale, some fine sand</td>
</tr>
<tr>
<td>401</td>
<td>404 Lignitic grey shale</td>
</tr>
<tr>
<td>404</td>
<td>413 Grey shale</td>
</tr>
<tr>
<td>413</td>
<td>422 Lignitic grey shale</td>
</tr>
<tr>
<td>422</td>
<td>493 Grey shale</td>
</tr>
<tr>
<td>493</td>
<td>505 Calcareous grey shale</td>
</tr>
<tr>
<td>505</td>
<td>641 Grey shale</td>
</tr>
<tr>
<td>641</td>
<td>646 Carbonaceous gray shale</td>
</tr>
<tr>
<td>646</td>
<td>652 Gray shale</td>
</tr>
<tr>
<td>652</td>
<td>661 Calcareous gray shale</td>
</tr>
<tr>
<td>661</td>
<td>741 Gray shale</td>
</tr>
<tr>
<td>741</td>
<td>747 Calcareous grey shale</td>
</tr>
<tr>
<td>747</td>
<td>800 Grey shale</td>
</tr>
<tr>
<td>800</td>
<td>860 Grey shale, much harder</td>
</tr>
<tr>
<td>860</td>
<td>947 Very hard grey shale</td>
</tr>
<tr>
<td>947</td>
<td>959 Calcareous very hard grey shale</td>
</tr>
<tr>
<td>959</td>
<td>965 Very hard grey shale</td>
</tr>
<tr>
<td>965</td>
<td>977 Grey hard shale with light grey clay</td>
</tr>
<tr>
<td>977</td>
<td>986 Hard grey and black shale with grey green clay, pieces of coal present</td>
</tr>
<tr>
<td>986</td>
<td>1014 Grey sandy grey shale, soft, sand are very fine</td>
</tr>
<tr>
<td>1014</td>
<td>1047 Pale grey very fine grained sandstone / siltstone with gray plastic clay and gray shale</td>
</tr>
<tr>
<td>1047</td>
<td>1059 Pale grey very fine grained sandstone / siltstone with coarse angular quartz sand and gray plastic clay</td>
</tr>
<tr>
<td>1059</td>
<td>1071 Coarse quartz angular sand with very fine grained sandstone and gray plastic clay (much faster drilling)</td>
</tr>
<tr>
<td>1071</td>
<td>1085 Coarse quartz angular sand with gray plastic clay</td>
</tr>
<tr>
<td>1085</td>
<td>1091 Coarse quartz angular sand</td>
</tr>
<tr>
<td>1091</td>
<td>1112 Unsorted, fine to coarse, angular quartz sand, mainly fine sand</td>
</tr>
</tbody>
</table>
E. Mulka Bore Decommissioning

This appendix contains:

- Drillers Well Construction Schedule 8 Report (1 page)
GOVERNMENT OF SOUTH AUSTRALIA
DRILLERS WELL CONSTRUCTION REPORT
Natural Resource Management Act 2004

NAME OF DRILLER: John L. Dixon
Licence No: 21652
Contact Phone: 08 8328 7622
Name of plant operator if under supervision: N/A

2. LOCATION OF WELL

Date of Survey: 22-04-2016
Surveyed by: M. C. Grant
GPS COORDINATES AND DATUM USED
GDA 94/WS84 6681087 6681087 ZONE 52 ZONE 53 ZONE 54

3. SUMMARY

Date work Commenced: 22-04-2016
Date work Completed: 25-04-2016

4. LAND IDENTIFICATION

Is this a Replacement well? YES
Is this an Existing well? NO
Is this an Existing well? NO

5. CONSTRUCTION DETAILS

Method: Cased Hole
Method: Lateral Auger
Method: Down Hole Hammers, etc.

6. WELL DETAILS

Drilling Method: Cable Tool
Drilling Tool: Rotary Auger
Down Hole: Hammer, etc.

Method: Cased Hole
Method: Lateral Auger
Method: Down Hole Hammers, etc.

7. Casing Left in Well

7.1 Dimensions

Internal Drain, (mm): 51
Internal Drain, (mm): 51
Internal Drain, (mm): 51
Internal Drain, (mm): 51

7.2 Type

7.3 Casing Cemented

8. CONSTRUCTION AT PRODUCTION LEVEL

8.1 Method

8.2 Screen or Casing (If variable aperture screens used give limits)

8.3 Liner Seal (Picker)

8.4 Gravel Packing

9. IF NOT A DRILLED WELL

9.1 Method

9.2 Development (state methods and time taken)

10. PUMPING TEST

11. SAMPLES

12. FORMATION LOG

13. DESCRIPTION OF MATERIAL

Driller to deliver this copy together with water samples collected and well location map within 14 days of completion to any of the below locations:

NAB Junkyard, Longwood, SA.

Department of Water Land and Biodiversity Conservation
Water Laboratory and Geophysical Services, 23 Curington Terrace GLENELDIE SA 5065 or Mount Gambier Regional Office, 11 Helen Street MOUNT GAMBIER SA 5290 or Naracoorte Regional Office, 101 Cedar Avenue, NARACOORTE SA 5271

UNIT NUMBER

DEWNR Technical note 2016/27
F. Mulka Bore Decommissioning Geophysical Logs

This appendix contains:

- Geophysical logs run on 22 April 2016 including caliper, gamma, casing collar locator (CCL), and temperature, from 0 m to 1051 m.
- Cement bond survey run on 22 April 2016 in the relined FRP section of the bore, from 6 m to 304 m.
**Client:** DEWNR (Silver City Drilling)  
**Location:** Mulka  
**Purpose:** Casing condition  
**Project:** Longevity/Easting: 270193  
**Date:** 22/04/2016  
**Bore name:** Mulka Bore  
**UTM zone:** 54J  
**Fluid level:** 76 m  
**Unit no.:** 6641-6  
**Permit no.:** Depth ref. elev.:  
**Fluid type:** Mud  
**Casing type:**  
**Witness:** Notes:  
**Depth reference:** GL  
**Depth:**  
<table>
<thead>
<tr>
<th>Depth</th>
<th>T</th>
<th>AMP5FT FRP E1 228-252 us</th>
<th>AMP5FT FRP E1 372-394 us</th>
<th>AMPMIN FRP E1 148-172 us</th>
<th>AMPMAX FRP E1 148-172 us</th>
<th>STL E1 316-340 us</th>
<th>STL E1 118-148 us</th>
</tr>
</thead>
<tbody>
<tr>
<td>1m:500m</td>
<td>35</td>
<td>DEGC</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**State:** SA  
**Latitude/Northing:** 6861086  
**Job number:**  
**Vehicle:** XQB449  
**Sample interval:** 5 cm  
**Driller depth:** 1050 m  
**Logged depth:** 1052.7 m  
**Bit size:** 80 mm / 150 mm  
**Casing I.D.:** 80 mm reline + FRP 0-283 m + STL 283-309 m. 150 mm to 1051 m  

---

**Client:** DEWNR Technical note 2016/27
G. Mulka Bore Decommissioning Perforation and Cementing

This appendix contains:

- Decommissioning cementing report (1 page, SCD)
- Mulka Bore Squeeze Perforations report (2 pages, Owen Oil Tools)
Mulka Bore 6641-6

Decommissioning Cementing

22-04-2016

Drilling mud from the construction of the adjacent replacement bore was pumped slowly to the bore via a temporary borehead to a final volume of 9295 L to a calculated 810 m minimum depth, which killed the bore.

Logging commenced and continued to 21:30.

23-04-2016

The bore casing was perforated with the assistance of the DEWNR logging equipment, from 1015.5m - 1018.5m and from 440.5m - 443.5m.

Drill stem (70mm O.D. x 60mm I.D.) was run into the bore to 600 m.

3500 kg (7 x bulker sacks) of cement was mixed in to 2310 L of water in 5 x 1m3 pod tanks, to make 3430 L of grout, which was pumped down the drill string and partially displaced from the string with 600 L of clean water, the drill string was then withdrawn 100m and flushed, then completely withdrawn from the bore. ROH to surface. W.O.C.

The 3430 L of averaged S.G. 1.66 grout, mixed in 90 minutes, was placed via the bean pump through the rods to the bore at 600m, in 30 minutes, displaced and completed at 18:00 hours.

24-04-2016

Sounding for the grout top found an obstruction at 273 m. - dislodged. Piece of FRP Casing found in rods.

RH injection / tagging tool on end of rods. Tagged grout plug at 489 m.

Mixed in 30 minutes and pumped in 15 minutes, 1980 L of averaged S.G. 1.67 grout from 470 to about 364 m. Displaced with clean water.

Pulled rods back to 364 m, mix time now 1 hour, and placed time now 30 mins, 1980 L of averaged S.G. 1.67 grout from 364 m to surface.

ROH to surface. W.O.C.

25-04-2016 ANZAC Day.

Tagged grout at 78 m.

Filled bore to surface via a tremmie pipe, with 1.65 S.G. Grout.

Mulka Bore Squeeze Perforations
Run #1

<table>
<thead>
<tr>
<th>Charge Specifications</th>
<th>Company</th>
<th>Ticket Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDP-2125-402NT3</td>
<td>DEWNR</td>
<td>SNAWR# 240416_PERF</td>
</tr>
<tr>
<td>RTG-2125-3023H</td>
<td>Rig</td>
<td></td>
</tr>
<tr>
<td>Region</td>
<td>South Australia</td>
<td>23-Apr-16</td>
</tr>
<tr>
<td>Rig Rep</td>
<td>Silver City SC004</td>
<td>Jeremy Wriddle</td>
</tr>
<tr>
<td>Penetration</td>
<td>South Australia</td>
<td>Glen Kleinschmidt</td>
</tr>
<tr>
<td>Well</td>
<td>Owen Rep</td>
<td>Matt Truscott</td>
</tr>
<tr>
<td>Entry Hole</td>
<td>#1</td>
<td>Australia</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Internal String</th>
<th>External String</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schematic</td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>Cable Head</td>
</tr>
<tr>
<td></td>
<td>Detonator Sub</td>
</tr>
<tr>
<td></td>
<td>Top Sub</td>
</tr>
<tr>
<td></td>
<td><strong>TOP CHARGE AT</strong></td>
</tr>
<tr>
<td></td>
<td>11ft 2 1 25&quot; Perf Gun</td>
</tr>
<tr>
<td></td>
<td>60 Shots</td>
</tr>
<tr>
<td></td>
<td><strong>BOTTOM CHARGE AT</strong></td>
</tr>
<tr>
<td></td>
<td>Bottom of Gun</td>
</tr>
<tr>
<td></td>
<td>Bottom Nose</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL CHARGE AT</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tubing Size</th>
<th>Weight</th>
<th>Grade</th>
<th>I.D</th>
<th>Drift</th>
<th>Restriction</th>
<th>Depth</th>
<th>Max. Dev.</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>153mm</td>
<td>N/A</td>
<td>153mm</td>
<td>80mm</td>
<td>0 - 280m</td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Casing Size</th>
<th>Weight</th>
<th>Grade</th>
<th>I.D</th>
<th>Drift</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>203mm</td>
<td>N/A</td>
<td>203</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Fluid Type</th>
<th>Weight</th>
<th>B.H.T</th>
<th>Firing Head Type</th>
<th>Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kill Mud</td>
<td>9.6 ppg</td>
<td>N/A</td>
<td>Electric</td>
<td>3/16&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tool String Length</th>
<th>Distance from Top Shot to Bottom Shot</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,258 m</td>
<td>3.00M</td>
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</tbody>
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COMMMENTS: PERFORATIONS SHOT IN BULLDOG SHALE AT 1018.5M - 1018.5M
# Mulka Bore Squeeze Perforations

## Run #2

<table>
<thead>
<tr>
<th>Charge Specifications</th>
<th>Company</th>
<th>Ticket Number</th>
<th>SDP-2125-402NT3</th>
<th>DEWNR</th>
<th>SNAWR# 240416_PERF</th>
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</thead>
<tbody>
<tr>
<td>Charge P/N</td>
<td>Region</td>
<td>Date</td>
<td>Region</td>
<td>South Australia</td>
<td>23-Apr-16</td>
</tr>
<tr>
<td>Charged Shocks</td>
<td>Rig</td>
<td>Rig Rep</td>
<td>Rig Rep</td>
<td>Silver City SC004</td>
<td>Glen Kleinschmidt</td>
</tr>
<tr>
<td>Loaded Shocks</td>
<td>Area</td>
<td>District</td>
<td>Area</td>
<td>South Australia</td>
<td>Australia</td>
</tr>
<tr>
<td>Penetration</td>
<td>Well</td>
<td>Owen Rep</td>
<td>Penetration</td>
<td>Mulka Bore</td>
<td>Matt Truscott</td>
</tr>
<tr>
<td>Entry Hole</td>
<td>No.</td>
<td></td>
<td>Entry Hole</td>
<td>0.18&quot; &amp; 0.34&quot;</td>
<td>#1</td>
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### Internal String

<table>
<thead>
<tr>
<th>Schematic</th>
<th>Description</th>
<th>O.D.</th>
<th>Schematic</th>
<th>Description</th>
<th>O.D.</th>
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<tbody>
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</tr>
</tbody>
</table>

#### Key Tools
- **Cable Head**: 1.375" x 0.380 m, 439.430 m
- **Detonator Sub**: 1.687" x 0.240 m, 439.810 m
- **Top Sub**: 2.125" x 0.450 m, 440.050 m

### External String

<table>
<thead>
<tr>
<th>Schematic</th>
<th>Description</th>
<th>O.D (in)</th>
<th>Length (m)</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Top Charge At</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>440.000</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bottom Charge At</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>443.500</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11ft 2.125&quot; Perf Gun</td>
<td>2.125</td>
<td>3.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60 Shots</td>
<td></td>
<td></td>
<td></td>
</tr>
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### Tubing Size

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<tr>
<th>Tubing size</th>
<th>Weight</th>
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<th>Restriction</th>
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<td>N/A</td>
<td>163mm</td>
<td>80mm</td>
<td>0 - 280m</td>
<td>N/A</td>
<td>443.500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>203mm</td>
<td>N/A</td>
<td>203</td>
<td></td>
<td></td>
<td></td>
<td>443.638</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Casing Size

<table>
<thead>
<tr>
<th>Casing Size</th>
<th>Weight</th>
<th>Grade</th>
<th>I.D</th>
<th>Drift</th>
<th>Restriction</th>
<th>Depth</th>
<th>Max. Dev.</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>203mm</td>
<td>N/A</td>
<td>203</td>
<td></td>
<td></td>
<td></td>
<td>443.500</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Well Fluid Type

<table>
<thead>
<tr>
<th>Well Fluid Type</th>
<th>Weight</th>
<th>B.H.T.</th>
<th>Firing Head Type</th>
<th>Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kill Mud</td>
<td>9.6 ppg</td>
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<td>Electric</td>
<td>3/16&quot;</td>
</tr>
</tbody>
</table>

### Tool String Length

<table>
<thead>
<tr>
<th>Tool String Length</th>
<th>Distance from Top Shot to Bottom Shot</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.257 m</td>
<td>3.00 M</td>
</tr>
</tbody>
</table>

**Comments:** PERFORATIONS SHOT IN MACKUNDA FORMATION AT 440.5M - 443.5M