

## **APPENDIX I: LITHOLOGICAL DESCRIPTIONS**

The Mereenie Rig 1 Mudlogging unit was manned by a crew provided by Colin Higgins and Associates. Samples were collected, washed and described at 10 m intervals from 30 m to 930 m and then at 3 m intervals from 930 m to T.D. at 1653 m.

## PARKE SILTSTONE (DEVONIAN)

From 6.0 m to 19.0 m

True Stratigraphic Thickness: 12.4 + m

6.0 - 19 m          Samples collected from 28 metres.

## MEREENIE SANDSTONE (LATE SILURIAN TO DEVONIAN)

From 19.0 m to 565.1 m

True Stratigraphic Thickness: 526.9 m

- 28.0 - 50.0 m      **SILTSTONE AND MINOR SANDSTONE.**  
SILTSTONE: light yellowish brown, reddish brown, siliceous, firm to moderately hard, subblocky.  
SANDSTONE: light to dark orange, occasionally clear, fine to medium grained, rarely coarse, moderately sorted, subrounded to subangular, loose, fair inferred porosity.
- 50 - 250 m        SANDSTONE: light to dark orange, translucent, occasionally white and clear, mostly fine to medium grained, rarely coarse, moderately sorted, subrounded to subangular, occasionally rounded, commonly loose, occasional aggregates with moderately strong siliceous cement and sparse orange clay matrix, fair inferred porosity.
- 250 - 400 m       SANDSTONE: light to dark orange, translucent, occasionally white and clear, mostly fine to medium grained, rarely coarse, moderately sorted, subrounded to subangular, occasionally rounded, commonly loose, occasional aggregates with moderately strong siliceous cement and sparse orange clay matrix, fair inferred porosity.
- 400 -430 m        SANDSTONE: clear, translucent, frosted, fine to coarse grained, poorly sorted, subangular to occasionally rounded- coarser grains are rounded, commonly loose, rare aggregates, fair to poor inferred porosity.
- 430 -490 m        **SANDSTONE WITH TRACE SILTSTONE.**  
SANDSTONE: clear, translucent, frosted, trace translucent orange, very fine to occasionally coarse grained, mostly fine to medium, poorly to moderately sorted, subangular to occasionally rounded- coarser grains are rounded, commonly loose, occasional friable aggregates with weak siliceous cement, rare argillaceous matrix, fair to poor inferred porosity.  
SILTSTONE: white, occasionally red brown, occasional carbonaceous specks, moderately hard, subblocky.

- 490 - 536 m SANDSTONE WITH TRACE SILTSTONE.  
SANDSTONE: clear, translucent, frosted, trace translucent orange, very fine to occasionally coarse grained, mostly fine to medium, poorly to moderately sorted, subangular to occasionally rounded- coarser grains are rounded, commonly loose, occasional friable aggregates with weak siliceous cement, rare argillaceous matrix, poor porosity.  
SILTSTONE: red brown, occasional carbonaceous specks, moderately hard, subblocky.
- 536 - 565.1 m DOMINANTLY SANDSTONE WITH MINOR SILTSTONE.  
SANDSTONE: as above but with influx of 10 + %, pinkish and light orange, mostly fine to medium, occasionally coarse grained, moderately well sorted, subangular to occasionally rounded, commonly loose, minor aggregates with weak to moderate siliceous cement, trace argillaceous matrix, poor inferred porosity.  
SILTSTONE: reddish brown, purplish brown, light grey green, argillaceous, trace mica, moderately hard, subblocky to fissile.

#### CARMICHAEL SANDSTONE (LATE ORDOVICIAN)

From 565.1 m to 642.0 m  
True Stratigraphic Thickness: 74.5 m

- 565.1 - 580 m SANDSTONE WITH TRACE SILTSTONE.  
SANDSTONE: mostly light to medium orange, occasionally clear, white and translucent, very fine to medium grained, moderately sorted, subangular to subrounded, weak to moderate siliceous cement in part, trace clay matrix, loose in part, poor to fair porosity.  
SILTSTONE: as above but with only rare grey green.
- 580 - 642 m SANDSTONE WITH MINOR SILTSTONE.  
SANDSTONE: mostly light to medium orange, brown, occasionally clear, white and translucent, very fine to medium grained, moderately well sorted, subangular to subrounded, weak to moderate siliceous cement in part, trace dolomite, trace clay matrix, loose in part, poor to fair porosity.  
SILTSTONE: red brown, minor purplish brown and grey green, argillaceous, siliceous where grey green, trace mica, hard, blocky to subfissile.

#### UPPER STOKES FORMATION (MID TO LATE ORDOVICIAN)

From 642.0 m to 888.1 m  
True Stratigraphic Thickness: 238.7 m

- 642 - 714 m SILTSTONE WITH TRACE SANDSTONE.  
 SILTSTONE: red brown, minor grey green, argillaceous where red brown, grey green is siliceous and grades in part to very fine sandstone, moderately hard, subfissile to fissile.  
 SANDSTONE: light grey, off white, clear, silty to fine grained, moderately well sorted, subangular to subrounded, siliceous cement in part, commonly loose, poor porosity.
- 714 - 760 m SILTSTONE WITH TRACE DOLOMITE.  
 SILTSTONE: dominantly medium red brown, minor grey green, occasionally mottled appearance, generally argillaceous, grey green is slightly arenaceous, hard, subfissile to subblocky.  
 DOLOMITE: light grey, hard, microcrystalline.
- 760m - 888.1m SILTSTONE WITH TRACE SANDSTONE AND TRACE DOLOMITE.  
 SILTSTONE: (1) reddish brown, weakly dolomitic, slightly arenaceous, trace micromicaceous, subfissile to subblocky, hard.  
 (2) 10-50%, greenish grey, light green, siliceous, arenaceous and grading to very fine sandstone in part, micromicaceous, moderately dolomitic, hard, subblocky- blocky.  
 SANDSTONE: off white, light grey green, grey brown, very fine to fine grained, moderately sorted, subangular to rounded, weak to moderate siliceous and dolomitic cement, occasional red brown clay matrix, tight porosity.  
 DOLOMITE: light grey, cream, microcrystalline, hard.

#### LOWER STOKES FORMATION (MID ORDOVICIAN)

From 888.1 m to 964.2 m

True Stratigraphic Thickness: 75.5 m

- 888m - 910m SILTSTONE WITH MINOR DOLOMITE  
 SILTSTONE: (1) dominantly red brown, minor brown grey and purple brown, slightly arenaceous, slightly to moderately dolomitic (especially where brown grey), subfissile to subblocky. (2) greenish grey, green, arenaceous and grading to very fine sandstone, slightly dolomitic, hard, subblocky.  
 DOLOMITE: bright orange red, occasionally off white and light brown, silty in part, very hard, blocky.
- 910m - 964.2m SILTSTONE WITH TRACE DOLOMITE  
 There is an obvious colour change at 910m from dominantly red brown to dominantly grey, green grey Siltstone. Red brown decreases from 15% at 910 m to trace at 958m.  
 SILTSTONE: (1) as above. (2) greenish grey, grey to light grey, dolomitic and grading to silty dolomite, hard, subblocky to subfissile.  
 DOLOMITE: dominantly white, light grey, occasionally orange, silty in part, very hard, blocky.

## UPPER STAIRWAY SANDSTONE (MID ORDOVICIAN)

From 964.2 m to 1024.0m

True Stratigraphic Thickness: 58.2 m

### 964.2 -1024.0m SANDSTONE WITH MINOR SILTSTONE AND DOLOMITE

SANDSTONE: white, off white, occasionally very light brown, dominantly very fine to fine grained aggregates, grading to siltstone in part, moderately well to well sorted, subangular to subrounded, strong dolomitic/siliceous cement, trace silty matrix, trace lithic inclusions, hard, nil to trace porosity. Also 10% to trace medium to coarse, moderately sorted, rounded to subrounded, loose, translucent to frosted quartz grains.

SILTSTONE: light to dark grey, light grey green, grey brown, dolomitic and grading to silty dolomite, slightly arenaceous, hard, subfissile.

DOLOMITE: off white, light grey, silty in part, hard, subblocky. Generally % dolomite decreases with depth.

## MIDDLE STAIRWAY SANDSTONE (MID ORDOVICIAN)

From 1024 m to 1145.6 m

True Stratigraphic Thickness: 114.5 m

### 1024 -1080m SILTSTONE WITH MINOR SANDSTONE

SILTSTONE: light to medium to dark grey, arenaceous and grading to very fine sandstone where light grey, occasionally micromicaceous, trace pyrite, trace carbonaceous, blocky to occasionally fissile (dark grey), hard.

SANDSTONE: off white, white, light grey, very fine to fine grained and silty, grades to siltstone in part, moderately well sorted, subangular to subrounded, strong siliceous cement, trace dolomitic towards top, sparse silty matrix, hard, very poor porosity.

### 1080 -1145.6m INTERBEDDED SILTSTONE AND SANDSTONE

SILTSTONE: light to medium to dark grey, arenaceous and grading to very fine sandstone where light grey, occasionally micromicaceous, trace pyrite, trace carbonaceous, blocky to occasionally fissile (dark grey), hard.

SANDSTONE: off white, white, light grey, very fine to fine grained and silty, grades to siltstone in part, occasional medium and coarse, subrounded to rounded, moderately well sorted, subangular to subrounded, strong siliceous cement, trace dolomitic towards top, sparse to common silty matrix, occasionally black lithics, trace pyrite, hard, very poor porosity.

## LOWER STAIRWAY SANDSTONE (2) (MID ORDOVICIAN)

From 1145.6 m to 1202.6 m

True Stratigraphic Thickness: 52.9 m

- 1145.6-1202.6m SANDSTONE WITH MINOR SILTSTONE
- SANDSTONE: white, clear, frosted, light grey - light brown, mostly very fine to fine grained aggregates, medium to coarse grains are loose in sample, moderate bimodal sorting, aggregates are subangular to subrounded, moderate siliceous cement, silty matrix, trace pyrite, trace to rare black lithics, friable to firm, very poor porosity, medium - coarse grains are subangular (commonly broken grains and quartz overgrowths), to well rounded, good porosity. There are rare aggregates where the coarser grains are enclosed by the finer grained groundmass and looks like micro conglomerate.
- SILTSTONE: light to medium to dark grey, arenaceous and grading to very fine sandstone where light grey, trace pyrite, carbonaceous specks and streaks, blocky to subfissile.

## LOWER STAIRWAY SANDSTONE (1) (MID ORDOVICIAN)

From 1202.6 m to 1231.7 m

True Stratigraphic Thickness: 27.2 m

- 1202.6-1231.7m SANDSTONE WITH MINOR SILTSTONE.
- SANDSTONE: off white, light grey, very fine to fine grained, well sorted, subangular to subrounded, moderately strong siliceous and dolomitic cement, sparse silty matrix, friable to hard, poor porosity plus occasional clear, medium grains, subrounded to rounded, loose.
- SILTSTONE: medium to dark grey, arenaceous in part, trace pyrite, hard, subfissile.

## HORN VALLEY SILTSTONE (EARLY ORDOVICIAN)

From 1231.7 m to 1309.1 m

True Stratigraphic Thickness: 71.9 m

- 1231.7-1280m SILTSTONE WITH MINOR SANDSTONE AND TRACE LIMESTONE
- SILTSTONE: light to medium grey, light brown grey, trace pyrite, trace mica, arenaceous in part, subblocky.
- SANDSTONE: light grey, light brown grey, rarely clear, fine to occasionally medium, well sorted, subangular, strong siliceous cement, sparse silty matrix, firm to occasionally loose, tight porosity.
- LIMESTONE: light grey, light brown, arenaceous in part, microcrystalline, hard.

1280m- SILTSTONE WITH MINOR LIMESTONE  
1309.1m SILTSTONE: medium to dark grey, argillaceous to arenaceous in part and grading to very fine sandstone, common pyrite, occasional black lithic grains, subblocky to fissile and grading to shale, hard.  
LIMESTONE: white, translucent, light grey, light brown microcrystalline, arenaceous in part and grades to siltstone, blocky, hard.

PACOOTTA SANDSTONE P1 UNIT (EARLY ORDOVICIAN)

From 1309.1 m to 1422.9 m  
True Stratigraphic Thickness: 104.7 m

1309.1-1332 m SILTSTONE WITH MINOR SANDSTONE AND DOLOMITE.  
SILTSTONE: generally as above, moderately dolomitic /calcareous in upper 10 m.  
SANDSTONE: off white, light grey, brown grey, very fine to fine grained, silty in part, well sorted, subangular, strong siliceous and carbonate cement in part, silty matrix, common glauconite, hard, poor porosity.  
DOLOMITE: off white, light grey, silty, generally associated with siltstone, occasional loose, blocky to angular pieces, hard.

1332-1371 m SANDSTONE WITH MINOR SILTSTONE.  
SANDSTONE: light grey, off white, occasionally medium grey, very fine to fine grained, trace medium grains, well sorted, subangular to occasionally subrounded, moderately strong siliceous cement, sparse silty matrix, trace glauconite, moderately hard, poor porosity.  
10% to trace, dull, bluish white, patchy to pinpoint fluorescence, very weak crush cut, thin film residue.  
SILTSTONE: medium to dark grey, slightly arenaceous in part, nil to rare carbonate, hard, subfissile to fissile.

1371-1397 m SANDSTONE WITH MINOR SILTSTONE.  
SANDSTONE: translucent, opaque, off white, light grey, very fine to fine grained, trace medium grains, well sorted, subangular to occasionally subrounded, moderately strong siliceous cement, sparse silty matrix, moderately hard, poor porosity. Trace, dull, bluish white, patchy to pinpoint fluorescence, no cut, no residue.  
SILTSTONE: medium to dark grey, slightly arenaceous in part, nil to rare carbonate, hard, subfissile to fissile.

1397-1402 m SANDSTONE (P1-280): clear, translucent, medium to coarse grained, moderately well sorted, subangular to subrounded, rare siliceous cement and trace silty matrix, generally loose and clean, fair inferred porosity, no fluorescence.

1402-1422.9 m SANDSTONE WITH TRACE-10% SILTSTONE.  
SANDSTONE: clear, translucent, frosted and pitted grains, medium to coarse grained, moderately to well sorted, angular to subrounded, trace siliceous cement, trace silty matrix, trace pyrite, fair inferred porosity.

PACOOTTA SANDSTONE P2 (EARLY ORDOVICIAN)

From 1422.9 m to 1496.5 m  
True Stratigraphic Thickness: 67.5 m

1422.9-1428 m SANDSTONE WITH MINOR SILTSTONE.  
SANDSTONE: clear, translucent, frosted, off white, medium to coarse grained, occasionally fine grained aggregates, moderately to well sorted, minor siliceous cement, trace pyrite, commonly loose, fair porosity.  
SILTSTONE: light to medium grey, arenaceous in part, hard, subblocky to occasionally fissile.

1428- 1461m SANDSTONE WITH MINOR SILTSTONE.  
SANDSTONE: white, light grey, fine grained, well sorted, subangular to subrounded, weak to moderately strong siliceous cement and minor argillaceous/silty matrix, trace pyrite, friable to hard, poor porosity. Also  
common clear, medium to coarse, subrounded to occasionally rounded, loose quartz grains. Trace fluorescence from 1458 - 1461 m, dim, spotted to patchy, yellow, no cut.  
SILTSTONE: medium to dark grey, arenaceous in part, trace pyrite, subblocky to fissile.

1461- 1476m SANDSTONE WITH MINOR SILTSTONE.  
SANDSTONE: white, light grey, fine grained, well sorted, subangular to subrounded, weak to moderately strong siliceous cement and minor argillaceous/silty matrix, trace pyrite, friable to hard, poor porosity. Also occasional clear, medium to coarse, subrounded to occasionally rounded, loose quartz grains. Trace fluorescence from 1461 - 1467 m, dim, spotted to patchy, yellow, no cut.  
SILTSTONE: medium to dark grey, arenaceous in part, trace pyrite, subblocky to fissile.

1476- 1496.5m SANDSTONE WITH MINOR SILTSTONE.  
SANDSTONE: white, light grey, green, very fine to fine grained, (rare clear, coarse, loose grains), moderately well sorted, subangular to subrounded, moderately strong siliceous cement, sparse white argillaceous matrix, occasional to abundant glauconite, trace pyrite, poor porosity.  
SILTSTONE: light to medium grey, grey brown, commonly pyritic, moderately hard, subfissile.



## PACOOTA SANDSTONE P3 (EARLY ORDOVICIAN)

From 1496.5 m to 1592.4 m

True Stratigraphic Thickness: 84.6 m

### 1496.5 - 1518m SANDSTONE WITH TRACE SILTSTONE.

SANDSTONE: white to translucent and clear, medium to coarse grained, moderately sorted, subangular to subrounded, weak siliceous cement, occasional silty matrix, occasional to rare glauconite (less with depth), firm to friable to loose, poor to fair porosity. From 1500 - 1518 m, 40% Fluorescence, dull to moderately bright, bluish white, patchy with brighter pinpoints, no cut to very slow crush cut, trace residue.

SILTSTONE: medium brown grey, occasional mica and pyrite, hard, subfissile to fissile.

### 1518 - 1531.5m SANDSTONE WITH TRACE SILTSTONE.

SANDSTONE: white to translucent and clear, pinkish orange (Fe staining), medium to coarse grained, occasionally fine and very fine, moderately sorted, mostly subangular, occasionally subrounded and angular, weak siliceous cement, occasional silty matrix, firm to friable to loose, poor to fair porosity. 20% Fluorescence, dull to moderately bright, bluish white, patchy with brighter pinpoints, no cut to very slow crush cut, trace residue.

SILTSTONE: medium brown grey, grey green, orange, occasional to common mica, pyrite, hard, subfissile to fissile.

### 1531.5-1551.2m SANDSTONE WITH MINOR SILTSTONE.

P3 - 120/130

SANDSTONE: light pinkish orange, off white, translucent, mostly medium to coarse grained, occasionally fine to very fine, moderately sorted, subangular, occasionally angular and subrounded, siliceous cement in part, commonly loose, minor silty matrix, poor to fair porosity. Fluorescence 1531.5 - 1542 m, 20 to 40%, dull to bright, yellow white, patchy with brighter pinpoints, no visible cut, very dull ring residue. 1542 - 1551.2 m, 60% Fluorescence as above.

SILTSTONE: as above.

### 1551.2 - 1563 m SANDSTONE WITH MINOR SILTSTONE.

P3 - 150

SANDSTONE: light pinkish orange, white, translucent, mostly medium to coarse grained, minor fine to very fine aggregates, moderately sorted, subangular, to occasionally angular, moderate siliceous cement in part, commonly loose, sparse silty matrix, firm aggregates, poor porosity. Fluorescence 40%, as above.

SILTSTONE: dark greenish grey, hard, fissile to subfissile.

### 1563 - 1575.8 m SANDSTONE WITH TRACE SILTSTONE.

P3 - 190

SANDSTONE: light pinkish orange, white, translucent, mostly medium to coarse grained, minor very fine to fine aggregates, subangular to occasionally angular, moderate siliceous cement in part, commonly loose, sparse silty matrix, firm aggregates, poor porosity. Fluorescence 20 - 40%, as above.

SILTSTONE: as above.

1575.8-1592.4m SANDSTONE WITH TRACE SILTSTONE.  
P3 - 230/250 SANDSTONE: light pinkish brown, orange, dominantly medium with occasional coarse grains, well sorted, subangular to subrounded, occasionally rounded where coarse, weak siliceous cement, sparse silty matrix, friable to firm aggregates and occasionally to commonly loose, poor to occasionally fair porosity. Fluorescence 40%, dull to bright, yellow white, patchy with brighter pinpoints, no visible cut, very dull ring residue.  
SILTSTONE: as above.

PACOOTTA SANDSTONE P4 (EARLY ORDOVICIAN)

From 1592.4 m to 1653.0 m (Total Depth)  
True Stratigraphic Thickness: 51.9+ m

1592.4-1617 m SANDSTONE WITH TRACE SILTSTONE.  
SANDSTONE: light pinkish brown, becoming dominantly translucent to clear and frosted, fine to occasionally coarse, mostly medium grained, moderately sorted, subangular to occasionally rounded, siliceous cement in part, sparse silty/argillaceous matrix, friable to hard aggregates to commonly loose, poor to fair porosity. Fluorescence 30% decreasing to trace, dull to occasionally bright yellow, patchy, no cut.  
SILTSTONE: dark greenish grey, occasionally red brown, hard, fissile.

1617 - 1653 m SANDSTONE WITH TRACE SILTSTONE.  
SANDSTONE: as above. Fluorescence Trace, dull to occasionally bright, yellow, patchy, no cut.  
SILTSTONE: as above.