# LAKES OIL N.L.

(A.C.N. 004 247 214)
as operator for

# PETRO TECH PTY. LTD.

(A.C.N. 009 116 429)
Permit Holder

# ECHIDNA HIGH-1
## EXPLORATION WELL
## PEP 157 VICTORIA

## WELL COMPLETION REPORT

### BASIC DATA

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May 2005

**CONFIDENTIAL**

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# TABLE OF CONTENTS

# TABLE OF ATTACHMENTS

## LIST OF FIGURES



## LIST OF TABLES



## LIST OF APPENDICES



## LIST OF ENCLOSURES

1. (a) Composite well Log
   (b) Mud Log
2. Electric Logs

| | | | |
|---|---|---|---|
| Reeves: | Suite 1 | Run 1 | 0-1605m |
| | | Run 2 | 0-1605m |
| | Suite 2 | Run 1 | 0-1590m |
| | Suite 3 | Run 1 | 1599-1869m |

3. Seismic Line GCR 87A_09

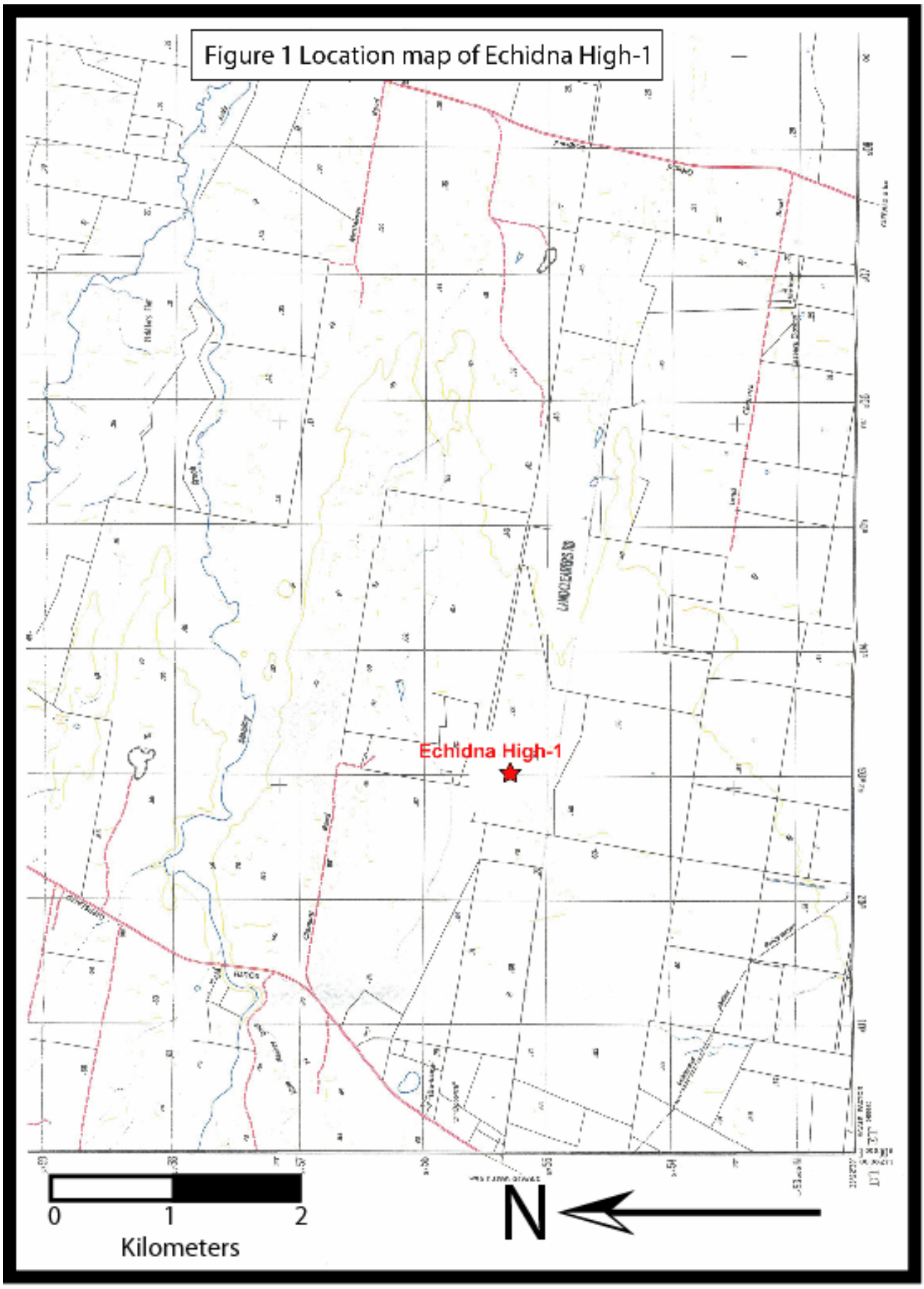
Figure 1 Location map of Echidna High-1
Echidna High-1
0
1
2
Kilometers
N

# 1.0 SUMMARY

Echidna High No. 1 well was located in PEP 157 and was designed to test the potential of a robust, seismically controlled Strzelecki Group prospect located on the northern flank of the Seaspray Depression. The well was located approximately 14km west-northwest of the township of Seaspray. Access was via approximately 800m of purpose built track adjoining Land Clearers Road (Figure 1).

The Echidna High No. 1 well was designed to definitively evaluate a seismically defined structure (Figure 2), with potential targets in the Giffard Sandstone Member of the Lakes Entrance Formation, the top and intra Latrobe Group sandstones, the sandstones within the Golden Beach Group and sandstones within the Strzelecki Group.

Echidna High No. 1 was spudded on the 26th February, 2005. 308mm hole was drilled to 275m, with 244mm casing run to 273m. 216mm hole was drilled to 1609m and 178mm casing run to 1604m. Finally, 156mm hole was drilled to 1868m (TD).

The hole was drilled with a PHPA/KCl mud system. Water was trucked to the site from the town of Sale. No gas readings were recorded in the Haunted Hills Gravels, Jemmy's Point Formation, Tambo River Formation, Gippsland Limestone or Lakes Entrance Formation. The Latrobe Group had background gas readings ranging from trace to 1 unit of gas.

Gas shows occurred over the interval of 1601-1609m, total gas readings ranging from trace- 4 units gas peak at 1590m of 4 units (C1 100%) in the very top only of a tight kaolinitic sandstone immediately below a claystone interval; 1609-1611m: total gas readings rose from 1 unit at the top to a peak of 24 units at 1609m (C1 81%, C2 12%, C3 6%, C4 1% C5+ 0). Also over the interval of 1601-1609m appears to be gas saturated with the gas contained in tight sandstone laminates within a dominantly claystone unit.

Electric logs were run Surface to 1605m (DLS-MRS-ATS-SP-GR-CAL-PDS-CNS), Surface to 1590m (WPS-ATS-CNS-CCL), and 1599m to 1868m (DLS-MLL-CSS-GR). A cased hole test was conducted over the interval 1588-1608m with no gas recorded at the surface. However, from the sonic log, it appeared that only the top of the fracture zone was tested. In addition, as soon as the gas show increased, under apparent high pressure, drilling ceased, casing was run and only after drilling to TD, was the gas in the fracture tested. The major fault may have already become blocked at this stage.

Echidna High No.1 was plugged and abandoned on the 25th of March 2005, with the possibility of re-entering the well for future fracture stimulation of tight gas sands within the Strzelecki Group.

# 2.0 WELL HISTORY

## 2.1 General Data

| | | |
|---|---|---|
| 2.1.1 | Well Name and Number | Echidna High 1 |
| 2.1.2 | Location | AMG Co-ordinates 502 999.20 E<br>5755 294.28 N<br>Latitude 38º 21’ 01.33”<br>Longitude 147º 02’ 03.57” |
| 2.1.3 | Elevations | G.L. 64.96 m A.S.L.<br>R.T. 68.46 m A.S.L. |
| 2.1.4 | Petroleum Tenement | PEP 157 |
| 2.1.5 | Name of Operator | LAKES OIL N.L.<br>Level 11, 500 Collins Street<br>Melbourne Victoria 3000 |
| 2.1.6 | Other Participants | None |
| 2.1.7 | Date Drilling Commenced | 26 February 2005 |
| 2.1.8 | Date Drilling Completed | 22 March 2005 |
| 2.1.9 | Date Rig Released | 25 March 2005 |
| 2.1.10 | Drilling Time to T.D. | 27 days |
| 2.1.11 | Total Depth | 1868m. |
| 2.1.12 | Status | Plugged and Abandoned |

## 2.2 RIG DATA

| | | |
|---|---|---|
| 2.2.1 | Drilling Contractor | Hunt Energy and Mineral Co. Australia Pty. Ltd. |
| 2.2.2 | Rig | Al Hicks Model AH-100 |
| 2.2.3 | Substructure | Box type |
| 2.2.4 | Weight Indicator | Hydraulic Pressure |
| 2.2.5 | Power | 2 engine compound |
| 2.2.6 | Rotary | Oilwell Mdl-175 |
| 2.2.7 | Blocks | Sowa Model S-150-4, 150 ton |
| 2.2.8 | Pumps | 1X Tri Service Machine TSM-500 7.5X16" Duplex<br>1X Continental Emsco DB-550 (7.5X16") Duplex |
| 2.2.9 | Mud mixing | Demco Style Hopper with 6X8 centifugal pump |
| 2.2.10 | Sump pump | Cellar Jet |
| 2.2.11 | Transfer Pump | 2X3" portable |
| 2.2.12 | Tubulars | 5.5" X 13.30lbs/ft Grade "E" D.P. |
| 2.2.13 | Fishing Tools | 1X Bowen C-5342 Overshot<br>1Xbowen C-5171 Overshot |
| 2.2.14 | Handling Tools | Elevators/Slips/Safety Clamp/Rotary Tongs/Chain Tongs |
| 2.2.15 | Stablizers | 17.5", 12.25", 8.5" , 6" |
| 2.2.16 | Spare Parts | As reasonably required to conduct operations for programmed well |
| 2.2.17 | Personnel | 13 Rig plus camp staff. |
| 2.2.18 | Drilling Hours | 24 hours with 12 hour shifts |

## 2.3 Drilling Data

The following is the daily operations summary for Echidna High No.1. It has been compiled from the daily drilling reports. Onsite drilling supervision for Lakes Oil N.L. was provided by L. DeVattimo. Further details are provided in the time/depth curve (Figure 2).

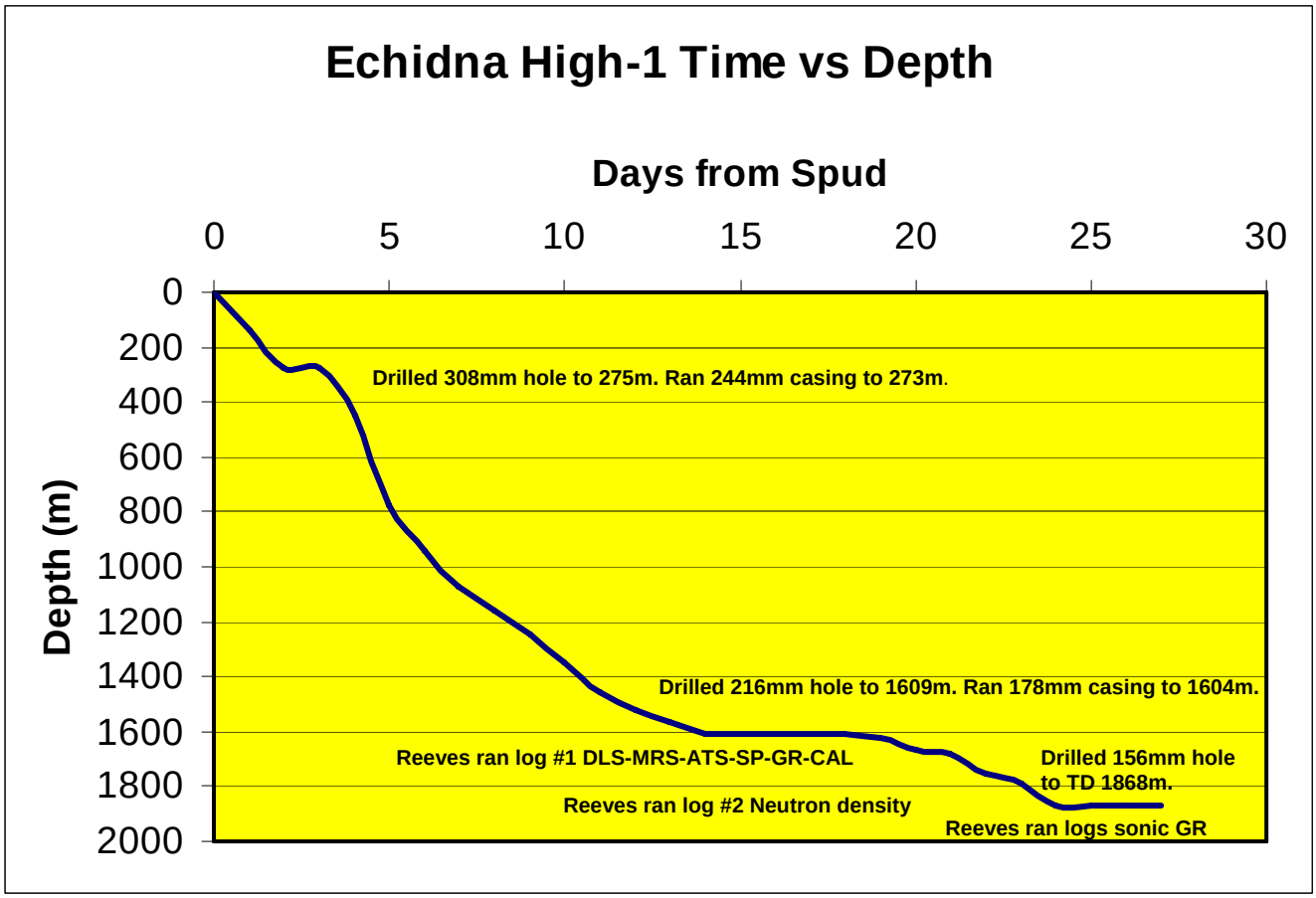


FIGURE 2 Time Vs Depth Curve of Echidna High-1.

Echidna High was spudded at 1200hrs on the 26th of February 2005. A 508mm conductor was preset at 12m prior to spud. The well was spudded with 308mm hole. 308mm hole was drilled from surface to 275m without hole problems. The hole was conditioned prior to running 244mm casing. 244mm casing was run to 273m where it was cemented. BOP's were then installed and pressure tested before the mud system was changed and drilling continued with 216mm hole. 216mm hole was drilled to 599m before a wiper trip to the shoe at 273m was conducted with no problems.

Drilling continued with 216mm hole drilled to 925m before tripping for a bit change. Tight hole was encountered on the trip back in and tight spots were reamed at 616-620m, through the Latrobe Group coals. Drilled 216mm hole to 1059 before encountering a drilling break to 1062 where the mud was conditioned and FLC-2000 added before drilling continued to 1075m before tripping out for a bit change. Drilled 216mm hole with the new bit to 1340m before wiper tripping to 1097m with no problems. Drilling continued with 216mm hole to 1494m before wiper tripping to 1300m.

Drilling continued to 1519m before tripping out for a bit change. Tight hole was encountered at 1079m on the trip out before drilling continued with the new bit to 1609 before tripping out for logging. Reeves ran Suite#1 Run#1 DLS-MRS-ATS-SP-GR-CAL (1605-surface) and Suite#1 Run#2 PDS-CNS (1605-surface) prior to circulating the hole clean for 178mm casing. Total gas readings of 475 units were

recorded on bottoms up. The BOP was pressure tested to 14000kpa after running in the 178mm casing and Reeves ran Suite#2 Run#1 WPS-ATS-CNS-CCL (1590-surface).

Tripped in hole with 156mm bit to 587m before tripping back out to clear blockage in drillpipe. Tripped back in hole to 701m before encountering a second blockage in the drillpipe. Tripped back to 677m, freed blockage in drillstring and continued running into hole. Drilled out of shoe at 1609m to 1613m before performing F.I.T. with 9.5ppg mud to 850psi. Drilled 156mm hole to 1670m before tripping for a bit change.

Tripped in hole to 380m before encountering blockage at the bit and tripping out to clear blockage. Tripped back in hole and continued drilling with 156mm hole to 1678m before pulling back to the shoe at 1609m due to mud pump failures. Fixed pumps and continued drilling 156mm hole to 1791m before tripping out for a bit change. Drilled 156mm hole with the new bit to TD at 1868m.

Reeves ran Suite#3 Run#1 DLS-MLL-CSS-GR (1868TD-shoe 1604m) before tripping in hole with Halliburton DST tools to perform a cased hole DST test, to 1420m before tripping out due to fluid invasion into the test string. Tripped back in hole with Halliburton DST tools after fixing tester valve. Set packer at 1552m and guns at 1588m to 1608m. Pressured annulus to 1300psi before firing the guns and monitoring well flow. After initial test flow showed good hydrostatic head, the pressure dropped and the tool was closed and reopened on a 2hr cycle (1hr shut, 1hr open.) DST#1 encountered no flow, closed tool at 0830hs (IF = 18.25hrs) before reverse circulating the contents of the drill string. Recovered 8 bbls of water cushion and rathole mud.

Pulled out of hole and lay out test string, before running in hole to 1604m and rigging up cement plug from 1604-1470m. Pulled back to 1400m reverse circulated and checked for any cement returns. Layed out drill pipe, removed BOP, set 10m surface cement plug and installed wellhead cap onto wellhead spool before releasing the rig at 1800 hrs 25 March, 2005.

### 2.3.1 Hole sizes and depths:

**TABLE 1**

| HOLE SIZE | INTERVAL |
|---|---|
| 308mm | Spud to 275m. |
| 216mm | 275 to 1609m. |
| 156mm | 1609 to 1868m. |

### 2.3.2 Casing and cementing:

**TABLE 2**

| TYPE | | CONDUCTOR | CASING | CASING |
|---|---|---|---|---|
| **Size** | mm | 508 | 244 | 178 |
| **Weight** | kg/m | | 69.94 | 58 |
| **Grade** | | Line pipe | | K-55 |
| **Connection** | | | NK-3SB | BTC |
| **Joints** | | 1 | 21 | 132 |
| **Length** | m | 12 | 268.35 | 1599.75 |
| **Shoe** | m | 12 from RKB | 273 | 1604 |
| **Sacks** | | | 303 | |
| **Class** | | | A | |
| **Av. Wt.** | ppg | | | |

### 2.3.3 Deviation Surveys:

**TABLE 3**

| DEPTH | DEVIATION |
|---|---|
| 50m | 0.50 degrees |
| 97m | 0.50 degrees |
| 200m | 0.75 degrees |
| 267m | 0.75 degrees |
| 399m | 0.75 degrees |
| 1340m | 1.75 degrees |
| 1604m | 1.50 degrees |

### 2.3.4 Drilling Fluid:

(A) Spud - 275 m. Type: Freshwater Gel /Starch spud mud.

(B) 275 - 1868m. KCl/PHPA mud system.

### 2.3.5 Physical Mud Properties:

**TABLE 4**

| | | | | |
|---|---|---|---|---|
| **DEPTH** | M | 137 | 275 | 275 |
| **Density** | Ppg | 9.2 | 9.4 | 8.8 |
| **Viscosity** | Sec | 40 | 42 | 45 |
| **Water Loss** | Cc | 15.0 | 15.0 | 9.5 |
| **pH** | Strip | 11.0 | 9.0 | 8.5 |
| **Filter Cake** | 32 nd | 4 | 4 | 2 |
| **PV / YP** | cp/lb/100’ | 13 / 11 | 8 / 24 | 10 / 20 |
| **Gels** | s/m | 18 / 30 | 14 / 18 / 0 | 2 / 3 / 0 |
| **Sand** | % Vol | 1.0 | 0.50 | |
| **Solids** | % Vol | | | 1.6 |
| **Oil** | % Vol | | | |
| **K+** | Mg/l | | | |
| **Chlorides** | Mg/l | | 200 | 22500 |
| **PHPA** | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **DEPTH** | M | 448 | 778 | 939 | 1075 | 1160 |
| **Density** | Ppg | 9.8 | 10.4 | 10.5 | 10.45 | 10.45 |
| **Viscosity** | Sec | 43 | 44 | 47 | 42 | 44 |
| **Plastic Viscosity** | °C | 13@20 | 20@20 | 47@20 | 45@20 | 21@20 |
| **Yield** | $100/ft^2$ | 24lbs | 30lbs | 30lbs | 29lbs | 26lbs |
| **Gels** | $100/ft^2$ | 10/14/0lbs | 10/17/0lbs | 10/14/0lbs | 6/11/0lbs | 6/8/0lbs |
| **API filtrate** | 30 min | 6.0ml | 4.5ml | 4.5ml | 4.0ml | 4.2ml |
| **Cake** | $32^{nd}$ in | 2.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **Corr solids** | % Vol | 5.9 | 8.9 | 9.3 | 8.8 | 8.8 |
| **Sand** | % Vol | 0.75 | 0.75 | 0.75 | 0.00 | 1.00 |
| **MBT** | Ppb eq | 12.00 | 12.00 | 14.00 | 11.00 | 11.00 |
| **Chlorides** | Mg/l | 26500 | 27000 | 28000 | 28500 | 28000 |
| **Hardness Ca** | Mg/l | 60 | 600 | 600 | 500 | 460 |
| **ASG** | | 3.432 | 3.417 | 3.422 | 3.496 | 3.492 |
| **KCL** | % wt | 5.5 | 5.5 | 5.7 | 5.5 | 5.6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **DEPTH** | M | 1246 | 1347 | 1456 | 1519 | 1564 |
| **Density** | Ppg | 10.45 | 10.50 | 10.50 | 10.50 | 10.55 |
| **Viscosity** | Sec | 45 | 44 | 46 | 47 | 48 |
| **Plastic Viscosity** | °C | 22@20 | 20@20 | 22@20 | 22@20 | 23@20 |
| **Yield** | $100/ft^2$ | 25 | 28 | 25 | 27 | 34 |
| **Gels** | $100/ft^2$ | 7/12/0lbs | 9/13/0lbs | 7/14/0lbs | 7/14/0lbs | 8/18/0lbs |

| | | | | | | |
|---|---|---|---|---|---|---|
| **API filtrate** | 30 min | 4.2ml | 4.2ml | 4.2ml | 4.2ml | 4.2ml |
| **Cake** | $32^{nd}$ in | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **Corr solids** | % Vol | 8.8 | 9.0 | 8.8 | 9.3 | 9.5 |
| **Sand** | % Vol | 1.00 | 0.80 | 0.80 | 0.80 | 0.80 |
| **MBT** | Ppb eq | 10.00 | 6.00 | 6.00 | 6.00 | 8.00 |
| **Chlorides** | Mg/l | 28500 | 26000 | 28000 | 28500 | 26000 |
| **Hardness Ca** | Mg/l | 440 | 440 | 420 | 360 | 360 |
| **ASG** | | 3.496 | 3.543 | 3.560 | 3.425 | 3.471 |
| **KCL** | % wt | 5.5 | 5.0 | 5.5 | 5.5 | 5.20 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **DEPTH** | M | 1609 | 1620 | 1670 | 1680 | 1750 |
| **Density** | ppg | 10.5 | 9.55 | 9.55 | 9.55 | 9.50 |
| **Viscosity** | Sec | 48 | 40 | 41 | 39 | 43 |
| **Plastic Viscosity** | °C | 24@20 | 13@20 | 15@20 | 14@20 | 16@20 |
| **Yield** | $100/ft^2$ | 28 | 15 | 15 | 13 | 20 |
| **Gels** | $100/ft^2$ | 5/15/0lbs | 3/6/0lbs | 3/6/0lbs | 5/12/0lbs | 4/6/0lbs |
| **API filtrate** | 30 min | 4.2ml | 5.2ml | 6.0ml | 6.1ml | 6.3ml |
| **Cake** | $32^{nd}$ in | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| **Corr solids** | % Vol | 9.3 | 5.4 | 5.1 | 5.2 | 5.2 |
| **Sand** | % Vol | 0.80 | 0.10 | 0.10 | 0.20 | 0.10 |
| **MBT** | Ppb eq | 8.00 | 5.00 | 5.00 | 5.00 | 6.00 |
| **Chlorides** | Mg/l | 29000 | 26500 | 29500 | 29500 | 28500 |
| **Hardness Ca** | Mg/l | 400 | 40 | 40 | 40 | 40 |
| **ASG** | | 3.429 | 3.102 | 3.128 | 3.124 | 3.124 |
| **KCL** | % wt | 5.5 | 5.1 | 5.5 | 5.5 | 5.5 |

| | | | | |
|---|---|---|---|---|
| **DEPTH** | M | 1791 | 1866 | 1868 |
| **Density** | ppg | 9.50 | 9.55 | 9.55 |
| **Viscosity** | Sec | 40 | 42 | 42 |
| **Plastic Viscosity** | °C | 13@20 | 17@20 | 17@20 |
| **Yield** | $100/ft^2$ | 15 | 20 | 20 |
| **Gels** | $100/ft^2$ | 3/5/0lbs | 4/6/0lbs | 4/6/0lbs |
| **API filtrate** | 30 min | 6.4 | 6.0 | 6.0 |
| **Cake** | $32^{nd}$ in | 2.0 | 2.0 | 2.0 |
| **Corr solids** | % Vol | 5.5 | 5.0 | 5.0 |
| **Sand** | % Vol | 0.10 | 0.10 | 0.10 |
| **MBT** | Ppb eq | 6.00 | 5.00 | 5.00 |
| **Chlorides** | Mg/l | 25000 | 24500 | 24500 |
| **Hardness Ca** | Mg/l | 40 | 40 | 40 |
| **ASG** | | 2.981 | 2.981 | 2.981 |
| **KCL** | % wt | 5.00 | 5.00 | 5.00 |

### 2.3.6 Water Supply:

Water was trucked to the site from Sale.

### 2.3.7 Perforation:

See DST summary in 2.4.6 and in reports of two enclosures to this report.

### 2.3.8 Completion

Plugged and Abandoned.

### 2.3.9 Bit Data

**TABLE 5**

| **BIT NUMBER** | 1 re-run | 2 re-run | 3 | 4 re-run | 5 | 6 re-run#3 | 7 re-run | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| **Size (mm)** | 308 | 216 | 216 | 216 | 216 | 216 | 156 | 152.4 | 152.4 |
| **Make** | Hughes | Varel | Varel | Reed | Security | Varel | Varel | Varel | Hughes |
| **Type** | M-22 | CHI-GMS | CHI-GMS | TD-53 | XS2-0S | CHI-GMS | L-127 | ETD4 | MX-18H |
| **IADC Code** | 1-1-7 | 1-1-7 | 1-1-7 | 5-3-7 | 5-1-7X | 1-1-7 | | 2-1-6 | 2-1-6 |
| **Serial Number** | 60093062 | 197685 | 205147 | J-565742 | 755410 | 205147 | 170018 | 198663 | 5041994 |
| **Nozzles (32)** | 18-18-18 | 13-13-13 | 13-13-13 | 12-13-13 | 13-13-13 | 13-0-0 | 16-16-16 | 11-11-11 | 13-13-13 |
| **Depth in (m)** | 12 | 275 | 925 | 1160 | 1519 | 1609 | 1609 | 1670 | 1791 |
| **Depth out (m)** | 275 | 925 | 1160 | 1519 | 1609 | Wiper trip | 1670 | 1791 | 1868 |
| **Total Metres** | 263 | 650 | 235 | 359 | 90 | | 61 | 121 | 77 |
| **Hours** | 16.5 | 47 | 42 | 76 | 28 | | 34.5 | 42.5 | 26 |
| **WOB (kg)** | 4000 | 5000 | 5000/10000 | 13000 | 13000 | | 9000 | 9000 | 9000 |
| **RPM** | 100 | 100 | 100 | 80 | 80 | | 75 | 75 | 80 |
| **Condition** | | 6-5-FC-A-4-3-ER-TQ | 8-4-ER(1-3)-E-1-WT-PR | 6-8-BT-A-E-I-ER-TQ | 4-6-BT-A-E-I-JD-LOG | | 4-6-ER(1-3)E-1-WT-HR | 6-7-WT-A-2-1-ER-PR | 0-0-NO-A-0-I-NO-TD |
| **Impact Force** | | 396.9ft/lb | 396.9ft/lb | | | | | 168.8ft/lb | |
| **Jet Velocity** | | 254ft/sec | 254ft/sec | | | | | 199ft/sec | |

## 2.4 LOGGING AND TESTING

### 2.4.1 Wellsite Geologist:

David Horner

### 2.4.2 Mudlogging:

F.I.D. total gas, chromatograph. 24 hour Mudlogging unit supplied by Colin Higgins and Associates.

A mudlog recording lithology, penetration rate, mud gas and other data was prepared and is enclosure 1 to this report.

### 2.4.3 Ditch Cutting Samples:

Cuttings were collected at 10 meter intervals from spud to 270m, then at 5m intervals to 950m then at 3m intervals to 1868m (T.D.)

These being 1 set 500gm unwashed calico bag, 2 sets 100 gm washed and dried and 1 set washed samplex trays.

### 2.4.4 Coring:

No cores were taken.

### 2.4.5 Sidewall Cores:

No sidewall cores were taken.

### 2.4.6 Testing:

**DST#1 Interval: 1588 to 1608m (logger depth)**
Produced no gas from Strzelecki Group.

Recovered 8 bbls water cushion and rathole mud.

### 2.4.7 Wireling Logs:

Suite No.1 (Reeves Wireline)

Run No.1 DLS-MRS-ATS-SP-GR-CAL 1605m to Surface.

Run No.2 PDS-CNS 1605 to Surface

Suite No.2 (Reeves Wireline)

Run No.1 WPS-ATS-CNS-CCL 1590m to Surface.

Suite No. 3 (Reeves Wireline)

Run No. 1 DLS-MLL-CSS-GR 1869m to 1599m.

### 2.4.8 Velocity Survey:

No velocity survey was conducted.

# 3.0 GEOLOGY

## 3.1 Regional Geology

The Gippsland Basin is an early Cretaceous to Cainozoic basin occupying approximately 46,000 square kilometres of the southeastern margin of the Australian continent. The basin is flanked on the north, west and south-west by Palaeozoic rocks and confined between the structural uplifts of the Victorian Highlands in the north and the Bassian Rise in the south. The eastern margin of the basin is open to the Tasman Sea. The Gippsland Basin is an east-west trending half graben feature with 70% of its area beneath Bass Strait and 30% onshore (Figure 3).

With the exception of occasional wildcat drilling in the boom of the 1980's, exploration of the onshore Gippsland Basin has been largely ignored since the 1970's.

The early exploration activities in the onshore part were aimed primarily at the Early Cretaceous Strzelecki Group and, later on after successful drilling offshore, at the top of the Latrobe Group "coarse clastics", but a lack of understanding of the stratigraphy (Figure 5) and the mechanism of hydrocarbon generation, migration and timing of structures, along with the poor quality of the seismic and well log data, resulted in a downgrading of the hydrocarbon potential of the onshore area.

Lakes Oil N.L. acquired the PEP 137 (now PEP 157) permit in April 1999, following the drilling by Roma Petroleum N.L. of the McCreesh-1 well, an unsuccessful test of the top Latrobe Group sands. PEP 157 covers an area of 1,680 square kilometres within the onshore Gippsland Basin. The permit extends over the northern part of the Seaspray Depression, the southern portion of the Lake Wellington Depression and part of the Baragwanath Anticline. Seventeen exploration wells have been drilled from 1962 - 2004, with Lakes Oil N.L. having tested gas at the North Seaspray-3, Trifon-1 and 2, Gangell-1 and Wombat-1, and 2 and discovering oil at Wombat-3. North Seaspray-3 was a follow up to Woodside/Lakes Oil North Seaspray-1 well, which also flowed gas from the top of the Strzelecki Group.

## 3.2 Permit PEP 157

Lakes Oil N.L. acquired the PEP 137 (now PEP 157) permit in April 1999, following the drilling by Roma Petroleum N.L. of the McCreesh-1 well, an unsuccessful test of the top Latrobe Group sands. PEP 157 covers an area of 1,680 square kilometers within the onshore Gippsland Basin. The permit extends over the northern part of the Seaspray Depression, the southern portion of the Lake Wellington Depression and part of the Baragwanath Anticline. Sixteen exploration wells have been drilled from 1962 - 2004, with Lakes Oil N.L. having tested gas at the North Seaspray-3, Trifon-1+2 Gangell-1, and Wombat-1+2+3 locations. North Seaspray-3 was a follow up to Woodside/Lakes Oil North Seaspray-1 well, which also flowed gas from the top of the Strzelecki Group.

## 3.3 Exploration History

Hydrocarbon exploration commenced in the onshore region of the basin in 1924 when the Lake Bunga No.1 well encountered traces of oil and gas, leading to the discovery and development of the Lakes Entrance oil field. The oil accumulation is found within a glauconitic sand member of the Oligocene Lakes Entrance Formation which appears to have acted as a 'thief zone' for oil migrating along the pre-Tertiary unconformity. The field produced a total of 10,000 bbls of 15.7 API gravity oil before production ceased in 1956. Aside from the Lakes Entrance oil accumulation, wet gas flowed to the surface during testing from the Strzelecki sandstones at North Seaspray 1 and 3, Gangell-1 and Trifon-1.

Petroleum exploration in the permit commenced in the early 1960s and continued into the early 1970s, conducted mainly by Woodside and Arco, with eight wells being drilled within the permit. This exploration originally had as its main objective the Strzelecki Group, with emphasis moving to the Latrobe Group later in this period. Few of these wells, except for North Seaspray-1, are thought to be located within closure at the Top Latrobe Group level.

Several shallow bores have been drilled in the vicinity of PEP 157 by Victorian Electricity, Coal and Water Resources authorities. However, none of these bores encountered Latrobe Group reservoirs at a significant depth or within closure.

During 1985, Hartogen Energy Ltd drilled Burong-1 to test the Top Latrobe at the crest of a northeast trending asymmetrical anticline which is fault controlled to the northwest. While the Latrobe Group contained excellent reservoir rock, no significant shows were recorded within this section.

Lakes Oil has drilled thirteen wells within their onshore Gippsland permits. PetroTech-1 targeted greensands of the Lakes Entrance Formation but was not tested; Hunters Lane-1 produced oil from the same formation but at a non-economic rate; Baudin-1 and Investigator-1, which both targeted Lower Latrobe Group sands, were unsuccessful, probably due to lack of seal. North Seaspray-3, Trifon-1 and Gangell-1 drilled between 2000 and 2001, all targeted Strzelecki Group sands. Boundary Creek-1 corehole was drilled in 2001 to obtain information on reservoir quality within the Strzelecki Group. York-1 was drilled in March 2002 as a Latrobe Group test of a robust four way dip closure located 7 km south of the town of Woodside in PEP 158. Later in 2002 Deadman Hill-1 and Protea-1 stratigraphic holes were drilled in PEP 157. They were designed to locate the pinchout of Golden Beach Group sediments between Colliers Hill-1 and Boundary Creek-1. North Seaspray-3 was re-entered and Trifon-2 was drilled, targeting Strzelecki gas sands, whilst Wombat-1 and 2 encountered gas in the Strzelecki Group in the Merriman Anticline in 2003-2004. Wombat-3 encountered an as yet untested amount of oil in the Strzelecki Group in 2004.

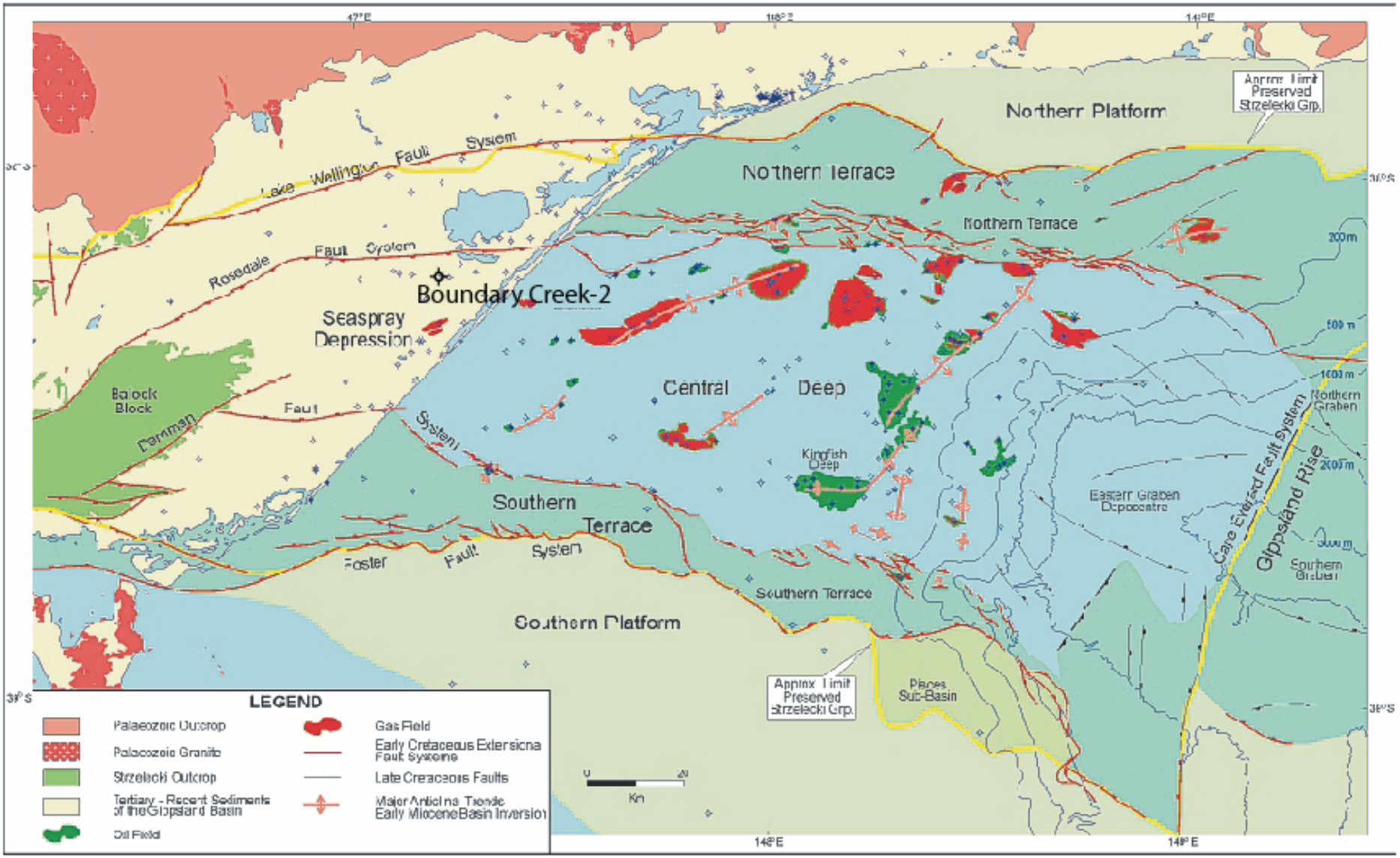


Figure 3) Structural Elements of the Gippsland Basnin

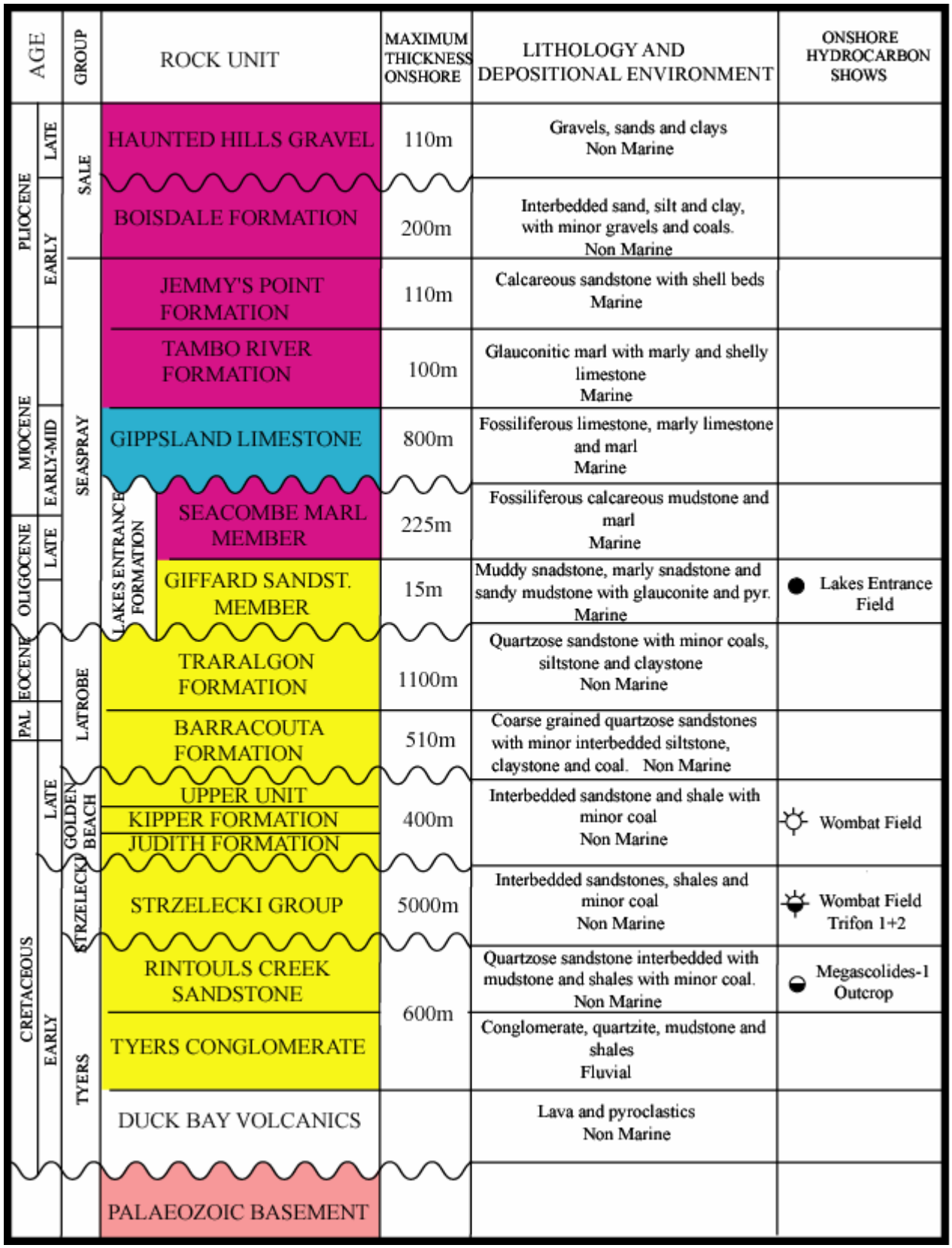


Figure 4) Generalised Gippsland Basin Stratigraphy

## 3.4 Tectonic History

The Gippsland Basin is a rift basin, which originated in the Late Jurassic to Early Cretaceous and consists of alternating half graben structures along its east-west trend (Figure 4). It is characterised by a deep central basin, flanked by northern and southern terraces. In the onshore area, the Late Cretaceous movements were accompanied with volcanism in the western margin of the basin. Several phases of positive structural inversion occurred in the Gippsland Basin from Mid-Oligocene to the present time, creating the major hydrocarbon bearing structures seen in the offshore region. The main phase occurred during the Late Miocene, which resulted in inversion of existing features and the creation of anticlinal structures.

## 3.5 Structural Elements

The onshore area can be tectonically sub-divided into six major areas (Figure 3):

**(A)** Northern Platform (Lakes Entrance Platform): This lies immediately south of the Eastern Highlands, where the Palaeozoic Basement gently slopes southwards and is unconformably overlapped by Oligocene - Miocene marine sediments and thin Pliocene - Quaternary continental deposits.

**(B)** Latrobe Valley Depression: This lies between the Palaeozoic Eastern Highlands to the north and the Early Cretaceous Balook Block to the south. Over 700 metres of continental Latrobe Valley sediments are present in this area.

**(C)** Lake Wellington Depression: This lies to the south of the Northern Platform, where over 1200 metres of Eocene to Pliocene sediments unconformably overlie the Early Cretaceous rocks. This trough is offset from the Latrobe Valley Depression to the west, by left lateral displacement on the Yinnar Transfer Fault Zone which occurred during the Tertiary. The boundary also closely coincides with the western limit of marine Tertiary sediments. To the east, the Lake Wellington depression merges with the Strzelecki Terrace.

**(D)** Baragwanath Anticline: This is the eastern extension of the outcropping Balook High. It is an Early Cretaceous block, which was elevated during the Late Miocene time as a result of the renewed lateral strike slip wrenching along the Boundary Fault Systems. It separates the Lake Wellington Depression to the north from the Seaspray Depression to the south. On the crest of the structure, thin Miocene strata are succeeded unconformably by a veneer of Pliocene-Pleistocene sediments. On the flanks of the structure, however, the Miocene sediments wedge out towards the crest by onlap at the base and erosion at the top of the sequence.

**(E)** Seaspray Depression: This is the onshore extension of the Central Deep. It occupies the southern onshore part of the basin, where the most complete stratigraphic section is present. The permit occupies the northeastern end of the Seaspray Depression.

**(F)** Southern Terrace: Wilson's Promontory is an erosional remnant of a broad shallow basement platform bounding the Gippsland Basin on its southern side. The Southern Terrace represents the edge of this platform. The Chitts Creek Conglomerate onlaps the South Terrace as a mirror image to the Tyers Conglomerate on the Northern Terrace.

## 3.6 Reason for Drilling

Echidna High No. 1 was designed to test the potential of a robust, seismically defined prospect located on the northern flank of the Seaspray Depression.

## 3.7 Geological Summary

A summary of the lithology penetrated appears below. Refer to Appendix 1 for detailed cuttings descriptions.

**12-65 m**
Massive unconsolidated Sand (100%).

SAND: light to medium yellow orange, very fine to pebble, dominantly very coarse, subrounded to well rounded, poorly sorted, rare strong iron oxide cement, trace to common light orange yellow clay and silt matrix, opaque to milky quartz grains often with orange brown iron oxide staining, common red brown iron oxide pellets, trace grey cherty and occasional black lithics, unconsolidated, very good inferred porosity, no oil fluorescence.

**65-95 m**
Massive Marl (100%).

MARL: medium green grey, abundant fossil fragments including shell fragments, gastropods, echinoid spines, sponge spicules, bryozoa and forams, trace black carbonaceous material, trace light green glauconite, very soft, sticky, non fissile.

**95-137 m**
Massive Calcarenite (100%) with minor Marl (Trace).

CALCARENITE: light to medium green grey, very fine to medium, moderate calcareous cement, abundant fossil fragments, trace to common light green glauconite, trace black carbonaceous material, moderately to very argillaceous, moderately hard, no visual porosity, no oil fluorescence.

**137-275 m**
Masive Calcarenite (100%) with minor Marl (Trace).

CALCARENITE: off white to medium green grey, very fine to fine, weak to moderate calcareous cement, calcilutitic in part, abundant fossil fragments, common light green to black glauconite, trace black carbonaceous material, slightly to to rarely very argillaceous, moderately hard, no visual porosity, no oil fluorescence.

MARL: medium brown grey, abundant fossil fragments including shell fragments, gastropods, echinoid spines, sponge spicules, bryozoa and forams, trace black carbonaceous material, trace glauconite, soft, non fissile.

**275-399 m**
Calcarenite (80%) grading in part to Marl (20%).

CALCARENITE: off white to light green grey to light brown grey, very fine to fine, weak to occasionally strong calcareous cement, rarely strong dolomite cement, calcilutitic in part, moderately argillaceous and marly in part, abundant bryozoa and fossil fragments, trace light green to black glauconite, trace black carbonaceous material, friable to occasionally hard, no visual porosity, no oil fluorescence.

MARL: light to medium brown grey, very calcareous, common bryozoa and fossil fragments, trace glauconite, soft, non fissile.

**399-448 m**

Massive Marl (100%).

MARL: medium grey to medium brown grey to medium green grey, moderately to very calcareous, trace fossil fragments, rare glauconite, firm, non fissile, grading with depth to:

MARL: off white to medium green grey to medium grey, moderately to very calcareous - calcilutitic in part, trace fossil fragments, rare glauconite, firm, non fissile.

**448-490 m**
Massive Marl (100%).

MARL: off white to medium green grey to medium grey, moderately to very calcareous - calcilutitic in part, trace fossil fragments, trace glauconite, firm, non fissile, grading with depth to:

MARL: off white to medium green grey to medium grey, moderately to very calcareous - calcilutitic in part, trace fossil fragments, abundant glauconite, common pyrite, firm, non fissile.

**490-553 m**
Coal (30%) interbedded with Sandstone (40%) and Claystone (30%).

COAL: black to very dark brown, very argillaceous in part - dominantly clean, irregular to blocky fracture, earthy to slightly subvitreous lustre, trace pyrite, firm to hard and brittle.

SANDSTONE: light brown grey, fine to very coarse, dominantly very coarse, subangular to subrounded, poorly sorted, very weak silica cement, trace to common medium brown argillaceous and silt matrix, clear to opaque quartz grains, trace black coal detritus, rare pyrite, loose to friable, very good inferred porosity, no oil fluorescence.

CLAYSTONE: medium to dark brown, moderately to very silty, moderately carbonaceous, common black coal detritus, soft, very dispersive, non fissile.

**553-686 m**
Coal (20%) interbedded with Sandstone (50%) grading to Claystone (30%).

COAL: black to very dark brown, very argillaceous in part, irregular to blocky fracture, earthy to slightly subvitreous lustre, trace pyrite, firm to hard and brittle.

SANDSTONE: light brown, very fine to grit, dominantly coarse, angular to subrounded, very poorly sorted, very weak silica cement, common to abundant medium brown argillaceous and silt matrix - matrix supported in part, clear to opaque quartz grains, trace black coal detritus, rare pyrite, friable, poor to very good inferred porosity, no oil fluorescence.

CLAYSTONE: medium to dark brown grey, very silty, moderately carbonaceous, common to abundant dispersed very fine to very coarse quartz sand grains, common black coal detritus, soft, very dispersive, non fissile.

**686-778 m**
Coal (20%) interbedded with Sandstone (60%) grading to Claystone (20%).

COAL: black to very dark brown, very argillaceous in part, irregular to blocky fracture, earthy to slightly subvitreous lustre, trace pyrite, firm to hard and brittle.

SANDSTONE: very light brown, very fine to pebble, dominantly coarse, angular to subrounded, very poorly sorted, very weak silica cement, abundant light to medium brown argillaceous and silt matrix, clear to opaque quartz grains, trace black coal detritus, rare pyrite, friable, fair to good inferred porosity, no oil fluorescence.

CLAYSTONE: light to dark brown, very silty, slightly to very carbonaceous, occasionally common dispersed very fine to very coarse quartz sand grains, abundant black coaly detritus, soft, very dispersive, non fissile.

**778-811 m**
Coal (20%) interbedded with Sandstone (60%) grading to Claystone (20%).

SANDSTONE: very light brown, very fine to very coarse, dominantly coarse, angular to subrounded, poorly sorted, very weak silica cement, common off white to light brown argillaceous and silt matrix, clear to opaque quartz grains, common black coal detritus, friable, very good inferred porosity, no oil fluorescence.

CLAYSTONE: light to medium brown, very silty, slightly to very carbonaceous, occasionally abundant dispersed very fine to very coarse quartz sand grains, common black coaly detritus, soft, very dispersive, non fissile.

COAL: black to very dark brown, very argillaceous in part, irregular to blocky fracture, earthy to slightly subvitreous lustre, firm to hard and brittle.

**811-939 m**
Sandstone (70%) interbedded with and grading to Claystone (30%).

SANDSTONE: very light brown, very fine to grit, dominantly very coarse, angular to subrounded, poorly sorted, very weak silica cement, common to abundant off white to light brown argillaceous and silt matrix, clear to opaque quartz grains, common black coal detritus, trace pyrite, friable, fair to good inferred porosity, no oil fluorescence.

CLAYSTONE: off white to medium brown to medium brown grey, very silty, slightly to very carbonaceous, abundant dispersed very fine to very coarse quartz sand grains, trace black coaly detritus, trace pyrite, soft, very dispersive, non fissile.

**939-1044 m**
Sandstone (40%) interbedded with and grading to Claystone (60%).

SANDSTONE: light brown, very fine to very coarse, dominantly coarse to very coarse, becomes coarser with depth with abundant quartz pebbles at base, angular to subrounded, very poorly sorted, weak silica cement, abundant off white to medium brown argillaceous and silt matrix - matrix supported, clear to opaque quartz grains, trace to common black coal detritus, trace grey green lithics, trace pyrite - increasing to common at base, friable, poor to good inferred porosity, no oil fluorescence.

CLAYSTONE: light to dark brown, occasionally dark grey, dominantly medium brown, moderately to very silty, slightly to moderately carbonaceous, trace dispersed very fine to very coarse quartz sand grains, common to abundant black coaly detritus, trace pyrite, soft, very dispersive, non fissile.

**1044-1059 m**
Weathered Volcanics (100%).

VOLCANICS: (basalt?) weathered at top and bottom to a soft mottled bright green and brick red claystone; where unweathered is composed of a glassy light green to black matrix with a diffuse crystal intergrowth of off white to black minerals, hard.

**1059-1075 m**
Claystone (50%) grading to Sandstone (50%).

SANDSTONE: (weathered at top) off white, very fine, subangular to subrounded, moderately sorted, moderate silica cement, abundant white argillaceous matrix - grades to claystone, abundant altered feldspar grains, common grey green lithics, trace quartz, trace fine black carbonaceous material, hard, no visual porosity, no oil fluorescence.

CLAYSTONE: (weathered at top) off white to medium grey, slightly silty, abundant altered very fine feldspar grains, trace black carbonaceous flecks and detritus, soft, non fissile.

**1075-1160 m**
Sandstone (70%) grading to and interbedded with Claystone (30%).

SANDSTONE: off white, very fine at top becoming fine with depth, subangular to subrounded, moderately sorted, moderate silica cement, weak calcareous cement, abundant white argillaceous matrix - grades to claystone, abundant altered feldspar grains, common to abundant grey green lithics, trace orange brown lithics, trace to common quartz grains, trace to common fine black carbonaceous material, hard, nil to very poor visual porosity, no oil fluorescence.

CLAYSTONE: medium grey to medium brown grey to off white, slightly silty, abundant altered lithic sand grains where off white, common black carbonaceous flecks and detritus, soft, non fissile.

**1160-1175 m**
Sandstone (60%) grading to and interbedded with Claystone (40%).

SANDSTONE: off white, very fine to fine, dominantly very fine, subangular to subrounded, moderately sorted, moderate silica cement, weak calcareous cement, abundant white argillaceous matrix - grades to claystone, abundant altered feldspar and grey green lithic grains, trace orange brown lithics, common quartz grains, trace to common fine black carbonaceous material, hard, very poor visual porosity, no oil fluorescence.

CLAYSTONE: medium grey to medium brown grey to off white, slightly silty, abundant altered lithic sand grains where off white, common black carbonaceous flecks and detritus, soft, non fissile.

**1175-1206 m**
Massive Volcanics (Basalt?) (100%).

VOLCANICS: (basalt?) dominantly weathered at top to a soft bright green (chloritic?) claystone; where unweathered is composed of a hard glassy green to black matrix with a diffuse crystal intergrowth of off white to black minerals, common crystalline quartz and calcite vein infill in part.

**1206-1246 m**
Sandstone (80%) grading to and interbedded with Claystone (20%).

SANDSTONE: off white, very fine to fine, dominantly fine, occasional medium grains, subangular to subrounded, moderately sorted, moderate silica cement, weak calcareous cement, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and grey green lithic grains, trace orange brown lithics, common quartz grains, trace fine black carbonaceous material, hard, very poor visual porosity, no oil fluorescence.

CLAYSTONE: medium grey to medium brown grey, moderately to very silty, abundant very fine altered feldspar grains in part, trace black carbonaceous flecks and detritus, soft, non fissile.

**1246-1347 m**
Sandstone (80%) grading to and interbedded with Claystone (20%).

SANDSTONE: off white, very fine to occasionally medium, dominantly fine, subangular to subrounded, moderately sorted, moderate silica cement, weak calcareous cement, abundant white argillaceous matrix - grades to claystone, abundant altered feldspar and grey green lithic grains, trace orange brown lithics, trace quartz grains, trace fine black carbonaceous material, hard, nil to very poor visual porosity, no oil fluorescence.

CLAYSTONE: medium grey to medium green grey to medium brown grey, moderately to very silty, slightly calcareous in part, trace very fine altered feldspar grains in part, trace to common black carbonaceous flecks and detritus, soft to firm, non to slightly subfissile.

**1347-1456 m**
Sandstone (80%) grading to and interbedded with Claystone (20%).

SANDSTONE: off white, very fine to medium, dominantly fine, subangular to subrounded, moderately sorted, moderate silica cement, weak to moderate calcareous cement, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and grey green lithic grains, trace to common orange brown lithics and quartz grains, trace fine black carbonaceous material, hard, nil to rarely poor visual porosity, no oil fluorescence.

CLAYSTONE: off white to medium brown to medium green grey to medium grey, slightly to occasionally very silty, slightly calcareous in part, trace to common very fine altered feldspar grains in part, trace to common black carbonaceous flecks and detritus, soft to firm, non to slightly subfissile.

**1456-1519 m**
Sandstone (80%) grading to and interbedded with Claystone (20%).

SANDSTONE: off white, very fine to occasionally medium, dominantly fine, subangular to subrounded, moderately sorted, moderate silica cement, moderate calcareous cement, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and grey green lithic grains, trace orange brown lithics, trace quartz grains, trace fine black carbonaceous material, hard, nil to very poor visual porosity, no oil fluorescence.

CLAYSTONE: light to medium grey to medium brown grey to occasionally medium green grey, slightly to moderately silty, slightly calcareous in part, common very fine altered feldspar grains in part, trace black carbonaceous flecks and detritus, soft to firm, non to slightly subfissile.

**1519-1564 m**
Sandstone (70%) grading to and interbedded with Claystone (30%).

SANDSTONE: off white, very fine to medium, dominantly fine, subangular to subrounded, moderately sorted, moderate silica and calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and grey green lithic grains, trace orange brown lithics, trace quartz grains, trace fine black carbonaceous material, hard, very poor visual porosity, no oil fluorescence.

CLAYSTONE: medium to dark grey to medium brown grey, slightly to moderately silty, slightly calcareous in part, common very fine altered feldspar grains in part, trace black carbonaceous flecks and detritus, soft to firm, non to slightly subfissile.

**1564-1601 m**
Sandstone (50%) grading to and interbedded with Claystone (50%).

SANDSTONE: off white, very fine to rarely medium, dominantly fine, subangular to subrounded, moderately sorted, moderate silica and calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and grey green lithic grains, trace orange brown lithics, trace to common quartz grains, trace black carbonaceous material, hard, nil to very poor visual porosity, no oil fluorescence.

CLAYSTONE: light to medium grey to medium brown grey, slightly to moderately silty, slightly calcareous in part, common very fine altered feldspar grains in part, trace black carbonaceous flecks and detritus, soft to firm, non to slightly subfissile.

**1601-1609 m**
Claystone (70%) laminated with Sandstone (30%).

SANDSTONE: off white, very fine to medium, dominantly fine, subangular to subrounded, moderately sorted, moderate silica and calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and grey green lithic grains, trace orange brown lithics, trace quartz grains, trace to common black carbonaceous material, hard, no visual porosity, no oil fluorescence.

CLAYSTONE: medium to dark grey to medium brown grey, moderately to very silty, slightly calcareous in part, common very fine altered feldspar grains in part, common black carbonaceous flecks and detritus, firm, slightly subfissile.

**1609-1611 m**
Sandstone (60%) thinly interbedded with Claystone (40%).

SANDSTONE: off white, very fine to medium, dominantly medium, subangular to subrounded, moderately sorted, moderate silica and calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and grey green lithic grains, trace orange brown lithics, trace quartz grains, trace to common black carbonaceous material, hard, no visual porosity, no oil fluorescence.

CLAYSTONE: medium grey to medium brown grey, moderately silty, slightly calcareous in part, common very fine altered feldspar grains in part, common black carbonaceous flecks and detritus, firm, slightly subfissile.

**1611-1620 m**
Hydrothermally altered Sandstone (100%).

HYDROTHERMALLY ALTERED SANDSTONE: light to medium grey, intergrown fine to medium grained plagioclase (weathered to kaolin at top), trace orthoclase, with common quartz, common dark mafic minerals and magnetite, trace biotite, very calcareous at top becoming slightly calcareous with depth, very hard, no visual porosity.

**1620-1642 m**
Hydrothermally altered Sandstone (100%).

HYDROTHERMALLY ALTERED SANDSTONE: light to medium grey, intergrown fine to medium grained plagioclase, (dominantly weathered to kaolin), trace orthoclase, common quartz, common dark mafic minerals and magnetite, trace biotite, moderately calcareous, very hard, no visual porosity.

**1642-1670 m**
Sandstone (80%) with thinly interbedded Claystone (10%) grading to Siltstone (10%).

SANDSTONE: light grey, very fine to medium, dominantly medium, angular to subrounded, moderately sorted, strong silica and weak calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and dark grey to black lithic grains, trace orange brown lithics, common quartz grains, abundant black vitreous carbonaceous material, trace crystalline vein quartz, very hard, no visual porosity, no oil fluorescence.

CLAYSTONE: medium brown grey to medium grey, moderately silty, slightly calcareous, common very fine altered feldspar grains in part, common black carbonaceous flecks and detritus, firm, slightly subfissile.

SILTSTONE: medium grey to medium brown grey, moderately to very argillaceous, slightly calcareous in part, common very fine altered feldspar grains, common black carbonaceous flecks, moderately hard, subfissile.

**1670-1680 m**
Sandstone (90%) with thinly interbedded Siltstone (10%).

SANDSTONE: light grey, very fine to medium, dominantly medium, angular to subrounded, moderately sorted, strong silica and weak to moderate calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and dark grey to black lithic grains, trace orange brown lithics, trace to common quartz grains, trace to common black vitreous carbonaceous material, trace to common crystalline vein quartz, very hard, no visual porosity, no oil fluorescence.

SILTSTONE: medium grey to occasionally medium brown grey, moderately to very argillaceous, common very fine altered feldspar grains in part, trace to common black carbonaceous flecks, trace micromica, moderately hard, subfissile.

**1680-1750 m**
Sandstone (90%) with thinly interbedded Siltstone (10%).

SANDSTONE: light grey, very fine to medium, dominantly medium, angular to subrounded, moderately sorted, strong silica and weak to moderate calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and dark grey to black lithic grains, trace orange brown lithics, trace to common quartz grains, trace to common black vitreous carbonaceous material, trace to common crystalline vein quartz, very hard, no visual porosity, no oil fluorescence.

SILTSTONE: medium to dark grey to occasionally medium brown grey, moderately to very argillaceous, common very fine altered feldspar grains in part, trace to common black carbonaceous flecks, trace micromica, moderately hard, subfissile.

**1750-1791 m**
Sandstone (80%) with thinly interbedded Siltstone (20%).

SANDSTONE: light grey, very fine to medium, dominantly fine to medium, angular to subrounded, moderately sorted, strong silica and moderate calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and dark grey to black lithic grains, trace orange brown lithics, trace quartz grains, trace black vitreous carbonaceous material, trace quartz vein infill, hard, no visual porosity, no oil fluorescence.

SILTSTONE: medium to dark grey to occasionally medium brown grey, moderately argillaceous, slightly to occasionally very carbonaceous, common very fine altered feldspar grains, common black carbonaceous flecks, trace micromica, moderately hard, subfissile.

**1791-1866 m**
Sandstone (80%) with thinly interbedded Siltstone (20%).

SANDSTONE: light grey, very fine to medium, dominantly medium, angular to subrounded, moderately sorted, strong silica and weak to moderate calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and dark grey to black lithic grains, trace orange brown lithics, trace to common quartz grains, trace black vitreous carbonaceous material, trace vein quartz in part, hard, no visual porosity, no oil fluorescence.

SILTSTONE: medium to occasionally dark grey to medium brown grey, moderately argillaceous, slightly carbonaceous in part, common very fine altered feldspar grains in part, trace to common black carbonaceous flecks, trace micromica, moderately hard, subfissile.

**1866-1868 m (TD)**
Sandstone (20%) with thinly interbedded Siltstone (80%).

SANDSTONE: light grey, very fine to fine, dominantly fine, angular to subrounded, moderately sorted, strong silica and weak calcareous cements, abundant white argillaceous matrix - matrix supported, abundant altered feldspar and dark grey to black lithic grains, trace orange brown lithics, trace quartz grains, trace black vitreous carbonaceous material, hard, no visual porosity, no oil fluorescence.

SILTSTONE: medium grey to medium brown grey, moderately argillaceous, slightly carbonaceous, common very fine altered feldspar grains in part, common black carbonaceous flecks, trace micromica, moderately hard, subfissile.

## 3.8 Hydrocarbon shows

No oil fluorescence was observed throughout the well.

No gas readings were recorded from the surface to 490m.

**490-553m:** Background gas readings ranging from 0-4 units (C1 100%)

**553-686m:** Background gas readings ranging from 0-1 unit (C1 100%)

**686-778m:** Background gas readings ranging from 0-1 unit (C1 100%)

**778-811m:** Background gas readings ranging from 0-trace units (C1 100%)

**811-939m:** Background gas readings ranging from 0-trace units (C1 100%)

**939-1044m:** Background gas readings ranging from 0-trace units (C1 100%)

**1044-1059m:** Background gas readings ranging from 0-trace units (C1 100%)

**1059-1075m:** Background gas readings ranging from trace-0.5 units (C1 100%)

**1075-1160m:** Background gas readings ranging from trace-1 unit (C1 100%)

**1160-1175m:** Background gas readings ranging from trace-1 unit (C1 100%)

**1175-1206m:** Background gas readings ranging from trace-0.5 units (C1 100%)

**1206-1246m:** Background gas readings ranging from trace-1 unit (C1 100%)

**1246-1347m:** Background gas readings ranging from trace-1 unit (C1 100%, C2 trace)

**1347-1456m:** Background gas readings ranging from trace-1 unit (C1 100%)

**1456-1519m:** Background gas readings ranging from trace-1 unit (C1 100%)

**1519-1564m:** Background gas readings ranging from trace-0.5 units (C1 100%)

**1564-1601m:** Total gas readings ranging from trace- 4 units Gas peak at 1590m of 4 units (C1 100%) in the very top only of a tight kaolinitic sandstone immediately below a claystone interval.

**1601-1609m:** Total gas readings rose from 1 unit at the top to a peak of 24 units at 1609m (C1 81%, C2 12%, C3 6%, C4 1% C5+ 0) The interval 1601-1609m appears to be gas saturated with the gas contained in tight sandstone laminates within :a dominantly claystone unit.

**1609-1611m:** Background gas readings ranging from trace-0.5 units (C1 100%)

**1611-1620m:** Background gas readings ranging from 0-trace units (C1 100%)

**1620-1642m:** No gas readings were recorded in this interval

**1642-1670m:** Background gas readings ranging from trace-1 unit (C1 100%)

**1670-1680m:** Background gas readings ranging from 0-trace units (C1 100%)

**1680-1750m:** Background gas readings ranging from 0-1 units (C1 100%)

**1750-1791m:** Background gas readings ranging from 0-1 units (C1 100%)

**1791-1866m:** Background gas readings ranging from trace-1 units (C1 100%)

**1866-1868m (TD):** Background gas readings ranging from 0-trace units (C1 100%)

## 4.0 COMPLETION

Echidna High-1 was plugged and abandoned.