



ALLIANCE OIL DEVELOPMENT

AUSTRALIA N.L.

W491

TARWIN MEADOWS NO. 1

WELL COMPLETION REPORT

P.E.P.53, VICTORIA

ALLIANCE OIL DEVELOPMENT AUSTRALIA N. L.

WELL COMPLETION REPORT

ALLIANCE TARWIN MEADOWS NO. 1.

P.E.P. 53, VICTORIA

BY: A. C. M. LAING

DECEMBER, 1965.

ALLIANCE TARWIN MEADOWS NO. 1 WELL

C O N T E N T S:

	<u>Page No.</u>
I. SUMMARY	1
II. INTRODUCTION	2
III. WELL HISTORY	
1. General Data	3
2. Drilling Data	4
3. Logging and Testing	6
IV. GEOLOGY	
1. Regional Geology	9
2. Regional Geological Structure	10
3. Detailed Stratigraphy	13
4. Structure	16
5. Relevance to occurrence of petroleum	16
6. Porosity and Permeability	17
7. Contribution to geological concepts resulting from drilling	17
V. REFERENCES	18

P L A T E S:

- ✓ Plate 1. Regional Geological Map of the Gippsland Basin.
- ✓ Plate 2. Cross-section.
- ✓ Plate 3. Composite Log (4 sheets).
- Plate 4. Electric Logs.

A P P E N D I C E S:

- Appendix 1. Cuttings Descriptions )
- Appendix 2. Core Descriptions ) By G.C. Campe & J.R. Cundill
- Appendix 3. ~~Electric Logs~~ Paleontology by David J. Taylor
- Appendix 4. Formation Tests
- Appendix 5. Palynology by Mary E. Detmann.

" " " " " } added by  
 " " P.R. Evans } DNLE  
 11/5/99

## I. SUMMARY

The Tarwin Meadows No. 1 Well was drilled to a total depth of 3,948 feet in the Tarwin Embayment of the Gippsland Basin. Drilling commenced on 7 June and terminated on 26 July, 1965. The site was near the coast of Bass Strait,  $1\frac{1}{4}$  mile from the township of Lower Tarwin. Lower Tarwin is in Gippsland about 130 miles southeast of Melbourne. The well was drilled for Alliance Oil Development Australia N.L., Alliance Petroleum Australia N.L. and Westralian Oil Limited by W.L. Sides & Son. using a Failing 2500 rig. The well was suspended on 26 July, 1965, pump capacity having been reached.

The well passed through Quaternary sands with marine shell horizons to 140 feet and then continued in sediments of the Strzelecki Group of Mesozoic age to total depth. The thickness of Strzelecki Group is much greater than expected considering that Ordovician basement outcrops only  $4\frac{1}{2}$  miles from the wellsite.

Minor gas shows were obtained from cores at 1,600 and 2,580 feet. A stronger gas show causing gas cutting of the mud was noted at 3,100. However, electric logs and the one successful formation test conducted indicates that the Strzelecki Group contains no effective porosity in the section penetrated.

## II. INTRODUCTION

The main objective of the Tarwin Meadows No. 1 Well, which was drilled at a location on the coast of Bass Strait and within P.E.P.53, Victoria, was to try to prove the presence of porosity in the Strzelecki Group of Mesozoic age. It was hoped that the arkosic sandstones of the Strzelecki Group would become porous and permeable close to their inferred source area, the Wilsons Promontory and Cape Woolamai Granites. For this reason the well was located close to the coast of Bass Strait and in the Tarwin Embayment. It was also hoped that in an off-structure position a porous sandstone, similar to the Pretty Hill Sandstone in the Otway Basin to the west, might be developed at the base of the Strzelecki Group even though it is not present at outcrop in the surrounding area.

It was also considered that a well located close to the coast near Tarwin would assist in evaluating the Alliance Group's offshore Permit, P.E.P.36. Unfortunately, the section was considerably thicker than expected and the well was suspended at rig capacity at a depth of 3,948 feet without reaching basement and it, therefore, failed to achieve all its objectives.

The Wellsite Geologist from surface to 3,710 feet was Mr. G.C. Campe of Cundill, Meyers & Associates and from 3,710 to total depth, Mr. J.R. Cundill of the same firm.

III. WELL HISTORY

1. GENERAL DATA:

Well Name and Number: Alliance Tarwin Meadows No. 1.

Location: The well was located beside the road from Lower Tarwin to Tarwin Meadows Homestead, about  $1\frac{1}{2}$  miles from Lower Tarwin village. The wellsite is on Block 70A, Parish of Tarwin, owned by Mr. J.C.M. Black of Tarwin Park. The co-ordinates of the wellsite are:-

Latitude       $38^{\circ} 43' 26.5''$       South  
Longitude      $145^{\circ} 51' 36''$       East

Name and Address of Tenement Holder:

Alliance Oil Development Australia N.L.  
100 Collins Street,  
MELBOURNE ... C.1.  
VICTORIA.

Details of Petroleum Tenement: P.E.P.53, which covers an area of 637 square miles was formed by amalgamating P.E.P.28, P.P.L. 199 and P.P.L. 210. The companies holding an interest in the tenement are :-

<u>Company</u>	<u>% interest</u>
Alliance Oil Development Australia N.L.	65 $\frac{1}{2}$ %
Alliance Petroleum Australia N.L.	21 $\frac{1}{8}$ %
Westralian Oil Limited	12 $\frac{1}{2}$ %

District: The area where the well is located is in West Gippsland near the coast at Venus Bay. The location is within the Wenthaggi 1 mile Army sheet area. Geologically, it is part of the Tarwin Embayment of the Gippsland Basin.

Total Depth: 3,948 feet (Schlumberger).  
3,945 feet (Driller).

Date Drilling Commenced: 7 June, 1965.

Date Drilling Completed: 26 July, 1965.

Date Well Abandoned: 27 July, 1965.

Date Rig Released: 28 July, 1965.

Drilling time in days to total depth: 50.

Elevations: Ground level: - 25 feet  
Rotary Table: - 36 feet (Datum  
used for all depths given in this report.

Status: The well was filled with viscous mud and plugs were set at surface and at the casing shoe; therefore, the well has been suspended only and may be deepened to basement using a larger drilling rig, should this be desirable at a later date.

2. DRILLING DATA:

Name and Address of Drilling Contractor:

W.L. Sides & Son Pty. Ltd.,  
Gay Street,  
MORWELL ... GIPPSLAND.

Drilling Plant:

Make: Failing 2500  
Rated Capacity: 5,000 feet with 2 $\frac{3}{8}$  inch  
drillpipe  
Motor: One GM 471 diesel, 110 H.P.

Mast:

Make: Failing Tubular  
Rated Capacity: 60,000 lbs.

Pumps:

Make: One Gardner Denver FX0  
One Wheatley 5x10

Blowout Preventer:

Baash Ross, Autolock, 6 inch working pressure  
1,000 psi.

Hole size and depths:

- (i) 7 $\frac{7}{8}$  inch to 225 feet.
- (ii) 5 $\frac{7}{8}$  inch to total depth.

Casing details:

- (i) Conductor Pipe size 9 $\frac{5}{8}$  inch set at 14 feet.
- (ii) Surface casing size 6 $\frac{3}{4}$  inch OD set at  
223 feet.

Casing Cement Details:

- (i) Conductor Pipe.
- (ii) Surface casing - used 30 bags cement.

Drilling Fluids: The mud programme was designed for the contractors by Munro Mud Sales Pty. Ltd. A bentonitic fresh water mud was used from below the surface casing to total depth.

Some caving problems were encountered at 974 feet causing the pipe to become stuck in the hole for about 10 hours.

At 2,940 the driller reported mud was being lost at about 75 gallons per hour. This loss was remedied by increasing the viscosity of the mud by the addition of bentonite.

At 3,113 feet the driller reported gas cut mud. Barytes was added while conditioning mud to increase the weight.

The following figures give the average properties of the mud throughout the drilling of the well :-

Week Ending	Depth	Mud weight lb/US gal.	Viscosity sec/qt.	Water loss cc/30 min	pH	Filter cake thickness (inches)	Sand %
13 June	610	9.1	43	7.0	8	1/32	1
20 June	1607	9.7	54	6.3	8	1/32	0.75
27 June	2305	10.7	53	4.8	9	1/32	1.0
4 July	2860	10.2	47	5.6	9	1/32	1.5
11 July	3145	10.5	52	5.0	9	1/32	1.1
18 July	3523	10.4	49	5.4	9	1/32	1
25 July	3945	10.6	50	5.4	9	1/32	1

The well was making a certain amount of mud during drilling and the additives used were for the treatment of this natural mud.

The total quantities of mud materials used during the drilling of the well are listed below :-

Bentonite (Supercol)	169 sacks
(Gel)	36 sacks
Unical	58 sacks
Milcon	37½ sacks
Myrtan	2 sacks
Caustic Soda	435 lbs.
Barytes	83 sacks



Water Supply: The well was situated beside a water hole excavated by the property owner, Mr. Black. This waterhole gave a plentiful supply of fresh water.

Plugging back and abandonment: As the well was only suspended at total depth the bottom part of the hole was filled with a thick viscous mud before running cement plugs at the casing shoe and at surface. Details of these plugs are as follows :-

Cement Plug No. 1

Date	27 July, 1965
Depth	175 to 275 feet
Hole size	6 $\frac{1}{8}$ inch
Cement	18 sacks

Cement Plug No. 2

Date	27 July, 1965
Depth	0 to 50 feet
Hole size	6 $\frac{1}{8}$ inch
Cement	8 sacks

Fishing Operations: No fishing operations were needed. The drill pipe was stuck at 97 $\frac{1}{2}$  feet while running in to core at 1,145 on 16 June. No rotation or circulation could be obtained for 10 hours. However, the pipe was finally worked free after 10 hours and the core barrel was found to be plugged withavings.

The drill pipe also became stuck at 3,945 for  $\frac{1}{2}$  hour on 25 July. On freeing the pipe the well was stopped as it was considered that the annular velocity had dropped too low to continue drilling with safety.

3. LOGGING AND TESTING:

Cuttings: Samples representative of each 10 foot interval were collected, examined and described under the binocular microscope. Samples were also examined under ultraviolet light for the presence of traces of oil.

Cores: Cores were cut in the following intervals :-

<u>Core No.</u>	<u>Interval</u>	<u>Recovery</u>
Core 1	304 - 314 feet	6 feet
Core 2	600 - 610 feet	4½ inches
Core 3	610 - 620 feet	10 feet
Core 4	1597 - 1607 feet	9 inches
Core 5	1607 - 1610 feet	1 foot 6 inches
Core 6	2563 - 2574 feet	7 feet 8 inches
Core 7	3113 - 3123 feet	10 feet
Core 8	3123 - 3128 feet	2 feet 6 inches

Logs: The following logs were run in the hole at total depth by Schlumberger Senco:-

Electric log (SP, 16 inch and 64 inch normal  
18 feet 8 inch lateral)

223 - 3948 feet

Microlog Caliper

223 - 3948 feet

Formation Testing: Two formation tests were conducted in open hole during the drilling of the well. These tests were conducted over a zone from which gas had been observed when it was penetrated by the drill. The second test was partly successful and seemed to indicate the zone was tight as only 200 feet of mud was recovered in the pipe. This is confirmed by the electric logs which show no porosity over this interval.

Details of the tests are given below. No pressure recorders were available so there are no down hole pressure records.

Interval	Time Open	Recovery	Remarks
<u>D.S.T. 1</u> 3101 - 3128'	Unable to open tool	430 feet of drilling mud	Test unsuccessful. Leak in drill pipe. M prevented go-devil breaking disc valve and opening tool.

Interval	Time Open	Recovery	Remarks
<u>D.S.T. 2</u> 3093 - 3160'	30 mins.	200 feet drilling mud.	Weak puff for 15 minutes on opening disc valve. Annulet dropped 4 feet and remained steady throughout test.

Deviation Surveys:

<u>Depth</u>	<u>Deviation</u> (degrees)
410'	$\frac{1}{2}^{\circ}$
940'	1 $^{\circ}$
1250'	1 $^{\circ}$
1680'	1 $^{\circ}$
1775'	$\frac{1}{4}^{\circ}$
2155'	$2\frac{3}{4}^{\circ}$
2300'	$\frac{1}{2}^{\circ}$
2735'	$\frac{3}{4}^{\circ}$
3200'	$\frac{1}{2}^{\circ}$
3650'	$\frac{3}{4}^{\circ}$

## IV. G E O L O G Y

### 1. REGIONAL GEOLOGY:

#### Previous Work in P.E.P.53:

- (i) Geological: Ferguson (1906, 1909, 1902-1927) geologically mapped an area including the whole of P.E.P.53. The results of his work are published on coloured geological parish plans and quarter sheets and even today represent the best geological maps available of the area, although his topographic base maps (parish plans on which the work is plotted), are distorted and cannot be fitted together.

Edwards and Baker (1943) petrologically examined and described the sandstone in the Strzelecki Group in Gippsland.

Edwards, Baker and Knight (1944) described the geology of the Wonthaggi Coalfield, 25 miles west of the Tarwin Meadows No. 1 Well.

Boutakoff (1956) discussed the petroleum possibilities of Gippsland, dealing particularly with the Tertiary of Eastern Gippsland.

Rade (1956) described the geology of the eastern part of P.E.P.53 (old P.P.Ls 199 and 210).

Cundill and Meyers (1963) drew a regional cross-section from Lakes Entrance to Mornington Peninsula crossing the Tarwin Embayment. This cross-section admirably illustrates the subsurface geology.

Geophoto Resources Consultants Inc. (Brundall 1964) made a photogeological study of the area now covered by P.E.P.53 producing a map and a memorandum report following a field check.

Stephens (1964) summarised the work done on P.P.L.s 199 and 210 and P.E.P.s 28 and 36 in his evaluation report on the areas held by the Alliance Group in Gippsland.

- (ii) Geophysical: Only aeromagnetic and gravity work have been carried out over P.E.P.53.

Aeroservice (Bahamas) Ltd. (Reford 1962, Stach 1962) flew the Andersons Inlet aeromagnetic survey over the adjoining offshore area (P.E.P.36), also held by Alliance Oil Development Australia N.L. This survey, which was conducted in conjunction with one flown for Hematite Exploration Pty. Ltd. over Bass Strait (Bass Strait Aeromagnetic Survey (see Hopkins 1965)), extended over part of P.E.P.53 including the Tarwin Meadows No. 1 wellsite.

The Gippsland Basin aeromagnetic survey was flown over Eastern Gippsland (Quilty 1962) including a part of P.E.P.53.

The Gormandale Gravity Survey covers P.E.P.53, although it is over the Tarwin Embayment only on a broad regional scale. (Dooley & Mulder 1961)

- (iii) Drilling: Four shallow wells to about 900 feet have been drilled for coal in the Tarwin Embayment by the Victorian Mines Department. Details are listed below :-

Well Name	Year Drilled	Total Depth	Formation Tops
Tarwin No. 1	1913	878'	Recent & Tertiary 0' Strzelecki 70'
Tarwin No. 2	1913	942'	Recent & Tertiary 0' Strzelecki 76'
Tarwin South No. 2	1914	902'	Recent & Tertiary 0' Strzelecki 124'
Drumdie- bara No. 1	1913	882'	Recent & Tertiary 0' Strzelecki 45'

## 2. REGIONAL GEOLOGICAL STRUCTURE:

The Tarwin Meadows No. 1 Well is located within the Tarwin Embayment near the junction of the Gippsland and Bass Basins (see Plate 1).

The Tarwin Embayment is an area of outcropping Recent marine sands, alluvial sands and sand dunes forming an alluvial plain at the mouth of the Tarwin River. The Tarwin Embayment is bounded to the southeast by the Waratah Fester basement high, to the northwest by the Wonthaggi Korrumburra High, a ridge of Mesozoic rocks along which there are some basement inliers outcropping and to the north by an extension of the Beech Hill High. The Beech Hill High is a structurally and topographically high area where the Strzelecki Group outcrops.

The following is an outline of the stratigraphy of the Gippsland Basin :-

TABLE I.

AGE	FORMATION NAME	LITHOLOGY	THICKNESS (feet)
<u>QUATERNARY</u> Recent & Pleistocene	Tarwin Beds	Fossiliferous, calcareous quartz, sandy minor coal beds	120'
<u>TERTIARY</u> Pliocene	Hushy Park Beds	Clayey, silty and sands with carbonaceous material	125-770'
	Jennys Point Formation	Shelly sands, gravels, marls with glauconite	25-190'
Miocene	Tambo River Formation	Mainly grey limestone	80-130'
	Gippsland Limestone	Dryocan, limestone, sandy limestone, calcareous sand	250-580'
Oligocene	Lakes Entrance Formation	Foraminiferal marls and glauconitic sandy marls	300-510'
Eocene	Upper Latrobe Valley Coal Measures	Coals and sands	405-2375'
Paleocene	Lower Latrobe Valley Coal Measures	Basalt and minor sediments	450'
-----	Regional Unconformity -----	-----	-----
<u>MESOZOIC</u>	Strzelecki Group	Arkosic sandstone, shale, minor coal	10,000'
-----	Regional Unconformity -----	-----	-----
<u>PALEOZOIC</u>	Basement		

BASEMENT: Cambrian volcanics are exposed on the coast of Waratah Peninsula.

Ordovician and Silurian beds outcrop around the southern edge of a Lower Cretaceous basin to the east of the Tarwin Embayment near Foster and in an inlier at Turtons Creek. They consist predominantly of phyllite.

The Devonian section includes the fossiliferous limestones and dolomites of Waratah Bay. These beds appear to be partly recrystallised at outcrop and so could probably be included as part of basement for petroleum search purposes. The Devonian section also includes highly contorted, indurated sandstone and mudstone of the Liptrap Formation which is exposed at Cape Liptrap and can also be regarded as basement. The Wilson's Promontory Granite was probably intruded into these beds in late Devonian time.

Definite Permian beds were penetrated in Duck Bay No. 1 well in the eastern part of the Gippsland Basin. These beds consist of interbedded siltstones and lava flows, and are effective basement.

Beds of Permian age may occur elsewhere; however, the Chitt Creek Conglomerate, poorly exposed at the base of the Strzelecki Group, a few miles east of Foster, is regarded as being Mesozoic in age despite reports of striated boulders being collected in the neighbourhood.

STRZELECKI GROUP: The Strzelecki Group is well exposed, dipping 20-40 degrees in the hilly country north of Fish Creek, Foster, Toora and Welshpool, on the flanks of the Balook and Kays Hill Anticline, Fish Creek Dome and other minor structures. At Foster, Fish Creek and around the edge of the Turtons Creek Inlier, the base of the Strzelecki Group is exposed. The beds are similar to those in the upper part of the section consisting of tight, arkosic sandstones and green shales with plant fragments. However, there appears to be a slight increase in the quartz percentage in the basal sandstones. There is a general increase in the percentage of sandstone eastward in the Strzelecki Group as a whole.

The base of the Strzelecki Group is not exposed east of Chitts Creek, a few miles east of Foster. Part of the unexposed lower section of the Strzelecki Group was penetrated in Woodside Hedley No. 1, which was located 18 miles east of Foster and which penetrated nearly 4,000 feet of tight, arkosic sandstones and shales below a thin Tertiary section.

The base of the Strzelecki Group is also exposed in a structural high at Wonthaggi on the western side of the Tarwin Embayment. Wells drilled in the coal mine area at Wonthaggi have penetrated basement about 1,000 feet below the top coal seam. Edwards, Baker and Knight (1944) considered that the evidence then available indicated that the Strzelecki Group had transgressed onto a pre-existing basement high and that, therefore, there would be basal beds of the Strzelecki Group developed off the Wonthaggi High that were not exposed at outcrop. The results of the Tarwin Meadows No. 1 Well have confirmed this supposition. There is more than 2,300 feet of Strzelecki Group below the top coal seam which was penetrated in the well at 1,460 feet, that is 1,300 feet below the basal section exposed at Wonthaggi.

Since the well was located only  $\frac{1}{4}$  miles west of the nearest basement outcrop and the sediments of the Strzelecki Group penetrated in the well are flatlying, it follows that the eastern boundary of the Tarwin Embayment must either be a fault against, or an onlap onto the Waratah Basement High.

TERTIARY: The complete Tertiary sequence as outlined in Table I is present only in Eastern Gippsland to the east of P.E.P.53.

In the eastern part of P.E.P.53, in wells around Yarram and Alberton, the Jenny's Point Formation rests directly on the Lower Latrobe Valley Coal Measures and the intervening prospective part of the Tertiary section is absent.

Similarly, offshore seismic work carried out for Hematite Exploration Pty. Ltd. (Hopkins pers comm) indicates that the Tertiary section is thinning into the Tarwin Embayment. In fact, the Tertiary has now been proved by the Tarwin Meadows No. 1 Well to be entirely absent from this side of P.E.P.53.

QUATERNARY: There are extensive sand dunes developed along the coast of Venus Bay and the Tarwin Meadows No. 1 Well was located on the edge of these sand dunes.

3. DETAILED STRATIGRAPHY OF TARWIN MEADOWS NO. 1 WELL:

The well stratigraphy is summarised below in Table II :-



TABLE II.

Age	Name	Lithology	Fmt. Top (feet from R.T.)	Thick- ness (feet)
Quaternary	RECENT	Unnamed	5'	15'
	PLEIST- OCENE	Tarwin Beds	20'	120'
	MESOZOIC	Strze- lecki Group	140'	3805'+

A detailed description of the well cuttings is given in Appendix 1 and of the cores in Appendix 3. A generalised description of the beds penetrated is given below :-

RECENT:

UNNAMED UNIT: 5 (ground level) - 20 feet. This unit consists of quartz sand, dark grey to black, very fine to coarse grained, with rounded to angular quartz grains and abundant humic material. The unit is slightly calcareous towards the base, with some fossil fragments of lamellibranchs (including Cardium) and gastropods.

The lower part of these beds were probably deposited in an estuarine or shallow water marine environment, but the upper part was deposited in a terrestrial environment, probably similar to the sand dune peat swamp environment existing in the area today.

PLEISTOCENE TO RECENT:

TARWIN BEDS: 20 - 140 feet. This is a new name used informally for a section of sands with marine fossils penetrated from 20 - 140 feet in the Tarwin Meadows No. 1 Well. One sample from 30 feet was examined for foraminifera by Taylor (Appendix 3) and has been shown to contain similar fauna to those now existing offshore. The percentage of planktonic forms present was 5%; high enough to indicate a direct

connection to the open sea. The Tarwin Beds are considered on the above evidence to be Pleistocene to Recent in age. They fall naturally into several lithologic units as described below :-

UNIT 1: 20 - 40 feet - Quartz sand, dark greenish-grey to black, fine grained with rounded to sub-rounded quartz grains, well sorted, with calcareous cement. The Unit includes abundant shell and fossil fragments up to 1 cm in size of lamellibranchs and gastropods, including Bulla? Turritella? Comus? Chione? Cucullaea Cardium. A few bands of plastic black clay are interbedded with the sands.

UNIT 2: 40 - 138 feet - Quartz sand, grey, some parts slightly greenish, very fine to very coarse grained, mainly poorly sorted, but in part well sorted with calcareous cement. There is some black to dark brown, fibrous coal, soft when wet. Dark green (glauconite?) grains are common in the basal 28 feet. Unit contains fossil fragments, lamellibranchs, gastropods, bryozoas.

UNIT 3: 138 - 140 feet - Quartz conglomerate, grey, with granules and pebbles of quartz in a calcareous sandstone matrix.

#### MESOZOIC:

STRZELECKI GROUP: 140 - 3945 feet. This group consists of tight green-grey, arkosic sandstone and green-grey siltstone and shale. There are minor pebbles and granules of quartz.

The group has been subdivided in the well into five informal units. The units have been differentiated on the basis of electric logs, for instance, an E log change at 675 and 3,095 feet and on the basis of lithology, for instance the presence of coal seams between 1,460 and 2,000 feet.

UNIT 1: 140 - 675 feet - Arkosic sandstone and siltstone with minor shale interbedded. The unit consists predominantly of sandstone. The base of the unit is placed at an E log break co-inciding with a lithological change to a shale unit.

UNIT 2: 675 - 1460 feet - Interbedded shale, siltstone and arkosic sandstone. The unit consists predominantly of shale. The base of the unit is placed at the top of the first coal seam.

UNIT 3: 1460 - 2000 feet - Interbedded shale, arkosic sandstone, siltstone and coal. This unit is differentiated by the presence of coal and may be equivalent to the upper part of the Wonthaggi Coal Measures.

UNIT 4: 2000 - 3095 feet - Shale, with interbedded arkosic sandstone and siltstone. This unit consists predominantly of shale. The base of this unit is an E log change corresponding to a lithological change to a unit consisting mainly of sandstone.

UNIT 5: 3095 - 3945 feet - Arkosic sandstone, siltstone and shale interbedded.

The lowest sample so far examined for spores (see Dettmann - Appendix 5 of this report) is from Core No. 6 (2606 feet). This sample yielded a lower speciosus assemblage indicating it is slightly younger than the basal coal seam of the Kirrak Coal Basin which contains spores of the Stylosus assemblage (see Dettmann 1963)

Samples from earlier cores also contain the speciosus assemblage.

#### 4. STRUCTURE:

Tarwin Meadows No. 1 was drilled as a stratigraphic test and there is little geological or geophysical evidence on which to infer geological structure around the well. However, it is possible that the well was located on the southeast flank of a north-northeast trending anticline, the presence of which is inferred from aeromagnetic and geological evidence (see Plate 1).

#### 5. RELEVANCE OF OCCURRENCE OF PETROLEUM:

The sediments of Eocene to Miocene age, from which the flows of gas have been obtained to the east in the Gippsland Shelf Nos. 1 and 2 Wells, are not present in the Tarwin Meadows No. 1 and are likely to be absent from the whole Tarwin Embayment.

Minor gas shows were obtained from Cores at 1,600 and 2,580 feet in the Mesozoic Strzelecki Group. A slightly stronger gas show, which caused gas cutting of the mud was noted at 3,100 feet, but mud only was obtained when the zone was drill stem tested in open hole.

Although a thicker section of Mesozoic sediments than anticipated has been encountered, this has not revealed any porous potential reservoir beds and to this extent the section so far penetrated has poor petroleum prospects.

6. POROSITY AND PERMEABILITY OF SEDIMENTS PENETRATED:

The Quaternary sediments are porous and permeable and contain freshwater. The Mesozoic sediments are uniformly tight, except possibly the intervals from 472 to 478 feet, 577 to 580 feet and from 1696 to 1718 feet, all of which show positive separation of the microlog. The two higher intervals were regarded as too thin to be worth testing, while the microlog separation in the interval 1696 to 1718 was considered spurious as no porosity was evident in the cuttings.

7. CONTRIBUTION TO GEOLOGICAL CONCEPTS RESULTING FROM DRILLING:

Tertiary sediments are absent from the Tarwin Embayment, but more than 3,800 feet of Mesozoic sediments has been found to be present. As the results of the Andersons Inlet Aeromagnetic Survey suggested, there were less than 500 feet of sediments present in the Tarwin Meadows area, the results of the aeromagnetic surveys in Bass Strait cannot be relied upon entirely. In particular the Bass Strait and Gippsland Basins are now thought to be connected through the Tarwin Embayment and the Strzelecki Group is thought to extend under Bass Strait to Tasmania.

Unfortunately, the Tarwin Meadows No. 1 Well was unable to penetrate deep enough to establish or disprove the presence of a porous sandstone at the base of the Strzelecki Group in this area. The well did, however, establish that the upper part of the Strzelecki Group has, as elsewhere in the Gippsland Basin, no effective porosity or permeability.

The presence of gas shows in the Strzelecki Group, however, suggests that either they are potential source rocks or there are potential source rocks deeper in the basin.

V. REFERENCES

Annual Report of Secretary for Mines for 1913 and 1914.  
Victorian Mines Department.

BAIN J.S. - 1956  
Geology of Turtons Creek Area, Gippsland, Victoria.

BOUTAKOFF N. - 1954 - 55  
A new approach to Petroleum Geology and Oil  
Possibilities in Gippsland. Mining & Geological  
Journal Vol. 5 Nos. 4-5.

BOUTAKOFF N. - 1956  
Significance of Oil Discovery in South Gippsland.  
Mining & Geological Journal Vol 6. No. 1.

BRUNDALL L. - 1964  
Memorandum Report on Photogeologic Evaluation  
of Portions of P.E.P.28, P.P.L. 199 and P.P.L. 210,  
Victoria. Geophote Resources Consultants Private  
Report to Alliance Oil Development Australia N.L.

CUNDILL J, and  
MEYERS N - 1963  
Gippsland Regional Cross-section Lakes Entrance -  
Mornington Peninsula - Dandenong Area (P.E.P.28,  
P.P.L. 199, P.P.L. 210, P.E.P.36, P.E.P.34).

DETTMAN, Mary E. - 1963  
Upper Mesozoic Microfloras from south-eastern  
Australia. Proc. R.S. Victoria N.S. Vol. 77 part 1.

DOOLEY and  
MULDER - 1953  
Discussion of Gravity Results, East Gippsland,  
Victoria.

DOUGLAS J - 1965  
Strzelecki Group.

EDWARDS A.B. and  
BAKER G. - 1943  
Jurassic Arkose in Southern Victoria. Proc. Reg.  
Soc. Victoria N.S. 45, P.P. 195-228.

EDWARDS A.B.,  
BAKER G and  
KNIGHT J.I - 1944  
The Geology of the Wonthaggi Coalfield, Victoria.  
Proc. A.I.M.M. No. 134 N.S.

FERGUSON W.H. - 1906  
Report on Glacial Conglomerate of supposed Jurassic  
age in Parish of Wonga Wonga near Foster, Southern  
Gippsland with plan. Rec. Geol. Surve. Vic.  
Vol 1. Part 4.

- FERGUSON W.H. 1902-1927  
Geological Plans of the following parishes - Welshpool, Toora, Wonga Wonga, Woorama, Dumbalk, Wonga Wonga South, Doomburrin, Waratah North, Waratah, Yanakie, Yanakie South, Tarwin, Tarwin South, Meehiyan, Drumdemara. Published by Geological Survey of Victoria
- FERGUSON W.H. - 1909  
Report on the Lower Powlett, Cape Paterson and Inverloch Quarter Sheets - Mem. Geol. Surv. Vic. No. 8.
- HOPKINS B.M. - 1965  
Geological Interpretation of the Structure of Bass Strait for Petroleum Exploration. Symposium on Geophysics and Oil Exploration A.I.M.M. and Geophysics Group of Institute of Physics.
- HOCKING J.B. - 1965  
Characteristics of the Tertiary Formations of Southern and Southeastern Gippsland. Gippsland Basin Study Progress Report Geol. Survey of Victoria.
- QUILTY J.H. - 1962  
Gippsland Basin Airborne Magnetic Surveys Victoria 1951-2 and 1956. B.M.R. Record 1962/53.
- RADE J. - 1956  
Report on Leases 199 and 210 Victoria. Westralian Oil Limited Private Report.
- REFORD M.S. - 1962  
Bass Strait and Encounter Bay Aeromagnetic Survey Interpretation Report.
- STACH L.W. - 1962  
Compilation Report for Oil Development N.L.'s Aeromagnetic Survey Andersons Inlet P.E.P.36.
- STEPHENS G.J. - 1964  
Evaluation of the Geology of Petroleum Prospects of P.P.L. 199, 210 and P.E.P.28, 36 South Gippsland, Victoria. Private Report Alliance Oil Management.
- WEBB E.A. -- 1961  
The Geology and Petroleum Potentialities of the Gippsland Area of Victoria. Australian Oil and Gas Journal Nov. 1961.

6.12.1965.

D.D.

APPENDIX NO. 1.

ALLIANCE TARWIN MEADOWS NO. 1. WELL  
LITHOLOGICAL DESCRIPTION

- 0' - 10' 100% QUARTZ GRAINS, fine grained, white and clear, some light brown, sub-rounded to angular, non-calcareous. Common trace HUMUS.
- 10' - 20' 90% QUARTZ GRAINS, fine to very coarse grained, mainly fine, white, clear, some light brown, rounded to sub-angular.  
5% Yellow CLAY, and red-brown, ferruginous material.  
5% CALCAREOUS GRAINS, rare trace black CLAY; a lamellibranch valve (Cardium?), fragments of gastropod and lamellibranch.
- 20' - 30' 40% QUARTZ GRAINS, fine grained, white and clear, common light to dark brown, rounded to sub-rounded.  
50% Fine grained CALCAREOUS FRAGMENTS.  
5% Black CLAY; trace yellow CLAY and trace ferruginous red material.  
5% Large shell fragments of lamelli-branches, gastropods and echinoids, including whole specimens of e.g. common Bulla?, Turritella?, Cardium?, etc., etc.
- 30' - 40' 30% QUARTZ GRAINS, as above.  
40% Calcareous FOSSIL FRAGMENTS, as above.  
30% Large FOSSIL FRAGMENTS, as above, also including Neptunea?, Conus?, Chione?, Cucullaea.  
Trace coarse, rounded, clear QUARTZ GRAINS.  
Trace black CLAY.
- 40' - 50' 50% QUARTZ GRAINS, very fine to very coarse, mainly medium grained, clear, with some white, very coarse is rounded, medium grains are sub-rounded to sub-angular.  
30% Fine grained FOSSIL FRAGMENTS.  
20% Large FOSSIL FRAGMENTS.  
Trace COAL, black, fibrous, soft.
- 50' - 60' About 80% of this interval was SILT, which was lost through the Shaker.  
Sample -  
100% QUARTZ GRAINS, 60% coarse to very coarse, clear to white, frosted, rounded to sub-rounded, 40% fine to medium, clear to white, rare trace pink, sub-rounded to sub-angular. Common trace fine grained SHELL FRAGMENTS.  
Trace COAL, black, soft, fibrous.  
Trace large SHELL FRAGMENTS.

- 60' - 70' 100% Calcareous QUARTZ SAND, 70% grey, coarse to very coarse grained, clear, cloudy and white, rounded to subrounded, fair to well sorted, 30% fine grained, occasionally medium grained, subangular to subrounded, fair sorted. Common fine shells and SHELL FRAGMENTS, large (to 1cm) fragments of PELECYPODS, GASTROPODS and BRYZOANS. Trace COAL, black, brittle, in part shiny. Trace WOOD FRAGMENTS.
- 70' - 80' 100% Calcareous QUARTZ SAND, as above, but with ratio coarse to fine (to silt size): 20 to 80. Numerous very fine to coarse SHELL FRAGMENTS of PELECYPODS, GASTROPODS.
- 80' - 90' 90% Calcareous QUARTZ SAND, as above, fine to medium grained, occasionally coarse grained. Common SHELL FRAGMENTS of pelecypods, gastropods, etc.  
10% COAL, black, dull, shiny on fresh surfaces, fibrous, slightly brittle but soft when wet.
- 90' - 100' 90% Calcareous QUARTZ SAND, as above, medium to fine and coarse grained, fair sorted; common SHELL FRAGMENTS, as above.  
10% COAL, as above.
- 100' - 110' 90% Calcareous QUARTZ SAND, as above, grey, very fine to occasionally coarse grained. Common SHELL FRAGMENTS, as above.  
10% COAL, as above.  
Trace CLAY, yellow, green, slightly silty, non-plastic, non-calcareous.
- 110' - 120' 100% Calcareous QUARTZ SAND, fine grained, occasionally very fine to medium grained, well sorted, subrounded to subangular, clear, cloudy and some white QUARTZ, common calcareous fragments, trace light to dark green, well rounded, fine grains of ?GLAUCONITE. Trace COAL, dark brown, dull, soft, fibrous. Trace CLAY, yellow-green, non-plastic, non-calcareous, hard when dry. Trace orange, sandy CLAY.
- 120' - 130' 100% Calcareous QUARTZ SAND, fine to medium grained, occasionally very fine to coarse grains, as above. Trace coloured QUARTZ and QUARTZITE GRAINS. Trace COAL, as above. Trace CLAY, yellow, green, as above.



130' - 140'

100% Calcareous QUARTZ SAND, as above, with common coarse to very coarse, angular to rounded QUARTZ GRAINS, possibly pebble fragments. Trace COAL, as above.

140' - 150'

70% MUDSTONE, light greenish-grey, light green, in part slightly sandy, soft, blocky, with occasional red, white and black specks. CAVES BADLY.

30% QUARTZ GRAINS, light grey, medium grained, occasionally fine to coarse grained, sub-rounded to subangular, with occasional angular, broken grains, clear and cloudy, occasional orange QUARTZ GRAINS.

150' - 160'

90% MUDSTONE, as above, in part very silty, also commonly orange, slightly silty.

10% QUARTZ GRAINS, as above.

160' - 170'

90% MUDSTONE, as above, more silty.

10% QUARTZ GRAINS, as above.

170' - 180'

70% MUDSTONE, grey, greenish-grey, as above, grading to argillaceous SILTSTONE.

10% SILTSTONE, dark brown, in part sandy, grades to very fine grained SANDSTONE, argillaceous, yellow, red and black specks, soft, blocky.

10% SILTSTONE, yellow-brown, soft, blocky, slightly argillaceous.

10% QUARTZ GRAINS, as above.

180' - 190'

60% MUDSTONE, light grey, very slightly silty, with white and black, silty specks, soft, blocky, well bedded.

20% SILTSTONE, light grey, argillaceous, black, white, red and yellow specks, soft, blocky. Still caving.

10% MUDSTONE, reddish, dark brown, orange brown, very slightly silty, soft, blocky, well bedded.

10% QUARTZ SAND, light grey, medium to fine grained, subrounded to angular and broken QUARTZ GRAINS, clear, occasionally reddish or milky, well sorted.

190' - 200'

70% MUDSTONE, light grey to grey, as above, with traces of carbonaceous matter.

30% SILTSTONE, light grey, as above, in part slightly sandy.

Trace sand, orange, brown (burnt grey MUDSTONE) MUDSTONE, as above.

- 200' - 210' 70% MUDSTONE, as above, in part silty. Still caving.  
30% SILTSTONE, as above, in part slightly sandy.
- 210' - 220' 90% MUDSTONE, as above, with traces of carbonaceous matter, as above.  
10% SILTSTONE, as above.
- 220' - 225' 60% MUDSTONE, as above, light to dark grey, occasional QUARTZ GRANULES, well bedded, blocky.  
30% SILTSTONE, as above, grading to very fine grained SANDSTONE, argillaceous, possibly feldspathic.  
10% QUARTZ GRANULES, ROCK FRAGMENTS. Trace dark brown COAL.
- 6 $\frac{3}{8}$ " casing to 223'
- 225' - 230' 10% MUDSTONE, as above.  
90% SILTSTONE, to very fine grained, arkosic SANDSTONE, grey to blueish grey, with greater than 25% white grains, feldspar as specks, less than 50% dark grey and blueish grey minerals as specks, soft to firm, blocky.  
Trace QUARTZ GRANULES, no shows.
- 230' - 240' 100% Arkosic SANDSTONE, as above, in part with up to 20% QUARTZ GRAINS, subrounded, cloudy, fine to medium grained. Rock has a speckled appearance, is firm in part, appears to have a feldspathic cement, is arenaceous and indicates quick deposition close to the source area. No shows.
- 240' - 250' 90% SANDSTONE, arkosic, light grey, occasionally slightly greenish, very fine to fine grained, composed of white FELDSPAR, occasionally euhedral, QUARTZ in part, well rounded, grey mineral and/or ROCK GRAINS, occasional green and red grains in a tight, sometimes feldspathic, sometimes argillaceous matrix. No shows; hard to firm. In part slightly calcareous.  
10% MUDSTONE, light grey, firm to soft, blocky, well bedded, occasionally slightly silty.
- 250' - 260' 100% SANDSTONE, as above, mainly fine grained, occasionally very fine grained, arkosic, in part feldspathic (FELDSPAR greater than 25%), tight, no shows.

- 260' - 270' 100% SANDSTONE, as above, very fine to fine grained. Possibly a lithic SANDSTONE, feldspathic, in part arkosic.
- 270' - 280' 100% SANDSTONE, as above, fine to very fine grained with numerous well rounded QUARTZ GRAINS, tight, no shows. Trace MUDSTONE, light brown-grey, slightly silty, firm, blocky.
- 280' - 290' 90% SANDSTONE, as above, with several granules and pebbles of QUARTZ and QUARTZITE (with amber QUARTZ GRAINS) SANDSTONE, calcareous in part, tight.  
10% LIMESTONE, light grey, dense with numerous silty inclusions with vein? CALCITE cutting across.  
Trace COAL, black, firm, detrital, occurs occasionally with inclusions of SANDSTONE, as above.  
Trace MUDSTONE, as above, no shows.
- 290' - 300' 100% SANDSTONE, as above, fine grained, no shows, tight, with numerous inclusions of dark grey rock, non-calcareous, possibly SHALE, LIMESTONE, QUARTZ, several apparent CALCITE VEINS, black COAL FRAGMENTS up to 2 cms. Rock is a lithic SANDSTONE, grading to a GREYWACKE.  
Trace MUDSTONE, as above.
- 300' - 304' 95% SANDSTONE, as above, occasionally yellowish, lithic fragments to 30%, no shows, tight.  
5% MUDSTONE, as above.
- 304' Circ. sample 100% SANDSTONE, lithic to sub-GREYWACKE, grey, occasionally grey, yellow, composed of fine to very fine grained QUARTZ, occasionally well rounded, FELDSPAR and accessory mineral, rare MICA, and rock fragments of black COAL, dull SHALE, grey; blocky, hard, occasionally slightly silty, QUARTZ GRANULES, trace grey LIMESTONE. SANDSTONE is occasionally slightly calcareous, tight, no shows.

CORE NO. 1 - SEE CORE DESCRIPTION  
304' - 314' Cut 10' Recovered 6' (60%)

314' - 320'

70% MUDSTONE, light grey, occasionally greenish, occasionally slightly reddish, in part silty, firm, well bedded, thinly bedded, blocky, in part flaggy. Trace light grey-yellow, silty, blocky, firm to soft, with numerous plant fossil remains.

30% SILTSTONE, light grey, argillaceous, in part grading to very fine grained SANDSTONE, firm, blocky, occasionally well and thinly bedded. Trace SANDSTONE, fine to very fine grained, light green-grey, feldspathic.

320' - 330'

60% MUDSTONE, as above, in part very silty, abundant plant remains, common black COAL inclusions.

40% SILTSTONE, trace very fine grained SANDSTONE, as above, with inclusions MUDSTONE. Overall finely interbedded MUDSTONE and SILTSTONE.

330' - 340'

50% MUDSTONE, light grey, occasionally yellowish, as above, occasional plant remains, blocky to slightly fissile.

50% SILTSTONE, as above, argillaceous, in part very sandy, often with abundant plant remains. Fragments green band, very fine grained, hard, non-calcareous, rock, possibly a MUDSTONE??

340' - 350'

70% SILTSTONE, light grey, argillaceous, rarely sandy, firm, occasionally well bedded, carbonaceous, with white, orange black (carbon?) green and red specks.

30% MUDSTONE, light grey, slightly silty, firm, blocky, occasionally well bedded, carbonaceous, no shows. Trace lithic SANDSTONE (cavings).

350' - 360'

60% MUDSTONE, as above, carbonaceous, with numerous plant fossil remains, occasionally slightly greenish.

40% SILTSTONE, as above. Trace COAL, black, fair cleat, firm.

360' - 370'

30% MUDSTONE, as above.

40% SILTSTONE, as above.

30% SANDSTONE, light grey, silty, very fine grained, gradation from SILTSTONE, possibly arkosic, firm, tight, no shows.

370' - 380'	40% MUDSTONE to SHALE, as above. 50% SILTSTONE, as above. 10% SANDSTONE, as above, carbonaceous, tight, no shows.
380' - 390'	30% MUDSTONE to SHALE, as above. 70% SILTSTONE, as above, in part sandy, carbonaceous. Trace white, calcareous, SILTSTONE - CHALK? - soft.
390' - 400'	20% MUDSTONE, as above. 70% SILTSTONE, as above, in part well bedded. 10% SANDSTONE, very fine grained, light grey, arkosic, as above, tight, no shows.
400' - 410'	20% MUDSTONE to SHALE, light grey, silty, firm, blocky, well bedded, carbonaceous. 60% SILTSTONE, light grey, in part sandy, firm, blocky, well bedded, carbonaceous, with orange, green, white and black (carb.) specks. 20% SANDSTONE, light grey, very fine grained, arkosic, well sorted, slightly carbonaceous, tight, no shows.
410' - 420'	10% MUDSTONE to SHALE, as above. 40% SILTSTONE, as above. 50% SANDSTONE, as above, with orange, red, green, black and white specks, in part lithic, otherwise arkosic, tight, no shows.
420' - 430'	10% MUDSTONE to SHALE, as above. 30% SILTSTONE, as above. 60% SANDSTONE, as above, argillaceous, in part arkosic, in part light yellow, calcareous, tight, no shows.
430' - 440'	20% MUDSTONE, as above. 60% SILTSTONE, as above, in part very argillaceous. 20% SANDSTONE, as above, tight, no shows.
440' - 450'	10% MUDSTONE to SHALE, as above. 40% SILTSTONE, as above. 50% SANDSTONE, as above, with well rounded fine QUARTZ GRAINS. Plant remains, tight, no shows. Trace COAL, black.
450' - 460'	20% MUDSTONE, SHALE, as above. 30% SILTSTONE, as above. 50% SANDSTONE, as above, argillaceous, tight, no shows.

460' - 470'

10% MUDSTONE to SHALE, as above.  
30% SILTSTONE, as above, argillaceous, carbonaceous.  
60% SANDSTONE, as above, very light grey to slightly whitish, in part with medium to fine QUARTZ GRAINS, slightly to very carbonaceous; tight, no shows.

470' - 480'

20% MUDSTONE to SHALE, light grey, slightly greenish in part, carbonaceous, slightly silty, firm, blocky, well bedded.  
40% SILTSTONE, light grey, sandy in part, argillaceous, firm, blocky, carbonaceous, well bedded, occasional interbeds with MUDSTONE, numerous specks of orange, green, red and black minerals.  
40% SANDSTONE, light grey, in part slightly greenish, very fine to fine grained, fair sorted, in part arkosic, argillaceous, with numerous specks of orange green, red, black mineral, slightly carbonaceous, tight, no shows, in part lithic.

480' - 490'

10% MUDSTONE, as above.  
20% SILTSTONE, as above.  
70% SANDSTONE, as above, in part lithic with ROCK GRAINS, medium grained, in very fine to silty matrix; tight, no shows.

490' - 500'

20% MUDSTONE to SHALE, as above.  
20% SILTSTONE, as above.  
60% SANDSTONE, as above, mainly arkosic, very fine to fine grained, tight, no shows.

500' - 510'

30% MUDSTONE to SHALE, light grey, blocky, as above.  
40% SILTSTONE.  
30% SANDSTONE, very fine grained, fair sorted, arkosic in part, slightly carbonaceous, slightly friable, occasionally round grained, black mineral, as above, tight, no shows.

510' - 520'

10% MUDSTONE to SHALE, light grey, some brown-grey, blocky, as above.  
40% SILTSTONE, light grey, brown-grey, as above. Sandy in part.  
50% SANDSTONE, very fine to fine grained, argillaceous, slightly friable, common white FELDSPAR, grains rounded and black mineral, tight, no show.

- 520' - 530'
- 10% MUDSTONE to SHALE, light grey, brown-grey, common carbon laminations.
  - 80% SILTSTONE, as above, grades to -
  - 10% SANDSTONE, as above, all fine grained, tight, no shows.
- 530' - 540'
- 10% MUDSTONE, as above.
  - 70% SILTSTONE, as above.
  - 20% SANDSTONE, as above, tight, no shows.
- 540' - 550'
- 10% MUDSTONE to SHALE, light grey and brown grey, slightly carbonaceous, silty, blocky, occasionally well laminated.
  - 10% SILTSTONE, light grey, slightly carbonaceous, rare trace FELDSPAR, occasionally interbedded with MUDSTONE.
  - 80% SANDSTONE, light green-grey, fine to medium grained, slightly carbonaceous, argillaceous, arkosic, firm, consists of green and grey QUARTZ with white FELDSPAR, rounded grains and black mineral, in an argillaceous matrix, tight, no shows.
- 550' - 560'
- 10% MUDSTONE to SHALE, grey and brown-grey, as above, laminated.
  - 10% SILTSTONE, as above.
  - 80% SANDSTONE, as above, fine grained, arkosic, tight, no shows, green-grey.
- 560' - 570'
- 10% MUDSTONE to SHALE, as above, commonly laminated, blocky with some carbonaceous flecks. Trace black, carbonaceous SHALE.
  - 20% SILTSTONE, grey, sandy, slightly carbonaceous, firm, occasionally laminated.
  - 70% SANDSTONE, grey-green, as above, argillaceous, tight, no shows.
- 570' - 580'
- 10% MUDSTONE, as above, silty.
  - 10% SILTSTONE, as above.
  - 80% SANDSTONE, as above, fine grained.
- 580' - 590'
- 20% MUDSTONE, as above.
  - 10% SILTSTONE, as above.
  - 70% SANDSTONE, as above, fine grained, tight, no shows, carbonaceous.

590' - 600'

- 20% MUDSTONE, as above, silty, carbonaceous.
- 20% SILTSTONE, as above, occasionally sandy.
- 60% SANDSTONE, as above, fine grained, tight, no shows. Trace QUARTZ GRANULES, sub rounded, cloudy QUARTZ.

600' - 610'

SEE CORE DESCRIPTION CORE NO. 2.

620' - 630'

- 80% SANDSTONE, light grey-greenish, fine to occasionally medium grained, in part arkosic, consists of clear and grey QUARTZ, white FELDSPAR (occasionally weathered) black, red and orange mineral grains, in an argillaceous, gray matrix; approx. 20% of sample, yellow, grey, constituents as above, with a yellowish, calcareous matrix; tight, no shows.
- 20% SHALE, light grey to mid grey, silty, firm, blocky, occasionally slightly fissile, occasionally slightly carbonaceous, well bedded.

630' - 640'

- 80% SANDSTONE, as above, with 20% yellow-grey, which has a greater amount of matrix to grains; approx. 60:40, with light grey having approx. 30:70. Yellow-grey variety is harder, more siliceous. Tight, no shows.
- 10% SILTSTONE, light grey, sandy, argillaceous, with red, orange, black and white mineral specks, carbonaceous, firm, blocky, well bedded.
- 10% SHALE, as above. Trace COAL, black, dull, brittle, fair cleat. Trace QUARTZ GRANULE, cloudy, rounded - associated with SANDSTONE.

640' - 650'

- 80% SANDSTONE, as above, approx. 20% yellow-grey; occasionally with COAL FRAGMENTS (to 1cm) and SHALE FRAGMENTS; tight, no show.
- 10% SILTSTONE, as above.
- 10% SHALE, as above. Trace COAL, as above.

650' - 660'

- 90% SANDSTONE, as above.
- 10% SHALE, silty, carbonaceous, as above, well bedded. Tight, no shows.



- 660' - 670' 70% SANDSTONE, as above, tight, no shows, light grey, arkosic; yellow-grey, slightly calcareous.  
10% SILTSTONE, as above.  
20% SHALE, as above, in part silty, firm, light grey, slightly greenish, slightly fissile.  
Trace COAL, as above.
- 670' - 680' 70% SANDSTONE, as above, tight, no shows.  
5% SILTSTONE, as above.  
25% SHALE, as above, in part silty.  
Trace COAL, as above.
- 680' - 690' 90% SHALE, light grey to mid grey, firm, fissile, in part slightly silty, well bedded, possibly fractured, in part slightly carbonaceous.  
10% SILTSTONE, argillaceous, light grey, firm, slightly blocky, or slightly fissile, well bedded, no shows.  
Trace COAL, black, dull, brittle; SANDSTONE, as above.
- 690' - 700'  
Trip 60% SHALE, as above, in part silty.  
30% SILTSTONE, as above, argillaceous.  
10% SANDSTONE, arkosic, light grey, fine grained, tight, no shows.
- 700' - 710' 70% SHALE, as above, occasionally dark grey to black, well bedded, slightly fissile, firm.  
30% SILTSTONE, as above, argillaceous.  
Trace COAL, black, as above;  
SANDSTONE, as above, no shows.
- 710' - 720' 80% SHALE, as above, mid grey and dark grey, darker variety more carbonaceous, well bedded, firm, fissile.  
20% SILTSTONE, light grey, as above.  
Trace SANDSTONE, as above;  
tight, no shows.
- 720' - 730' 70% SHALE, as above, mid and dark grey, as above.  
30% SILTSTONE, light grey, argillaceous, in part grades to very fine SANDSTONE.  
Trace SANDSTONE, as above, fine grained, with occasional granule.  
Trace QUARTZ GRANULE, white, angular.

- 730' - 740' 40% SHALE, mid to dark grey, as above.  
60% SILTSTONE, light grey, sandy, grades almost to very fine grained SANDSTONE, argillaceous, firm to medium soft, massive with mineral specks, white, black, red, slightly carbonaceous; tight, no shows.
- 740' - 750' 60% SHALE, as above, in part silty.  
40% SILTSTONE, as above.  
Trace SANDSTONE, as above, slightly calcareous, arkosic.
- 750' - 760' 30% SHALE, mid to dark grey, slightly silty, firm, slightly fissile, well bedded, thinly bedded, in part calcareous.  
50% SILTSTONE, light to mid grey, slightly greenish, argillaceous, in part grades to very fine grained SANDSTONE, firm, blocky, in part slightly carbonaceous, occasionally well bedded.  
20% SANDSTONE, light grey, slightly greenish, arkosic, fine grained, with occasional medium to coarse QUARTZ GRAINS, fairly sorted, composed of clear to cloudy grey QUARTZ, white FELDSPAR, red, orange and black mineral specks, in an argillaceous matrix, with occasional lithic, black COAL FRAGMENTS, tight, no shows.
- 760' - 770' 50% SHALE, as above, in part silty.  
10% SILTSTONE, as above.  
40% SANDSTONE, arkosic, fine grained, as above, tight, no shows.
- 770' - 780' 20% SHALE, as above.  
10% SILTSTONE, as above, in part carbonaceous.  
70% SANDSTONE, arkosic, as above, tight, no shows. Trace COAL.
- 780' - 790' 70% SHALE, as above, mid to dark grey, in part silty, with carbonaceous PLANT REMAINS.  
10% SILTSTONE, as above.  
20% SANDSTONE, arkosic, as above, tight, no shows.  
Trace COAL, as above.
- 790' - 800' 70% SHALE, as above, in part very carbonaceous, firm, fissile, well bedded.  
20% SILTSTONE, as above, argillaceous.  
10% SANDSTONE, as above, tight, no shows. Trace COAL.

800' - 810'	<p>80% SHALE, as above, in part slightly silty.            10% SILTSTONE, as above.            10% SANDSTONE, as above, arkosic, tight, no shows,            Trace COAL, as above.</p>
810' - 820'	<p>90% SHALE, mid to dark grey, occasionally light grey, in part slightly silty, firm, fissile, occasionally blocky, in part carbonaceous with plant fossil remains, well bedded, in part massive. Occasionally carbonaceous SHALE.            10% SILTSTONE, light to mid grey, argillaceous, firm, blocky, occasionally well bedded, carbonaceous, orange, red, black and white mineral specks.            Trace SANDSTONE, arkosic, light grey, fine grained, tight, no shows; COAL.</p>
820' - 830'	<p>80% SHALE, as above and carbonaceous SHALE.            20% SILTSTONE, as above, in part slightly sandy with rare QUARTZ GRAINS, trace medium grained.            Trace SANDSTONE, no shows.</p>
830' - 840'	<p>80% SHALE, as above, and carbonaceous SHALE.            20% SILTSTONE, as above, in part slightly greenish.            Trace SANDSTONE, no shows.</p>
840' - 850'	<p>70% SHALE, as above and carbonaceous SHALE, etc.            10% SILTSTONE, as above.            20% SANDSTONE, light grey-greenish, arkosic, fine to very fine grained, argillaceous matrix, composed of QUARTZ, FELDSPAR and coloured mineral specks, tight, no shows.</p>
850' - 860'	<p>80% SHALE, as above, in part slightly silty.            20% SANDSTONE, as above, in part silty; tight, no shows.</p>
860' - 870'	<p>70% SHALE, as above.            10% SILTSTONE, light grey, slightly carbonaceous, firm, blocky.            20% SANDSTONE, as above, fine grained, occasionally very fine grained, tight, no shows, in part with plant fossil remains.</p>
870' - 880'	<p>80% SHALE, as above.            10% SILTSTONE, as above.</p>

- 870' - 880'  
(cont)
- 10% SANDSTONE, as above, very fine grained, part very slightly calcareous, tight, no shows. Trace COAL, black, dull, brittle.
- 880' - 890'
- 70% SHALE, medium to dark grey, occasionally greenish, firm, fissile, in part silty, slightly carbonaceous, well bedded, occasionally massive; occasionally dark grey, carbonaceous SHALE, with slight fracture.
- 30% SILTSTONE, light to mid grey-greenish, in part very finely sandy, argillaceous, in part slightly carbonaceous, occasionally well bedded, firm, blocky, occasionally fissile. Trace SANDSTONE, arkosic, fine to very fine grained, tight, no shows.
- 890' - 900'
- 70% SHALE, as above, in part purple-grey.
- 20% SILTSTONE, as above.
- 10% SANDSTONE, arkosic, fine grained, light grey and green-grey, fairly sorted, massive, tight, no shows, occasionally slightly carbonaceous.
- 900' - 910'
- 40% SHALE, as above.
- 40% SILTSTONE, as above, commonly siliceous, hard, slightly sandy.
- 20% SANDSTONE, arkosic, fine to very fine grained, as above, in part slightly calcareous, slightly carbonaceous, tight, no shows. Trace PYRITE, massive.
- 910' - 920'
- 70% SHALE, as above, in part well bedded.
- 25% SILTSTONE, as above.
- 5% SANDSTONE, arkosic, as above, tight, no shows.
- 920' - 930'
- 70% SHALE, as above.
- 30% SILTSTONE, grading to very fine grained SANDSTONE, as above, no shows. Trace COAL, black.
- 930' - 940'
- 30% SHALE, as above, in part very carbonaceous.
- 40% SILTSTONE, as above, argillaceous and slightly sandy.
- 30% SANDSTONE, very fine grained, fair sorted QUARTZ, FELDSPAR, green, red, black mineral specks, in fine, argillaceous matrix; tight, no shows.

- 940' - 950'
- 10% SHALE, as above.
  - 70% SILTSTONE, as above, light grey and mid grey-greenish, carbonaceous, in part slightly sandy.
  - 20% SANDSTONE, as above, but arkosic, with more FELDSPAR, tight, no shows.
- 950' - 960'
- 60% SANDSTONE, arkosic, light grey-greenish, fine grained, occasionally medium grained, fair sorted, argillaceous, consists of QUARTZ, FELDSPAR, and green, red, orange, black and white mineral specks, in an argillaceous matrix, occasionally slightly carbonaceous, massive, tight, no shows.
  - 30% SILTSTONE, light to mid grey, slightly greenish, in part sandy, argillaceous, firm, blocky, occasionally well bedded, carbonaceous, with white, red, green and black mineral specks.
  - 10% SHALE, mid to dark grey, occasionally greenish, slightly silty, firm, fissile, occasionally blocky, slightly carbonaceous, well bedded, occasionally massive.
- 960' - 970'
- 30% SANDSTONE, as above, tight, no shows.
  - 20% SILTSTONE, as above.
  - 50% SHALE, as above, in part very carbonaceous.
- 970' - 980'
- 5% SANDSTONE, as above.
  - 5% SILTSTONE, as above.
  - 90% SHALE, as above, in part slightly brownish, slightly silty, no shows.
- 980' - 990'
- 30% SILTSTONE, as above, occasionally slightly sandy, carbonaceous.
  - 70% SHALE, as above, no shows. Trace SANDSTONE, as above.
- 990' - 1000'
- 40% SILTSTONE, as above, rarely grades to very fine grained SANDSTONE.
  - 60% SHALE, as above, in part very silty; no shows. Trace SANDSTONE, as above, fine to very fine grained.
- 1000' - 1010'
- 40% SHALE, as above.
  - 60% SILTSTONE, as above, in part sandy, in part siliceous, no shows. Trace SANDSTONE, as above, tight.

- 1010' - 1020'      40% SHALE, as above, in part silty to very silty.  
60% SILTSTONE, as above, in part grades to very fine grained SANDSTONE.  
Trace SANDSTONE, as above, tight, no shows.
- 1020' - 1030'      60% SHALE, as above, in part silty.  
40% SILTSTONE, as above, argillaceous, in part sandy, as above.  
Trace SANDSTONE, as above, tight, no shows.
- 1030' - 1040'      50% SHALE, mid to dark grey, slightly greenish, slightly silty, firm, fissile, occasionally blocky, in part slightly carbonaceous, well bedded, in part massive.  
40% SILTSTONE, light to mid grey, argillaceous, slightly sandy in part, firm, blocky, occasionally fissile, occasionally siliceous and hard, in part grades to very fine grained arkosic SANDSTONE, in part carbonaceous.  
10% SANDSTONE, arkosic, very fine to fine grained, firm, composed of QUARTZ, FELDSPAR, red, black, green and white mineral specks in an argillaceous matrix, massive, tight, no shows. Speckled white and grey appearance.
- 1040' - 1050'      20% SHALE, as above.  
80% SILTSTONE, as above, mainly grading to very fine grained arkosic SANDSTONE.  
Trace SANDSTONE, as above, no shows.
- 1050' - 1060'      30% SHALE, as above, slightly silty, slightly carbonaceous.  
50% SILTSTONE, as above.  
20% SANDSTONE, light grey, arkosic, very fine to fine grained, as above, tight, no shows.
- 1060' - 1070'      20% SHALE, as above.  
30% SILTSTONE, as above.  
50% SANDSTONE, arkosic, very fine to fine grained, occasionally medium grained, firm, in part very slightly calcareous, as above; tight, no shows.

- 1070' - 1080'      10% SHALE, as above.  
20% SILTSTONE, as above, in part well bedded.  
70% SANDSTONE, arkosic, as above, fine grained, occasionally very fine or medium grained, tight, no shows.
- 1080' - 1090'      20% SHALE, as above, silty, in part very carbonaceous.  
20% SILTSTONE, as above.  
60% SANDSTONE, arkosic, fine to medium grained, as above, tight, no shows.
- 1090' - 1100'      10% SHALE, as above.  
20% SILTSTONE, as above.  
70% SANDSTONE, arkosic, as above, in part more a feldspathic QUARTZ SANDSTONE; tight no shows.
- 1100' - 1110'      30% SHALE, as above, in part very silty.  
10% SILTSTONE, as above, argillaceous, in part slightly sandy.  
60% SANDSTONE, arkosic, as above, fine to medium grained, in part very argillaceous; tight, no shows.
- 1110' - 1120'      20% SHALE, mid to dark grey, firm, slightly silty, slightly carbonaceous, fissile, occasionally blocky, in part well bedded.  
30% SILTSTONE, light to mid grey, in part slightly sandy, argillaceous, coloured mineral specks, in part slightly carbonaceous, firm, blocky.  
50% SANDSTONE, arkosic, light grey, greenish, fine to medium grained, occasionally very fine grained, consists of QUARTZ FELDSPAR, red, white, black, green mineral specks, massive, in part slightly carbonaceous with occasional carbonaceous lenses; tight, no shows.
- 1120' - 1130'      30% SHALE, as above.  
40% SILTSTONE, as above.  
30% SANDSTONE, as above, commonly very fine to fine grained; tight, no shows.
- 1130' - 1140'      40% SHALE, as above, in part very silty.  
50% SILTSTONE, as above, in part sandy and grading to very fine grained SANDSTONE.  
10% SANDSTONE, as above, tight, no shows.

- 1140' - 1145'  
(Cavings consist  
of SANDSTONE,  
arkosic, SILTSTONE  
and SHALE)
- 1145' - 1150'
- 1150' - 1160'
- 1160' - 1170'
- 1170' - 1180'
- 1180' - 1190'
- Circ. Sample.  
60% SHALE, as above.  
20% SILTSTONE, as above.  
20% SANDSTONE, as above, tight, no  
shows; speckled appearance  
due to white FELDSPAR and  
grey QUARTZ, in part  
slightly greenish. Much  
caving on trip in. Bit  
stuck. Hole cleaned.
- Trip Sample. 30% Cavings.  
30% SHALE, as above, in part  
silty, firm, blocky, occasion-  
ally fissile, mainly massive.  
40% SILTSTONE, as above.  
30% SANDSTONE, as above, very  
fine to medium grained, well  
sorted, tight, no shows.
- 50% SHALE, as above, fissile.  
50% SILTSTONE, as above, sandy,  
rarely slightly carbonaceous.  
Trace SANDSTONE, as above,  
no shows.
- 40% SHALE, as above, hard, fissile.  
50% SILTSTONE, as above, sandy.  
10% SANDSTONE, arkosic with  
lithic fragments of SILTSTONE;  
tight, no shows.
- 60% SHALE, mid to dark grey,  
slightly brownish or greenish,  
very rarely slightly silty,  
hard, fissile, in part slightly  
carbonaceous.  
30% SILTSTONE, light to mid grey,  
occasionally slightly greenish,  
argillaceous, in part slightly  
sandy, with black and white  
occasionally coloured mineral  
specks, firm, blocky.  
10% SANDSTONE, light grey, arkosic,  
fine to medium grained, rarely  
very fine grained, fair sorted,  
composed of clear to grey  
QUARTZ, white FELDSPAR and  
coloured mineral grains in an  
argillaceous, slightly greenish  
matrix; massive, tight, no  
shows.
- 30% SHALE, as above, fissile, hard.  
50% SILTSTONE, as above, grades to  
very fine grained SANDSTONE.  
20% SANDSTONE, as above, very  
fine grained to occasionally  
fine grained, tight, no shows,  
slightly siliceous, in part  
very slightly calcareous.



1190' - 1200'

50% SHALE, as above, trace light brown, slightly yellowish, firm, massive.  
40% SILTSTONE, as above.  
10% SANDSTONE, as above, very fine grained; tight, no show.  
Trace COAL, black, dull.

1200' - 1210'

60% SHALE, as above, and slightly brownish, carbonaceous.  
30% SILTSTONE, as above, in part slightly sandy.  
10% SANDSTONE, as above, very fine to occasionally fine grained, tight, no shows.  
One large, 1 cm, CALCITE CRYSTAL.  
Trace COAL, as above.

1210' - 1220'

40% SHALE, as above and buff, slightly calcareous, slightly silty, firm.  
40% SILTSTONE, as above, argillaceous in part sandy.  
20% SANDSTONE, as above, very fine to fine grained, tight, no shows.  
Trace CALCITE VEINS in SHALE.

1220' - 1230'

60% SHALE, as above, in part very silty.  
40% SILTSTONE, as above, very argillaceous, in part slightly sandy.  
Trace SANDSTONE, fine grained, as above.

1230' - 1240'

30% SHALE, as above, in part with CALCITE VEINS.  
50% SILTSTONE, as above, argillaceous in part sandy, firm, massive.  
20% SANDSTONE, as above, very fine to fine grained, tight, no shows.

1240' - 1250'

30% SHALE, as above, trace buff to light brown, in part very silty.  
50% SILTSTONE, as above, argillaceous.  
20% SANDSTONE, as above, very fine to fine grained, tight, no shows.

1250' - 1260'

60% SHALE, dark to mid grey and light yellow-brown, firm, in part slightly silty, fissile, massive, rarely slightly carbonaceous.  
30% SILTSTONE, light to mid grey, occasionally light yellow-brown; in part very slightly sandy, firm, blocky, argillaceous.

1250' - 1260'  
(cont)

10% SANDSTONE, light grey, slightly greenish, arkosic and occasionally brown-grey, calcareous, siliceous, very fine grained, firm to hard, argillaceous, composed of QUARTZ FELDSPAR, coloured mineral specks in an argillaceous matrix, tight, massive, no shows.

1260' - 1270'

40% SHALE, as above, in part very carbonaceous.  
30% SILTSTONE, as above, argillaceous, firm, in part with carbonaceous flecks.  
30% SANDSTONE, arkosic, very fine grained, silty, arkosic, tight, no shows.

1270' - 1280'

20% SHALE, as above.  
40% SILTSTONE, as above, very sandy in part.  
40% SANDSTONE, as above, arkosic, speckled light grey, very fine to occasionally fine grained, argillaceous matrix, slightly calcareous in part, rare trace MICA, tight, no shows.

1280' - 1290'

20% SHALE,  
50% SILTSTONE, as above, in part very sandy, commonly with carbonaceous flecks.  
30% SANDSTONE, as above, very fine grained, occasionally fine grained, in part very silty; gradation from SILTSTONE to very fine SANDSTONE, tight, no show.

1290' - 1300'

20% SHALE, as above, commonly very carbonaceous.  
40% SILTSTONE, as above.  
40% SANDSTONE, as above, tight, no show.

1300' - 1310'

30% SHALE, as above.  
40% SILTSTONE, as above, very argillaceous.  
30% SANDSTONE, as above, very fine to occasionally fine grained, tight, no shows.

1310' - 1320'

20% SHALE, as above, in part very carbonaceous.  
60% SILTSTONE, as above, argillaceous, firm.  
20% SANDSTONE, as above, fine grained to very fine grained, in part very silty, tight, no shows.

1320' - 1330'

10% SHALE, as above.  
40% SILTSTONE, as above, argillaceous, sandy in part.  
50% SANDSTONE, arkosic, as above, very fine to fine grained, occasionally very silty, calcareous, carbonaceous, tight, no shows.

1330' - 1340'

20% SHALE, as above, with common traces yellow-brown SHALE, slightly silty.  
50% SILTSTONE, as above, slightly sandy, grades to very fine grained, arkosic SANDSTONE.  
30% SANDSTONE, as above, arkosic and FELDSPAR QUARTZ, fine to very fine grained with rare granules, tight, no shows.

1340' - 1350'

50% SHALE, mid to dark grey, occasionally slightly brownish, yellow or brown, in part slightly silty, firm, fissile, occasionally blocky.  
40% SILTSTONE, light to mid grey, occasionally slightly brown or green, argillaceous, in part very finely sandy, firm, blocky, rarely slightly carbonaceous.  
10% SANDSTONE, light grey, greenish, arkosic and sub-arkosic, very fine to fine grained, massive, tight, no shows.  
Trace COAL, black, dull.

1350' - 1360'

30% SHALE, as above, in part very carbonaceous SHALE.  
20% SILTSTONE, as above.  
50% SANDSTONE, light grey, greenish, fine to very fine grained, fair sorted, arkosic, massive, firm, in part slightly calcareous, tight no shows, in part slightly carbonaceous, trace MICA.

1360' - 1370'

20% SHALE, as above.  
30% SILTSTONE, as above, in part slightly carbonaceous.  
30% SANDSTONE, as above, tight.  
20% SANDSTONE, buff to pink, fine to occasionally fine grained, fairly sorted, hard, massive, tight, arkosic, with clear to cloudy quartz, pink to buff FELDSPAR, grey, white and green mineral specks in a (?) feldspathic matrix, slightly calcareous, no shows.

1370' - 1380'

- 20% SHALE, as above, with some carbonaceous SHALE.
- 20% SILTSTONE, as above, slightly carbonaceous.
- 40% SANDSTONE, light grey, as above, fine to very fine grained, tight.
- 20% SANDSTONE, buff, as above, in part with common green mineral grains, rarely medium grained, tight, no shows.

1380' - 1390'

- 40% SHALE, as above, mid to dark grey, slightly greenish, occasionally slightly brownish and carbonaceous SHALE, fissile.
- 30% SILTSTONE, as above.
- 30% SANDSTONE, as above, light grey, fine to very fine grained, fair sorted with approx. 5% buff, as above; tight, no shows.

1390' - 1400'

- 40% SHALE, as above, silty in part; occasional plant fossil.
- 30% SILTSTONE, as above, argillaceous, in part very slightly sandy.
- 30% SANDSTONE, as above, light grey with trace buff; tight, no shows.

1400' - 1410'

- 40% SHALE, mid to dark grey, in part slightly greenish, grey, black, carbonaceous, buff to dark yellow-brown, firm, fissile, in part slightly silty, occasionally well bedded, mainly blocks.
- 40% SILTSTONE, light to mid grey, slightly greenish in part, in part slightly sandy, argillaceous, firm, blocky, occasionally well and thinly bedded, mainly blocky, slightly carbonaceous, slightly micaceous.
- 20% SANDSTONE, arkosic, light grey-greenish and buff, very fine to fine grained, fair to well sorted quartz, feldspar and coloured mineral grains, trace MICA, in an argillaceous, feldspathic matrix, massive, firm, tight, no shows. Trace COAL.

1410' - 1420'

- 30% SHALE, as above, and purple-brown, slightly carbonaceous.
- 40% SILTSTONE, as above, in part very finely sandy, in part well and thinly bedded.
- 30% SANDSTONE, as above, arkosic, fine to very fine grained, tight, no shows.

1420' - 1430'

30% SHALE, as above.  
20% SILTSTONE, as above, argillaceous, in part slightly sandy.  
50% SANDSTONE, as above, arkosic, very fine to fine grained, fair sorted, tight, no shows.  
Trace COAL, black dull.

1430' - 1440'

20% SHALE, as above.  
50% SILTSTONE, as above, firm, massive, occasionally well and thinly bedded, slightly carbonaceous.  
30% SANDSTONE, as above, light grey and buff, slightly calcareous, tight, no shows.  
Trace COAL.

1440' - 1450'

30% SHALE, as above, with common carbonaceous SHALE and purple-brown SHALE.  
40% SILTSTONE, as above, sandy in part, argillaceous, firm, massive.  
30% SANDSTONE, as above, very fine grained, occasionally fine grained.  
Trace CALCITE in crystals to  $\frac{1}{2}$  cm.  
Trace COAL.

1450' - 1453'

CIRC. SAMPLE FOR BIT CHANGE  
40% SHALE, as above.  
30% SILTSTONE, as above.  
30% SANDSTONE, as above, light grey and buff, fine to very fine grained, tight, no shows.

1453' - 1460'

20% SHALE, mid to dark grey and brown-purple, slightly silty, firm, fissile, occasionally blocky, massive, in part very slightly carbonaceous, rare trace MICA.  
30% SILTSTONE, light grey, slightly sandy, argillaceous, firm, massive, in part well bedded, slightly carbonaceous.  
50% SANDSTONE, arkosic, light grey speckled minerals and buff, very fine to fine grained, massive, firm, well sorted, composed of QUARTZ, FELDSPAR, coloured mineral grains in an argillaceous matrix, tight, no shows.

1460' - 1470'

10% SHALE, as above.  
20% SILTSTONE, as above, in part very finely sandy.  
65% SANDSTONE, as above, mainly fine grained, well rounded QUARTZ, tight, no shows.  
5% COAL, black, dull, sub-conchoidal fractures.

1470' - 1480'

10% SHALE, as above.  
20% SILTSTONE, as above.  
70% SANDSTONE, as above, mainly very fine grained to SILTSTONE, occasionally fine grained, occasionally buff to dark brown, fine to very fine grained, tight, no shows.

1480' - 1490'

20% SHALE, as above.  
30% SILTSTONE, as above.  
50% SANDSTONE, as above, fine grained and very fine grained - silt. No shows.  
Trace COAL, as above.

1490' - 1500'

10% SHALE, as above, very silty in part.  
10% SILTSTONE, very sandy, light grey, slightly greenish in part, argillaceous with coloured mineral specks, slightly carbonaceous, in part well bedded, firm, blocky.  
80% SANDSTONE, as above, arkosic, mainly very fine grained to silty, some fine grained, tight, no shows.

1500' - 1510'

10% SHALE, as above.  
50% SILTSTONE, as above, very sandy in part.  
40% SANDSTONE, as above, arkosic, silty, trace very fine grained, some fine grained, tight, no shows.  
Trace COAL, black, in part slightly carbonaceous with plant fossils.

1510' - 1520'

30% SHALE, as above.  
60% SILTSTONE, as above.  
10% SANDSTONE, as above, fine grained, occasionally very fine grained, tight, no shows.

1520' - 1530'

40% SHALE, as above, in part carbonaceous.  
40% SILTSTONE, as above, argillaceous, slightly sandy.  
20% SANDSTONE, as above, fine and very fine grained, tight, no shows.  
Trace COAL.

1530' - 1540'

45% SHALE, mid to dark grey, grey-black, carbonaceous, slightly silty, firm, blocky or fissile (50/50), in part well bedded, slightly carbonaceous.  
35% SILTSTONE, light to mid grey, occasionally slightly greenish, argillaceous, slightly sandy in part, firm, blocky, occasionally well and thinly bedded.

1530' - 1540'  
(cont)

20% SANDSTONE, arkosic, light grey, speckled, slightly greenish, fine to very fine grained, fair sorted, massive, firm, slightly calcareous, in part slightly carbonaceous, consists of quartz feldspar and coloured mineral specks in an argillaceous matrix; tight, no shows.  
Trace COAL, black, some dull, subchoidal fracturing.  
Trace QUARTZ PEBBLE, angular.

1540' - 1550'

40% SHALE, as above, in part very carbonaceous.  
50% SILTSTONE, as above, in part sandy,  
10% SANDSTONE, as above, very fine grained, tight, no shows.  
Trace COAL, as above.

1550' - 1560'

20% SHALE, as above.  
40% SILTSTONE, as above, grades to very fine SANDSTONE. trace MICA.  
40% SANDSTONE, as above, arkosic, very fine grained to silty, occasionally fine grained, tight, no shows.  
Trace MICA.

1560' - 1570'

20% SHALE, as above.  
40% SILTSTONE, as above.  
40% SANDSTONE, as above, very fine to silty, occasionally fine grained; tight, no shows.

1570' - 1580'

20% SHALE, as above.  
50% SILTSTONE, as above.  
30% SANDSTONE, as above, arkosic, very fine grained to silty, occasionally fine grained, tight, no shows.  
Trace COAL, as above.

1580' - 1590'

30% SHALE, as above, in part very silty.  
30% SILTSTONE, as above.  
40% SANDSTONE, as above, arkosic, very fine grained to silty, slightly carbonaceous, tight, no shows.  
Trace COAL, black, as above.

1590' - 1597'

CIRC. SAMPLE - FOR CORE NO. 4.  
20% SHALE, as above.  
60% SILTSTONE, as above.  
20% SANDSTONE, as above, arkosic, very fine to silty; tight, no shows.  
Trace COAL, as above.

1597' - 1607'

CORE NO. 4 Recovered 0'9" 7.5%

1610' - 1620'

- 60% SHALE, mid to dark grey, occasionally greenish, minor purple, buff-yellow (soft), in part very silty, firm, fissile, occasionally blocky, slightly carbonaceous and carbonaceous SHALE, grey-black in part purplish, well and thinly bedded.
- 20% SILTSTONE, light grey, sandy, argillaceous, with mineral specks, firm, blocky, occasionally well bedded.
- 10% SANDSTONE, very fine to fine grained, arkosic, fair sorted, light grey, slightly argillaceous, tight, no shows and buff, very fine grained, argillaceous.
- 10% COAL, black, shiny and plant fossil remains.

1620' - 1630'

- 30% SHALE, as above and carbonaceous, slightly purplish.
- 10% SILTSTONE, as above, sandy.
- 30% SANDSTONE, arkosic, light grey, very fine, occasionally fine grained, well sorted, tight, no shows.
- 30% COAL, black, as above; grades to carbonaceous SHALE.

1630' - 1640'

- 20% SHALE, as above.
- 30% SILTSTONE, as above, in part very sandy, grades to very fine grained SANDSTONE, argillaceous.
- 20% SANDSTONE, as above, very fine grained to silty, occasionally fine grained, tight, no shows.
- 10% COAL, as above.

1640' - 1650'

- 30% SHALE, as above.
- 20% SILTSTONE, as above.
- 50% SANDSTONE, as above, very fine to silty, occasionally fine grained, tight, no shows. Trace COAL, as above.

1650' - 1660'

- 20% SHALE, as above, in part slightly carbonaceous.
- 40% SILTSTONE, as above, grading to very fine SANDSTONE, argillaceous.
- 40% SANDSTONE, as above, mainly very fine to silty, some fine grained (40%), tight, no shows. Trace COAL; QUARTZ FRAGMENTS to 1 cm.



1660' - 1670'

20% SHALE, as above.  
20% SILTSTONE, as above, slightly sandy.  
60% SANDSTONE, as above, arkosic, light grey and yellow-brown, very fine to silty, occasionally fine grained, tight, no show, with rare CALCITE VEIN.  
Trace COAL, as above.

1670' - 1680'

50% SHALE, as above, and carbonaceous, in part silty.  
30% SILTSTONE, as above, argillaceous, slightly sandy.  
20% SANDSTONE, as above, tight, no show, fine to very fine grained, in part carbonaceous.  
Trace COAL, black, as above.

1680' - 1690'

50% SHALE, mid to dark grey, slightly silty, firm, fissile, occasionally blocky, slightly carbonaceous.  
20% SILTSTONE, mid to light grey, argillaceous, slightly sandy, firm, blocky, very slightly calcareous.  
30% SANDSTONE, light grey, arkosic, very fine to fine grained, well sorted, firm, massive, in part slightly carbonaceous, very slightly calcareous, with QUARTZ FELDSPAR, occasionally decomposed coloured mineral specks; tight, no shows.  
Trace COAL, black, shiny, clean fracture.  
Trace CALCITE, vein material.

1690' - 1700'

50% SHALE, as above, mid to dark grey, occasionally brown-grey.  
10% SILTSTONE, as above, light grey, slightly greenish.  
20% SANDSTONE, as above, very fine, occasionally fine grained, tight, no shows.  
20% COAL, black, shiny, poor fracture.

1700' - 1710'

60% SHALE, as above, in part greenish, some light green, firm, blocky.  
20% SILTSTONE, as above, in part slightly sandy.  
20% SANDSTONE, as above, very fine to occasionally fine grained, well sorted, tight, no shows.  
Trace COAL, as above; SAND, loose, very fine to fine QUARTZ grains.

1710' - 1720'

40% SHALE, mid to dark grey, grey-brown, light buff, soft, in part slightly silty, in part very slightly carbonaceous, firm.

1710' - 1720'  
(cont)

- 15% SILTSTONE, as above, light to mid grey, in part greenish, very slightly sandy, in part slightly calcareous, in part sandy.
- 40% SANDSTONE, arkosic, as above, speckled as above, very fine to fine grained, fair to well sorted, tight, no shows, in part very slightly calcareous.
- 5% COAL, black, shiny to dull.

1720' - 1730'

- 20% SHALE, as above, occasionally light grey, firm, blocky; trace white.
- 50% SILTSTONE, as above, grades to very fine SANDSTONE.
- 30% SANDSTONE, as above, very fine to fine grained, well sorted, tight, no show.  
Trace COAL, as above.

1730' - 1740'

- 30% SHALE, as above, in part very silty; trace white, soft.
- 40% SILTSTONE, as above.
- 30% SANDSTONE, as above, very fine to fine grained, trace red-brown, siliceous, slightly calcareous, tight, no shows.  
Trace COAL, as above.

1740' - 1750'

- 30% SHALE, as above, in part silty and white, soft, blocky.
- 50% SILTSTONE, as above, argillaceous, slightly carbonaceous, in part sandy.
- 20% SANDSTONE, as above, very fine to fine grained, tight, no show.  
Trace CALCED.

1750' - 1760'

- 45% SHALE, as above, in part very carbonaceous, in part silty.
- 20% SILTSTONE, as above, in part sandy.
- 30% SANDSTONE, as above, fine grained, occasionally very fine grained, tight, no shows.
- 5% COAL, black, as above.  
Trace QUARTZ GRANULES, angular.

1760' - 1770'

- 50% SHALE, mid to dark grey, in part greenish or brownish, occasionally purple-brown and grey-black, slightly silty, firm to hard, fissile, occasionally blocky, in part carbonaceous, in part well and thinly bedded.
- 30% SILTSTONE, light to mid grey, slightly greenish in part, argillaceous, in part sandy, occasionally grades to very fine grained SANDSTONE, arkosic, firm, blocky, in part well and thinly bedded, in part slightly carbonaceous, in part very slightly calcareous.

1760' - 1770'  
(cont)

15% SANDSTONE, light grey, speckled, in part greenish, very fine to fine grained, well sorted, arkosic, firm, massive, consists of QUARTZ FELDSPAR (often decomposed) and mineral specks in an argillaceous matrix, tight, no shows.  
5% COAL, black, shiny.

1770' - 1780'

60% SHALE, as above, trace white, soft, blocky.  
30% SILTSTONE, as above.  
10% SANDSTONE, as above, very fine to fine grained and occasionally brown, silty; tight, no shows.  
Trace COAL.

1780' - 1790'

30% SHALE, as above.  
50% SILTSTONE, as above, in part sandy.  
20% SANDSTONE, as above, very fine to fine grained, occasionally silty, tight, no shows.  
Trace brown, as above.  
Trace CALCITE crystals, clear to white.

1790' - 1800'

20% SHALE, as above and light grey, blocky, firm, slightly silty.  
40% SILTSTONE, as above, slightly sandy.  
40% SANDSTONE, arkosic, soft to very fine grained, occasionally fine grained, tight, no shows.  
Trace COAL, black, as above.

1800' - 1810'

30% SHALE, as above, in part silty, trace light grey, firm to soft, blocky.  
20% SILTSTONE, as above and trace buff, blocky, soft, very slightly calcareous.  
50% SANDSTONE, light grey, arkosic, very fine grained to silty, occasionally fine grained, well sorted, slightly carbonaceous, tight, no shows.  
Trace COAL, CALCITE.

1810' - 1820'

30% SHALE, as above.  
40% SILTSTONE, as above.  
30% SANDSTONE, very fine to fine grained, arkosic, tight, no show.  
Trace COAL, CALCITE, QUARTZ GRAINS.

1820' - 1830'

Slow drilling - grinding up SANDSTONE to loose SAND.

20% SHALE, mid to dark brown, firm to hard, fissile, occasionally blocky, and purplish-brown, slightly silty, hard, massive, in part thinly bedded, with evidence of folding and calcite veins and quartz - often with PYRITE.

10% SILTSTONE, light to mid grey, argillaceous, slightly sandy, firm, blocky.

20% SANDSTONE, arkosic, light grey, speckled, fine to very fine grained, well sorted and cream, hard, arkosic, fine to medium grained, tight, no shows. Trace PYRITE.

50% SAND, loose quartz grains from grinding of SANDSTONE above, fine to very fine grained with occasional medium grains, well sorted. Trace COAL. Trace PYRITE.

1830' - 1833'

CIRC. SAMPLE - TRIP FOR NEW BIT.

20% SHALE, mid to dark grey, as above.

10% SHALE, indurated, light purplish-brown, very hard, as above, in part pyritic.

20% SILTSTONE, as above.

50% SANDSTONE, as above, and loose SAND.

1833' - 1840'

30% SHALE, as above, and slightly brown-grey, in part carbonaceous, firm to soft, blocky, very slightly silty.

30% SILTSTONE, as above.

40% SANDSTONE, arkosic, very fine to fine grained, occasionally cream to buff, fine to medium grained, tight, no shows. Trace COAL, black, Hard.

1840' - 1850'

20% SHALE, as above, silty, in part carbonaceous.

20% SILTSTONE, as above, in part slightly carbonaceous.

60% SANDSTONE, mainly very fine to occasionally fine grained, well sorted, some fine grained and rare buff, fine to medium grained. Tight, no shows. Trace COAL, CALCITE, loose QUARTZ GRAINS.

1850' - 1860'

20% SHALE, as above, in part greenish.

20% SILTSTONE, as above.

60% SILTSTONE, as above, very fine to fine grained, fair sorted, tight, no shows. Trace COAL.

1860' - 1870'

- 20% SHALE, as above.
- 15% SILTSTONE, as above, grades to very fine grained SANDSTONE.
- 60% SANDSTONE, as above, very fine to fine grained, in part green-grey, trace bedding tight, no shows.
- 5% COAL.

1870' - 1880'

- 20% SHALE, as above, dark to mid-grey, light brown-grey and trace purple-brown, hard.
- 10% SILTSTONE, as above, argillaceous, in part sandy.
- 70% SANDSTONE, as above, light grey, occasionally trace mid grey, slightly greenish, speckled, very fine to fine grained, tight, no shows.

1880' - 1890'

- 10% COAL, black, in part shaly, poor fracture, semi dull.
- 20% SHALE, mid grey, occasionally dark or light grey, occasionally slightly greenish, in part slightly silty, firm, fissile, rarely slightly carbonaceous, in part well bedded, mainly massive.
- 30% SILTSTONE, light grey, greenish, in part sandy, argillaceous, firm, blocky, consists of white, grey, green, red and black mineral specks in green-grey matrix, in part slightly carbonaceous.
- 40% SANDSTONE, light grey, occasionally very light grey, occasionally slightly greenish, arkosic, very fine grained, occasionally fine grained, well sorted, firm to hard, massive, in part carbonaceous, in part slightly calcareous, tight, no shows, and rarely buff, arkosic, yellow-brown matrix, fine to medium grained.

1890' - 1900'

- 20% COAL, as above.
- 10% SHALE, as above, in part purple brown and brownish, carbonaceous.
- 10% SILTSTONE, as above, grades to very fine SANDSTONE.
- 60% SANDSTONE, light grey, as above, very fine to fine grained, rarely poorly sorted (rounded QUARTZ)  
25% buff to cream, hard, medium to fine grained QUARTZ, FELDSPAR, green and red mineral in creamy matrix, slightly calcareous, slightly carbonaceous, tight, no shows.

1900' - 1910'

10% SHALE, as above, and trace white to cream, soft, blocky.  
30% SILTSTONE, as above, in part very sandy - grades to very fine grained SANDSTONE.  
60% SANDSTONE, light grey, very fine to fine grained and some buff, medium to fine grained, tight, no shows.  
Trace COAL, as above.

1910' - 1920'

10% COAL, as above.  
10% SHALE, as above, mid to dark grey, occasionally white, in part silty.  
20% SILTSTONE, as above, light to mid grey, argillaceous, in part sandy.  
60% SANDSTONE, as above, fine to very fine grained, occasionally with decomposed FELDSPAR, tight, no shows.

1920' - 1930'

20% SHALE, as above.  
30% SILTSTONE, as above, in part carbonaceous, argillaceous.  
Trace COAL, as above.  
50% SANDSTONE, as above, very fine to fine grained, rare medium grains. Trace cream, tight, no shows, in part carbonaceous.

1930' - 1940'

10% COAL, as above.  
30% SHALE, as above, mid to dark grey, light grey, in part carbonaceous.  
30% SILTSTONE, light and mid grey, occasionally brownish, carbonaceous, sandy in part.  
30% SANDSTONE, very fine to fine grained, occasionally poorly sorted with rare medium grains, tight, no shows.

1940' - 1950'

30% SHALE, mid to dark grey, in part greenish, brown, in part slightly silty, firm, fissile, occasionally blocky, in part slightly carbonaceous.  
50% SILTSTONE, light to mid grey, rarely brown, argillaceous, in part sandy, in part carbonaceous, rare trace thin bedding, firm, blocky, trace MICA, in part grades to very fine grained SANDSTONE.

1950' - 1960'

20% SHALE, as above. Trace COAL, as above.  
50% SILTSTONE, as above, in part sandy, grades to very fine grained SANDSTONE and silty SANDSTONE.

1950' - 1960'  
(cont)

30% SANDSTONE, as above, very fine grained to silty, occasionally fine grained, tight, no shows.

1960' - 1970'

30% SHALE, mid to dark grey, occasionally greenish and possibly light brown. Water soluble.

50% SILTSTONE, as above, in part sandy.

20% SANDSTONE, as above, silty to very fine grained, tight, no shows. Trace COAL.

1970' - 1980'

40% SHALE, as above.

40% SILTSTONE, as above, in part sandy.

20% SANDSTONE, as above, silty, very fine grained. Trace COAL.

1980' - 1990'

20% SHALE, as above, in part crumbles on exposure to moisture.

30% SILTSTONE, as above and brown, siliceous, slightly sandy, calcareous, hard, grading to SANDSTONE.

50% SANDSTONE, as above, light grey, very fine to fine grained, slightly carbonaceous, tight, no shows, and brown, siliceous, calcareous, hard, massive, silty, very fine grained, tight, no shows.

1990' - 2000'

25% SHALE, as above, and dark brown, slightly carbonaceous, slightly silty.

5% COAL, as above.

30% SILTSTONE, as above, and brown, as above.

40% SANDSTONE, as above, and brown, as above, very fine grained, in part silty, tight, no show. Trace PYRITE and pyritic SHALE.

2000' - 2010'

30% SHALE, mid to dark grey, occasionally brownish or greenish, slightly silty, firm, fissile, occasionally blocky, massive, in part very slightly carbonaceous and white, soft.

40% SILTSTONE, light to mid grey, argillaceous with rare SHALE inclusions, firm, blocky, in part sandy and brown, siliceous, hard, slightly calcareous, in part slightly sandy, massive.

- 2000' - 2010' 30% SANDSTONE, light grey, arkosic, very fine to fine grained and silty, occasionally argillaceous, medium QUARTZ GRAINS, massive, firm; brown, fine to very fine grained, hard, siliceous, slightly calcareous, slightly argillaceous, tight, no shows. Trace COAL, black. Trace PYRITE.
- 2010' - 2020' 30% SHALE, as above.  
50% SILTSTONE, as above, in part sandy.  
20% SANDSTONE, as above, light grey, arkosic, tight, no shows, very fine, silty, occasionally fine grained, occasionally brown, fine to medium grained, as above. Trace COAL, black, dull, occasionally shiny.
- 2020' - 2030' 40% SHALE, as above, silty, slightly carbonaceous.  
40% SANDSTONE, as above, very fine to silty and fine to medium grained, subangular QUARTZ and FELDSPAR mineral grains in an argillaceous, feldspathic matrix, tight, no shows, Trace COAL, as above.
- 2030' - 2040' 40% SHALE, as above, in part very silty.  
50% SILTSTONE, as above, in part well and thinly bedded.  
10% SANDSTONE, as above, very fine grained, grades to SILTSTONE, tight, no shows. Trace COAL,
- 2040' - 2050' 20% SHALE, as above, mid to dark grey, brownish, slightly silty, slightly carbonaceous.  
50% SILTSTONE, as above, argillaceous, slightly sandy, slightly carbonaceous.  
30% SANDSTONE, as above, arkosic, light grey, speckled, very fine to silty, occasionally fine grained, tight, no shows. Trace COAL.
- 2050' - 2060' 20% SHALE, as above, in part water soluble - SHALE percentage high.  
60% SILTSTONE, as above, and brown, argillaceous, well bedded. In part sandy.  
20% SANDSTONE, as above, very fine to silty, occasionally very fine to fine grained, tight, no shows.
- 2060' - 2070' 50% SHALE, as above, more grey-brown and light brown (water soluble)  
40% SILTSTONE, as above, occasionally light grey, brown, and grey-brown, slightly sandy.  
10% SANDSTONE, as above, very fine to fine grained, tight, no shows.



2070' - 2080'

- 40% SHALE, light to dark grey, slightly silty, in part very slightly carbonaceous, firm, fissile to blocky, occasionally water soluble, in part well bedded, occasionally brown, blocky firm to hard.
- 50% SILTSTONE, light to mid grey, in part slightly sandy, argillaceous, firm, blocky, in part slightly water soluble.
- 10% SANDSTONE, arkosic, light grey, speckled, whitish, very fine to silty, occasionally fine grained, composed of clear to grey, rounded to subrounded QUARTZ, sub-angular to euhedral, white FELDSPAR GRAINS, black, red and green mineral grains in an argillaceous, occasionally kaolinitic matrix, firm, massive, in part very slightly carbonaceous, tight, no shows.  
Rare trace PYRITE in SANDSTONE.  
TRACE COAL.

2080' - 2090'

- 60% SHALE, as above, light brown, very soft, very soluble.
- 30% SILTSTONE, as above, argillaceous, in part slightly carbonaceous, water soluble.
- 10% SANDSTONE, fine grained to very fine grained, tight, no shows.  
Trace COAL (to carbonaceous SHALE). Trace vein CALCITE.

2090' - 2100'

- 50% SHALE, as above, in part carbonaceous.
- 30% SILTSTONE, as above, in part very water soluble.
- 20% SANDSTONE, as above, very fine to fine, with rare mineral grains, tight, no shows.  
Trace COAL.

2100' - 2110'

- 50% SHALE, as above.
- 30% SILTSTONE, as above, in part sandy.
- 20% SILTSTONE, as above, very fine grained to occasionally fine grained, tight, no show.

2110' - 2120'

- 50% SHALE, as above, mid to dark grey, occasionally light grey, firm to hard.
- 30% SILTSTONE, as above, argillaceous, in part sandy.
- 20% SANDSTONE, as above, arkosic, speckled, light grey, very fine to fine grained, tight, no shows.  
Trace COAL, as above.

2120' - 2130'

- 30% SHALE, as above, and brown.
- 50% SILTSTONE, as above.
- 20% SANDSTONE, as above, tight, no shows, silty to very fine grained, occasionally fine grained.  
Trace COAL, as above.

2130' - 2140'

- 60% SHALE, mid to dark grey, in part slightly greenish, firm, fissile, in part slightly silty, and white, soft, blocky.
- 30% SILTSTONE, light to mid grey, in part slightly greenish, argillaceous, in part sandy, firm, blocky, rarely slightly carbonaceous.
- 10% SANDSTONE, arkosic, light grey, speckled, very fine to fine grained, fair sorted, tight, no shows.  
Trace PYRITE.  
Trace CALCITE.

2140' - 2150'

- 40% SHALE, as above, in part slightly carbonaceous.
- 40% SILTSTONE, as above, in part sandy.
- 20% SANDSTONE, as above, light grey, occasionally whitish, arkosic, very fine to fine grained, well sorted, clear to grey QUARTZ, FELDSPAR, coloured mineral grains and carbonaceous fragments. 50% light grey, as above, but more of a feldspathic SANDSTONE with 10% decomposed FELDSPAR CLASTS, calcareous, with white (?) kaolinitic/calcareous(?) matrix.  
Trace COAL.

2150' - 2160'

- 30% SHALE, as above, in part silty, firm, fissile.
- 40% SILTSTONE, as above, argillaceous, in part slightly sandy, in part carbonaceous.
- 30% SANDSTONE, as above; 50% arkosic, 50% very fine grained, feldspathic.  
Trace CALCITE.

2160' - 2170'

- 40% SHALE, rarely silty, in part carbonaceous.
- 30% SILTSTONE, in part very sandy.
- 30% SANDSTONE, as above, 50% arkosic, in part very carbonaceous, very fine to fine, occasionally medium grained, in part grading to feldspathic SANDSTONE, as above, very fine with occasional fine grains, fair sorting, tight, no shows.  
Trace CALCITE.

2170' - 2180'

- 30% SHALE, as above, in part very carbonaceous.
- 50% SILTSTONE, as above, argillaceous, firm, blocky, in part slightly carbonaceous.
- 20% SANDSTONE, as above, mainly arkosic, as above, tight, no show.  
Trace COAL, CALCITE.

2180' - 2190'

40% SHALE, as above.  
30% SILTSTONE, as above.  
30% SANDSTONE, as above, very fine to fine, occasionally medium grained, arkosic, with trace feldspathic, very fine, occasionally fine grained, tight, no show.  
Trace COAL, PYRITE, CALCITE.

2190' - 2200'

20% SHALE, light to dark grey, in part slightly greenish or brownish, slightly silty, firm, fissile, occasional trace bedding, in part very slightly carbonaceous.  
50% SILTSTONE, light to mid grey, in part slightly greenish, argillaceous, in part sandy, grading to very fine grained SANDSTONE, firm, blocky, in part slightly carbonaceous, occasional trace thin bedding.  
30% SANDSTONE, arkosic, light grey, speckled, very fine grained to occasionally fine grained or silty, firm, massive, in part slightly carbonaceous, consists of clear to grey, rounded to angular QUARTZ, white FELDSPAR, coloured mineral grains in an argillaceous matrix, occasionally grades to a feldspathic QUARTZ SANDSTONE; tight, no shows.  
Trace COAL, black, dull.

2200' - 2210'

20% SHALE, as above, dark brown to black, carbonaceous, thin bedded, firm to soft.  
40% SILTSTONE, as above, brown, carbonaceous.  
40% SANDSTONE, as above, very fine grained, well sorted, tight, no shows.  
Trace COAL, as above.

2210' - 2220'

20% SHALE, as above.  
20% SILTSTONE, in part sandy, grades to very fine grained SANDSTONE.  
60% SANDSTONE, as above, very fine to fine grained, fair sorted, tight, no shows, tight.

2220' - 2230'

20% SHALE, as above, in part slightly carbonaceous.  
30% SILTSTONE, as above.  
50% SANDSTONE, as above, very fine to fine grained, fair sorted, in part very quartzose, sub-rounded to angular QUARTZ, rare trace PYRITE, tight, no shows.  
Much loose QUARTZ GRAINS.

2230' - 2240'

30% SHALE, as above, silty, in part carbonaceous.  
50% SILTSTONE, as above, in part very sandy.  
20% SANDSTONE, as above, arkosic, light grey, fine grained, occasionally very fine grained, tight, no show.  
Trace PYRITE (as cement in SANDSTONE). Trace COAL.

2240' - 2250'

40% SHALE, as above, in part very silty.  
40% SANDSTONE, as above, fine to very fine grained with occasional coarse grains, tight, no shows.  
20% SILTSTONE, as above.  
Trace COAL, CALCITE GRAINS.

2250' - 2260'

30% SHALE, mid to dark grey, occasionally purple-brown, slightly silty, in part very silty, firm, fissile, occasionally blocky, in part slightly carbonaceous.  
40% SILTSTONE, mid to light grey, argillaceous, in part sandy, firm, blocky, in part with carbonaceous specks.  
30% SANDSTONE, arkosic, 60% light grey, very fine to fine grained, firm, massive, in part slightly carbonaceous, well sorted, angular to subrounded QUARTZ, FELDSPAR and coloured mineral,  
40% light grey, occasionally pinkish, medium grained, firm, massive, in part slightly carbonaceous, fair sorted, rounded to subangular QUARTZ, FELDSPAR, coloured mineral; tight, no shows.  
Trace COAL, black.

2260' - 2270'

30% SHALE, as above.  
40% SILTSTONE, as above, in part very sandy.  
30% SANDSTONE, as above, 60% occasionally slightly greenish, 40% with common pinkish matrix; tight, no shows.

2270' - 2280'

30% SHALE.  
40% SILTSTONE, in part sandy and carbonaceous.  
20% SANDSTONE, as above, arkosic, light grey, slightly greenish and light grey, pink to brown, fine to occasionally medium grained, occasionally very fine grained; tight, no shows.

- 2280' - 2290'
- 40% SHALE, as above, in part silty, firm, fissile.
  - 40% SILTSTONE, as above.
  - 20% SANDSTONE, as above, fine to medium grained, rarely very fine grained, tight, no shows. Trace PYRITE, COAL, CALCITE.
- 2290' - 2300'
- 30% SHALE, as above.
  - 30% SILTSTONE, as above, argillaceous, in part sandy.
  - 40% SANDSTONE, light grey, slightly greenish, very fine to occasionally fine grained, and light grey, occasionally brownish, fine to medium grained, both well to fairly sorted, tight, no shows. Trace PYRITE, COAL.
- 2300' - 2310'
- 40% SHALE, as above, in part brown.
  - 30% SILTSTONE, as above.
  - 30% SANDSTONE, as above, arkosic, 50/50 light grey, very fine to occasionally fine and light grey, pinkish, fine to medium grained, massive, firm, tight, no shows. Trace PYRITE, COAL.
- 2310' - 2320'
- 20% SHALE, as above, with rare CALCITE VEIN.
  - 40% SILTSTONE, as above, occasionally slightly carbonaceous.
  - 40% SANDSTONE, as above, in part with SOME interlamination (thin), grades from very fine to fine to medium grained, well sorted, in part greenish or pinkish; tight, no show, in part with slight amount PYRITE FLAKES. Trace CALCITE, COAL, PYRITE.
- 2320' - 2330'
- 30% SHALE, light to dark grey, in part greenish or brownish, dark brown, in part silty, firm, fissile, occasionally blocky, occasionally well and thinly bedded, occasional trace carbonaceous.
  - 30% SILTSTONE, light to mid grey, in part slightly greenish, in part slightly sandy, argillaceous, firm, blocky, occasionally well and thinly bedded, in part slightly carbonaceous.
  - 40% SANDSTONE, arkosic, light grey, greenish, occasionally pinkish, and off-white, speckled, very fine to fine grained or fine grained, fair to well sorted, firm, massive, in part slight trace bedding shown by carbonaceous inclusions, consists of clear to grey and white, rounded

2320' - 2330'  
(cont)

to subangular QUARTZ, white FELDSPAR, coloured mineral grains and carbonaceous specks in an argillaceous, often feldspathic matrix; tight, no shows, in part slightly calcareous.  
Trace COAL, black, good fracture.

2330' - 2340'

30% SHALE, as above, in part very silty.  
30% SILTSTONE, as above.  
40% SANDSTONE, as above, in part slightly silty, very fine to fine and fine grained, tight, no shows.  
Trace COAL, CHALK, PYRITE cubes.

2340' - 2350'

50% SHALE, as above, in part water soluble, in part silty.  
30% SILTSTONE, as above.  
20% SANDSTONE, as above, very fine to fine grained, tight, no show, in part slightly calcareous.  
Trace COAL.

2350' - 2360'

60% SHALE, as above, in part silty.  
30% SILTSTONE, as above, in part grades to very fine SANDSTONE.  
10% SANDSTONE, as above, mainly very fine grained, occasionally fine grained, tight, no shows.  
Trace COAL, CALCITE.

2360' - 2370'

40% SHALE, as above, in part very silty, in part water soluble.  
40% SILTSTONE, as above.  
20% SANDSTONE, as above, arkasic, very fine to fine grained, tight, no shows.

2370' - 2380'

40% SHALE, as above, in part very silty.  
40% SILTSTONE, as above, argillaceous very occasionally slightly sandy.  
20% SANDSTONE, as above, very fine to fine grained; tight, no shows.  
Trace COAL.

2380' - 2390'

40% SHALE, light to dark grey, occasionally dark brown, carbonaceous, in part very silty, firm, fissile, slightly blocky, in part well and thinly bedded, in part slightly carbonaceous.  
40% SILTSTONE, light to mid grey, argillaceous, in part slightly sandy, speckled with white to black and green mineral specks, firm, blocky, in part slightly carbonaceous.  
20% SANDSTONE, arkasic, light grey to white, speckled, very fine to

2380' - 2390'  
(cont)

fine grained, in part slightly silty, firm, massive, occasionally very slightly carbonaceous, occasionally slightly calcareous, fair to well sorted, tight, no shows. Trace COAL, black, PYRITE, granular, rare QUARTZ GRAINS.

2390' - 2400'

40% SHALE, as above, in part very silty.  
20% SILTSTONE, as above.  
40% SANDSTONE, as above, in part very greenish, very fine grained, well sorted and fine to medium grained, subangular, fair sorted, tight, no shows.  
Trace CALCITE, COAL.

2400' - 2410'

40% SHALE, as above, very silty in part.  
30% SILTSTONE, as above, in part carbonaceous.  
30% SANDSTONE, as above, very fine to fine grained, subrounded QUARTZ, tight, no shows.  
Trace CALCITE, GYPSUM(?), COAL.

2410' - 2420'

40% SHALE, as above, in part silty, in part very carbonaceous and thin bedded.  
20% SILTSTONE, as above, occasionally grades to very fine SANDSTONE.  
40% SANDSTONE, as above, light grey to white, speckled, very fine to fine, occasionally medium grained, fair sorted, in part slightly carbonaceous, firm, massive, consists of clear to white and grey QUARTZ, sub-rounded to angular, white PEBBLES, coloured mineral grains, black, carbonaceous specks and occasional PYRITE GRAINS and FLAKES; tight, no shows.  
Trace COAL.

2420' - 2430'

40% SHALE, as above, in part slightly brownish, carbonaceous.  
30% SILTSTONE, as above, argillaceous, in part slightly sandy.  
30% SANDSTONE, as above, very fine to mainly fine grained, tight, no shows.

2430' - 2440'

60% SHALE, as above.  
30% SILTSTONE, as above.  
10% SANDSTONE, as above, in part very greenish, very fine to fine, occasionally medium grained, tight, no shows.  
Trace COAL.

2440' - 2450'

- 60% SHALE, mid to dark grey, occasionally brownish or greenish, in part silty, firm, fissile, occasionally blocky, in part slightly carbonaceous, rarely carbonaceous, in part well bedded.
- 30% SILTSTONE, light to mid grey, in part slightly greenish, argillaceous, slightly sandy, firm, blocky, with coloured mineral grains in an argillaceous matrix, in part slightly carbonaceous, in part thinly bedded.
- 10% SANDSTONE, arkosic, light grey to white, slightly green in part, very fine to fine grained and fine to medium grained, fair sorted, firm, massive, consists of clear to dark grey and white, subangular to sub-rounded QUARTZ GRAINS, white FELDSPAR, red, green mineral grains, occasionally black carbonaceous specks and rare PYRITE, in an argillaceous, feldspathic matrix, tight, no shows, in part slightly carbonaceous; fine to medium grained is more angular than very fine to fine grained. Rare CALCITE VEINS.  
Trace COAL, black.

2450' - 2460'

- 60% SHALE, as above, brown, very slightly silty, hard, fissile.
- 20% SILTSTONE, as above.
- 20% SANDSTONE, as above, tight, no shows, in part very carbonaceous with COAL interlamination. Trace water soluble SHALE, COAL, quartz rounded granule, clear.  
N.B. SANDSTONE being ground up into loess, very fine to fine QUARTZ GRAINS.

2460' - 2470'

- 50% SHALE, as above, in part very thinly and well bedded.
- 20% SILTSTONE, as above, in part sandy, argillaceous.
- 30% SANDSTONE, as above, very fine to fine and fine to medium grained, trace QUARTZ GRANULES, tight, no shows.  
Trace COAL.

2470' - 2480'

- 40% SHALE, as above, occasionally slightly greenish.
- 40% SILTSTONE, as above, in part slightly sandy, occasionally slightly carbonaceous.
- 20% SANDSTONE, as above, arkosic, very fine to fine grained and



2470' - 2480'  
(cont)

fine to medium grained with well rounded, medium grains clear QUARTZ GRAINS, tight, no shows.  
Trace COAL.

2480' - 2490'

30% SHALE, as above, in part very carbonaceous, black.  
30% SILTSTONE, as above, mid grey, carbonaceous.  
40% SANDSTONE, as above, very fine to fine grained, occasional angular QUARTZ GRAIN and fine to medium grained; tight, no show.  
Trace COAL.

2490' - 2500'

30% SHALE, mid to dark grey and grey-black, in part very slightly silty, firm, fissile, in part slightly carbonaceous.  
10% SILTSTONE, mid to light grey, occasionally greenish, argillaceous, very slightly sandy, firm, blocky, occasionally slightly carbonaceous.  
60% SANDSTONE, light grey to white, speckled, arkosic, very fine to fine grained, fair sorted, firm, massive, in part slightly carbonaceous, consists of clear to white and grey subrounded to subangular QUARTZ, FELDSPAR, coloured mineral grains, carbonaceous flocks, in an argillaceous/taconitic matrix, tight, no shows.

2500' - 2510'

50% SHALE, as above, in part greenish.  
20% SILTSTONE, as above.  
30% SANDSTONE, very fine to fine grained, with occasional medium grains, tight, no shows.

2510' - 2520'

50% SHALE, as above, in part silty, occasionally dark brown, carbonaceous.  
30% SILTSTONE, as above, in part very sandy.  
20% SANDSTONE, as above, very fine to fine grained, fair sorted, tight, no show.  
Trace COAL, loose QUARTZ, coarse grains, well rounded, CALCITE.

2520' - 2530'

40% SHALE, as above, in part greenish  
40% SILTSTONE, as above, in part sandy, firm, blocky, argillaceous.  
20% SANDSTONE, as above, very fine, occasionally fine grained, tight, no show.  
Trace COAL, PYRITE, QUARTZ GRAINS, well rounded, coarse to granules, CALCITE.

- 2530' - 2540' 60% SHALE, as above, in part very carbonaceous.  
30% SILTSTONE, as above.  
10% SANDSTONE, as above, very fine, occasionally fine grained, tight, no shows.  
Trace COAL, QUARTZ, as above.
- 2540' - 2550' 50% SHALE, as above, in part very silty and trace buff, soft, slightly silty.  
30% SILTSTONE, as above, grades to very fine grained SANDSTONE.  
20% SANDSTONE, as above, arkosic, light grey to white, speckled, slightly greenish, very fine grained, occasionally fine grained, firm, massive, tight, no show.  
Trace COAL, CALCITE.
- 2550' - 2560' 30% SHALE, as above, trace buff.  
20% SILTSTONE, as above, argillaceous, in part slightly sandy.  
50% SANDSTONE, as above, very fine to fine grained, tight, no show.  
Trace COAL, CALCITE, QUARTZ GRAINS, as above.
- 2565' - 2574' SEE CORE DESCRIPTION.  
Core No. 6 Recovered 7'8".
- 2574' - 2580' 30% SHALE, light to dark grey, greenish and black, in part slightly silty, firm, blocky, slightly carbonaceous.  
50% SANDSTONE, light grey, greenish, speckled, very fine to fine grained, fairly sorted, firm, massive, tight, no shows.  
Trace CALCITE, COAL.
- 2580' - 2590' 80% SHALE, light to dark grey, slightly greenish, black and purple-brown, in part slightly silty, firm, fissile, slightly carbonaceous, in part water soluble (carvings)  
20% SILTSTONE, light grey, greenish, argillaceous, firm, blocky, slightly carbonaceous.  
Trace SANDSTONE, very fine grained, silty, as above.  
Trace COAL.
- 2590' - 2600' 40% SHALE, as above and water soluble SHALE.  
10% SILTSTONE, as above.  
50% SANDSTONE, light grey-greenish, arkosic, speckled, very fine grained, occasionally fine grained, well sorted, firm, massive, very slightly carbonaceous, tight, no show. Consists of QUARTZ, FELDSPAR, coloured mineral grains in an argillaceous siliceous matrix.  
Trace COAL, CALCITE.

- 2600' - 2610'
- 20% SHALE, as above, very slightly micaceous, trace PYRITE CRYSTALS.
  - 10% SILTSTONE, as above.
  - 70% SANDSTONE, as above, very fine, occasionally fine grained, tight, no shows, very slightly micaceous.  
Trace CALCITE. Trace bedding.
- 2610' - 2620'
- 50% SHALE, light to dark grey and black, rarely water soluble.
  - 20% SILTSTONE, as above, slightly sandy, light grey, argillaceous and brownish-grey, sandy.
  - 30% SANDSTONE, as above, light grey to white, in part brownish, very fine grained, slightly silty, tight no shows.  
Trace CALCITE, orange FELDSPAR, rounded coarse QUARTZ GRAINS.
- 2620' - 2630'
- 20% SHALE, as above.
  - 40% SILTSTONE, as above, light grey, slightly greenish, sandy.
  - 40% SANDSTONE, as above, grades from SILTSTONE, very fine grained tight, no shows. Trace COAL.
- 2630' - 2640'
- 30% SHALE, light to dark grey, slightly silty and brown to black, carbonaceous, firm, fissile trace MICA.
  - 40% SILTSTONE, light to mid grey, in part greenish or slightly black, in part slightly sandy, slightly carbonaceous, firm, in part slightly calcareous, blocky, argillaceous, grades in part to SANDSTONE, very fine grained (see below).
  - 30% SANDSTONE, arkosic, light grey to white, slightly greenish, very fine grained to silty, fair sorted, firm, massive, slightly carbonaceous, occasional bedding traces, consists of clean to white and grey QUARTZ, white FELDSPAR, green mineral grains in a siliceous/argillaceous matrix, tight, no shows.  
Trace MICA.  
Trace COAL, FELDSPAR.
- 2640' - 2650'
- 20% SHALE, as above, in part silty.
  - 30% SILTSTONE, as above, carbonaceous in part.
  - 30% SANDSTONE, as above, arkosic light grey-greenish, very fine grained, occasionally fine grained, hard, tight, no shows.
  - 20% SANDSTONE, arkosic, pink-brown, very fine to fine grained, hard, siliceous, massive, slightly calcareous, with rare vein? of QUARTZ, carbon, tight, no show.

2650' - 2660'

- 50% SHALE, as above, green-grey, slightly silty and black, carbonaceous.
- 20% SILTSTONE.
- 20% SANDSTONE, light grey-greenish, very fine grained, tight, no show.
- 10% SANDSTONE, pink-brown, very fine grained, siliceous, slightly argillaceous matrix, tight, no shows.
- Trace CALCITE, FELDSPAR, orange.

2660' - 2670'

- 60% SHALE, as above, in part slightly sandy with rounded QUARTZ.
- 20% SILTSTONE, as above, argillaceous firm, blocky, slightly sandy, trace bedding.
- 10% SANDSTONE, as above, green-grey, tight, no shows.
- 10% SANDSTONE, as above, purple-brown in part silty, tight, no shows, Trace QUARTZ, FELDSPAR (orange), CALCITE.

2670' - 2680'

- 40% SHALE, as above, in part water soluble.
- 30% SILTSTONE, as above, grades to very fine grained, light grey SANDSTONE, slightly greenish.
- 20% SANDSTONE, as above, arkosic, light grey, greenish, very fine grained, tight, no shows.
- 10% SANDSTONE, as above, pink, brown, very fine to fine grained; one piece shows bedding by thin laminations, very fine grained SANDSTONE, very fine grained SANDSTONE.
- Trace QUARTZ GRANULES and very coarse grains, well rounded, orange FELDSPAR, white and clear CALCITE.

2680' - 2690'

- 60% SHALE, light to dark grey-greenish, dark grey to black, carbonaceous, in part very slightly silty, firm, fissile, occasionally well bedded.
- 30% SILTSTONE, light grey, mid grey, greenish, slightly sandy, argillaceous, firm, blocky, in part well and thinly bedded, slightly carbonaceous; trace reddish-pink, argillaceous.
- 10% SANDSTONE, light grey, white, greenish, speckled, arkosic, fine to very fine grained to silty, with an argillaceous matrix, slightly calcareous, tight, no shows.
- Trace CALCITE, FELDSPAR GRAINS, subhedral.

2690' - 2700'

40% SHALE, as above, and brown-black, carbonaceous.  
30% SILTSTONE, as above, light grey-greenish, sandy, grades to very fine grained SANDSTONE.  
30% SANDSTONE, as above, arkosic, very fine to fine grained, tight, no show.  
Trace COAL, CALCITE, FELDSPAR, orange subcubical.

2700' - 2710'

20% SHALE, as above.  
30% SILTSTONE, as above.  
50% SANDSTONE, as above, very fine to fine grained, tight, no shows, fair sorted.  
Trace COAL.

2710' - 2720'

20% SHALE, as above, light to dark grey, greenish, black to brown, carbonaceous.  
10% SILTSTONE, as above, in part very sandy.  
70% SANDSTONE, as above, very fine to fine grained, fair to well sorted, in part very carbonaceous, tight, no shows.  
Trace COAL, QUARTZ, cloudy, rounded, very coarse grains.

2720' - 2730'

20% SHALE, in part very carbonaceous brown.  
10% SILTSTONE, as above, argillaceous sandy, firm, blocky, slightly carbonaceous.  
70% SANDSTONE, as above, arkosic, very fine to fine grained, light grey to white to greenish, speckled, fair to well sorted, tight, no shows; trace carbonaceous matter and occasional (20%) light yellow-brown, arkosic, very fine to fine grained, firm to hard, massive, slightly siliceous, slightly calcareous, tight, no shows.  
Trace COAL, CALCITE.

2730' - 2740'

20% SHALE, mid to dark grey-greenish occasionally black to brown, carbonaceous, slightly silty, firm, fissile, occasionally slightly carbonaceous, occasionally well bedded.  
40% SILTSTONE, light to mid grey, greenish, very slightly sandy and occasionally grades to very fine grained SANDSTONE, argillaceous, firm, blocky, occasionally slightly carbonaceous, in part well bedded.  
40% SANDSTONE, arkosic, light grey to white, greenish, speckled, very fine to fine grained, firm massive, in part slightly

2730' - 2740'  
(cont)

carbonaceous, consists clear to gray and cloudy, subrounded QUARTZ, white and occasional orange PEBBLESPAR, coloured mineral grains and occasional carbonaceous specks in an argillaceous matrix, tight, no shows.

Trace COAL, CALCITE, yellow to buff SHALE.

2740' - 2750'

20% SHALE, as above, in part well and thinly bedded.

30% SILTSTONE, as above, argillaceous, sandy.

50% SANDSTONE, as above, very fine to fine, occasionally medium grained, fair sorted, in part very carbonaceous, tight, no shows.  
Trace CALCITE, COAL.

2750' - 2760'

30% SHALE, as above, in part very carbonaceous.

50% SILTSTONE, as above, light grey-greenish, argillaceous, in part sandy, firm, blocky.

20% SANDSTONE, as above, very fine to fine grained, tight, no show.  
Trace COAL, common (to approx. 5%) pebbles QUARTZ, white, clear, brown, from coarse grained to 1 cm, well to sub-rounded.

2760' - 2770'

40% SHALE, as above, occasionally very carbonaceous.

20% SILTSTONE, as above, very sandy, argillaceous.

30% SANDSTONE, as above, very fine to fine grained, tight, no show; occasional trace PYRITE.  
10% CONGLOMERATIC GRAINS AND PEBBLES QUARTZ, clear, white, cloudy, coarse, size to 1 cm, well to subrounded.  
Trace COAL, CALCITE.

2770' - 2780'

60% SHALE, as above, mid to dark grey, occasionally greenish, in part slightly silty.

10% SILTSTONE, as above, argillaceous, firm, blocky, rarely slightly carbonaceous.

30% SANDSTONE, as above, very fine to fine grained, slightly carbonaceous, rarely pyritic, tight, no shows.  
Trace COAL, PYRITE, CALCITE, QUARTZ GRAINS, as above.

2780' - 2790'

- 60% SHALE, light to dark grey, greenish, black to brown, carbonaceous, firm, fissile, occasionally silty, in part well bedded, in part very carbonaceous.
- 20% SILTSTONE, light grey, greenish, argillaceous, very slightly sandy, firm, blocky, trace bedding, slightly carbonaceous.
- 10% SANDSTONE, light grey to white, greenish, arkosic, very fine grained, occasionally fine grained, in part silty, tight, no show.
- 10% CONGLOMERATE, very coarse grains to 1 mm, well to sub-rounded, clear, cloudy, white and slightly brown to amber QUARTZ GRAINS, occasionally pitted.  
Trace PYRITE, COAL.

2790' - 2800'

- 60% SHALE, as above, in part very silty and well bedded.
- 30% SILTSTONE, light grey, as above, in part sandy and grading to very fine grained SANDSTONE.
- 10% SANDSTONE, as above, very fine to fine grained, tight, no show.  
Trace COAL, QUARTZ GRAINS, as above.

2800' - 2810'

- 50% SHALE, as above, in part milky.
- 30% SILTSTONE, as above, argillaceous occasionally sandy, in part slightly carbonaceous.
- 10% SANDSTONE, as above, arkosic, very fine to fine grained, tight, no shows.
- 10% CONGLOMERATE, QUARTZ, clear to white and cloudy, rounded to sub-rounded, very coarse to 1 cm, and occasional QUARTZITE PEBBLE to 2cm, yellow-brown, well rounded.  
Trace COAL.

2810' - 2820'

- 60% SHALE, as above and (25%) light brown, firm, very slightly silty, fissile, well bedded.
- 20% SILTSTONE, as above, occasionally very sandy and grading to very fine grained SANDSTONE.
- 20% SANDSTONE, arkosic, as above, very fine to fine grained, occasionally very carbonaceous, tight, no shows.  
Trace COAL, CONGLOMERATE, as above. Occasional trace bedding.

2820' - 2830'

40% SHALE, as above, approx.  
10% Brown as above.  
30% SILTSTONE, argillaceous,  
slightly sandy, as above.  
20% SANDSTONE, as above, very  
fine to fine grained, tight,  
no show.  
10% CONGLOMERATE, very coarse to  
pebbles (1cm), well rounded,  
occasionally pitted.  
Trace COAL, CALCITE.

2830' - 2840'

50% SHALE, as above and approx.  
10% brown, as above.  
30% SILTSTONE, light to mid grey,  
occasionally greenish,  
argillaceous, slightly sandy,  
very slightly carbonaceous.  
20% SANDSTONE, as above, very fine  
to occasionally fine grained,  
tight, no shows (Possibly more  
SANDSTONE in interval but fines  
have passed through sieve).  
Trace COAL, CONGLOMERATE (approx  
5%).

2840' - 2850'

20% SHALE, light to dark grey,  
slightly silty, slightly  
greenish and black, carbonaceous  
firm, fissile, in part well  
bedded, thinly bedded.  
30% SILTSTONE, light grey-greenish,  
occasionally mid grey,  
argillaceous, in part slightly  
sandy, firm, blocky, occasional  
well bedded, very slightly  
carbonaceous.  
40% SANDSTONE, arkosic, light grey,  
in part green-grey, very fine  
to fine grained, occasionally  
medium grained, fairly sorted,  
consists of QUARTZ, FELDSPAR,  
green and red mineral grains,  
carbonaceous specks in an  
argillaceous matrix; tight,  
no show, firm, massive.  
Trace PYRITE.  
10% CONGLOMERATE, occasionally  
amber and pinkish, well to sub-  
rounded, occasionally pitted  
QUARTZ. Unknown matrix,  
possibly occurs as pebbles in  
the SANDSTONE.  
Trace COAL, CALCITE.

2850' - 2860'

50% SHALE, as above, in part  
slightly silty, firm, fissile.  
30% SILTSTONE, as above, in part  
grades to very fine grained  
SANDSTONE.  
20% SANDSTONE, as above, very fine  
to fine grained, occasionally  
silty and green-grey, as above,  
fine grained to occasionally  
medium grained; tight, no show.  
Trace COAL, QUARTZ, CALCITE.



2860' - 2870'

40% SHALE, as above, light to dark grey, slightly greenish, black, carbonaceous and light brown, slightly silty.  
40% SILTSTONE, as above, light grey, occasionally greenish, in part sandy, argillaceous, firm, slightly carbonaceous.  
20% SANDSTONE, as above, light grey, greenish, very fine grained, occasionally silty, tight, no shows.  
Trace CALCITE, CONGLOMERATE.

2870' - 2880'

40% SHALE, as above, no light brown.  
30% SILTSTONE, as above, in part dark grey, very argillaceous, carbonaceous, firm, blocky.  
30% SHALE, as above, very fine, occasionally fine grained, occasionally green-grey, fair sorted, tight, no shows.  
Trace COAL, PYRITE.

2880' - 2890'

40% SHALE, as above, also occasionally green, firm, fissile.  
20% SILTSTONE, as above, in part sandy, in part very carbonaceous  
40% SANDSTONE, as above, light grey to white, in part green-grey, very fine to fine grained, tight, no shows.  
Trace MICA.  
Trace PYRITE, QUARTZ, FELDSPAR.

2890' - 2900'

60% SHALE, light to dark grey, in part black, carbonaceous, firm, fissile, occasionally slightly silty, in part well and thinly bedded, occasionally slightly carbonaceous.  
20% SILTSTONE, light to mid grey, greenish, in part sandy, firm, blocky, argillaceous, slightly carbonaceous.  
20% SANDSTONE, light grey to white, slightly greenish, arkosic, fine to very fine grained, fair sorted, firm, massive, in part very slightly carbonaceous, tight, no shows.  
Trace MICA.  
Trace COAL, black, brittle;  
QUARTZ GRAINS.

2900' - 2910'

50% SHALE, as above, in part greenish.  
30% SILTSTONE, as above, argillaceous, slightly sandy, firm, blocky.  
20% SANDSTONE, as above, very fine to fine grained, tight, no shows.  
Trace COAL, QUARTZ.

2910' - 2920'

40% SHALE, as above, and black to brown, carbonaceous, in part very silty.  
 10% SILTSTONE, as above.  
 50% SANDSTONE, light grey to white, occasionally slightly greenish, arkosic, fine to very fine grained, fair sorted, firm, massive, consists of clear to grey, subangular to subrounded QUARTZ, white FELDSPAR, rare coloured mineral grains, occasional carbonaceous specks or MICA in a white, kaolinitic matrix (Matrix: grains varies  $\frac{2}{3}$  to  $\frac{1}{4}$ ), occasionally slightly calcareous.  
 Trace COAL, CALCITE.

2920' - 2930'

30% SHALE, as above, with abundant black to brown, carbonaceous.  
 30% SILTSTONE, as above, in part very sandy.  
 40% SANDSTONE, as above, tight, no shows, and trace brown, hard, fine grained, sub-arkosic, tight, no shows, slightly calcareous.  
 Trace COAL, QUARTZ, rounded granules.

2930' - 2934'

50% SHALE, as above, in part well bedded.  
 20% SILTSTONE, as above, argillaceous sandy in part, firm, blocky, slightly carbonaceous.  
 30% SANDSTONE, as above, light grey to white, very fine to fine grained, occasionally silty, tight, no shows and trace brown to yellow-brown, fine to medium grained, tight, no shows.  
 Trace COAL, QUARTZ PEBBLE and very scarce grains, CALCITE, white.

2934' - 2940'  
 TRIP

N.B. Inch pipe logs in sample.  
 30% SHALE, as above, light to dark grey and occasionally black, carbonaceous; rare light brown, firm.  
 40% SILTSTONE, light to mid grey, occasionally greenish, argillaceous, slightly sandy, in part carbonaceous, occasionally dark brown.  
 30% SANDSTONE, as above, in part greenish, tight, no show.  
 Trace PYRITE, QUARTZ PEBBLE.

2940' - 2950'

40% SHALE, light to dark grey, in part greenish and black, carbonaceous, occasionally slightly silty, firm, blocky.  
20% SILTSTONE, light to mid grey, slightly greenish, argillaceous, very slightly sandy, firm, massive, occasionally very slightly carbonaceous.  
40% SANDSTONE, arkosic, light grey, greenish, very fine to occasionally fine grained, occasionally silty, fairly sorted, firm, massive, occasionally slightly carbonaceous, tight, no shows.  
Trace COAL, QUARTZ, CALCITE, white and crystalline aggregates

2950' - 2960'

50% SHALE, as above, mainly slightly silty.  
30% SILTSTONE, as above, argillaceous, very slightly sandy, firm, blocky, slightly carbonaceous.  
20% SANDSTONE, arkosic, light greenish-grey, as above, very fine to occasionally fine or medium grained, tight, no show.  
Trace CALCITE, QUARTZ, COAL.

2960' - 2970'

50% SHALE, as above, firm, fissile, occasionally carbonaceous.  
20% SILTSTONE, as above, occasionally white, very fine grained, fair to well sorted.  
30% SANDSTONE, as above, very fine to fine grained; occasionally fine to medium grained, fair sorted, occasionally carbonaceous, tight, no shows.  
Trace COAL, CALCITE, coarse to very coarse QUARTZ GRAINS, approx. 10% well rounded, medium to fine QUARTZ GRAINS.

2970' - 2980'

30% SHALE, as above, with 5% white, sandy, soft, well bedded, non calcareous.  
40% SILTSTONE, as above, in part well bedded, occasionally carbonaceous.  
30% SANDSTONE, as above, light grey to white, occasionally greenish, very fine to fine grained, occasionally silty, firm, massive, occasionally slightly carbonaceous, trace bedding, tight, no shows.  
Trace PYRITE, and white, occasionally greenish, very fine to fine grained, tight, no show.  
Trace COAL, CALCITE.

2980' - 2990'

- 30% SHALE, as above, light to dark grey, occasionally greenish, slightly carbonaceous, occasionally well bedded, slightly silty, firm, fissile.
- 50% SILTSTONE, as above, argillaceous, very slightly sandy, slightly carbonaceous, well bedded.
- 20% SANDSTONE, as above, mainly very fine grained, occasionally fine or silty, tight, no shov. Trace COAL, QUARTZ PEBBLES.

2990' - 3000'

40 mins. circ.

- 40% SHALE, as above, in part silty, firm, and occasionally black and carbonaceous.
- 40% SILTSTONE, as above, argillaceous, occasionally slightly sandy.
- 20% SANDSTONE, as above, very fine to occasionally fine grained, tight, no shov. Trace COAL, SILTSTONE, QUARTZ PEBBLES and very coarse grains, well rounded.

3000' - 3010'

- 10% SHALE, as above.
- 20% SILTSTONE, as above.
- 70% SANDSTONE, silty, light grey, occasionally carbonaceous, occasionally black-grey, very fine to occasionally fine grained, tight, no shov. Trace COAL, coarse QUARTZ GRAINS, well rounded.

3010' - 3020'

- 30% SHALE, light to dark grey, occasionally greenish, black, carbonaceous, firm, in part silty, fissile, occasionally slightly carbonaceous, occasionally well bedded. Trace red-brown, silty, shov. soft, blocky.
- 10% SILTSTONE, light to silty grey, in part greenish, argillaceous, occasionally slightly sandy, firm, blocky, occasionally slightly carbonaceous.
- 60% SANDSTONE, silty, light grey to white, occasionally greenish or green-grey, speckled, very fine to fine grained, fair sorted, firm to occasionally hard and brittle, massive, occasionally slightly carbonaceous, consists of QUARTZ, PEBBLES and minor coloured (green, red and black) mineral grains, in an argillaceous/matrix (matrix) matrix, tight, no shov. Trace COAL, QUARTZ GRAINS.

3020' - 3030'

40% SHALE, as above, light to dark grey, in part slightly greenish, slightly carbonaceous.  
30% SILTSTONE, as above, argillaceous, occasionally slightly sandy.  
30% SANDSTONE, as above, very fine to fine grained, with occasional mineral grains, tight, no shows. Trace COAL, QUARTZ GRAINS, white CALCITE.

3030' - 3040'

40% SHALE, as above, in part black and carbonaceous; trace white, slightly sandy, blocky.  
20% SILTSTONE, as above, occasionally very slightly sandy.  
40% SANDSTONE, as above, very fine to fine grained, occasionally silty, rarely medium grained, tight, no shows. Trace COAL, QUARTZ GRANULES.

3040' - 3050'

20% SHALE, as above, occasionally black to brown, slightly carbonaceous.  
10% SILTSTONE, as above.  
70% SANDSTONE, as above, generally fairly to poorly sorted, very fine to fine grained, very silty, 30% white (kaolinitic cement) and 70% grey-green, tight, no shows.

3050' - 3060'

30% SHALE, as above.  
30% SILTSTONE, as above, in part slightly carbonaceous, well and thinly bedded.  
40% SANDSTONE, as above, very fine to fine grained, silty, tight, no shows; 60% grey-green, as above. Trace QUARTZ, COAL, PYRITE.

3060' - 3070"

40% SHALE, as above, occasionally slightly brownish.  
20% SILTSTONE, as above, occasionally carbonaceous and dark grey.  
40% SANDSTONE, very fine grained, occasionally fine grained, tight, no show. Trace COAL, QUARTZ.

3070' - 3080'

50% SHALE, light to dark grey, occasionally slightly greenish, black, carbonaceous. Trace yellow, slightly sandy, blocky, in part silty, firm, fissile, occasionally slightly carbonaceous, occasionally well and thinly bedded.  
20% SILTSTONE, light to mid grey, greenish in part, argillaceous, occasionally slightly sandy, firm, blocky, in part slightly carbonaceous.  
30% SANDSTONE, light grey to white, occasionally green-grey, argillaceous.

- 3070' - 3080'  
(cont) very fine to fine grained, fair sorted, firm to hard, in part slightly siliceous, massive, tight, no shows. Trace COAL, CALCITE.
- 3080' - 3090' 40% SHALE, as above, in part silty.  
10% SILTSTONE, as above, green, argillaceous.  
50% SANDSTONE, as above, light grey to white and green-grey, fine to very fine and occasionally medium grained, fair to well sorted, tight, no shows.
- 3090' - 3100' 30% SHALE, as above.  
20% SILTSTONE, as above, in part slightly carbonaceous.  
50% SANDSTONE, as above, very fine to fine and medium grained, tight, no shows. Trace QUARTZ, COAL, CALCITE.
- 3100' - 3113'  
+ 10 min. circ. 30% SHALE, as above, mainly mid grey.  
10% SILTSTONE, as above.  
60% SANDSTONE, arkosic, light grey, greenish and white, slightly greenish, very fine to medium grained (with many loose QUARTZ GRAINS, subrounded to subangular, fine to medium grained), firm, massive, rarely slightly carbonaceous, very slightly calcareous, tight, no shows. Trace CALCITE, pinkish; LIMESTONE, grey, crystalline.
- 3113' and circ. 50% SHALE, as above.  
20% SILTSTONE, as above.  
30% SANDSTONE, as above, tight, no shows.
- 3113' - 3123' CORE NO. 7. Recovered 10' 100%  
SEE CORE DESCRIPTION.  
(Picked up with Core No. 8.)
- 3123' - 3128' CORE NO. 8. Recovered 2'6" 50%  
SEE CORE DESCRIPTION.
- 3128' - 3140' 20% SHALE, dark grey, slightly silty, firm, fissile, well and thinly bedded.  
80% SANDSTONE, arkosic, light green-grey, fine to medium grained, occasionally very fine grained, fair sorted, firm, massive, consists of QUARTZ, FELDSPAR, minor MICA, coloured mineral grains, occasional carbonaceous flecks and black aggregates of very fine grains; tight, no shows.

3140' - 3150'

20% SHALE, as above.  
80% SANDSTONE, as above, in part very fine grained to silty, occasionally yellow-grey, tight, no shows.  
Trace QUARTZ GRANULES; PYRITE, SILTSTONE, light grey, argillaceous, firm, blocky.

3150' - 3160'

20% SHALE, as above, occasionally slightly silty.  
20% SILTSTONE, light grey, slightly greenish, argillaceous, firm, blocky, well and thinly bedded.  
60% SANDSTONE, as above, very fine to fine grained, light green-grey and fine to medium grained, yellow-grey, tight, no shows.  
Trace COAL, black, brittle.

3160'  
Circ. Sample  
TRIP

30% SHALE, as above, in part silty, occasionally greenish.  
10% SILTSTONE, as above.  
60% SANDSTONE, as above, occasionally grades to white; tight, no shows mainly very fine to fine, occasionally medium grained.

R.S.T. NO. 2. 3095 - 3160'.

3160' - 3170'

30% SHALE, light to mid grey, in part very silty, firm, fissile, occasionally slightly carbonaceous.  
20% SILTSTONE, light to mid grey, argillaceous, very slightly sandy, firm, blocky.  
50% SANDSTONE, calcic, light grey to white, greenish, very fine to fine grained, fair to well sorted, firm, massive, occasionally very slightly carbonaceous, tight, no shows.

3170' - 3180'

50% SHALE, as above, in part very silty, occasionally slightly carbonaceous.  
30% SILTSTONE, as above, argillaceous slightly sandy, firm, blocky, occasionally slightly carbonaceous, occasionally well and thinly bedded.  
20% SANDSTONE, as above, very fine to fine grained, well to fair sorted, tight, no shows.  
Trace COAL, CALCITE, white to buff, soft, blocky, slightly sandy SHALE.

3180' - 3190'

- 50% SHALE, as above, and brown-grey, firm, fissile, in part slightly carbonaceous, occasionally well bedded, trace PYRITE.
- 20% SILTSTONE, as above, occasionally with sandy streaks, well and thinly bedded.
- 30% SANDSTONE, as above, very fine to fine grained, occasionally slightly carbonaceous, tight, no shows.

3190' - 3200'

- 30% SHALE, dark to mid grey, rarely greenish, very slightly silty, firm to hard, fissile, occasionally well and thinly bedded, in part slightly calcareous, in part slightly carbonaceous.
- 10% SILTSTONE, mid grey, argillaceous, slightly sandy, firm, blocky, occasionally well and thinly bedded, in part slightly calcareous, in part slightly carbonaceous.
- 60% SANDSTONE, arkosic, light grey to white, greenish, very fine to fine grained, occasionally medium grained, fair to well sorted, firm, massive, rarely slightly carbonaceous, slightly micaceous, very slightly calcareous, tight, no shows. Trace QUARTZ, COAL, CALCITE. Trace CALCITE VEINS in SANDSTONE.

3200' - 3210'

- 50% SHALE, as above, occasionally green, occasionally black, scaly, well and thinly bedded.
- 20% SILTSTONE, as above, in part very well and thinly bedded, slightly carbonaceous.
- 30% SANDSTONE, as above, light green-grey to occasionally white, very fine to fine, occasionally medium grained and occasionally very fine grained to silty, well and thinly bedded, slightly carbonaceous, white, tight, no shows, Trace CALCITE.

3210' - 3220'

- 50% SHALE, as above, and brown-black, carbonaceous.
- 20% SILTSTONE, as above, occasionally slightly sandy.
- 30% SANDSTONE, as above, light green-grey, trace white, very fine to fine grained, well sorted, occasionally slightly carbonaceous, tight, no shows, with rare "veins" of QUARTZ, granular aggregate, clear to amber at contact with SANDSTONE.



3220' - 3230'

- 40% SHALE, as above, light to dark grey, green-grey, black, brown, firm, fissile, in part carbonaceous, occasionally well and thinly bedded, occasionally slightly micaceous.
- 20% SILTSTONE, in part mid grey, occasionally greenish, rare grey-brown, carbonaceous, argillaceous, occasionally slightly sandy, firm, blocky, occasionally well and thinly bedded.
- 40% SANDSTONE, as above, arkosic, grey-green to light grey and white, very fine to fine grained, occasionally medium grained, well sorted, firm, massive, occasionally slightly carbonaceous; tight, no shows, rare trace bedding.

3230' - 3240'

- 70% SHALE, light to dark grey, occasionally greenish, black, in part slightly silty, firm, fissile, occasionally slightly carbonaceous, in part slightly calcareous, occasionally well and thinly bedded.
- 20% SILTSTONE, in part well and thinly bedded, light grey, argillaceous, slightly sandy, firm, blocky, in part slightly calcareous, occasionally well and thinly bedded.
- 10% SANDSTONE, arkosic, very fine to fine grained, tight, no shows.

3240' - 3250'

- 10% SANDSTONE, arkosic, very fine to fine grained, tight, no shows.
- 50% SHALE, as above, and black, slightly scaly looking.
- 20% SILTSTONE, as above, in part greenish.
- 20% SANDSTONE, arkosic, light green-grey, very fine to silty, firm, massive, slightly carbonaceous, tight, no shows. Trace PYRITE, CALCITE, QUARTZ.

3250' - 3260'

- 50% SHALE, as above, occasionally brownish.
- 30% SILTSTONE, as above, grades to very fine grained SANDSTONE.
- 20% SANDSTONE, as above, very fine grained to silty, occasionally fine grained, occasional trace bedding; tight, no shows. Trace CALCITE, clear and white.

3260' - 3270'

40% SHALE, as above.  
20% SILTSTONE, as above.  
40% SANDSTONE, arkosic, light grey-green, very fine to fine grained, fair sorted, firm, massive, rare trace bedding, in part slightly carbonaceous, composed of clear to white and grey, well to subrounded QUARTZ, white FELDSPAR, green and red mineral grains, carbonaceous specks, rare MICA in a green-grey, argillaceous matrix, tight, no shows.  
Trace CALCITE.

3270' - 3280'

60% SHALE, as above, and brown, very slightly carbonaceous.  
20% SILTSTONE, as above, light to mid grey, argillaceous, slightly sandy, slightly carbonaceous.  
20% SANDSTONE, arkosic, as above, very fine to fine grained and occasionally very fine grained to silty, tight, no shows.  
Trace COAL, black, brittle.

3280' - 3290'

40% SHALE, as above, occasionally with CALCITE VENS.  
20% SILTSTONE, as above.  
40% SANDSTONE, as above, in part carbonaceous, with lithic, carbonaceous fragments; tight, no shows.

3290' - 3300'

60% SHALE, as above, in part silty, light to dark grey, brown to black.  
30% SILTSTONE, as above, in part grades to very fine grained SANDSTONE, light to mid grey, occasionally greenish.  
10% SANDSTONE, as above, very fine to fine grained, tight, no shows. Trace COAL, CALCITE.

3300' - 3305'

50% SHALE, as above, mainly black to brown, occasionally grades to carbonaceous SHALE and COAL; occasionally greenish.  
30% SILTSTONE, as above, argillaceous, slightly sandy to very fine grained SANDSTONE, occasionally slightly carbonaceous, well and thinly bedded.  
20% SANDSTONE, very fine to fine grained, as above, tight, no shows.  
Trace CALCITE, COAL, PYRITE.

- 3005' - 3310'
- 50% SHALE, mid to dark grey, greenish and brown to black, carbonaceous, occasionally silty, rarely slightly sandy, firm, fissile, in part well bedded, occasionally slightly carbonaceous.
  - 40% SILTSTONE, light to mid grey, occasionally greenish and brown-grey, argillaceous, grades in part to very fine grained SANDSTONE, firm, blocky, in part slightly carbonaceous, occasionally well and thinly bedded.
  - 10% SANDSTONE, arkosic, light grey, greenish, very fine grained to silty, firm, massive, rarely with pyritic cement, tight, no shows.
- Trace COAL, CALCITE.
- 3310' - 3320'
- 70% SHALE, as above, occasionally black, slightly scaly in appearance.
  - 20% SILTSTONE, as above.
  - 10% SANDSTONE, as above, tight, no shows.
- Trace PYRITE, COAL, CALCITE.
- 3320' - 3330'
- 60% SHALE, as above, in part green-grey, and occasionally light grey.
  - 30% SILTSTONE, as above, grades into very fine grained SANDSTONE, light grey-green.
  - 10% SANDSTONE, as above, very fine grained to silty, tight, no shows. Large percentage FELDSPAR.
- Trace COAL, CALCITE, rare QUARTZ.
- 3330' - 3340'
- 20% SHALE, as above.
  - 20% SILTSTONE, as above.
  - 60% SANDSTONE, 50% light green-grey arkosic, fair to well sorted, occasionally silty, 50% brown, very fine to fine and silty, hard, slightly calcareous, massive, composed of QUARTZ, some FELDSPAR, mineral grains, in a slightly calcareous matrix, tight, no shows.
- Trace CALCITE, QUARTZ.
- 3340' - 3350'
- 30% SHALE, as above, in part slightly silty, occasionally carbonaceous.
  - 20% SILTSTONE, as above, light grey-green, grades to very fine grained SANDSTONE, argillaceous.
  - 50% SANDSTONE, as above, 50% light grey to grey-green, very fine grained to silty, 20% brown, as above.

- 3350' - 3360'
- 30% SHALE, as above.
  - 20% SILTSTONE, as above.
  - 50% SANDSTONE, as above, light grey to light grey-green, very fine to fine grained, silty, much being ground up to individual QUARTZ GRAINS, tight, argillaceous/kaolinitic cement, no shows. Trace CALCITE, QUARTZ.
- 3360' - 3370'
- 20% SHALE, light to dark grey, occasionally greenish and black carbonaceous, silty, firm, fissile, well and thinly bedded, occasionally slightly carbonaceous.
  - 20% SILTSTONE, light to mid grey, greenish, and grey-brown and white, argillaceous, occasionally slightly sandy, firm, blocky, in part carbonaceous, well and thinly bedded, occasional CALCITE VEINS to  $\frac{1}{4}$ " , orange.
  - 60% SANDSTONE, white and light green grey, arkosic, very fine to fine grained, silty, fair sorted, firm, massive, rarely slightly carbonaceous, tight, no shows. Trace PYRITE, COAL, CALCITE, QUARTZ PEBBLE. Trace bedding.
- 3370' - 3380'
- 40% SHALE, as above, brown to black, carbonaceous.
  - 20% SILTSTONE, as above, grades to very fine grained SANDSTONE.
  - 40% SANDSTONE, arkosic, white to light green-grey, very fine to fine grained, silty, tight, no shows.
- 3380' - 3385'  
Circ.
- 20% SHALE, as above.
  - 60% SILTSTONE, as above, 50% of sample brown, sandy, slightly calcareous, hard, slightly siliceous, massive, grades to very fine grained silty SANDSTONE.
  - 20% SANDSTONE, as above, and brown, very fine grained, silty, tight, no shows. Trace COAL, PYRITE.
- 3385' - 3390'  
TRIP
- 40% SHALE, as above.
  - 30% SILTSTONE, light to mid grey, greenish, occasionally brown, argillaceous, occasionally slightly silty.
  - 30% SANDSTONE, light grey, occasionally greenish, very fine grained, arkosic, tight, no shows.

3390' - 3400'

- 20% SHALE, as above, light to dark grey, occasionally greenish, rare brown to black, carbonaceous.
- 30% SILTSTONE, as above, and trace brown, siliceous, slightly calcareous, as above.
- 50% SANDSTONE, mainly white, occasionally green-grey and brown, very fine grained, arkosic, tight, no shows, kaolinitic cement. Trace COAL, CALCITE.

3400' - 3410'

- 20% SHALE, as above, slightly silty, firm, fissile, occasionally slightly carbonaceous, well bedded.
- 20% SILTSTONE, as above, mainly well and thinly bedded.
- 60% SANDSTONE, as above, mainly white, occasionally slightly greenish, very fine grained, occasionally fine to medium grained, fair to poorly sorted, tight, no shows. Trace COAL.

3410' - 3420'

- 40% SHALE, as above, in part brown to black, carbonaceous.
- 10% SILTSTONE, as above.
- 50% SANDSTONE, as above, white and occasionally brown, very fine grained and occasionally fine to medium grained; tight, no shows. Trace COAL, orange CALCITE.

3420' - 3430'

(New sample catching method - as samples getting smaller - better samples especially for fines)

- 10% SHALE, light to mid grey and brown to black, firm, fissile, occasionally slightly silty, in part carbonaceous, occasionally well and thinly bedded.
- 10% SILTSTONE, light grey, greenish, argillaceous, very slightly sandy, firm, blocky, well and thinly bedded, slightly carbonaceous.
- 80% SANDSTONE, white to very light grey-green, arkosic to sub-arkosic, very fine to fine grained, rare medium grains, firm to hard, occasionally slightly carbonaceous to very carbonaceous, composed of clear to cloudy and occasional coloured QUARTZ, white and occasional orange FELDSPAR, carbonaceous matter (detrital?) occasionally red, green or brown, mineral grains, rare MICA, in a white, kaolinitic matrix, tight, no shows. Trace COAL, black, SHALE light brown, CALCITE, dark brown.

3430' - 3440'

- 20% SHALE, as above, in part slightly calcareous.
- 10% SILTSTONE, as above, light grey-greenish and occasionally grey-brown, slightly carbonaceous.
- 70% SANDSTONE, but more greenish than above, and occasionally yellow-brown, tight, no shows. Trace CALCITE to iron; QUARTZ granule, COAL, black, brittle.

3440' - 3450'

- 30% SANDSTONE, as above, in part carbonaceous to very carbonaceous.
- 20% SILTSTONE, as above, light to mid, occasionally dark grey, argillaceous, very slightly sandy, occasionally slightly carbonaceous.
- 50% SANDSTONE, as above, very fine to fine grained, well to fair sorted, tight, no shows. Trace CALCITE, QUARTZ granule and pebbles, PYRITE, COAL.

3450' - 3460'

- 10% SHALE, as above.
- 10% SILTSTONE, as above.
- 80% SANDSTONE, as above, arkosic, white to very light greenish-grey, very fine to fine grained, occasionally medium grained, hard to firm, well to fairly sorted, tight, no shows, massive, rarely slightly carbonaceous and slightly calcareous. Trace QUARTZ, COAL, PYRITE.

3460' - 3470'

- 10% SHALE, as above, light to dark brown-grey, occasionally greenish, slightly silty, occasionally slightly carbonaceous, firm, fissile.
- 20% SILTSTONE, as above, argillaceous, occasionally slightly sandy, occasionally slightly carbonaceous, well and thinly bedded.
- 70% SANDSTONE, as above, tight, no shows, arkosic, very fine to fine grained, occasionally slightly carbonaceous. Trace COAL, QUARTZ, PYRITE, CALCITE.

3470' - 3480'

- 30% SHALE, as above, in part silty.
- 30% SILTSTONE, as above, occasionally grades to very fine grained SANDSTONE.
- 40% SANDSTONE, as above, white to light grey, arkosic, fine grained to silty, firm, tight, no shows.

3480' - 3490'

10% SHALE, mid to dark grey, grey-brown.  
10% SILTSTONE, light to mid grey-greenish, argillaceous.  
80% SANDSTONE, light green-grey, arkosic, very fine grained, occasionally silty or fine grained, well to fair sorted, occasionally slightly carbonaceous, firm, massive, tight, no shows, grades to SILTSTONE. Trace CALCITE, pink; COAL, black.  
Much white to light grey mud in sample.

3490' - 3495'  
Circ.

20% SHALE, as above.  
50% SILTSTONE, as above, argillaceous, well and thinly bedded, slightly carbonaceous.  
30% SANDSTONE, as above, arkosic, very fine grained to silty, tight, no shows, occasionally slightly carbonaceous, grades to SILTSTONE.  
Trace black COAL, PYRITE.

3495' - 3500'

30% SHALE, as above, silty in part.  
50% SILTSTONE, as above, argillaceous, slightly carbonaceous, well and thinly bedded.  
20% SANDSTONE, as above, very fine to silty, slightly argillaceous, tight, no shows. Trace CALCITE.

3500' - 3510'

10% SHALE, as above.  
50% SILTSTONE, as above, light to mid green-grey, slightly sandy.  
40% SANDSTONE, as above, arkosic, light green-grey, very fine grained to silty, fair to well sorted, tight, no shows, Trace COAL, black; PYRITE.

3510' - 3520'

20% SHALE, as above, and grey-brown to black, carbonaceous, silty.  
50% SILTSTONE, as above, occasionally grading to very fine grained SANDSTONE.  
30% SANDSTONE, as above, very fine grained to silty, occasionally brownish-grey, tight, no shows. Trace black COAL, clear CALCITE.

3520' - 3523'  
Circ.

20% SHALE, as above, in part slightly silty, well and thinly bedded, slightly carbonaceous.  
50% SILTSTONE, as above, light to mid greenish-grey, occasionally slightly carbonaceous, occasionally sandy.  
30% SANDSTONE, as above, very fine grained, occasionally fine

3520' - 3523'  
(cont)

grained, in part silty, occasionally carbonaceous and well bedded, firm, slightly brittle, tight, no shows.  
Trace PYRITE, CALCITE.

3523' - 3530'

60% SHALE, light to dark grey, occasionally green-grey, and brown, carbonaceous, in part very slightly silty, firm, fissile, in part very slightly carbonaceous, in part very slightly calcareous, occasionally well and thinly bedded.

30% SILTSTONE, light to mid and occasionally dark grey, occasionally greenish, argillaceous, rarely slightly sandy, firm, blocky, occasionally slightly carbonaceous, occasionally well and thinly bedded.

10% SANDSTONE, arkosic, light grey-green, very fine grained to occasionally silty, fair to well sorted, firm, massive, kaolinitic/argillaceous matrix, tight, no shows.

Trace CALCITE, milky, QUARTZ GRANULE; COAL, black; SHALE, white, soft, blocky, occasionally slightly silty.

3530' - 3540'

70% SHALE, as above and brown to purplish-brown, carbonaceous.

20% SANDSTONE, as above, very fine grained, occasionally fine or silty, tight, no shows.

10% SILTSTONE, as above, argillaceous, very slightly sandy.  
Trace COAL, CALCITE.

3540' - 3550'

60% SHALE, as above, in part very silty.

20% SILTSTONE, as above, occasionally grades to very fine grained silty, rarely very carbonaceous SANDSTONE.

20% SANDSTONE, light green-grey and buff, occasionally non-arkosic to sub-arkosic, very fine to fine grained, tight, no shows.

Trace COAL, black; CALCITE, vein type; PYRITE.

3550' - 3560'

40% SHALE, as above.

20% SILTSTONE, as above, argillaceous, well and thinly bedded.

40% SANDSTONE, light green-grey, as above, and mid to dark grey (burnt in drying?), arkosic, silty to very fine grained, firm, massive, carbonaceous, tight, no shows.

Trace PYRITE, CALCITE.



3560' - 3570'

60% SHALE, as above, light to dark brown and occasionally black, carbonaceous, firm, fissile.  
30% SILTSTONE, as above, light to mid greenish-grey, argillaceous, in part slightly sandy.  
10% SANDSTONE, as above, tight, no shows.  
Trace CALCITE, COAL, PYRITE.

3570' - 3580'

50% SHALE, as above and occasionally grey-green or brown.  
40% SILTSTONE, as above, light to mid grey and greenish-grey, argillaceous, in part slightly sandy.  
10% SHALE, as above, very fine to fine grained, tight, no shows.  
Trace CALCITE.

3580' - 3590'

10% SHALE, as above, light to dark grey, occasionally silty.  
30% SILTSTONE, as above, in part sandy, occasionally slightly calcareous, in part grades to SANDSTONE.  
60% SANDSTONE, grey-green, yellow-brown, arkosic, silty to very fine grained, slightly siliceous, slightly calcareous, fair sorted, with argillaceous matrix, tight, no shows.  
Trace CALCITE.

3590' - 3600'

20% SHALE, light to dark grey, occasionally greenish, firm, fissile, well and thinly bedded, in part slightly carbonaceous, in part slightly calcareous.  
50% SILTSTONE, light grey to light green-grey, argillaceous, grades to very fine grained SANDSTONE, firm, blocky, in part well bedded, in part massive.  
30% SANDSTONE, arkosic, light green-grey, light grey and occasionally yellow-brown, very fine grained to silty, fair sorted, firm to hard, massive, in part carbonaceous, thinly bedded, with argillaceous (slightly silicified?) matrix, tight, no shows.  
Trace CALCITE, white to clear; PYRITE.

3600' - 3620'

50% SHALE, as above with trace slickensides.  
20% SILTSTONE, as above, light grey to light green-grey, argillaceous.  
30% SANDSTONE, as above, (mostly as loose QUARTZ GRAINS 30% of sample) arkosic, very fine

3610' - 3620'  
(cont)

to fine grained, fair sorted, light grey to buff, speckled, firm, massive, composed of clear, cloudy to grey QUARTZ GRAINS, rounded to subangular, white FELDSPAR GRAINS, rare mineral specks in a kaolinitic or argillaceous matrix, tight, no shows, slightly calcareous. Trace COAL, black brittle; PYRITE; CALCITE, clear, granules of QUARTZ.

3620' - 3630'

- 30% SHALE, as above, in part slightly silty, firm, fissile, occasionally well and thinly bedded.
- 20% SILTSTONE, as above, in part well and thinly bedded.
- 50% SANDSTONE, as above, fine to very fine grained, light grey to light green-grey and buff, fair sorted, tight, no shows. Trace COAL, as above, QUARTZ GRAINS, CALCITE.

3630' - 3640'

- 30% SHALE, as above, firm, fissile, occasionally slightly silty, slightly carbonaceous.
- 30% SILTSTONE, as above, argillaceous, light grey, occasionally green-grey, in part very slightly sandy.
- 40% SANDSTONE, as above, tight, no shows, kaolinitic cement.

3640' - 3650'

- 20% SHALE, light to dark grey, very slightly silty, firm, fissile, slightly carbonaceous.
- 20% SILTSTONE, light grey and greenish-grey, argillaceous, firm, blocky, slightly carbonaceous.
- 60% SANDSTONE, as above, light grey to green-grey, occasionally blueish tinge and buff to yellow-brown, very fine to fine grained, tight, no shows. Trace COAL, CALCITE.

3650' - 3660'

- 30% SHALE, light to dark grey, occasionally greenish and brown to black, carbonaceous, occasionally very slightly silty, firm, fissile, occasionally well and thinly bedded, in part slightly calcareous, in part slightly carbonaceous.
- 30% SILTSTONE, light to mid grey, occasionally greenish, grades to very fine grained, silty SANDSTONE, argillaceous, firm, blocky, in part slightly calcareous, well and thinly bedded, occasionally slightly siliceous, non argillaceous, massive.

2650' - 3660'  
(cont)

40% SANDSTONE, arkosic, white to light grey, and light green-grey, silty to fine and very fine grained, fair to poorly sorted, firm, massive, occasionally slightly carbonaceous, kaolinitic matrix, slightly calcareous, tight, no shows.

Trace CALCITE, vein type, black COAL, QUARTZ GRAINS.

Most likely much very fine grained QUARTZ and SILT sized QUARTZ going through shaker; therefore, more SILTSTONE and SANDSTONE than shown.

3660' - 3670'

30% SHALE, as above, occasionally slightly silty.

40% SILTSTONE, as above, in part argillaceous, in part grades to very fine grained SANDSTONE.

30% SANDSTONE, very fine to silty, occasionally fine grained, tight, no shows, occasionally light green mineral grains. Trace CALCITE, as above, PYRITE.

3670' - 3680'

30% SHALE, as above.

50% SILTSTONE, as above, occasionally slightly sandy.

20% SANDSTONE, as above, very fine grained to silty, occasionally fine grained, tight, no shows. Trace CALCITE, QUARTZ, COAL.

3680' - 3690'

50% SHALE, as above, light to dark grey, firm, slightly fissile, occasionally black, carbonaceous

40% SILTSTONE, as above, mainly argillaceous, very slightly sandy, light to mid grey.

10% SANDSTONE, as above, very fine to fine grained or silty, tight, no shows.

3690' - 3700'

60% SHALE, as above, mainly light to mid grey, firm, slightly fissile, slightly calcareous.

30% SILTSTONE, as above, argillaceous, in part slightly sandy.

10% SANDSTONE, as above, very fine to fine grained, tight, no shows, grey-green to light grey.

Trace CALCITE, COAL, QUARTZ.

3700' - 3710'

30% SHALE, as above, light to dark grey, brown to black, firm, fissile, occasionally silty.

20% SILTSTONE, as above, argillaceous, occasionally slightly sandy, firm, blocky, occasionally well and thinly bedded.

3700' - 3710'  
(cont)

50% SANDSTONE, (including loose very fine QUARTZ GRAINS), as above, arkosic, light grey to green grey, occasionally buff and occasionally white, very fine grained, occasionally fine grained, sometimes silty, firm, massive, kaolinitic cement, tight, no shows.  
Trace COAL, CALCITE, PYRITE.

3710' - 3711'  
Circ.

40% SHALE, light to dark grey, grey-green, black to brown, occasionally grey-brown, occasionally slightly silty, firm, fissile, occasionally slightly carbonaceous, occasionally well and thinly bedded.

20% SILTSTONE, light to mid grey, occasionally greenish, argillaceous, in part slightly sandy, firm, blocky, occasionally slightly carbonaceous, occasionally well and thinly bedded.

40% SANDSTONE, arkosic (includes loose, very fine to silty grains), very fine to silty, occasionally fine grained, light grey to light green-grey and buff, occasionally slightly carbonaceous, firm, massive with rare trace bedding, composed of QUARTZ, FELDSPAR, minor coloured mineral grains (green, black and occasionally red), rare MICA, in a white kaolinitic matrix, tight, no shows.  
Trace CALCITE, COAL, PYRITE.

3711' - 3720'

60% SANDSTONE, light greenish-grey, very fine grained to fine grained, arkosic, slightly calcareous, firm, consists of fairly sorted, subangular, light grey QUARTZ, pale brown FELDSPAR, minor indeterminate green grains, trace brown MICA, carbonaceous and coaly grains, and red specks in kaolinitic, slightly calcareous matrix; tight.

40% SHALE, grey, green-grey, some brown, firm, silty in places, very slightly micaceous, occasional carbonaceous specks, only rarely fissile. The brown variety shows trace slickensides, is slightly carbonaceous.

- 3720' - 3730' 60% SHALE, as above, mostly grey variety.  
40% SANDSTONE, as above, tight.  
Trace CALCITE, COAL.
- 3730' - 3740' Sample contaminated -  
70% SHALE, as above.  
30% SANDSTONE, as above, tight.
- 3740' - 3750' 50% SHALE, medium grey, occasionally green-grey, as above, some dark grey, carbonaceous.  
50% SANDSTONE, as above, tight, varies to brown, very calcareous, in a few places; coaly and carbonaceous grains slightly more common.  
Trace CALCITE, PYRITE and medium to coarse grained, loose, subangular to angular QUARTZ GRAINS.
- 3750' - 3760' 80% SHALE, medium grey, silty in places, slightly micaceous, (very fine), occasionally slightly carbonaceous, some weak fissility.  
20% SANDSTONE, as above, tight.  
Trace CALCITE, loose, very coarse grained, angular, clear QUARTZ grains and granules.
- 3760' - 3770' 50% SANDSTONE, light greenish-grey, light brown, fine grained to occasionally medium grained, fairly sorted, subangular QUARTZ, etc. as above. Light brown variety very calcareous, tight.  
50% SHALE, as above; some dark grey, dark brown-grey, slightly slickensided SHALE.  
Rare coaly inclusions in dark grey SHALE.  
Trace CALCITE, very coarse grains of QUARTZ, as above.
- 3770' - 3780' 10% SILTSTONE, light grey, whitish-grey, firm to rather friable, kaolinitic, fine carbonaceous specks, common - grades to very fine grained SANDSTONE.  
30% SANDSTONE, light greenish-grey, very fine to fine grained, consists of fairly sorted, subangular QUARTZ, etc. as above, in a kaolinitic, slightly calcareous matrix, tight.  
60% SHALE, as above.  
Common trace COAL (black and shaley) in sample. Trace CALCITE, white, some pink. Rare trace PYRITE.

- 3780' - 3790' 70% SANDSTONE, as above, very fine to fine grained; tight.  
30% SHALE, as above.  
Common trace COAL, black. Some bright, brittle, better quality than previously.
- 3790' - 3800' 30% SANDSTONE, as above, tight.  
70% SHALE, as above, occasionally very silty.  
Trace COAL, as above, Trace very coarse grained, sub-angular to angular, clear QUARTZ GRAINS, occasional granules. Trace CALCITE.
- 3800' - 3805'  
Circ. 20% SANDSTONE, as above, tight, rarely with coaly laminae.  
80% SHALE, medium grey, brown, greenish-grey, slightly micaceous, silty in part, occasional carbonaceous specks. Between 5 and 10% of SHALE is black or dark brownish, soft, fissile, coaly, occasionally slightly slickensided. Common trace COAL (possibly 2-5%) black, bright, brittle and black, shaley.
- 3805' - 3810' 40% SANDSTONE, light grey, light greenish-grey, fine to occasionally medium grained, arkosic, slightly calcareous in places, fairly hard, brittle. Consists of fairly sorted, subangular to sub-rounded, light grey to medium grey QUARTZ, pale to medium brown FELDSPAR, trace carbonaceous grains, some greenish, reworked, shaley grains, rare trace brown MICA, red specks, some brown, ashy, tuffaceous? grains in a kaolinitic, slightly calcareous, very slightly siliceous matrix. Tight.  
20% SILTSTONE, light medium grey, finely micaceous, argillaceous, carbonaceous specks.  
40% SHALE, medium grey, green-grey, dark brown-grey, rarely fissile, firm, silty in part. Dark brown variety slightly carbonaceous.
- 3810' - 3820' 30% SANDSTONE, as above, slightly more calcareous, traces of pale brown, calcite filled fractures. Less well sorted, tight.  
10% SILTSTONE, as above.  
60% SHALE, as above.  
Trace CALCITE loose in sample.

3820' - 3830'

20% SANDSTONE, as above, tight.  
Trace grains CHLORITE?  
10% SILTSTONE, as above.  
70% SHALE, as above. Trace black  
COAL. Trace plant fragments  
in dark brown to grey SHALE.  
Trace loose, coarse to very  
coarse grained, clear, sub-  
angular to angular QUARTZ  
GRAINS.

3830' - 3840'

30% SANDSTONE, as above, tight.  
10% SILTSTONE, as above.  
60% SHALE, as above.  
Trace CALCITE, loose in  
sample. Rare trace COAL.

3840' - 3850'

10% SANDSTONE, as above, tight.  
20% SILTSTONE, as above.  
70% SHALE, as above. Includes  
20% of dark brown-grey and  
dark grey SHALE, which is  
carbonaceous, coaly, slicken-  
sided in part, soft, with rare  
laminations of GYPSUM,  
CALCITE, associated with  
coaly laminations

3850' - 3860'

70% SHALE, mid grey, medium  
green-grey and medium brown-  
grey. Some dark brown-grey  
and dark grey. Mid grey  
variety slightly micromicaceous,  
firm, rarely fissile. Dark  
grey variety soft, slightly  
carbonaceous, occasionally  
coaly.  
20% SANDSTONE, light greenish-  
grey, fine grained, arkosic,  
fairly hard, brittle, con-  
sisting of fairly sorted grey  
QUARTZ, pale brown FELDSPAR,  
some reworked green-grey  
SHALE GRAINS? some coaly  
flecks, trace CHLORITE?  
GRAINS, trace brown, ashy,  
tuffaceous? grains in  
kaolinitic to slightly calcar-  
eous matrix. Tight.  
10% SILTSTONE, light grey, whitish  
grey, argillaceous. Trace  
carbonaceous specks.  
Trace CALCITE.

3860' - 3870'

80% SHALE, as above.  
10% SANDSTONE, as above, tight,  
some softer, rather friable.  
Tight.  
10% SILTSTONE, as above.

3870' - 3878'  
Circ.

70% SHALE, as above.  
20% SANDSTONE, as above, tight.  
10% SILTSTONE, as above.  
Trace black COAL, GYPSUM  
and CALCITE as laminae in  
dark grey SHALE.

- 3878' - 3890'      80% SHALE, as above.  
20% SANDSTONE, as above, fine grained, occasionally medium grained, tight. Common trace SILTSTONE, as above. Trace COAL. Trace soft, brown, ashy TUFF which hydrates readily.
- 3890' - 3900'      70% SHALE, as above, slightly silty in places.  
20% SANDSTONE, as above, very fine grained to fine grained, tight.  
10% SILTSTONE, as above. Trace COAL, CALCITE. Rare trace PYRITE.
- 3900' - 3910'      60% SHALE, as above, slightly more silty. SHALE is dominantly the medium grey to medium greenish-grey variety.  
20% SILTSTONE, light to medium grey and greenish-grey, argillaceous, finely micaceous, fine carbonaceous specks.  
20% SANDSTONE, as above, mostly fine grained, some very fine grained. In places very hard, partly silicified, occasionally fairly soft, slightly friable. Tight. Trace COAL, CALCITE. Rare trace brown, soft, ashy, tuff, hydrates readily.
- 3910' - 3920'      70% SHALE, as above.  
20% SILTSTONE, as above.  
10% SANDSTONE, as above, tight. Trace COAL, CALCITE. Rare trace soft, ashy TUFF, as above.
- 3920' - 3930'      80% SHALE, as above, includes 10% of black, soft, coaly, fissile, partly slickensided SHALE.  
20% SANDSTONE, light to medium grey, very fine to fine grained arkosic, consists of fairly sorted, subangular to subrounded QUARTZ, pale brown FELDSPAR and reworked carbonaceous and coaly grains in a slightly calcareous, slightly siliceous, clayey matrix. Trace red specks. Tight, moderately hard. Trace CALCITE, common trace COAL. One chip of ashy TUFF, as above with scattered QUARTZ GRAINS.



3930' - 3940'

70% SHALE, as above, commonly slightly silty. Trace only black, carbonaceous, coaly SHALE, as above.  
 20% SILTSTONE, as above.  
 10% SANDSTONE, as above, occasionally medium grained. Rare trace coaly laminations; tight.  
 Trace CALCITE (white). Rare trace pink CALCITE.  
 One chip of soft, ashy TUFF, as above, with scattered fine to medium grained, subrounded QUARTZ GRAINS.

3940' - 3945'

70% SHALE, as above. Common trace black coaly SHALE.  
 20% SILTSTONE, as above, generally light grey. Occasionally very slightly calcareous.  
 10% SANDSTONE, as above, varies to whitish-grey, lacustrine. Some greenish-grey SANDSTONE present, well reworked greenish-grey SHALE GRAINS? and rare trace brown MICA, in addition to pale brown FELDSPAR and coaly grains. Tight.  
 Trace CALCITE, COAL and rare trace soft, ashy, sandy TUFF, as above.

3945'  
Circ.

60% SHALE, as above, silty. Includes 20% of dark brown to black, soft, fissile, partly slickensided coaly SHALE.  
 30% SILTSTONE, as above, varies to medium grey and greenish-grey in places.  
 10% SANDSTONE, as above, very fine to fine grained, tight. Common trace COAL, black, brown-black, shaley. Trace CALCITE. One small (4mm) subrounded, frosted QUARTZ PEBBLE noted, loose in sample.

CORE NO. 2:

600' - 610'

Recovered  $4\frac{1}{2}$ "

Cuttings:

600' - 605'

10% MUDSTONE, light grey, silty, blocky, occasionally laminated, firm, slightly carbonaceous.  
10% SILTSTONE, light grey, sandy in part, some occasional white FELDSPAR and carbonaceous flecks.  
80% SANDSTONE, light green-grey, fine grained, arkosic, argillaceous, consists of QUARTZ, white FELDSPAR and green and black minerals, in an argillaceous matrix; occasionally coaly flecks; tight, no shows.

605' - 610'

20% MUDSTONE, as above.  
10% SILTSTONE, as above.  
70% SANDSTONE, as above, very argillaceous in part, occasionally lithic; tight, no shows.

Top 2"

SANDSTONE, arkosic, grey-green, fine grained, occasionally medium grained, with very argillaceous matrix (grains: matrix = 1.2) consists of clear, cloudy and grey QUARTZ, white FELDSPAR, black and red mineral specks, in a green to grey-green, argillaceous matrix, tight, no shows, very slightly calcareous; massive.

Bottom  $2\frac{1}{2}$ "

SANDSTONE, medium grey-green, fine grained, hard, slightly siliceous, consists of clear to light grey QUARTZ, carbonaceous flecks and partly decomposed FELDSPAR, in a medium grey, argillaceous, slightly siliceous matrix, calcareous, tight, no shows; massive, but has tendency to split vertically.

CORE NO. 3:

610' - 620'

Recovered 10'

UNIFORM LITHOLOGY - Greenish-grey, speckled SANDSTONE, arkosic, very fine to fine grained, occasionally fine to medium grained, well sorted, consisting of clear, white and grey QUARTZ, white FELDSPAR, often decomposed, green, red, black mineral grains and specks, in a greenish or greenish-grey, argillaceous, very slightly calcareous matrix. Rare mica, possibly black mineral is carbonaceous; tight, no shows. The core exhibits no definite bedding with only the very slightest indication of a dip of 15-20°. In the bottom feet the core is, in part, more siliceous than arkosic - slightly harder with less green colour.

CORE NO. 4:

1597' - 1607'

Recovered 9"

Ditch Cuttings:  
1597' - 1607'

20% SAND, loose QUARTZOSE, fine to occasionally medium grained, fair sorted, well to subrounded, clear and cloudy and grey QUARTZ GRAINS, occasionally coloured (red, green and white), mineral grains. Constituents same as of arkosic SANDSTONE and probably result of grinding instead of coring.

20% SANDSTONE, arkosic, in part QUARTZOSE, fine, occasionally very fine or medium grained, well sorted, consists as above, with MICA, massive, firm, tight, no shows.

10% SILTSTONE, light grey, argillaceous, slightly sandy, firm, well bedded, in part massive.

50% SHALE, mid to dark grey and grey-black, carbonaceous, firm, blocky, occasionally fissile, in part slightly silty, in part carbonaceous. Trace COAL, black.

CORE DESCRIPTION:

Top 6"

SHALE, dark grey, in part slightly silty, firm, fissile, very carbonaceous with abundant plant fossils, well and thinly bedded with occasional thin laminations and lenses of very silty SHALE and shaly SILTSTONE, light to mid grey, slightly carbonaceous.

Bottom 3"

Silty SHALE, mid grey, firm, fissile, well and thinly bedded with black and white mineral specks, slightly micaceous, in part grades to SILTSTONE and very fine grained SANDSTONE, arkosic, firm, calcareous, light greenish-grey, massive with QUARTZ, FELDSPAR and coloured mineral grains, tight, no shows. The silty SHALE had a distinctive coal gas odour upon removing from core barrel.

CORE NO. 5:

1607' - 1610'

Recovered 1'6"  
(Cut 3' only as core head appeared to be blocked, and was).

Top 5"

Silty SHALE, dark grey, hard, fissile, well and thinly bedded with undulatory bedding and lensing, general flat dip, carbonaceous with plant fossil fragments, occasionally fine FELDSPAR GRAINS.

CORE NO. 5(cont):

Next 5"

CONGLOMERATE, brown-grey, consists of granules and pebbles to 2cms in a silty matrix, firm, fissile, in part very carbonaceous, in part slightly calcareous, thinly bedded with undulatory bedding. Pebbles and granules consist of well rounded green-grey, brown-grey and yellow-brown SHALE, occasionally well bedded and contorted and soft, white, non-calcareous mineral, usually in a carbonaceous coating. Coal gas odour upon extraction from core barrel.

Next 8"

SILTSTONE, mid-grey, hard, slightly fissile, argillaceous, in part very slightly sandy, very slightly calcareous, well and thinly bedded with undulatory bedding and lensing, in part carbonaceous with plant fossils, in part very slightly micaceous with trace PYRITE. Shows in core due to coal gas.

Recovered 7' 8"

CORE NO. 6:

Interlaminated SHALE and silty SHALE, finely interlaminated, fissile, in part carbonaceous and in part with plant fossils, hard, occasionally CALCITE covered, slickenside planes approx 60° to axis of core and CALCITE filled cracks, trace of coal gas in the silty SHALE, light grey-greenish and dark grey to black, slightly greenish. Top 4'9" SHALE and silty SHALE, black. Shows current structures, lensing, washouts, occasionally short break shown by uneven bedding plane and small fragments in overlying sediments. Dips vary from 0-30° with dips between black SHALE and silty SHALE from 5-20°.

Top 4'9"

Thinly interlaminated SHALE and silty SHALE, light green-grey, in part slightly silty, rarely slightly micaceous, firm to hard, fissile, carbonaceous with fragments of plants and it breaks more readily along bedding delineated by more carbonaceous content, very occasionally slightly calcareous and rare interbeds of SHALE, black, very slightly sandy with occasionally fine grained, well rounded QUARTZ, slightly silty, hard, fissile, carbonaceous, thinly bedded. Dips 0-30°. Trace coal gas in silty SHALE in bottom 3".

CORE NO. 6(cont):

Bottom 2'11"

SHALE, black, rarely very slightly silty, carbonaceous, firm to hard, fissile, non calcareous with carbonaceous fragments of plants and trees, with rare interlamination of light green-grey SHALE, as above. Bedding dips up to  $10^{\circ}$ . Occasionally slickensided surfaces making  $60^{\circ}$  to axis of core, CALCITE covered and occasionally CALCITE FILLED cracks. No shows.

CORE NO. 7:

3113' - 3123'

Recovered 10'

(Core No. 7 picked up in barrel with Core No. 8).

SANDSTONE, arkosic, grey-green, speckled, fine to medium or very fine grained, fairly to poorly sorted, firm, slightly crumbly on exposure to atmosphere with grains held reasonably loosely in matrix, mainly massively bedded with occasional bedding planes visible (due often to black MICA type matter) showing dips from approx  $2^{\circ}$  to approx  $20^{\circ}$ . Rare trace of (?) bedding on a fine (mm scale) scale. The SANDSTONE consists of QUARTZ, well to occasionally subrounded, clear, cloudy and grey, medium to very fine grained with roundness decreasing with grain size, FELDSPAR, usually white, occasionally orange to pink, in clear blocks and subhedral grains, usually rarely twinned, slightly decomposed, occasional MICA PLATES, occasionally green; red, black and white mineral grains, occasionally carbonaceous specks, rare trace MICA, in part slightly calcareous, in a green to greenish white matrix, chloritic or chloritic/kaolinitic. The core has no visible porosity (x30) and has no fluorescence.

CORE NO. 8:

3123' - 3128'

Recovered 2'6"

SANDSTONE, as above, but fine to very fine grained, fair to well sorted, bedding traces  $0-5^{\circ}$ , with abundant black MICA type mineral, scapy (chloritic?) or occasionally finely granular; tight, no shows.

GEOLOGICAL SURVEY OF VICTORIA - UNPUBLISHED REPORT 30/1965.

REPORT OF MARINE FAUNAS FROM TARWIN MEADOWS NO. 1 WELL

Cores and cuttings were submitted from Alliance Oil Development's Tarwin Meadows No. 1 Well. The sample datum was 30 feet, this being the elevation of the rotary table above sea level (ground level = 25 feet).

Sediments bearing marine fauna was first intersected at 30 feet within a silty sand. This fauna was present in cuttings for 130 feet below its initial appearance, but these occurrences were probably due to caving or mud contamination. No other fauna was reported from the section.

The fauna consists of predominantly foraminifera, with some gastropods, ostracods, bryozoa fragments and adherent coiled worm tubes.

Foraminifera:- Ammonia Beccarii is the dominant form, with Elphidium spp (including E. Advenum and E. pseudonodosum) and miliolids common. Planktonic species are present (approx. 5%) and include Globigerina bulloides, G. subcretacea and Globorotalia inflata. Rarer species include Patellinella inconspica and Trifarina bradyi.

The faunal aspect is similar to that living at present off the Victorian coast line. The planktonic fauna suggests direct communication with oceanic currents, and thus the depositional site was in the vicinity of an open shore line and not in a narrow embayment. A. beccarii indicates near-shore conditions.

Gastropods:- The gastropods include Charisma josephi, Notosetia cf N. atkinsoni and Lodderia lodderia, which are listed and illustrated by Valentine (1965) from a near shore Quaternary deposit at Port Fairy (Western Victoria). As is the case of the foraminifera, the preservation of the gastropods is near perfect with the retention of delicate ornamentation and traces of shell colouration.

Age:- The close similarities to living foraminiferal faunas and comparison with the Port Fairy Quaternary molluscan faunas, together with the excellent state of shell preservation suggests these faunas to be of recent origin. The Port Fairy deposits are post "Newer Basalt" and thus are obviously Quaternary. Therefore, the Tarwin Meadows fauna is considered as being of Quaternary age.

Similar foraminiferal and molluscan faunas are present within 100 feet of the surface along the Gippsland coastline. These Gippsland Quaternary faunas are specifically distinct and stratigraphically above the Pliocene Jemmys Point Formation.

Reference:-

VALENTINE J.W. - 1965

Quaternary mollusca from Port Fairy, Victoria, Australia, and their palaeoecological implications. Proc. Roy. Soc. Vict., 78 (1) 15-73.

David J. Taylor

1.8.65.

ALLIANCE OIL MANAGEMENT PTY. LTD.

SHEET No.: 1

DRILL STEM TEST DATA SHEET

TEST No.: 1

DATE: 11.7.1965

WELL NAME TARWIN MEADOWS NO. 1

CO- \_\_\_\_\_ 'E  
ORDINATES \_\_\_\_\_ 'S

HOLE DATA

DEPTH 3128' FULL HOLE SIZE 5 5/8" RAT HOLE TOP \_\_\_\_\_ RAT HOLE SIZE \_\_\_\_\_

TESTING EQUIPMENT

TESTING COMPANY \_\_\_\_\_ OPERATOR W.L. Sides & Son  
PACKER(S): No. \_\_\_\_\_ TYPE Full Hole SIZE 4 3/4" BOTTOM CHOKE SIZE 5/8"  
TOOL TYPE: Johnson Disc Valve Formation Tester TOOL SIZE 2 3/8"  
LENGTH OF PERFORATIONS 11.2 ft. JARS USED \_\_\_\_\_  
SURFACE CHOKE SIZE \_\_\_\_\_ WATER CUSHION \_\_\_\_\_ ft. LENGTH ANCHOR 11.7  
DRILL PIPE SIZE, OD. 2 3/8" LENGTH DRILL COLLARS 345.4 ft. SIZE 4 1/4"

TEST DATA

FORMATION TESTED Sandstone - Strzelecki Fm. TESTER ON BOTTOM 0945 AM/PM  
INTERVAL TESTED - FROM 3101' TO 3128' INITIAL OPENING \_\_\_\_\_ AM/PM  
TIME OPEN \_\_\_\_\_ MIN. INITIAL S.I. \_\_\_\_\_ FINAL S.I. \_\_\_\_\_ INITIAL CLOSING \_\_\_\_\_ AM/PM  
WATER CUSHION TO SURFACE \_\_\_\_\_ MIN. INITIAL FLOW \_\_\_\_\_ AM/PM  
GAS TO SURFACE \_\_\_\_\_ MIN., OIL TO SURFACE \_\_\_\_\_ MIN. FINAL CLOSING \_\_\_\_\_ AM/PM  
NATURE OF BLOW \_\_\_\_\_ PULLED LOOSE 1040 AM/PM  
\_\_\_\_\_ OUT OF HOLE 1515 AM/PM

GAS FLOW

MAXIMUM RATE \_\_\_\_\_ "H<sub>2</sub>O" \_\_\_\_\_ "Hg" \_\_\_\_\_ p.s.ig. \_\_\_\_\_ MCF/DAY  
METHOD OF MEASUREMENT \_\_\_\_\_ RISER SIZE \_\_\_\_\_  
GAS FLARE LIT \_\_\_\_\_ ESTIMATED HEIGHT OF FLARE \_\_\_\_\_

PIPE RECOVERY

TOTAL RECOVERY 430' FT. \_\_\_\_\_ BBLs No. SAMPLES TAKEN \_\_\_\_\_ SENT TO \_\_\_\_\_  
MUD RECOVERY 430' FT. \_\_\_\_\_ BBLs DESCRIPTION \_\_\_\_\_  
OIL RECOVERY \_\_\_\_\_ FT. \_\_\_\_\_ BBLs DESCRIPTION \_\_\_\_\_  
WATER RECOVERY \_\_\_\_\_ FT. \_\_\_\_\_ BBLs DESCRIPTION \_\_\_\_\_

DRILLING MUD

WT 10.5 VISC 49 DID LEVEL DROP IN ANNULUS No. \_\_\_\_\_ FT.

RECORD OF PRESSURES:

BOTTOM OR TOP RECORDER \_\_\_\_\_ INITIAL HYDROSTATIC \_\_\_\_\_ FINAL HYDROSTATIC \_\_\_\_\_  
INITIAL SHUT-IN \_\_\_\_\_ INITIAL FLOW \_\_\_\_\_ FINAL FLOW \_\_\_\_\_ FINAL SHUT-IN \_\_\_\_\_  
MAX. SURFACE PRESSURE \_\_\_\_\_ TYPE OF RECORDS \_\_\_\_\_

WEIGHT OF STRING

BEFORE 5200 LBS. AFTER 5200 LBS. PULL LOOSE 5200 LBS.

REMARKS Leak in drill pipe? enables 430' mud to enter pipe and collars.  
This acted as a "water cushion" and caused the "go devil" to strike the disc valve with insufficient force to break it.

SUPERVISOR: G. C. Campe

ALLIANCE OIL MANAGEMENT PTY. LTD.

SHEET No.: 2

DRILL STEM TEST DATA SHEET

TEST No.: 12.7.1965

DATE:

WELL NAME TARWIN MEADOWS NO. 1.

CO- \_\_\_\_\_ 'E  
ORDINATES \_\_\_\_\_ 'S

HOLEDATA

DEPTH 3160' FULL HOLE SIZE 5 5/8" RAT HOLE TOP \_\_\_\_\_ RAT HOLE SIZE \_\_\_\_\_

TESTING EQUIPMENT

TESTING COMPANY \_\_\_\_\_ OPERATOR W.L. Sides & Son  
PACKER(S): No. \_\_\_\_\_ TYPE Full Hole SIZE 4 3/4" BOTTOM CHOKE SIZE 5/8"  
TOOL TYPE: Johnson Disc Valve Tester TOOL SIZE 2 3/8"  
LENGTH OF PERFORATIONS \_\_\_\_\_ ft. JARS USED \_\_\_\_\_  
SURFACE CHOKE SIZE \_\_\_\_\_ WATER CUSHION \_\_\_\_\_ ft. LENGTH ANCHOR 51.7  
DRILL PIPE SIZE, OD. 2 3/8" LENGTH DRILL COLLARS 345 ft. SIZE 4 1/4"

TEST DATA

FORMATION TESTED Sandstone - Strzelecki Fm. TESTER ON BOTTOM 2.30 AM/PM  
INTERVAL TESTED - FROM 3093' TO 3160' INITIAL OPENING 2.45 AM/PM  
TIME OPEN 30 MIN. INITIAL S.I. \_\_\_\_\_ FINAL S.I. \_\_\_\_\_ INITIAL CLOSING \_\_\_\_\_ AM/PM  
WATER CUSHION TO SURFACE \_\_\_\_\_ MIN. INITIAL FLOW \_\_\_\_\_ AM/PM  
GAS TO SURFACE \_\_\_\_\_ MIN., OIL TO SURFACE \_\_\_\_\_ MIN. FINAL CLOSING 3.15 AM/PM  
NATURE OF BLOW Weak puff, dimin. gradually PULLED LOOSE 3.15 AM/PM  
No puff or blow after 15 mins. OUT OF HOLE 6.45 AM/PM

GAS FLOW

MAXIMUM RATE \_\_\_\_\_ "H<sub>2</sub>O \_\_\_\_\_ "Hg \_\_\_\_\_ p.s.ig. \_\_\_\_\_ MCF/DAY  
METHOD OF MEASUREMENT \_\_\_\_\_ RISER SIZE \_\_\_\_\_  
GAS FLARE LIT \_\_\_\_\_ ESTIMATED HEIGHT OF FLARE \_\_\_\_\_

PIPE RECOVERY

TOTAL RECOVERY 200' FT. \_\_\_\_\_ BBLs No. SAMPLES TAKEN \_\_\_\_\_ SENT TO \_\_\_\_\_  
MUD RECOVERY 200' FT. \_\_\_\_\_ BBLs DESCRIPTION Drilling mud, wt. 10.6  
OIL RECOVERY \_\_\_\_\_ FT. \_\_\_\_\_ BBLs DESCRIPTION \_\_\_\_\_  
WATER RECOVERY \_\_\_\_\_ FT. \_\_\_\_\_ BBLs DESCRIPTION \_\_\_\_\_

DRILLING MUD

WT 10.6 VISC 47 DID LEVEL DROP IN ANNULUS approx. 4' FT.

RECORD OF PRESSURES:

BOTTOM OR TOP RECORDER \_\_\_\_\_ INITIAL HYDROSTATIC \_\_\_\_\_ FINAL HYDROSTATIC \_\_\_\_\_  
INITIAL SHUT-IN \_\_\_\_\_ INITIAL FLOW \_\_\_\_\_ FINAL FLOW \_\_\_\_\_ FINAL SHUT-IN \_\_\_\_\_  
MAX. SURFACE PRESSURE \_\_\_\_\_ TYPE OF RECORDS \_\_\_\_\_

WEIGHT OF STRING

BEFORE 5200 LBS. AFTER 5200 LBS. PULL LOOSE 5200 LBS.

REMARKS Weak puff, very weak for 15 mins, then no blow. On opening of disc valve annulus dropped 4' and remained steady throughout test. Formation tight.

SUPERVISOR: G.C. Campe



P A L Y N O L O G Y

by Mary E. Dettmann

TARWIN MEADOWS NO. 1 WELL:

Samples from between 600 and 2,572 feet yielded restricted microfloras in which Dictyotosporites speciosus is a component. Thus, the Valanginian-Aptian Speciosus Assemblage is represented at these horizons. Beds at 2,567 - 2,572 feet also yielded Cookeonites variabilis Pocock which indicates the presence of the older category of the Speciosus Assemblage and suggests correlation of the beds with those at 6,845 feet in Wellington Park No. 1 Well and at 3,977 feet in Bengworden South No. 1 Well (see Dettmann 1965).

The succeeding horizons (600 - 1,610 feet) that contain Dictyotosporites speciosus are probable equivalents of at least part of the sequence between 3,818 and 6,845 feet in Wellington Park No. 1 Well, but the absence of Cyclosporites hughesi and Crybelesporites striatus within the Tarwin Meadows interval precludes precise correlation.

The uppermost horizon (304 - 314 feet) lacked diagnostic species of the Speciosus and Paradoxia Assemblages. However, the presence of Pilosporites notensis Cookson & Dettmann indicates an age no younger than Aptian.

REFERENCES:

DETTMANN, M.E. - 1963.

Upper Mesozoic microfloras from south-eastern Australia. Proc. Roy. Soc. Vict. 77, 1-148.

DETTMANN, M.E. - 1965.

Palynological report on Woodside Wellington Park No. 1 Well. Unpublished report submitted to Haematite Explorations Pty. Ltd. 9/8/65.

Mary E. Dettmann,  
Department of Geology,  
University of Queensland,  
St. Lucia, Queensland.

4 November, 1965.

D.D.  
6.12.1965.

		Microspores											Pollen							
		<i>Cyclosporites hughesi</i>																		
		<i>Diclyctosporites speciosus</i>																		
		<i>Aequitriradites spinulosus</i>																		
		<i>Cicatricosisporites australiensis</i>																		
		<i>Cochsonites variabilis</i>																		
		<i>Kiliasporites scaberis</i>																		
		<i>Leptolepidites verrucatus</i>																		
		<i>Cyathidites</i> spp.																		
		<i>Lycopodiumsporites</i> spp.																		
		<i>Ceratoporphites equeolis</i>																		
		<i>Neoralstrickia truncata</i>																		
		<i>Pilosporites notensis</i>																		
		<i>Foraminisporis dailyi</i>																		
		<i>Foraminisporis vonthaggiensis</i>																		
		<i>Foraminisporis asymmetricus</i>																		
		<i>Crybelosporites striatus</i>																		
		<i>Goptospora striata</i>																		
		<i>Alisporites</i> spp.																		
		<i>Trugaeopollenites dampieri</i>																		
Tarwin Meadows	30-314'																		Indet.	
	600-610'	+																		
	1597-1607'	+																		Speciosus
	1607-10'	+																		
	2567-72'	+																		

Table 1: Distribution of selected spore and pollen species from Rosedale, Barrinan, and Tarwin Meadows wells.

+ - species present

PALYNOLOGICAL EXAMINATION OF ROSEDALE, DARRIMAN, AND  
TARWIN MEADOWS WELLS

Samples of 19 cores were submitted for palynological examination by Haematite Explorations Pty. Ltd. from three wells sunk in eastern Victoria. The wells and the intervals examined include: Rosedale well between 2469 and 5836 feet, Darriman well between 4309 and 4475 feet, and Tarwin Meadows well between 304 and 2572 feet. The majority of the samples yielded identifiable spores and pollen grains, but the microfloras are generally poorly preserved. Moreover, the plant matter contained in samples from between 5243 and 5836 feet in Rosedale well has been carbonized such that identifiable spores and pollen grains appear to be lacking. As outlined below the productive samples contain microfloras that conform with the Lower Cretaceous assemblages described by Dettmann (1965) from south-eastern Australia. The presence of these microfloras enables correlation of the well sequences both with each other and with Lower Cretaceous sediments at other localities in Gippsland. Details of the microfloral sequence in each of the wells follows (see also Table 1).

Rosedale well

Samples from the lower part (5243 - 5836 feet) of the sequence failed to produce identifiable spores and pollen grains and thus no age assessment can be made on palynological grounds. Sediments between 4747 and 5065 feet yielded only a few poorly preserved spores and pollen grains that signify an Upper Mesozoic age, but possess little stratigraphical value within the Upper Mesozoic.

More diverse and better preserved microfloras were obtained from the remainder of the sequence (between 2469 and 4496 feet). Samples between 34 and 4496 feet yielded Dictyotosporites speciosus Cookson & Dettmann in assoc

Cyclosporites hughesi (Cookson & Dettmann). The combined occurrence of these species indicates the presence of the older category of the Valanginian-Aptian Speciosus Assemblage that was described by Dettmann (1965). Comparable microfloras were obtained in Wellington Park No.1 well between 6845 and 9019 feet (Dettmann 1965).

The two uppermost samples (2469-83 feet and 3208-28 feet) are also of Valanginian-Aptian age since Dictyotosporites speciosus occurs at 2469-83 feet. However, neither Cyclosporites hughesi nor Crybelosporites striatus (Cookson & Dettmann) was observed and there is thus insufficient evidence to determine whether the microflora belongs to the older or younger categories of the Speciosus Assemblage. Although no precise correlation can be achieved, the horizons between 2469 and 3228 feet in Rosedale well can be regarded as equivalents of at least part of the sequence between 3818 and 9019 feet in Wellington Park No.1 well.

Darriman well

Neither of the two samples examined provided abundant microfloras. That obtained from 4474-75 feet includes Crybelosporites striatus and Coptospora striata Dettmann which indicate the presence of either the younger (Aptian) category of the Speciosus Assemblage or the Aptian-Albian Paradoxa Assemblage. It should be noted that Coptospora striata possesses a restricted stratigraphical range in sediments of the Otway Basin where it extends from the uppermost horizons containing the Speciosus Assemblage to the lowermost beds that have yielded the Paradoxa Assemblage. This evidence indicates that the deposits at 4474-75 feet in Darriman well are similar in age or younger than those between 3818 and 4340 feet in Wellington Park No.1 well.

The sample from 4309-10 feet provided only a few spores and pollen grains

that are of little stratigraphical significance within the Upper Mesozoic.

Tarwin Meadows well

Samples from between 600 and 2872 feet yielded restricted microfloras in which Dictyosporites speciosus is a component. Thus, the Valanginian-Aptian Speciosus Assemblage is represented at these horizons. Beds at 6340 feet also yielded Cooksonia variabilis Pocock which indicates the presence of the older category of the Speciosus Assemblage and suggests correlation of the beds with those at 6345 feet in Wellington Park No.1 well and at 3977 feet in Bengworden South No.1 well (see Dettmann 1965).

The succeeding horizons (600-1610 feet) that contain Dictyosporites speciosus are probable equivalents of at least part of the sequence between 6348 and 6345 feet in Wellington Park No.1 well, but the absence of Cyclosporites hughesi and Crybelosporites striatus within the interval preclude precise correlation.

The uppermost horizon (504-14 feet) lacked diagnostic species of the Speciosus and Paradoxa Assemblages. However, the presence of Pilosites variabilis Jackson & Dettmann indicates an age no younger than Aptian.

References

Dettmann, M.E. 1965. Upper Mesozoic microfloras from south-eastern Australia. Proc. Roy. Soc. Vict., 77, 1-148.  
Dettmann, M.E. 1965. Palynological report on Woodside Wellington Park well. Unpublished report submitted to Haematite Explorations Pty. Ltd 9/8/65.

4th November, 1965.

Mary E. Dettmann,  
Department of Geo  
University of Que  
St. Lucia, Queens

		Microspores	Pollen	
		<i>Cyclosporites hughesi</i> <i>Dictyosporites speciosus</i> <i>Acquitriredites spinulosus</i> <i>Cicatricosporites australiensis</i> <i>Cooksonites variabilis</i> <i>Klukisporites scaberis</i> <i>Leptolepidites verrucatus</i> <i>Cyathidites</i> spp. <i>Lycopodiumsporites</i> spp. <i>Ceratoporesites equalis</i> <i>Necosisstrictia truncata</i> <i>Pilosiporites notensis</i> <i>Foraminisporis dellyi</i> <i>Foraminisporis vontheggenensis</i> <i>Foraminisporis asymmetricus</i> <i>Crybelosporites striatus</i> <i>Coctospore stricta</i>	<i>Alisporites</i> spp. <i>Tsugaepollenites dampieri</i>	
Rosedale	c.15 2469-35'	+ +	+ +	Speciosus
	c.18 3208-23'		+ +	
	c.19 3447-37'	+ +	+ +	
	c.20 3615-35'	+ +	+ +	
	c.21 3926-42'	+ +	+ +	
	c.23 4476-96'	+ +	+ +	
	c.24 4747-67'		+ +	
	c.25 5045-65'		+ +	
	c.26 5245-61'			
	c.27 5495-5508'			
c.28 5742-58'				
c.29 5818-36'				
Darriman	4309-10'		+ +	Indet.
	4474-75'	+ +	+ + + +	
Tarwin Meadows	304-514'		+ + + + + + + +	Indet.
	600-610'	+ +	+ + + + + + + +	
	1597-1607'	+ +	+ + + + + + + +	Speciosus
	1607-10'	+ +	+ + + + + + + +	
	2567-72'	+ +	+ + + + + + + +	

Table 1: Distribution of selected spore and pollen species from Rosedale, Darriman, and Tarwin Meadows wells.

+ - species present

ED  
OIL and GAS DIVISION

2<sup>nd</sup> copy Pa

(02)662.3762  
467.2458

TARWIN ME  
c/- School of Applied Geology  
University of New South Wal  
PO Box 1  
KENSINGTON NSW 2033

27 October 1981

Mr. D.J.French,  
Bell, Cochrane & Associates Pty Ltd,  
44 Chetwynd Street,  
WEST MELBOURNE VIC 3003

Dear Mr French,

Please find enclosed my report on the six samples submitted for palynological examination and age determination early this month (no covering letter).

In comparison with the previous batch this set has yielded relatively good results. Even the outcrop sample, HH-7, contained a well preserved, although not very diverse microflora.

I have not included species lists for each sample, but am keeping in my laboratory permanent slides of each preparation and a record of the locations thereon of specimens and species sighted which are available for further study or comparisons as necessary.

Yours sincerely,

  
P.R. Evans

ADDED BY DNRE

11/5/99

Copied D.S.  
22.4.1966.

copy (copy) 11  
9/11/76  
J.S.B.

1

PALYNOLOGICAL REPORT ON SIX SAMPLES FROM THE STREZELECKI  
GROUP, GIPPSLAND BASIN

---

GENERAL

Six samples of core, cuttings and outcrop from the Strezelecki Group, Gippsland Basin were received early in October from Bell, Cochrane & Associates Pty Ltd for palynological age determination.

RESULTS

All six samples proved to contain relatively abundant and well preserved microfloras, the nature of which permits assignment of the samples to the following Early Cretaceous zones.

SAMPLE	ZONE
(TARWIN MEADOWS No 1) TM-1 Core 1600'	? <i>Dictyosporites speciosus</i>
" " 2565'	<i>Foraminisporis asymmetricus</i>
" " 2574'	" "
" Cutt. 2930-34'	" "
" " 3400-30'	" "
HH-7 Outcrop (Harmer's Haven)	<i>Crybelosporites stylosus</i> or <i>Cyclosporites hughesi</i>

The relative ages of these zones are expressed in the attached table.

COMMENT

No standard zonation of the Australian Lower Cretaceous based on microfloral content has yet come into being. Two basic schemes are used.

The scheme that has been widely applied to the Lower Cretaceous of Victoria is that established by Dettmann (1963) and Playford & Dettmann (1969) in which three zones, the *stylosus*, *speciosus* and *paradoxa* were recognized. The *speciosus* Zone was divided into two subzones, *C. hughesi* and *C. striatus*. Douglas further

...2



divided the *C. hughesi* Subzone into three units (Douglas 1976).

The second major scheme was instituted by Evans (1966) and elaborated by Burger (1973, 1980), who, from studies of the Surat Basin, identified the *M. florida* and *O. du* Zones below the *C. striatus* Zone. Burger divided the *M. florida* Zone into the *C. australiensis*, *F. wonthaggie* and *F. asymmetricus* Subzones.

Allocation of a sample to one of these divisions depends on the content of the component assemblage. He the varied designations applied to the samples examined.

The yield from TM-1 core 1600' was insufficiently diverse to be dated more precisely than Early Cretaceous ?*D. speciosus* Zone and hence does little to place a precise upper limit on the age of the well sequence.

The yields from TM-1 core 2565' and 2574' were definitive in that rare specimens of key species were identified.

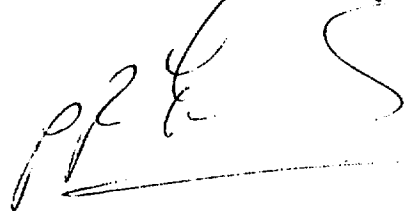
For TM-1 cuttings 2930' and 3400' the assigned age of the *F. asymmetricus* Zone must be regarded as their upper limit; the samples could be older. None of the few critical species which could define an older zone in cuttings were observed.

The outcrop sample HH-7 was very coaly. Unlike the batch of samples previously examined (Report 21 Sep 81), HH-7 withstood considerable oxidation and yielded a remarkably well preserved, although not diverse assemblage

...3

REFERENCES

- BURGER, D., 1973: Palynological zonation and sedimentary history of the Neocomian in the Great Artesia Basin, Queensland; *in* Mesozoic and Cenozoic Palynology; essays in honour of Isabel Cookson (Eds J.E.Glover and G. Playford). *Geol.Soc. Aust.Spec.Publ.* 4, 87-118.
- \_\_\_\_\_ 1980: Palynology of the Lower Cretaceous in the Surat Basin. *Bur.Mineral.Resour.Aust.Bull.*,
- DETTMANN, M.E., 1963: Upper Mesozoic microfloras from southeastern Australia. *Proc.Roy.Soc.Vict.*, 77(1), 1-148.
- DETTMANN, M.E. & DOUGLAS, J.G., 1976: Mesozoic Palaeontology; *in* Geology of Victoria (Eds J.G.Douglas and J.A.Ferguson). *Geol.Soc.Aust.Spec.Publ.*,
- DETTMANN, M.E. & PLAYFORD, G., 1969: Palynology of the Australian Cretaceous: a review; *in* Stratigraphy and Palaeontology; essays in honour of Dorot Hill (Ed. K.S.W.Campbell), Canberra.
- EVANS, P.R., 1966: Mesozoic stratigraphy palynology in Australia. *Aust.Oil Gas j.*, 12(6), 58-63.



P.R. Evans

27 October 1981

TABLE 1

AGE	DETMANN (1963)	EVANS (1966)	BURGER (1973, 1980)
ALB	C. paradoxa	K2	C. paradoxa
APT	D. speciosus	K1d	C. striatus
	C. striatus C. hughesi	K1b-c	O. dubius
NEOCOM	C. stylosus	K1a	M. florida F. asymmetricus F. wonthaggiensi C. australiensis
JUR	--- ? --- ? --- ? ---		J6

NOTE

Although the relative positions of the zonal scales are well defined, the relationship of the zones to the time scale are not so accurately fixed. The Aptian/Albian boundary is satisfactorily fixed by information from the marine of the Great Artesian Basin. Subdivisions of the Neocomian (which represents a major time interval) have not yet been satisfactorily assigned to the microfloral scales.

ST. LOUIS

PE906421

This is an enclosure indicator page.  
The enclosure PE906421 is enclosed within the  
container PE902940 at this location in this  
document.

The enclosure PE906421 has the following characteristics:

ITEM\_BARCODE = PE906421  
CONTAINER\_BARCODE = PE902940  
NAME = Regional Geological Map  
BASIN = GIPPSLAND  
PERMIT = PEP53  
TYPE = GENERAL  
SUBTYPE = GEOL\_MAP  
DESCRIPTION = Regional Geological Map showing Tarwin  
Meadows-1  
REMARKS =  
DATE\_CREATED = 12/12/65  
DATE\_RECEIVED =  
W\_NO = W491  
WELL\_NAME = TARWIN MEADOWS-1  
CONTRACTOR =  
CLIENT\_OP\_CO = ALLIANCE OIL DEVELOPMENT AUSTRALIA NL

(Inserted by DNRE - Vic Govt Mines Dept)

PE602040

This is an enclosure indicator page.  
The enclosure PE602040 is enclosed within the  
container PE902940 at this location in this  
document.

The enclosure PE602040 has the following characteristics:

- ITEM\_BARCODE = PE602040
- CONTAINER\_BARCODE = PE902940
  - NAME = Cross Section
  - BASIN = GIPPSLAND
  - PERMIT =
  - TYPE = WELL
  - SUBTYPE = cross section
- DESCRIPTION = Cross Section through Tarwin Embayment
- REMARKS =
- DATE\_CREATED =
- DATE\_RECEIVED =
  - W\_NO = W491
  - WELL\_NAME = Tarwin Meadows-1
  - CONTRACTOR = Geodrafting services
  - CLIENT\_OP\_CO = Alliance Oil Development

(Inserted by DNRE - Vic Govt Mines Dept)

PE602705

This is an enclosure indicator page.  
The enclosure PE602705 is enclosed within the  
container PE902940 at this location in this  
document.

The enclosure PE602705 has the following characteristics:

ITEM\_BARCODE = PE602705  
CONTAINER\_BARCODE = PE902940  
    NAME = Tarwin Meadows 1 Composite well log  
          sheet 1 of 4  
    BASIN = GIPPSLAND  
    PERMIT = PEP53  
    TYPE = WELL  
    SUBTYPE = COMPOSITE\_LOG  
    DESCRIPTION = Tarwin Meadows 1 Composite well log  
                  sheet 1 of 4  
    REMARKS =  
    DATE\_CREATED = 31/12/65  
    DATE\_RECEIVED =  
    W\_NO = W491  
    WELL\_NAME = Tarwin Meadows-1  
    CONTRACTOR = Schlumberger  
    CLIENT\_OP\_CO = Alliance Oil Development Australia N.L

(Inserted by DNRE - Vic Govt Mines Dept)

PE602706

This is an enclosure indicator page.  
The enclosure PE602706 is enclosed within the  
container PE902940 at this location in this  
document.

The enclosure PE602706 has the following characteristics:

ITEM\_BARCODE = PE602706  
CONTAINER\_BARCODE = PE902940  
    NAME = Tarwin Meadows 1 Composite well log  
          sheet 2 of 4  
    BASIN = GIPPSLAND  
    PERMIT = PEP53  
    TYPE = WELL  
    SUBTYPE = COMPOSITE\_LOG  
    DESCRIPTION = Tarwin Meadows 1 Composite well log  
                  sheet 2 of 4  
    REMARKS =  
    DATE\_CREATED = 31/12/65  
    DATE\_RECEIVED =  
    W\_NO = W491  
    WELL\_NAME = Tarwin Meadows-1  
    CONTRACTOR = Schlumberger  
    CLIENT\_OP\_CO = Alliance Oil Development Australia N.L

(Inserted by DNRE - Vic Govt Mines Dept)

PE602707

This is an enclosure indicator page.  
The enclosure PE602707 is enclosed within the  
container PE902940 at this location in this  
document.

The enclosure PE602707 has the following characteristics:

- ITEM\_BARCODE = PE602707
- CONTAINER\_BARCODE = PE902940
  - NAME = Tarwin Meadows 1 Composite well log  
sheet 3 of 4
  - BASIN = GIPPSLAND
  - PERMIT = PEP53
  - TYPE = WELL
  - SUBTYPE = COMPOSITE\_LOG
  - DESCRIPTION = Tarwin Meadows 1 Composite well log  
sheet 3 of 4
  - REMARKS =
  - DATE\_CREATED = 31/12/65
  - DATE\_RECEIVED =
  - W\_NO = W491
  - WELL\_NAME = Tarwin Meadows-1
  - CONTRACTOR = Schlumberger
  - CLIENT\_OP\_CO = Alliance Oil Development Australia N.L

(Inserted by DNRE - Vic Govt Mines Dept)



PE602708

This is an enclosure indicator page.  
The enclosure PE602708 is enclosed within the  
container PE902940 at this location in this  
document.

The enclosure PE602708 has the following characteristics:

ITEM\_BARCODE = PE602708  
CONTAINER\_BARCODE = PE902940  
    NAME = Tarwin Meadows 1 Composite well log  
          sheet 4 of 4  
    BASIN = GIPPSLAND  
    PERMIT = PEP53  
    TYPE = WELL  
    SUBTYPE = COMPOSITE\_LOG  
    DESCRIPTION = Tarwin Meadows 1 Composite well log  
                  sheet 4 of 4  
    REMARKS =  
    DATE\_CREATED = 31/12/65  
    DATE\_RECEIVED =  
        W\_NO = W491  
        WELL\_NAME = Tarwin Meadows-1  
        CONTRACTOR = Schlumberger  
    CLIENT\_OP\_CO = Alliance Oil Development Australia N.L

(Inserted by DNRE - Vic Govt Mines Dept)

PE603801

This is an enclosure indicator page.  
The enclosure PE603801 is enclosed within the  
container PE902940 at this location in this  
document.

The enclosure PE603801 has the following characteristics:

ITEM\_BARCODE = PE603801  
CONTAINER\_BARCODE = PE902940  
NAME = Composite Well Log (Header)  
BASIN = GIPPSLAND  
PERMIT = PEP53  
TYPE = WELL  
SUBTYPE = COMPOSITE\_LOG  
DESCRIPTION = Composite Well Log (Header) for Tarwin  
Meadows-1  
REMARKS = Header only, no data  
DATE\_CREATED = 28/07/65  
DATE\_RECEIVED =  
W\_NO = W491  
WELL\_NAME = TARWIN MEADOWS-1  
CONTRACTOR =  
CLIENT\_OP\_CO = ALLIANCE OIL DEVELOPMENT AUSTRALIA NL

(Inserted by DNRE - Vic Govt Mines Dept)

PE907688

This is an enclosure indicator page.  
The enclosure PE907688 is enclosed within the  
container PE902940 at this location in this  
document.

The enclosure PE907688 has the following characteristics:

ITEM\_BARCODE = PE907688  
CONTAINER\_BARCODE = PE902940  
NAME = Bouger Anomalies Gravity Map  
BASIN = GIPPSLAND  
PERMIT = PEP53  
TYPE = OTHER\_SURVEY  
SUBTYPE = GRAVITY\_MAP  
DESCRIPTION = Bouger Anomalies Gravity Map,  
Gormandale Gravity Survey, Plan of  
Strezelecki Ranges and adjoining area,  
(enclosure from WCR) for Tarwin  
Meadows-1  
REMARKS =  
DATE\_CREATED =  
DATE\_RECEIVED =  
W\_NO = W491  
WELL\_NAME = Tarwin Meadows-1  
CONTRACTOR =  
CLIENT\_OP\_CO =

(Inserted by DNRE - Vic Govt Mines Dept)