

NATIONAL PETROLEUM RESERVE IN ALASKA

GEOLOGICAL REPORT

U. S. NAVY

SOUTH HARRISON BAY NO. 1

HUSKY OIL NPR OPERATIONS, INC.  
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Edited by: Gordon W. Legg

For the

U. S. GEOLOGICAL SURVEY  
Office of the National Petroleum Reserve in Alaska  
Department of the Interior  
AUGUST 1983

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COMPOSITE LITHOLOGY LOG (In Pocket)

## GEOLOGIC SUMMARY

### INTRODUCTION

The South Harrison Bay No. 1, 1968' FNL and 1981' FWL of protracted Section 6, T12N, R2E, Umiat Meridian (Figures 1 and 2), was drilled out from under conductor casing on November 21, 1976. Enroute to a total depth of 11,290 feet, rocks ranging in age from Upper Cretaceous to Pennsylvanian were penetrated. Total depth was reached on January 27, 1977 and the rig released on February 8, 1977 after performing two drill-stem tests for final evaluation of the well. A previous open-hole drill-stem test had been conducted from 7119-7207' and the same zone was retested through casing from 7120-7290' on Drill-Stem Test No. 2. No producible hydrocarbons were found and the well was abandoned as a dry hole.

### PRE-DRILLING PROGNOSIS

The well was located on the northeast flank of the Fish Creek Platform and near a seismically postulated truncation edge at the top of Jurassic rocks. The primary objectives of this well were rocks of the Sadlerochit and Lisburne Groups and the "Pebble Shale" sandstones (possible Kuparuk Sandstone equivalent). Secondary objectives were sandstones of the Torok and Kingak Formations and the Sag River Sandstone.

It was expected that the normal sequence of strata present in NPRA (Cretaceous through Mississippian) would be drilled, but that the Nanushuk Group would be very thin. The tops of the Sadlerochit and Lisburne Groups (primary objectives) were expected to be approximately 9147' and 10,292', respectively.

### POST-DRILLING SUMMARY

Drilling of the South Harrison Bay No. 1 began in the Prince Creek-Schrader Bluff Formations (Upper Cretaceous) with Cretaceous rocks extending to a depth of 7290'. The Nanushuk Group, which was expected to be very thin in this well, was found to be 2000' thick. Approximately 345' of "Pebble Shale" was expected, but found to be missing in this well. A zone in the Torok Formation (6430-6680') contained rounded frosted grains which are not common to the Torok and may represent a reworking of the missing "Pebble Shale".

Hydrocarbon shows were limited to minor methane gas and scattered fluorescence until sandstones of the Torok were encountered. Two sandstone units (5677-5795' and 7123-7220') exhibiting fair to good fluorescence and cut were drill-stem tested with negative results (Appendix D). Electric log characteristics show these sandy zones to have low porosities.

The Sadlerochit Group, which was expected at 9147', actually came in 213' lower at 9360', while the Lisburne Group, topped at 10,234', was 58' higher than predicted.

Hydrocarbon shows below the Cretaceous consisted of only scattered fluorescence and minor gas peaks in the limestones of the Shublik Formation. Some porosity, up to 15%, was noted in the Sag River Sandstone and Ivishak Formation. All computed to have high water saturations.

The Lisburne Group of carbonates had a few zones with porosities up to 3% which were void of hydrocarbons.

It was deemed, after evaluation of the well, that no potential hydrocarbon reservoirs were encountered and the well was abandoned.

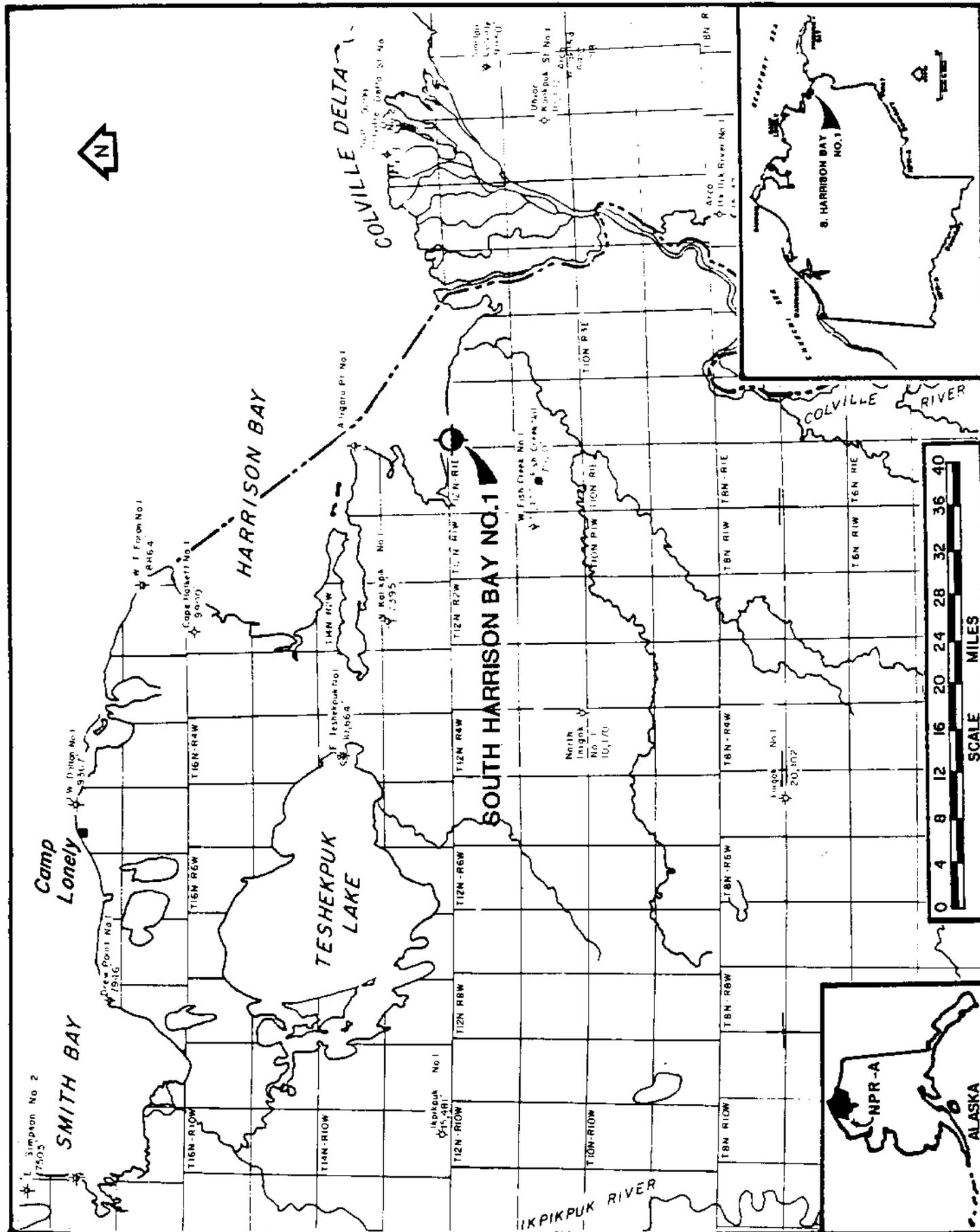


FIGURE 1 - LOCATION MAP - SOUTH HARRISON BAY NO. 1

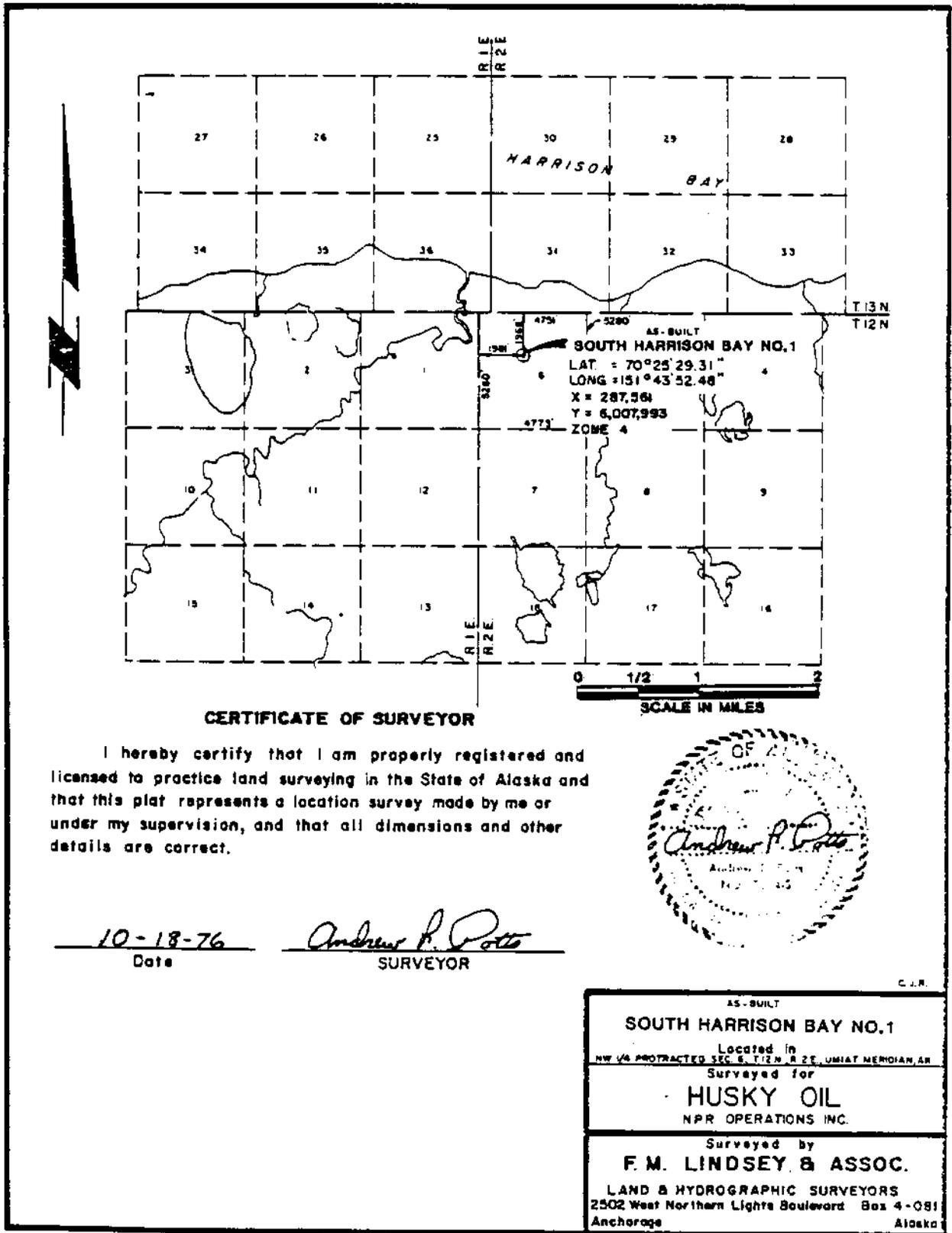


FIGURE 2 - CERTIFICATE OF SURVEYOR - SOUTH HARRISON BAY NO. 1

WELLSITE GEOLOGIST'S REPORT  
BY: RONALD G. BROCKWAY

INTRODUCTION

The South Harrison Bay No. 1, located approximately 130 miles east-southeast of Barrow Alaska, was drilled in protracted Section 6, T12N, R2E, Umiat Meridian, in the Naval Petroleum Reserve No. 4 just prior to the transfer of the reserve to the Department of the Interior on June 1, 1977. A suite of rocks ranging in age from Upper Cretaceous to Pennsylvanian were penetrated. Missing from the normal progression of formations found in most wells in the area is the "Pebble Shale".

A zone (6430-6680') in the Torok Formation had some rounded frosted quartz grains and granules, which are not common to the Torok, and these may be reworked from the missing "Pebble Shale".

Significant hydrocarbon shows were limited to sandstones of the lower Torok Formation. Two zones were drill-stem tested, both with negative results (Appendix D). The primary objectives (Sadlerochit and Lisburne Groups) were void of hydrocarbons with the exception of a few scattered occurrences of slight fluorescence. Porosities varied from 5-15% and computed to be water saturated.

Two conventional cores were cut and 54 sidewall cores shot with a recovery of 27.

After all information was evaluated, the well was abandoned as a dry hole.

STRATIGRAPHY

WIRELINE TOPS

	<u>Drilled Depth (BKB)</u>	<u>Subsea Depth KB 45'</u>
CRETACEOUS		
Colville Group		
Prince Creek-Schrader Bluff Formations undifferentiated	500' (samples start)	-455'
Seabee Formation	2,377'	-2,332'
Nanushuk Group (undifferentiated)	3,223'	-3,178'
Torok Formation	5,224'	-5,179'
JURASSIC		
Kingak Formation	7,290'	-7,245'
TRIASSIC		
Sag River Sandstone	8,876'	-8,831'
Shublik Formation	8,987'	-8,932'

TRIASSIC-PERMIAN

Sadlerochit Group

Ivishak Formation	9,360'	-9,315'
Kavik Shale Member	9,930'	-9,885'
Echooka Formation	10,140'	-10,095'

PENNSYLVANIAN-MISSISSIPPIAN

Lisburne Group	10,234'	-10,189'
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TOTAL DEPTH: 11,290 feet.

CRETACEOUS

Colville Group

Prince Creek-Schrader Bluff Formations undifferentiated: 500-2377'

Samples began at 500' in the South Harrison Bay No. 1 and were described as light to medium gray, silty, sandy claystones and light to medium gray siltstones to a depth of 1715'. Traces of loose sand, chert pebbles, coal chips and rare fossil fragments were observed. The electric logs indicate the presence of thin sandstones, especially above 1000'. Because of the soft nature of the rocks and fast rate of penetration (0.2-0.6 min. per foot), these sandstones were probably decomposed and lost over the shale shakers as isolated grains. Thin bentonite stringers were noted in the interval 1380-1530'. The electric logs indicate that probably the same type samples are present from 87' (Schlumberger's casing point) to 500'.

At 1715', the first recognizable sandstone was noted. Below this point, light gray, very fine to medium grained conglomeratic sandstones were interbedded with medium gray claystones and siltstones.

Minor methane gas was detected in the interval 1370-2850' where background gas averaged from 50 to 100 units and individual peaks reached a maximum of 240 units at 1615' and 1720-1730'. No staining or fluorescence was noted.

Anderson, Warren & Associates, Inc. (AWA) have placed the base of the Prince Creek-Schrader Bluff Formations at 2330' in the middle of a sandstone sequence. For the purposes of this report, the base has been moved downward to the bottom of the sandstone at 2377'. Their microfaunal determinations have dated the interval 500' to 950' as probable Late Cretaceous and the interval from 950' to 2330' as Late Cretaceous (Senonian) in age.

Seabee Formation: 2377-3223'

The Seabee Formation is primarily a medium gray siltstone with thin sandstones and minor claystones and shales to a depth of approximately 2790'. Shales become increasingly important below this point. These shales are medium gray, soft, silty and partly bentonitic. The sandstones are generally represented by loose fine to coarse "salt and pepper" to varicolored sand grains. Some very fine grained sandstones were noted in the upper 200' of the formation. A trace of bentonitic sandstone was

observed from 2580-2620' and probably this bentonitic cementing agent was dispersed from sandstones below 2620' leaving only the loose grains mentioned above. Mica, carbonaceous material, chert pebbles and coal chips were common throughout. A few scattered coal partings were noted.

Bentonite stringers, which are indicative of the lower Seabee, were observed below 2790'.

These sediments were probably deposited in an open marine environment and the interval 2330-3210' has been assigned by paleontological data to a Late Cretaceous (Cenomanian-Turonian) age; 2210-3376' by palynology (AWA).

Nanushuk Group (undifferentiated): 3223-5224'

The upper 1000'± of the Nanushuk is characterized by a sequence of interbedded siltstones, sandstones, shales and claystones. Sandstones of the interval are tannish-gray to light gray-brown, very fine grained, silty and friable. It was not until 3485' that the first recognizable sandstone of the Nanushuk Group was observed in the samples, although some loose sand was noted in the upper 262'. Here again, it is probable that the soft matrix of clay and silt was dispersed by the mud leaving only loose sand and silt grains, most of which went through the shaker screens. The electric logs indicate that the upper 80' of the formation is a "dirty" low permeable sandstone as are most of the other sandstones in the Nanushuk. The siltstones vary in color from light gray to gray-brown, are soft and interbedded with other strata as mentioned above. The claystones and shales are medium gray.

Traces of hydrocarbon fluorescence and cut were present in both the sandstones and siltstones throughout the upper 1000'.

At 3200', background gas increased to approximately 160 units and remained at that level to a depth of 4370' where it began to decline. Some individual gas peaks, not exceeding 100 units over background, were observed. One exception was in the interval 3270-3275' where a maximum gas peak of 1,200 units was recorded. This gas consisted of 240,000 ppm C<sub>1</sub>.

Below 4235', the formation becomes predominantly a medium gray, micaceous and carbonaceous shale which darkens with depth to a dark gray. Interbedded with the shales are thin, very fine grained sandstones and siltstones. Pyrite and bentonitic streaks are common throughout.

Microfaunal determinations by Anderson, Warren & Associates, Inc. have placed the interval 3210-3330' into the Albian to Cenomanian and 3330-5260' into the Albian stages. Palynology specimens are Early Cretaceous (Albian) from 3376-6090'.

Torok Formation: 5224-7290'

From 5224' to 5677', dark gray carbonaceous shales are the dominant lithology. At 5677', a 118' sandstone sequence with interbedded shales

and siltstones was encountered. The sandstones of this zone were light gray, very fine grained, subangular, carbonaceous, silty, partly calcareous, and generally tight, but had good fluorescence and cut at the top of the zone. The fluorescence and cut diminished to a trace with depth. Gas shows were recorded throughout the interval, varying from 320-400 units. This was the first indication that the gas contained components other than methane (C<sub>1</sub>). The composition of the gas at 5715-5720, as read from the mud log, was 70,000 ppm C<sub>1</sub>, 3,300± ppm C<sub>2</sub>, 1,800± ppm C<sub>3</sub>, and 1,000 ppm C<sub>4</sub>. Drill-Stem Test No. 3 (5680-5790') was taken with a slight amount of gas (TSTM), water cushion and some rat hole mud recovered (Appendix D).

Medium to dark gray shales with some light gray zones were present from 5795' to a depth of 7123'. They also had a brownish tinge in the lower portion of the section. Some thin sandstone units were present in the upper 215' with siltstone and sandstone laminations present throughout. Below 6700', there appears to be an increase in the amount of siltstone and sandstone laminations which becomes definite below 6950'. Hydrocarbon fluorescence and cut was present in the laminations and some of the shales below 6800'. Core No. 1 (7022-7052') recovered 13.6' of dark gray shale which graded to siltstone and then to a fine grained sandstone. The siltstone and sandstone exhibited a bright yellow fluorescence which appeared concentrated along fracture planes.

Black chert nodules (granules?) and grains were noted below 6260' with rounded frosted quartz grains and nodules present from 6430-6680'. Chert pebbles and granules have previously been logged in the Torok Formation, but quartz grains and nodules are not usually common to the formation and may represent a reworking of the "Pebble Shale" where rounded quartz grains are representative. The "Pebble Shale" is missing in this well, but present in surrounding wells.

Another interbedded sandstone, siltstone and shale sequence was present from 7123-7220'. These sandstones were gray to brownish-gray, fine to medium grained, slightly calcareous, predominantly tight. A greenish-yellow to bright yellow hydrocarbon fluorescence was observed with some residual oil present in minute fractures. Gas peaks up to 800 units were recorded in the interval 7175-7200'. Maximum components were 90,000 ppm C<sub>1</sub>, 6,500 ppm C<sub>2</sub>, 3,200 ppm C<sub>3</sub>, and 1,500 ppm C<sub>4</sub>. The sandstone interval was tested twice (Drill-Stem Tests Nos. 1 & 2), both with negative results (Appendix D).

A medium to dark gray shale was present below the sandstone interval to the base of the formation at 7290'.

The Torok Formation was deposited in an open marine environment with microfaunal data establishing an Early Cretaceous (Aptian to early Albian) age which is supported closely by palynological data.

## JURASSIC

### Kingak Formation: 7290-8876'

Paleontological studies by Anderson, Warren & Associates, Inc. have dated the Kingak Formation as Late Jurassic to Early-Middle Jurassic for the interval 7270-8970'. This also includes the underlying Sag River Sandstone. Palynological information reports a Jurassic age to a depth of 9300' which is in the lower part of the Shublik Formation.

The Kingak is composed primarily of shales that vary in color from medium gray to dark brown. Brown shales are predominant in the upper portion of the formation and have interbedded brown sideritic siltstones which occur as units up to 35' in thickness. Some thin sandstones are also present. Siderite is moderately common and occurs as nodules, thin partings and as grains and cement in the siltstones.

Below 8350', the shales become darker and are medium to very dark gray with some black and dark brownish-gray. Some siltstone and sandstone laminations were observed. Glauconite, pyrite and fossil prisms (Inoceramus?) were scattered throughout the formation.

Hydrocarbon shows were limited to scattered very faint cut fluorescence which occurred in both the shales and laminations.

## TRIASSIC

### Sag River Sandstone: 8876-8987'

The 111' of the Sag River Sandstone is composed mainly of very fine to fine grained, subangular, siliceous sandstones with glauconite grains. They become slightly calcareous at the base. A 29-foot zone of dark gray siltstone and shale has been included at the top of the Sag River.

A neutron-density cross-plot shows porosities of 10-15% in the main body of the Sag River Sandstone. It also shows water saturation of 85-100% (Appendix C). Scattered yellowish-green fluorescence was observed in the samples.

As mentioned in the previous discussion, the Sag River Sandstone yielded only Early to Middle Jurassic fossils even though it is generally considered to be of Triassic age.

### Shublik Formation: 8987-9360'

White to dark brownish-gray, argillaceous, fossiliferous limestones with interbedded shales comprise approximately 65% of the Shublik. Phosphate pellets were moderately common in the interval 9150-9200'.

This upper unit of the formation is underlain by a lower unit composed of interbedded sandstones, shales and siltstones.

The sandstones were light to dark gray, fine grained, calcareous, and contain scattered glauconite grains. Traces of "patchy" poor porosity were observed. The shales were medium to dark gray and the siltstones medium to light gray.

Minor gas shows were recorded in the limestone section, with a maximum peak of 180 units over a background of approximately 100 units. No fluorescence or cut was noted.

Paleontological determinations date the interval 8970-9360' as Triassic and assign a depositional environment of fluctuating inner to outer neritic open marine.

### TRIASSIC-PERMIAN

Sadlerochit Group: 9360-10,234'

Ivishak Formation: 9360-9930'

Below 9360', the sandstones become siliceous and contain tripolite and chert fragments. Ivishak sandstones are predominantly fine to medium grained, but have some conglomeratic zones in the thicker units. Individual units vary in thickness to a maximum of 100' at 9600-9700'.

Another thick sandstone, similar to the one above, but containing pink and green mottling was present at 9812-9880'. Spot checks through these sands indicate porosities of 5-15% and high water saturations. Hydrocarbon shows were nil, with the exception of some faint scattered fluorescence in the 9600-9700' sandstone.

Separating these two thick sandstones is a 112-foot zone (9700-9812') of dark gray to brick-red shales and siltstones and light gray to light green sandstones and siltstones. The red shales and siltstones have been called lateritic by the wellsite geologist. If this is true, then this interval was probably deposited in a nonmarine high humidity environment. Anderson, Warren & Associates, Inc. have placed the Sadlerochit Group to a depth of 10,210' into a Triassic-Permian age and note that they were deposited in a turbid inner to middle shelf environment.

Unusually high densities were recorded through the 9700-9812' zone, which approach those exhibited by limestones and dolomites. Carbonates were not noted in the samples, therefore, these high densities may have been caused by a high concentration of iron minerals. Disseminated pyrite was observed in some of the shales and sandstones of this interval. This phenomena also occurs at 9500-9525' where red and green shales were observed.

Kavik Shale Member: 9930-10,140'

The Kavik Shale Member of the Ivishak Formation is made up of medium to dark shales with a trace of brownish-gray. Interlaminated siltstones and sandstones were present along with scattered chert pebbles and traces of limestone and dolomite.

Echooka Formation: 10,140-10,234'

Light to very dark gray sandstones are the predominant lithology of the Echooka Formation. They are very fine to fine grained, slightly to very calcareous, argillaceous and contain glauconite. Thin light to dark gray shales were interbedded with the sandstones. Traces of limestone and dolomite were noted in the samples.

#### PENNSYLVANIAN-MISSISSIPPIAN

Lisburne Group: 10,234-11,290' (Total Depth)

The upper 266' of the Lisburne was massive, predominantly cryptocrystalline limestones that vary in color from white to medium gray with traces of brownish-gray. Fossils and chert are common and glauconite scattered. Thin dolomites are present to a depth of 10,350'. The limestones of this section have been called calcarenites and calcilutites, as are nearly all of the limestones below, by the wellsite geologist. Some minute fracturing with calcite filling and rare traces of pyrobitumen were observed. Thin shale stringers are indicated on the electric logs, but not noted in the sample descriptions.

At 10,500', a 12-foot shaly zone is indicated on the electric logs, but was not detected in the samples. This zone has been logged as a dark maroon shale with red interbedded siltstone by American Stratigraphic Co.

Below this shale the limestones become less massive with increasing shale stringers as indicated on the electric logs. A slight increase in shales was noted in the samples which were light green to dark gray in color. The limestones appear to become more brownish-gray and less white than those of the upper section. Core No. 2 (10,613-10,628') recovered 13.8' of light gray to dark brownish-gray crypto to microcrystalline limestones (calcarenites and calcilutites). They were in part siliceous and dolomitic and displayed some vertical fracturing. Some algal pellets and nodules were observed. The upper two feet exhibited a faint brownish-yellow to yellow fluorescence. Below 10,900', dark gray streaks became moderately common. Fossils and chert are still a common constituent, but there appears to be a decrease in glauconite. Amphipora, as identified, becomes common to abundant below 10,500'.

At 11,120', the limestones become lighter colored and partly varicolored with buff, green and pink below 11,200'. Light green to brick-red lateritic siltstones and shales and abundant chert were observed below 11,200' to total depth (11,290'). Some soft marly limestone was present in the bottom 20'.

Scattered zones of slight (not exceeding 3%) porosity were present in the Lisburne Group, but all were void of hydrocarbons.

Anderson, Warren & Associates, Inc. have placed the Lisburne Group of this well into a Middle Pennsylvanian, or younger age. Depositional environments are depicted to be restricted shelf and lagoon to a depth of 10,870' and open shelf and platform edge below this point.

## STRUCTURE

A study of the dipmeter log, which starts at 2624', shows a general northeast dip of  $1^{\circ}$  to  $2^{\circ}$ , to a depth of 4410'. From 4410' to 4910', there is a change in direction of dip to the southeast and south with dips varying from horizontal to  $8^{\circ}$ . Several zones of anomalous dips occur at 4350', at 4410', 4600-4680', 4715' and 4910'; possibly due to slump with minor fracturing or perhaps a zone of minor faulting with some slip and drag accounting for the changes in direction of dip. Dips read from  $0^{\circ}$  to a maximum of  $11^{\circ}$  in this interval.

A northeast dip ( $0^{\circ}$ - $8^{\circ}$ ) is again present from 4910' to 5250'. At 5250-5300', an anomaly occurs which possibly indicates a minor unconformity at the top of the Torok Formation. Below this point to 5680', the dips vary in direction for some unknown reason and make an almost  $360^{\circ}$  change, but the strata is predominantly horizontal.

Direction of dip is northwest to southwest below 5680', with dips beginning at  $2^{\circ}$  and increasing with depth to  $15^{\circ}$  at 6680' where it remains to the top of the Kingak Formation at 7290'. The Pre-Cretaceous unconformity is reflected at this point with the beds below becoming nearly flat-lying ( $1^{\circ}$ - $3^{\circ}$ ) although maintaining a general southwest direction.

The southwest direction of dip remains to total depth of the well although readings in the Sadlerochit and Lisburne Groups are somewhat scattered. The strata remains fairly flat-lying with dips not exceeding  $8^{\circ}$  and generally less than  $3^{\circ}$ .

## CONCLUSIONS

After evaluation of all available data, it was deemed that no potential hydrocarbon reservoirs were present and that the well was a dry hole.

The absence of sandstone development near the base of the "Pebble Shale" (Kuparuk Sandstone equivalent) and the disappointingly low porosity development in the primary objectives (Sadlerochit and Lisburne Groups) downgrades this immediate area for further prospects.

PERTINENT DATA AND APPENDICES

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SUMMARY OF PERTINENT DATA \*

WELL NAME: South Harrison Bay No. 1  
 API NO.: 50-103-20007  
 OPERATOR: Husky Oil NPR Operations, Inc.  
 LOCATION: 1968' FNL, 1981' FWL,  
 protracted Section 6, T12N, R2E,  
 Umiat Meridian, Alaska  
 COORDINATES: Latitude: 70°25'29.31"N  
 Longitude: 151°43'52.48"W  
 X = 287,561  
 Y = 6,007,993  
 Zone 4  
 ELEVATION: 45' Kelly Bushing, 25' Ground  
 DATE SPUDDED: November 21, 1976  
 TOTAL DEPTH: 11,290 feet  
 DATE REACHED  
 TOTAL DEPTH: January 27, 1977  
 RIG RELEASED: February 8, 1977  
 STATUS: Dry and abandoned  
 CASING: 20" @ 83' (driller)  
 13-3/8" @ 2600' (driller)  
 9-5/8" @ 8370' (driller)

LOGGING RECORD:

DIL/SP	87- 2,633' 2,600- 8,374' 8,369-11,266'
BHCS/GR/TTI/Caliper	87- 2,635' 2,600- 8,372' 8,170-11,260'
FDC/CNL/GR/Caliper	2,600- 8,373' 8,170-11,250'
FDC/GR/Caliper	2,600- 8,373' 8,170-11,250'
HDT Dipmeter	2,600- 8,375' 8,369-11,254'
CBL/VDL	4,800- 8,369'

LOGGING RECORD: (Continued)

CCL/GR	60- 2,740'
Mud Log	500-11,290'
Formation Pressure Log	3,800-11,275'
Check Shot Velocity Survey	1,000-11,290'
Computed Logs:	
Dipmeter Arrow Plot	8,383-11,246'
Saraband	5,000-10,049'
Coriband	10,050-11,245'

SIDEWALL CORES:                   Run 1, shot 30, recovered 22.  
                                      Run 2, shot 24, recovered 5.

CONVENTIONAL CORES:

<u>Core</u>	<u>Depth</u>	<u>Recovered</u>	<u>Formation</u>
1	7,022- 7,052'	13.6'	Torok
2	10,613-10,628'	13.8'	Lisburne Group

WELLSITE GEOLOGIST:           R. Brockway  
                                      S. P. Burden

LOG ANALYST:                    Armour Kane

CONTRACTOR:                    Parco, Inc.

MUD LOGGERS:                   Borst & Giddens Logging Service, Inc.

BIOSTRATIGRAPHIC  
ANALYSIS:                       Anderson, Warren & Associates, Inc.

\* Copies and/or reproducibles of all geological data are available from:

National Oceanic and Atmospheric Administration  
EDIS/NGSDC (D62)  
325 Broadway  
Boulder, CO 80303

SOUTH HARRISON BAY NO. 1  
 DRILL CUTTINGS AND CORE DESCRIPTIONS  
 R. Brockway - 500- 6,100'  
 S. P. Burden - 6,100-11,290'

DEPTH DRILLED  
 (FEET BELOW  
 KELLY BUSHING)

0- 500	Reports start at 500 feet.
500- 540	Sandstone: gray to black, partly "salt and pepper", conglomeratic, medium to coarse grained, subrounded, poorly sorted, chert pebbles, interbedded siltstone, tannish-gray, and Claystone: tannish-gray to light gray, slightly carbonaceous.
540- 580	Siltstone: brown, light gray, very argillaceous, micaceous, scattered carbonaceous flakes, interbedded Claystone: as above.
580- 610	Sandstone, Siltstone and Claystone: as above.
610- 700	Claystone: light to medium gray, silty, partly sandy, chert pebbles, interbedded conglomerates, predominately chert pebbles, some sand grains, loose in samples, trace of pyrite.
700- 710	Conglomerate: gray, black and white chert and quartz pebbles, subrounded, loose.
710- 740	Claystone: as above.
740- 770	Conglomerate: as above, loose in sample, some sand grains.
770- 870	Claystone: medium to light gray, silty, partly sandy, carbonaceous flakes, some pebbles, interbedded Conglomerates: as above.
870- 920	Conglomerates: gray to black, chert and quartz pebbles, trace of sand grains, loose in sample, interbedded Claystone: as above.
920- 1020	Claystone: tannish-gray, silty, sandy streaks, thin Conglomerates: as above, at 995-1000'.
1020- 1180	Claystone: gray, very to slightly silty, partly sandy, scattered pebbles, some tuff stringers 1120-1180'.

- 1180- 1360 Claystone: gray to light gray, soft, sandy streaks, rare dark chert pebbles, trace of pyrite.
- 1360- 1510 Claystone: medium to dark gray, trace of dark gray shale, slightly carbonaceous, scattered pebbles and pyrite inclusions, a few bentonite stringers.
- 1510- 1640 Siltstone: light to dark gray, partly carbonaceous, some loose medium and coarse sand grains, possible thin stringers.
- 1640- 1670 Shale: dark gray, carbonaceous, slightly silty, trace of pyrite.
- 1670- 1740 Claystone: gray, silty, sandy, scattered carbonaceous flakes, trace of bentonite and tuff.
- 1740-1780 Sandstone: light gray, fine to medium grained, subangular, medium sorting, slightly calcareous, slight porosity, no shows, claystone interbeds, bituminous coal stringer at 1760'.
- 1780- 1880 Siltstone: gray, very argillaceous, slightly sandy, scattered carbonaceous material, claystone interbeds.
- 1880- 1930 Sandstone: light gray, very fine to fine grained, subangular, medium sorted, silty, very argillaceous, slightly carbonaceous and calcareous, micaceous, no visible shows.
- 1930- 2020 Claystone and Shale: gray, silty, slightly carbonaceous.
- 2020- 2080 Sandstone: light to medium gray, very fine grained, subangular, silty, very slightly calcareous, slightly porous, interbedded Shale: gray.
- 2080- 2100 Sandstone: light gray, gray, slightly conglomeratic, very fine to fine grained, subangular to rounded, carbonaceous, silty, slightly porous, no shows.
- 2100- 2270 Siltstone: gray, sandy, argillaceous, carbonaceous flakes, interbedded shale, becoming silty claystone.
- 2270- 2300 Sandstone: very light gray, slightly conglomeratic, very fine to fine grained, subangular, very silty, clayey, claystone stringers.
- 2300- 2330 Siltstone: gray, sandy, scattered pebbles.
- 2330- 2380 Sandstone: gray, slightly conglomeratic, very fine grained, subangular, silty, no shows.

2380- 2530	Siltstone: gray, carbonaceous, sandstone stringers, trace of pyrite, slightly carbonaceous.
2530- 2540	Sandstone: conglomeratic, loose, medium to coarse grains, probably very silty.
2540- 2870	Siltstone: gray to gray-brown, shaly, micaceous, thin sandstone interbeds.
2870- 2890	Sandstone: light gray, very fine grained, subangular, very silty, argillaceous, micaceous, very slight porosity, no show.
2890- 2930	Siltstone: gray, very argillaceous, slightly bentonitic, claystone interbeds.
2930- 2960	Sandstone: gray, very fine grained, subangular, very silty, argillaceous, very slight porosity, no shows.
2960- 2980	Claystone: gray, bentonite stringers, silty, becoming siltstone.
2980- 3000	Sandstone: as above.
3000- 3020	Claystone: gray, sandy, silty, bentonite stringer.
3020- 3040	Siltstone: gray, very argillaceous, micaceous, bentonitic.
3040- 3080	Claystone: gray, as above, sandstone bed as above.
3080- 3120	Sandstone: gray, very fine grained, subangular, very argillaceous and silty, no shows.
3120- 3220	Siltstone: gray, very argillaceous, interbedded with Claystone: gray, silty, sandy in part.
3220- 3300	Sandstone: medium to light gray, very fine grained, subangular, very silty, argillaceous, slight porosity, fair fluorescence and cut.
3300- 3370	Claystone: light brownish-gray, light brown, silty, slight stain, fluorescence and cut.
3370- 3390	Sandstone: light gray-brown, very fine grained, subangular, very silty, trace of gas.
3390- 3440	Claystone: light brown, micaceous, silty, bentonitic streaks, interbedded Sandstone: light gray-brown, very fine grained, subangular, trace of gas.
3440- 3540	Siltstone: light gray, light brown, very argillaceous, interbedded Claystone: tan, bentonitic, partly carbonaceous.

- 3540- 3580 Sandstone: tannish-gray, very fine grained, subangular, very silty and clayey, no shows.
- 3580- 3650 Claystone: gray to tan, silty, rare siderite nodules, becoming siltstone.
- 3650- 3660 Sandstone: tannish-gray, very fine grained, subangular, carbonaceous, trace of fluorescence and cut.
- 3660- 3720 Siltstone and Claystone: gray-tan, tan, partly calcareous.
- 3720- 3770 Sandstone: tannish-gray, very fine grained, subangular, silty, friable, trace of fluorescence and cut.
- 3770- 3910 Siltstone: tannish-gray to light gray-brown, partly sandy, with light gray claystone interbeds, becomes shale.
- 3910-3980 Sandstone: tannish-gray to medium gray, very fine grained, subangular, silty, scattered carbonaceous flakes.
- 3980- 4050 Shale: gray, silty, rare carbonaceous flakes, trace of siderite nodules.
- 4050- 4120 Siltstone: gray-brown, gray, argillaceous, slightly carbonaceous.
- 4120- 4170 Shale: light to medium gray, soft, slightly silty.
- 4170- 4210 Sandstone: light gray-brown, very fine grained, subangular, slightly calcareous, silty.
- 4210- 4790 Shale: gray, micaceous, carbonaceous, bentonite stringers, interbedded Siltstone: gray, micaceous.
- 4790- 4830 Siltstone, Sandstone and Shale: gray to light gray, carbonaceous and micaceous, interlaminated.
- 4830- 5180 Shale: gray to dark gray, micaceous, carbonaceous, bentonite stringers, sandstone and siltstone partings.
- 5180- 5500 Shale: dark gray, carbonaceous, fissile to blocky, interlaminated sandstone and siltstone, bentonite stringers, pyritic, rare calcite vein.
- 5500- 5673 Shale: as above.
- 5673- 5791 Sandstone: light gray, carbonaceous, very fine grained, subangular, poorly sorted, tight, with Siltstone: gray, argillaceous, carbonaceous at 5771-5774', hydrocarbon shows.

- 5791- 6000 Shale: dark gray, carbonaceous, micaceous, fissile to slightly blocky, with thin sandstone and siltstone partings and laminations, becomes bentonitic at 5997'.
- 6000- 6009 Sandstone: gray, very fine grained, silty, argillaceous, scattered carbonaceous flakes, trace of calcite.
- 6009- 6090 Shale: medium to dark gray, scattered sandstone and siltstone stringers, trace pyrite, trace of calcareous inclusions.
- 6090- 6100 Shale: gray, silty, becoming darker gray, in part slightly silty, micromicaceous; trace of carbonaceous streaks in the gray shale; trace of bentonite.
- 6100- 6110 Shale: as above; trace of light gray siltstone.
- 6110- 6120 Shale: as above; trace of light gray Siltstone: slightly argillaceous; trace of very fine sandstone.
- 6120- 6130 As above; trace of bentonite.
- 6130- 6140 Shale, Siltstone and Sandstone: as above.
- 6140- 6150 Shale: gray, rough texture, silty, becoming darker gray, in part slightly silty, in part micromicaceous; trace of carbonaceous streaks in the shale; trace of Sandstone: "salt and pepper", quartz and chert grains, fine, subangular, poorly sorted, well consolidated, calcareous matrix; trace of bentonite.
- 6150- 6160 Shale: as above; trace of light gray siltstone; trace of bentonite.
- 6160- 6170 Shale: as above, with increased light gray siltstone and sandstone; trace of bentonite.
- 6170- 6180 Shale: as above; in part the lighter gray shale has a slightly brownish tinge; trace of calcite and bentonite; trace of pyrite.
- 6180- 6190 Shale: as above; trace of marcasite.
- 6190- 6200 Shale: medium to light gray, silty, in part with carbonaceous streaks; and Shale: dark gray, platy to fissile; small amount of Siltstone: light gray, "salt and pepper", argillaceous; trace of Sandstone: "salt and pepper", fine grained, argillaceous.
- 6200- 6210 Shale: as above; increase in sandstone, 30%, and siltstone, 40%; rare traces of siderite in the sandstone.

- 6210- 6220 Siltstone, sandstone and Shale: as above.
- 6220- 6230 Siltstone, sandstone and Shale: as above; slight reduction in shale; in general the siltstone and sandstone are lighter gray, less argillaceous; trace of calcite and bentonite.
- 6230- 6240 As above; the shale is slightly more carbonaceous.
- 6240- 6250 Shale: medium to dark gray, in part silty and micromicaceous, partly platy; Siltstone and Sandstone: as above.
- 6250- 6260 Shale: gray, in part with a brownish tinge, silty; with Shale: dark gray; small amount of siltstone; small amount of "salt and pepper", calcareous sandstone; trace of brown, chitinous fish scales in the siltstone.
- 6260- 6410 Shale: as above, in general less silty; trace of tight, indurated siltstone; minor Sandstone: dark gray, "salt and pepper", argillaceous; trace of coarse, black chert grains.
- 6410- 6420 As above; increased siltstone; trace of calcite and bentonite; scattered black chert nodules.
- 6420- 6430 Shale: increasing dark gray Shale: rough texture, irregular fracture; trace of siltstone and fine grained sandstone; trace of calcite and chert nodules.
- 6430- 6440 Shale: medium to dark gray; some argillaceous sandstone; trace of rounded, frosted quartz nodules.
- 6440- 6450 Shale: as above; dark gray shale is soft; trace of coarse, rounded chert grains.
- 6450- 6460 Shale: as above; slight increase in siltstone; trace of black chert nodules.
- 6460- 6470 Shale: as above; increased light gray, bentonitic shale; trace of chert.
- 6470- 6490 Shale: light gray, in part bentonitic, and Shale: medium to dark gray, silty; small amount of siltstone; trace of chert nodules.
- 6490- 6500 Shale: light to medium gray, micromicaceous, silty, and Shale: dark gray, in part silty, in part carbonaceous; trace of marcasite.
- 6500- 6510 Shale: as above; trace of siltstone; trace of calcite and chert nodules.

- 6510- 6520 Shale: light, medium and dark gray, silty; trace of bentonite; trace of chert nodules.
- 6520- 6530 Shale: as above; small amount of gray, "salt and pepper" Siltstone: argillaceous; some light gray to green, bentonitic shale; trace of bentonite.
- 6530- 6540 Shale: medium to dark gray, silty, grading to an argillaceous siltstone; trace of bentonite.
- 6540- 6550 Shale: as above; increased "salt and pepper" sandstone, no shows; trace of phlogopite in the sandstone; increased bentonite; trace of calcite and chert nodules; slight bright yellow fluorescence in the sandstone.
- 6550- 6560 Shale: light, medium and dark gray; trace of sandstone with some phlogopite inclusions; minor Shale: green, with a waxy luster; trace of black chert nodules; scattered subrounded, frosted quartz nodules.
- 6560- 6570 Shale: as above; light gray shale is bentonitic; trace of calcite and chert.
- 6570- 6580 Shale: as above; trace of sandstone, with some sericite inclusions; rare calcite; trace of bentonite.
- 6580- 6590 Shale: as above; in general the shale is lighter; traces of a light green mineral associated with pyrite.
- 6590- 6600 Siltstone: light gray, firm, "salt and pepper", slightly argillaceous; Shale: as above, 40%.
- 6600- 6610 Shale: as above, mostly gray; trace of sandstone, reduced siltstone.
- 6610- 6620 Shale: as above; reduced siltstone, 15%.
- 6620- 6630 Shale: as above; some granitic fragments, with orthoclase, biotite and quartz grains and a trace of limestone; probable cavings from the shaker box.
- 6630- 6640 Shale: as above; still granitic material and some dark mafic minerals; trace of gray limestone; some rounded quartz nodules and a clear quartz, euhedral crystal.
- 6640- 6650 Shale: as above, but more silty; trace of sandstone, with some amber quartz grains and some rounded, oolitic appearing grains, very calcareous.
- 6650- 6660 Shale: light to dark gray, platy to fissile, silty; trace of Sandstone: subangular to angular, poorly sorted, with almost a fused appearance and indistinct grain boundaries.

- 6660- 6670 Shale: medium to dark gray, silty, blocky to platy; trace of light green, bentonitic shale; small amount of quartz grains and nodules, clear to frosted, semiround to subangular.
- 6670- 6680 Shale: light gray, bentonitic; with Shale: medium and dark gray, silty, in part fissile; trace of chert nodules; rare coarse, rounded quartz grains; trace of clear quartz fragments, with scattered green staining.
- 6680- 6690 Shale: as above; in part the darker shale has thin, carbonaceous separations; trace of light green and light gray, bentonitic shale; rare Sandstone: fine grained, angular, argillaceous.
- 6690- 6700 Shale: as above, with increased lighter gray shale; trace of siltstone and sandstone; scattered black chert pebbles.
- 6700- 6710 Shale: as above; trace of bentonite; small amount of bentonitic shale; some argillaceous sandstone; trace of calcite.
- 6710- 6720 Shale: medium to dark gray, silty, platy to fissile; minor siltstone; trace of pyrite and chert nodules; rare calcite.
- 6720- 6730 Shale: as above, more fissile; trace of sandstone with rare chlorite inclusions; small amount of siltstone.
- 6730- 6740 Shale: mostly gray, rough texture, silty, blocky to platy; trace of black, semiround chert nodules; scattered marcasite; rare calcite.
- 6740- 6750 Shale: as above, in general darker than above; trace of siltstone; some finely crystalline pyrite.
- 6750- 6760 Shale: as above, mostly gray; trace of siltstone; grading to a very fine sandstone, in part with rare siderite grains.
- 6760- 6770 Shale: as above; slight increase in siltiness.
- 6770- 6780 Shale: medium to dark gray, platy to fissile; in part the darker shale has a brownish tinge; argillaceous Siltstone: as above; trace of Sandstone: as above; trace of calcite.
- 6780- 6790 Shale: as above, but the medium gray shale has a brownish tinge; in general the shale is more silty; the shale has a yellowish-white cut fluorescence; minor siltstone; trace of dark gray, argillaceous sandstone; rare calcite and pyrite.

- 6790- 6800 Shale: as above, with increased brownish-gray shale; trace of greenish-gray, bentonitic shale; brownish-gray siltstone, with a faint cut fluorescence; and sandstone with bright yellow cut fluorescence; trace of marcasite.
- 6800- 6810 Shale: as above, with increased dark gray shale; in part the shale has a smoother texture; trace of Sandstone: brownish-gray, "salt and pepper", fine grained, subangular, well sorted, fairly well consolidated, bright yellowish-white cut fluorescence; some lighter gray, bentonitic shale; trace of calcite.
- 6810- 6820 Shale: as above; small amount of dark gray, silty shale; trace of brownish-gray siltstone, with faint cut fluorescence; minor Sandstone: brownish-gray, soft, with a bright yellowish-white cut fluorescence and a very faint cut.
- 6820- 6830 Shale: as above, in general less silty; trace of brownish-gray Siltstone: as above; some dark brownish-gray sandstone with rare weathered glauconite and pyrite grains; trace of Sandstone: "salt and pepper", quartz and chert grains, fine, subangular to semiround, bright yellow fluorescence; scattered marcasite; rare bentonite.
- 6830- 6840 Shale: as above, but darker; rare, scattered, dull brown fluorescence; the shale is mainly blocky; trace of siltstone and soft, poorly consolidated sandstone.
- 6840- 6850 Shale: as above; Siltstone: gray, argillaceous; Sandstone: brownish-gray, soft, with a brownish-yellow fluorescence.
- 6850- 6860 Shale: brownish-gray and medium to dark gray, rough texture, silty, with a faint cut fluorescence; Siltstone: brownish-gray, argillaceous, with a poor, yellowish-white cut fluorescence; Sandstone: brownish-gray, "salt and pepper", quartz and chert grains, fine grained, subangular, well sorted, soft, poorly consolidated, with a bright yellowish-white fluorescence; trace of calcite and bentonite.
- 6860- 6870 Shale, 60%; Siltstone, 25%; Sandstone: 15%, as above; shows as above; trace of marcasite and calcite.
- 6870- 6880 Shale, siltstone and Sandstone: as above, but with more brownish-gray shale; slight increase in fine grained sandstone, with a dull yellow fluorescence.
- 6880- 6890 Shale: gray to brownish-gray, silty; Siltstone: brownish-gray, with a dull yellow fluorescence; trace of Sandstone: gray, "salt and pepper", no shows.

- 6890- 6900 Shale: dark gray, smoother texture, 35%, silty; Shale: as above, with some faint fluorescence; Siltstone: as above, with increased fluorescence; trace of Sandstone: "salt and pepper", gray, fine, subangular, no shows.
- 6900- 6910 Shale: gray and brownish-gray to darker gray, in part with a smoother texture, in part silty; Siltstone: as above, with a dull yellowish-brown to greenish-brown fluorescence; trace of hard sandstone, in part with a yellow fluorescence; scattered marcasite.
- 6910- 6920 Shale, siltstone and Sandstone: as above; slight reduction in fluorescence; scattered marcasite; trace of calcite.
- 6920- 6930 As above; scattered dull yellow fluorescence; trace of black chert nodules.
- 6930- 6940 As above, with reduced fluorescence in the siltstone; the fluorescence is greenish-yellow; considerable clay in the sample.
- 6940- 6950 As above; increased dark gray, platy shale.
- 6950- 6960 Shale: medium to dark gray, smooth texture, platy; siltstone, grading to a fine grained Sandstone: brownish-gray, quartz and chert grains, subangular, well sorted, fairly well consolidated, argillaceous, greenish-yellow fluorescence, 30%.
- 6960- 6970 As above; siltstone, 30%; trace of sandstone; rare calcite.
- 6970- 6980 Shale: 60%, medium to dark gray, fissile, in part silty; Siltstone: 30%, brownish-gray, argillaceous, with yellowish-green fluorescence; Sandstone: 10%, gray, "salt and pepper", fine grained.
- 6980- 7010 Shale: as above, but more silty; Siltstone: as above, but harder, greenish-yellow fluorescence; trace of dense, hard Sandstone.
- 7010- 7022 Siltstone: as above, grading into a fine grained sandstone, with increased yellowish-green fluorescence; trace of hard sandstone, no shows; Shale: as above, mostly dark gray, fissile.
- 7022-7052 Core No. 1 - Cut 30', Recovered 13.6'
- 7022.0- 7035.6' Shale: dark gray, slightly rough  
(13.6') texture, irregular fracture, micromicaceous, in part silty, in part

fissile; siltstone grading to a fine grained sandstone, gray to brownish-gray, quartz and chert grains, subangular, well sorted, well consolidated, slightly calcareous matrix; occurring as rare, very thin irregular bands and thin lenses lying in the bedding planes; the siltstone and sandstone has a bright yellow fluorescence which appears to be mainly concentrated along fracture planes; the core dips at an angle of approximately 12° and exhibits some crossbedding.

7035.6- 7052.0' No recovery.  
(16.4')

- 7052- 7060 Shale: dark gray, rough texture, irregular fracture, in part silty, and Shale: medium gray, rough texture, silty; Siltstone, grading to a very fine grained Sandstone: "salt and pepper", quartz and chert grains, fine, subangular, well sorted, well consolidated, slightly calcareous matrix; some of the quartz grains are light brown, yellowish-green fluorescence, poor porosity; trace of black chert pebbles.
- 7060- 7070 Shale: medium gray, silty, with minor dark gray, smoother texture, platy to fissile; Siltstone: as above, grading to a fine grained Sandstone: "salt and pepper", mainly quartz, clear to light brown, with scattered chert grains and rare, widely scattered siderite grains; trace of pyrite and pyritized worm casts; the sandstone is 15%.
- 7070- 7080 Shale: medium to dark gray, blocky to platy, in part silty; Sandstone: gray, "salt and pepper", calcareous matrix, in part argillaceous, with poor porosity and a yellowish-green fluorescence, 35%.
- 7080- 7090 Shale: as above; Siltstone, grading to a Sandstone, in part much more argillaceous, poor porosity, greenish-yellow fluorescence, 40%.
- 7090- 7100 Shale: as above; the darker gray shale has a smoother texture and is less silty; slight increase in sandstone and fluorescence, 45%; trace of pyrite and calcite; some quartz sandstone with a light green stain.
- 7100- 7110 Shale: as above; Sandstone: as above, in general finer, with fluorescence, as above; trace of bentonite; scattered pyrite.

- 7110- 7120 Shale: as above; increased dark gray Shale: smooth texture, platy to fissile; Sandstone: as above, with yellowish-green fluorescence, 35%; small amount of gray, argillaceous siltstone; trace of bentonite and calcite.
- 7120- 7130 Shale: as above, dark to medium gray, with some brownish-gray; small amount of siltstone; Sandstone: as above, with fluorescence, some carbonaceous banding and streaks, 40%; trace of bentonite; single glauconite grain seen in the sandstone.
- 7130- 7140 Sandstone: gray and brownish-gray, "salt and pepper", quartz and chert grains, fine grained, subangular, well sorted, well consolidated, slightly calcareous matrix, in part slightly friable, with rare scattered kaolinitic infilling, greenish-yellow fluorescence, 60%; Shale: gray to dark gray, in part slightly silty, platy to fissile; small amount of lighter gray shale.
- 7140- 7150 Sandstone: as above, but in general finer, more argillaceous; increased siltstone; sandstone and siltstone, with 50% fluorescence, as above; Shale: as above, but less silty; trace of bentonite.
- 7150- 7160 Sandstone: as above, more argillaceous, in part more friable, with greenish-yellow fluorescence, 60%; Shale: as above, in general darker; the shale is micromicaceous; trace of marcasite.
- 7160- 7170 Sandstone: as above, but coarser and with brighter yellow fluorescence, 60%; there is some evidence of very fine fracture porosity with some pyrobitumen in the fractures; Shale: as above.
- 7170- 7180 Sandstone: as above, 50%; Shale: as above.
- 7180- 7190 Sandstone: as above, fine to medium grained, slightly friable, with a trace of patchy, kaolinitic infilling; trace of finely disseminated pyrite in the matrix and rare siderite grains in the sandstone; the fluorescence is a brighter yellow with some patchy yellowish-green; sandstone, 80%; Shale: as above.
- 7190- 7200 Sandstone: as above, slightly more friable, 85%; trace of heavy, residual oil in minute fractures; fluorescence, as above, and a streaming cut; Shale: as above.
- 7200- 7207 Sandstone: "salt and pepper", quartz and chert grains, with very rare glauconite, fine to medium grained, subangular, poorly sorted, well consolidated, calcareous matrix, poor porosity, yellowish-green fluorescence, with rare pyrobitumen in minute fractures; Shale: as above.

- 7207- 7210 Shale: gray and brownish-gray to dark gray; trace of light gray, bentonitic shale; Sandstone: as above, brownish-gray and gray, with greenish-yellow fluorescence.
- 7210- 7220 Shale: medium to dark gray and brownish-gray, rough texture, irregular fracture, slightly silty; small amount of Siltstone: gray, "salt and pepper", argillaceous; small amount of Sandstone: "salt and pepper", quartz and chert grains, very fine to medium grained, subangular, poorly sorted, well consolidated, slightly calcareous, with a greenish-yellow fluorescence; some carbonaceous streaks in the sandstone; in part has a high percentage of chert grains; trace of weathered glauconite in the sandstone.
- 7220- 7230 Shale: as above, soft; Siltstone: as above; increased sandstone, in part slightly friable, 20%; trace of quartz sandstone, with a green staining; trace of marcasite and glauconite; increased fluorescence.
- 7230- 7240 Shale: medium to dark gray, blocky to platy, silty; Sandstone: as above, in part fine grained and well sorted, in part fine to medium grained and poorly sorted, with carbonaceous streaks; rare traces of a light green mineral in the sandstone; sandstone appears tight, but has a uniform, greenish-yellow fluorescence; in part the sandstone is very calcareous; sandstone, 35%; trace of Shale: gray, bentonitic, slightly calcareous; trace of very limy siltstone; scattered marcasite.
- 7240- 7245 Shale: as above; shale is slightly calcareous; some black chert nodules; scattered marcasite; trace of lateritic siltstone.
- 7245- 7250 Shale: medium to dark gray, blocky to platy, silty; Sandstone: "salt and pepper", quartz and chert grains, fine grained, subangular, fairly well sorted, well consolidated, calcareous matrix, greenish-yellow fluorescence, in part with parallel coaly streaks; trace of Limestone: white, finely crystalline, finely brecciated and recemented, a calcarenite; some calcite; trace of milky quartz with chlorite in minute fractures.
- 7250- 7260 Shale: medium to dark gray, platy, less silty; Sandstone: as above, gray, argillaceous, with yellowish-green fluorescence, 40%; trace of marcasite.
- 7260- 7270 Shale: medium to dark gray, in part slightly silty; Sandstone: as above, with increased mafic minerals, in part slightly argillaceous, with greenish fluorescence; trace of black chert nodules.

- 7270- 7280 Shale: medium to dark gray and brownish-gray, silty, blocky; reduced Sandstone: less well consolidated, with increased mafic minerals, very slightly calcareous, argillaceous, 5%; trace of siltstone.
- 7280- 7289 Shale: light to medium gray, with minor dark gray, less silty, blocky; some argillaceous Sandstone: as above; trace of Sandstone conglomerate: mainly rounded chert grains in a sideritic matrix, with a trace of glauconite grains, fine to coarse grained, poorly sorted, tight; some subrounded to round, frosted quartz nodules; trace of black chert nodules; some coarse, rounded, clear quartz grains; scattered subrounded glauconite grains.
- 7289- 7292 Siderite and sideritic siltstone, 35%; some of the siderite has rounded chert inclusions; Shale: as above, with increased darker gray, shale; small amount of Sandstone: gray, "salt and pepper", quartz and chert grains, fine grained, subangular, well sorted, well consolidated, with a light green fluorescence and a whitish-yellow cut; small amount of rounded, frosted quartz and dark chert nodules; trace of limestone, finely brecciated and recemented, a calcarenite with chert inclusions; trace of marcasite; some loose quartz and siderite sand.
- 7292- 7300 Siderite and sideritic siltstone, in part with rounded quartz and chert grains and very rare glauconite grains, 20%; Shale: light gray to gray, with minor dark gray; Sandstone: gray, "salt and pepper", as above, with a pale greenish-yellow fluorescence, 3%; reduced chert nodules; trace of Limestone: light brown, cryptocrystalline, finely brecciated and recemented, a calcarenite, with a high silica content.
- 7300- 7310 Shale: medium to dark gray, platy, in part slightly silty, 30%; reduced siderite, 15%; Sandstone: light brownish-gray, "salt and pepper", poor porosity, greenish-yellow fluorescence, streaming cut; trace of Sandstone: gray, "salt and pepper", tight; small amount of "salt and pepper" siltstone; trace of chert nodules.
- 7310- 7315 Shale: medium to dark gray, blocky to platy, in part slightly silty; small amount of Sandstone: dark gray, "salt and pepper", quartz and chert grains, friable, with a green fluorescence; trace of sandstone, clear quartz and glauconite grains in a dark, brownish-gray matrix, fine to medium grained, subrounded, poorly sorted, well consolidated, noncalcareous; scattered siderite; trace of light gray Limestone: cryptocrystalline, a calcarenite, finely brecciated and recemented; rare black chert nodules.

- 7315- 7320 Shale: medium to dark gray, blocky to platy, in part silty; small amount of Siltstone: dark gray, argillaceous; trace of Sandstone: gray, "salt and pepper", as above, with very rare greenish fluorescence; some sandstone, with rounded Quartz grains: as above; trace of chert conglomerate; minor brown, sideritic siltstone; trace of siderite; scattered black chert pebbles.
- 7320- 7330 Shale: gray and brownish-gray to dark gray, rough texture, mainly blocky, in part silty; small amount of Sandstone: dark gray, "salt and pepper", quartz and chert grains, fine grained, subangular, poorly sorted, well consolidated, very slightly calcareous, with scattered faint green fluorescence; trace of quartz sandstone with some chlorite inclusions; some argillaceous siltstone; scattered fine, loose, rounded quartz grains.
- 7330- 7340 Shale: as above, blocky to platy; the dark gray shale is less silty; increased siderite and sideritic siltstone; trace of Sandstone: as above, with green fluorescence; trace of claystone; scattered black chert nodules.
- 7340- 7350 Shale: as above; siderite, 3%; trace of sandstone and clay ironstone; scattered black chert nodules.
- 7350- 7360 Shale: light gray to gray, blocky to platy, in part micromicaceous, in part silty; small amount of siderite; small amount of sandstone.
- 7360- 7370 Shale: medium to dark gray and dark brownish-gray, rough texture, in part silty; the dark gray and dark brownish-gray shales have a fair yellowish-white cut fluorescence; small amount of argillaceous, "salt and pepper" sandstone, with a greenish fluorescence; minor amount of siderite; trace of light gray, bentonitic shale; scattered marcasite; trace of bentonite.
- 7370- 7380 Shale: as above; increased brown to dark brown, silty shale; trace of argillaceous siltstone; some gray, fluorescent sandstone; trace of coarse, clear quartz sandstone, with glauconite grains; scattered subrounded glauconite nodules; trace of brecciated limestone; rare minute limestone cylinders, possible crinoids; scattered marcasite and milky chert.
- 7380- 7390 Shale: medium to dark gray and brownish-gray, rough texture, blocky to platy, in part grading to an argillaceous siltstone; trace of lighter gray, "salt and pepper" siltstone; siltstone, 20%; the brown siltstone has a slight cut fluorescence; scattered marcasite; trace of black chert nodules.

- 7390- 7400 Siderite and sideritic siltstone, 40%; Shale: medium to dark gray and dark brownish-gray, in part micromicaceous, in part silty; trace of claystone, in part marly; minor Siltstone: "salt and pepper", argillaceous; trace of "salt and pepper" sandstone with some phlogopite; trace of chert conglomerate; scattered pyrite and black chert nodules.
- 7400- 7410 Siderite and sideritic siltstone, 40%; Shale: medium to dark gray, in part silty; trace of "salt and pepper" sandstone; scattered marcasite and pyrite.
- 7410- 7420 Siderite and sideritic siltstone, 55%; Shale: medium to dark gray and brownish-gray, rough texture, blocky to platy; trace of quartz conglomerate, with a pyritic matrix; scattered pyrite and marcasite; trace of Inoceramus prisms with attached marcasite.
- 7420- 7430 Siderite and sideritic siltstone, 30%; Shale, increasingly darker gray, in part soft; trace of Sandstone: gray, "salt and pepper", soft; rare marcasite.
- 7430- 7440 As above; trace of marcasite; scattered black chert nodules.
- 7440- 7450 Siderite and sideritic siltstone, 60%; Shale: medium to dark gray, blocky to platy, in part slightly silty; trace of Sandstone: "salt and pepper", fine grained, subangular, well sorted, well consolidated, noncalcareous; some marcasite and pyrite; rare calcite; trace of Inoceramus prisms.
- 7450- 7460 Siderite and sideritic siltstone, 60%; Shale: gray to dark gray and dark brownish-gray; trace of Siltstone: "salt and pepper", argillaceous; minor Sandstone: "salt and pepper", with some mafic minerals and rare glauconite grains, poorly sorted; trace of smoky chert; scattered marcasite.
- 7460- 7470 Siderite and sideritic siltstone; small amount of Shale: gray to dark gray, smoother texture; trace of dark green shale with a waxy luster; rare Limestone: light gray, cryptocrystalline, finely brecciated and recemented, a calcarenite; increased marcasite; some Inoceramus prisms.
- 7470- 7480 Sideritic siltstone, 90%; Shale: gray to dark gray and dark brown, in part silty; trace of limestone; scattered marcasite; some Inoceramus prisms; rare gastropods replaced by marcasite.

- 7480- 7490 Siltstone: sideritic, 90%; Shale: gray and dark brown, with a trace of very dark brownish-gray; trace of glauconite grains in a limy matrix; some calcite; scattered pyrite; rare gastropods replaced by marcasite.
- 7490- 7500 As above; trace of siderite; minor sandstone; some marcasite; scattered Inoceramus prisms.
- 7500- 7510 As above; trace of marcasite; no Inoceramus prisms; the siltstone grades to a fine grained sandstone.
- 7510- 7520 Siltstone: brown, "salt and pepper", quartz, chert and siderite grains, with rare glauconite grains, grading to a fine grained sandstone; some gray, "salt and pepper" siltstone; trace of Sandstone: "salt and pepper", with some glauconite grains; trace of Inoceramus prisms; scattered pyritized worm casts; trace of a columnar type coral, possible favosites.
- 7520- 7530 Siltstone: as above, but lighter tan in color; Shale: gray with minor dark gray, and Shale: dark brownish-gray, rough texture, in part platy, silty; trace of a dark brown material having almost the appearance of a volcanic with amygdaloidal cavities.
- 7530- 7540 Shale: light brown to brown, in part silty, sideritic, grading to a sideritic siltstone; Shale: dark gray, with minor light gray, in part silty; minor "salt and pepper" sandstone; trace of claystone; rare calcite; scattered pyrite and siderite.
- 7540- 7550 Shale: as above; increasing medium to dark gray shale; trace of Limestone: dense, massive, light gray to gray; some Limestone: brown to dark brown, cryptocrystalline, finely brecciated and recemented, a calcarenite, argillaceous; scattered marcasite.
- 7550- 7570 Shale: medium to dark gray, in part silty, 65%; Shale: dark brownish-gray, sideritic.
- 7570- 7580 Shale: medium to dark gray, and Shale: light brown to dark brown, in part silty; some brown siltstone; trace of Sandstone: "salt and pepper", with some phlogopite inclusions; trace of calcite; scattered marcasite.
- 7580- 7590 Shale: medium to dark gray and brownish-gray, some dark brownish-gray, with rough texture, irregular fracture, silty, with a yellowish-white cut fluorescence; trace of Sandstone: brownish-gray, "salt and pepper", with a green fluorescence; rare pyrite.

- 7590- 7600 Shale: medium to dark gray, in part silty; Siltstone: light brown to brown, sideritic, argillaceous, 40%; trace of calcite; scattered Inoceramus prisms.
- 7600- 7610 Siltstone: sideritic, soft, 15%; Shale: medium to dark gray and dark brownish-gray, in part platy, in part silty; small amount of gray, "salt and pepper" siltstone; small amount of "salt and pepper" sandstone; trace of Inoceramus prisms.
- 7610- 7620 Shale: gray, rough texture, irregular fracture, calcareous, bentonitic, very silty, almost a siltstone, soft, 55%; Shale: light brown, rough texture, sideritic, bentonitic, very silty, soft; trace of gray, "salt and pepper" sandstone; scattered marcasite and siderite.
- 7620- 7630 Shale: gray and light brown, as above, very silty; trace of siderite and marcasite; rare brachiopod casts replaced by marcasite.
- 7630- 7640 Shale: grading to a Siltstone: light brown to brown, sideritic, 60%; partly light gray, bentonitic, and medium gray, in part silty, soft; trace of marcasite.
- 7640- 7650 Shale: brown, silty, as above, but with some darker brown, in general firmer; Shale: gray to dark gray, 10%; trace of marcasite.
- 7650- 7660 Shale: brown to gray, grading to a siltstone, in part firmer; the dark brown siltstone has a light brown streak; trace of Sandstone: light gray, "salt and pepper", fine grained, subangular, well sorted, well consolidated, tight, occurring in thin bands; some Shale: gray, scaly, hard; scattered marcasite; trace of bentonite.
- 7660- 7670 Shale: light brown to dark brown, grading into a Siltstone: argillaceous, in part slightly bentonitic; Shale: gray to dark gray, 15%; trace of white quartz sandstone; rare claystone; scattered marcasite and black chert pebbles.
- 7670- 7680 Shale: as above; gray, silty, 10%; trace of marcasite, possibly replacing a bryozoa.
- 7680- 7690 Shale: brown, sideritic, silty; Shale: gray to dark gray, silty, 15%; trace of fine grained, "salt and pepper" sandstone; rare marcasite; scattered brachiopods.
- 7690- 7700 Shale: as above, brown to dark brown, in general less silty; Shale: gray to dark gray, 20%; trace of marcasite; the brown shale has a faint cut fluorescence.

- 7700- 7710 Shale: as above; gray, 30%; trace of marcasite; minor calcite.
- 7710- 7720 Shale: brown, soft, sideritic, grading to a very fine, sideritic siltstone, blocky, with a faint cut fluorescence; Shale: gray to dark gray, less silty than above, 40%.
- 7720- 7730 As above; trace of Sandstone: gray, "salt and pepper"; quartz and chert grains, fine grained, subangular, well sorted, well consolidated, slightly calcareous, slightly friable, pale yellow fluorescence, whitish-yellow cut fluorescence.
- 7730- 7740 As above; trace of gray, "salt and pepper" Sandstone: very fine grained.
- 7740- 7750 Shale: light brown to dark brown, silty, in part platy; Shale: gray to dark gray, in part slightly silty, blocky; trace of Limestone: light to dark gray, cryptocrystalline, finely brecciated and recemented, a calcarenite.
- 7750- 7760 Shale: brown, in part silty, with a faint yellowish-white cut fluorescence; Shale: gray, in part silty; Sandstone: "salt and pepper", fine to medium grained, subrounded, poorly sorted, well consolidated, light green fluorescence; trace of pyrite and pyritized worm casts.
- 7760- 7770 Shale: brown, firm, nonsilty, grading to very silty and to a siltstone and fine grained sandstone; quartz grains; sideritic, with increased yellowish-white cut fluorescence; trace of gray to dark gray shale, in part silty; scattered marcasite and pyritized wood fragments.
- 7770- 7780 Shale: brown, sideritic, as above, with yellowish-white cut fluorescence, in general lighter, less silty; Shale: gray to dark gray, in part silty; trace of Sandstone: "salt and pepper", poorly sorted; some Limestone: white to dark gray, cryptocrystalline, a calcarenite; trace of finely crystalline pyrite.
- 7780- 7790 Shale: as above, brown to dark brown, sideritic; Shale: gray to dark gray, 5%; small amount of marcasite; trace of pyrite; reduced fluorescence in the brown shale.
- 7790- 7800 Shale: sideritic, as above, with a yellowish-white cut fluorescence; increased gray shale, 30%; trace of Sandstone: gray, "salt and pepper", argillaceous; minor Limestone: white and dark brownish-gray, subtranslucent fragments; trace of pyrite and marcasite.

- 7800- 7810 Shale: sideritic, as above, in general less silty, with less fluorescence; Shale: lighter gray to dark gray, in part silty; trace of marcasite.
- 7810- 7820 Shale: as above; the sideritic shale is darker with more brownish-gray; Shale: predominantly dark gray with reduced gray; trace of marcasite.
- 7820- 7830 Shale: brown to dark brownish-gray, blocky, sideritic, in part silty; faint cut fluorescence in the brown shale; trace of claystone; scattered marcasite and magnetite.
- 7830- 7840 Shale: brown to dark brownish-gray, firm, sideritic, bentonitic, in part silty, with a yellowish-white cut fluorescence; Shale: gray to dark gray, in part silty, 25%; trace of gray, "salt and pepper" siltstone; some limestone breccia, with finely crystalline pyrite outlining the fragments.
- 7840- 7850 Shale: as above, but soft, more bentonitic; trace of selenite with pyrite on the crystal boundaries; minor Calcilutite: subtranslucent, with a high silica content; some gray shale.
- 7850- 7860 Shale: brown, as above; Shale: gray to dark gray, 5%; Siltstone: gray, "salt and pepper", grading to a fine grained sandstone, in part with considerable mafic minerals.
- 7860- 7870 Shale: brown, sideritic, in part silty, with a yellowish-white fluorescence when cut with chloroethane; Shale: gray to dark gray, 10%; marcasite, 2%; trace of siltstone, appears tuffaceous.
- 7870- 7880 Shale: brown to dark brown, sideritic, in part silty, with faint yellowish-white cut fluorescence; Shale: gray, 30%; trace of dark gray limestone, a calcilutite associated with finely disseminated pyrite.
- 7880- 7900 Shale: brown, as above, in general lighter; gray shale, 5%; small amount of marcasite and pyrite; trace of calcite.
- 7900- 7910 Shale: as above; in general the brown shale is more platy; Shale: mostly gray, blocky, 20%.
- 7910- 7920 Shale: as above, brown to dark brown, sideritic, in part silty; Shale: gray to dark gray, in part silty, 10%; trace of Calcilutite: mottled; trace of gray, "salt and pepper" siltstone; scattered pyrite and marcasite.

- 7920- 7930 Shale: brown to dark brownish-gray, sideritic, with a faint cut fluorescence; the darker shale is more silty; Shale: gray to dark gray, in part silty, 50%; trace of argillaceous Sandstone: fine grained, subangular; rare worm casts, in part pyritized.
- 7930- 7940 Shale: predominantly dark brown, with a lighter brown streak, firm, very slightly sideritic, faint yellowish-white cut fluorescence; Shale: gray, soft, bentonitic; trace of marcasite.
- 7940- 7950 Shale: as above; gray shale, 5%; trace of sandstone, mainly quartz grains: fine to medium, subrounded, poorly sorted, well consolidated, siliceous matrix; trace of marcasite.
- 7950- 7960 Shale: in general lighter brown, in part slightly silty, sideritic; Shale: gray, with minor dark gray, soft, bentonitic, 15%; trace of gray, "salt and pepper" siltstone; scattered marcasite.
- 7960- 7970 Shale: brown, as above, more platy; increased gray, 50%; some gray, argillaceous siltstone; trace of Tuff: dark gray with fine, rounded quartz grain inclusions; rare calcite; scattered phosphatic pellets.
- 7970- 7980 Shale: dark gray, with minor gray, slightly calcareous, in part silty, 80%; Shale: brown to dark brown, smoother texture, less silty, slightly sideritic; trace of Limestone: dark brown, subtranslucent, cryptocrystalline, a calcilutite.
- 7980- 7990 Shale: increased brown, in part much lighter, siltier, more sideritic, 40%; Shale: gray, rough texture, silty, and Shale: dark gray, smoother texture, less silty, calcareous; trace of Limestone: as above.
- 7990- 7995 Shale: brown, as above, 55%; Shale: gray to dark gray; some dark gray, silty shale inclusions in the brown shale; trace of Limestone: finely brecciated, dark brown to light reddish-brown, subtranslucent; appears to have been formed in a deep basin environment then subjected to a disturbance; trace of calcite.
- 7995- 8010 Shale: smoother texture, more platy, slightly sideritic, faint cut fluorescence; Shale: gray to dark gray, blocky, in part micromicaceous, calcareous, 10%.
- 8010- 8020 Shale: brown, as above, in part silty, grading to a fine siltstone, with a faint cut fluorescence; Shale: gray, soft, in part bentonitic, and Shale: medium to dark

- gray, harder, in part silty, grading to a siltstone; one piece of siltstone was bleeding gas, with a faint cut fluorescence; trace of pyritized wood.
- 8020- 8030 Shale: brown, as above, more platy, less silty, less sideritic, with a light brown streak; Shale: gray to dark gray, in part silty; the lighter gray shale is bentonitic; trace of Siltstone: gray, "salt and pepper", hard, calcareous; increased marcasite; marcasite replacement of a cup coral.
- 8030- 8040 Shale: as above; brown shale grades into a siltstone; gray shale, 30%; Siltstone: gray, "salt and pepper", hard, as above, with what looks like very fine phosphatic pellets as inclusions; small pods of gray, silty shale in the brown, silty shale; trace of marcasite.
- 8040- 8050 Shale: brown and gray, 50-50%; trace of marcasite.
- 8050- 8060 Shale: brown, as above; rare, fine pyrite inclusions; Shale: gray, as above, 30%; trace of lighter gray, bentonitic shale; trace of fine grained, "salt and pepper" sandstone, with rare siderite grains; scattered pyrite and pyritized worm casts.
- 8060- 8070 Shale: as above, brown, darker in general; gray shale reduced to 15%; trace of fine, "salt and pepper" sandstone; rare pyrite.
- 8070- 8080 Shale: brown, as above, less silty, firmer; gray shale, 5%; trace of Siltstone: gray, "salt and pepper", argillaceous; rare bentonite; scattered pyrite and marcasite.
- 8080- 8090 Shale: light brown to brown, as above, in part silty, with faint yellowish-white cut fluorescence; Shale: gray to dark gray, 5%; trace of light gray, bentonitic shale; some fine grained, "salt and pepper" sandstone, with rare siderite grains; increased marcasite; trace of pyrite.
- 8090- 8100 Shale: as above; the brown shale is darker in general; dark gray shale, 5%; trace of quartz conglomerate, with finely disseminated pyrite in the matrix; scattered pyrite and marcasite.
- 8100- 8110 Shale: brown and brownish-gray to dark brown, rough texture, blocky, slightly sideritic; Shale: gray, blocky, calcareous, in part bentonitic, 5%; trace of calcite.
- 8110- 8120 Shale: brown, as above; siderite, 5%; gray shale, 15%; trace of Limestone: finely brecciated and recemented, a calcarenite; increased marcasite; rare pyrite.

- 8120- 8130 Shale: brown to dark brown, with minor light brown, rough texture, in part silty, slight cut fluorescence, sideritic, in part bentonitic; Shale: gray, in part silty, 5%; some dark gray, carbonaceous shale; trace of Sandstone: white, "salt and pepper", quartz and Chert grains: fine, subangular, well sorted, well consolidated, tight; trace of marcasite; scattered black chert nodules.
- 8130- 8140 Shale: brown to dark brown, as above; reduced gray shale; trace of light green Shale: rough texture; some Sandstone: "salt and pepper", in part dark gray, more argillaceous, poorly sorted, very well consolidated; small amount of marcasite; trace of dark lutite.
- 8140- 8150 Shale: brown to dark brownish-gray, silty, very slightly sideritic; small amount of gray to dark gray, micromicaceous, in part platy; trace of dark calcilutite; scattered marcasite.
- 8150- 8160 Shale: brown and silty to dark brown, less silty, very slightly sideritic; Shale: gray, silty to dark gray, smoother texture, less silty; trace of Sandstone: "salt and pepper", tight, occurring in thin, alternating, light and dark bands; scattered marcasite and pyrite.
- 8160- 8170 Shale: as above, brown to dark brownish-gray, grading to a siltstone; Shale: gray to dark gray, in part silty, 25%; trace of Limestone: white to dark brown, mottled, cryptocrystalline, finely brecciated and recemented, a calcarenite; rare marcasite.
- 8170- 8180 Shale: silty, as above; gray shale, 10%.
- 8180- 8190 Shale: brown, as above, grading to a brown siltstone; Shale: gray to dark gray, soft, bentonitic, calcareous, 5%; trace of dark gray, carbonaceous shale; scattered marcasite.
- 8190- 8200 Shale: brown to dark brown, hard, in part silty; Shale: gray to dark gray, soft, bentonitic, silty in part, 10%; small amount of Sandstone: light brown, patchy, "salt and pepper", quartz and chert grains: fine grained, subangular, poorly sorted, indurated, calcareous matrix, faint yellowish-white cut fluorescence; trace of marcasite.
- 8200- 8210 Shale: brown, with reduced darker brown, very slightly sideritic, in part silty, grading to a fine siltstone; increased Shale: gray, as above, 35%; some gray, argillaceous siltstone; trace of tight Sandstone: as above, in part with some mafic minerals, faint cut fluorescence when crushed; scattered pyrite.

- 8210- 8220 Shale: as above; gray shale, 10%; trace of Sandstone: as above.
- 8220- 8230 Shale: brown to dark brown, firmer, very slightly sideritic, in part silty; Shale: gray to dark gray, in part silty, 15%; trace of Sandstone: as above; scattered marcasite and pyrite; trace of calcite.
- 8230- 8240 Shale: brown, as above, with increased darker brownish-gray; Shale: gray to dark gray, 15%; slight increase in Sandstone: dark gray, with some mafic minerals.
- 8240- 8250 Shale: brown, mostly dark, smoother texture, platy; Shale: gray, soft, in part platy, in part silty, 35%; trace of marcasite; some Glauconite: fine, rounded grains, in a pyritic matrix; rare loose glauconite grains.
- 8250- 8260 Shale: as above; gray shale, 40%; trace of marcasite and finely crystalline pyrite, with some fine, rounded glauconite grains included.
- 8260- 8270 Shale: reduced brownish-gray, 40%; Shale: gray to dark gray, blocky to platy; trace of soft, gray shale, with glauconite grain inclusions, noncalcareous; some finely crystalline pyrite, with glauconite inclusions; trace of a dark gray, tuffaceous material.
- 8270- 8280 Shale: gray, rough texture, in part fissile, in part silty, noncalcareous; small amount of darker gray Shale: smoother texture, platy, firmer; Shale: brown to dark brown, smoother texture, platy, 40%; trace of Limestone: white, dense, massive, occurring as thin bands in the shale; some Siltstone: light gray, hard, noncalcareous, slightly argillaceous; trace of pyrite, in part associated with some dark chert; rare marcasite.
- 8280- 8290 Shale: medium to dark gray, blocky to platy, noncalcareous; small amount of brown to dark brown; some Sandstone: "salt and pepper", dense, hard; trace of bentonite; scattered marcasite; trace of gray, argillaceous limestone; minor dark gray shale, with some glauconite inclusions.
- 8290- 8300 Shale: brown to dark brown, platy, with minor light brown, soft, bentonitic shale; brown shale grades to a very fine grained sandstone, mainly quartz with scattered chert grains, subangular, well sorted, fairly well consolidated, poor porosity and permeability, bleeding a small amount of gas; Shale: gray to dark gray, with some light gray, soft, bentonitic, in part silty; rare marcasite; trace of Inoceramus prisms.

- 8300- 8310 Shale: brown to darker brown, platy to fissile, 40%, grading to a siltstone and very fine grained sandstone; sandstone is argillaceous, with poor porosity; Shale: light gray to gray and dark gray; the dark shale has a smoother texture; small amount of Siltstone: gray, "salt and pepper"; trace of finely crystalline pyrite, glauconite inclusions; scattered Inoceramus prisms.
- 8310- 8320 Shale: brown to dark brown, rough texture, blocky to platy, in part silty, 70%, grading to a very fine siltstone; Shale: gray, rough texture, silty to dark gray, smoother texture, platy; trace of Sandstone: "salt and pepper", quartz and chert with scattered mafic minerals, fine grained, subangular, well sorted, well consolidated, slightly calcareous; trace of a conglomerate containing marcasite nodules and some calcite; some light brown sandstone; scattered marcasite and pyrite.
- 8320- 8330 Shale: brown and gray, as above, more fissile, 50-50; small amount of brown siltstone; trace of gray siltstone; some gray, "salt and pepper" sandstone; trace of white, chalky limestone; scattered marcasite and pyritized worm casts.
- 8330- 8340 Shale: as above, brown, 45%; trace of brown siltstone; minor very fine grained, "salt and pepper" sandstone; trace of marcasite, in part with glauconite grain inclusions.
- 8340- 8350 Shale: as above, in general darker brown and darker gray, more fissile; trace of siltstone and sandstone; rare calcite.
- 8350- 8360 Shale: gray to dark gray, in part silty; trace of light gray, paper shale, with some small, dark patches (possibly from up the hole); reduced brown shale and brown siltstone, 15%; scattered pyrite associated with rounded glauconite grains; trace of gray, "salt and pepper" siltstone and sandstone.
- 8360- 8370 Shale: medium to dark gray, in part with a brownish cast, platy to fissile; trace of gray shale, with rounded glauconite inclusions; some dark gray, carbonaceous shale; trace of dark gray Limestone: cryptocrystalline, finely brecciated and recemented.
- 8370- 8380 Shale: as above; small amount of brown shale and a trace of brown siltstone; increased gray shale, with glauconite inclusions, noncalcareous; trace of marcasite.
- 8380- 8390 Shale: as above, mostly dark brownish-gray, platy; slight increase in light gray shale, with dark gray spots;

trace of Sandstone: "salt and pepper", clear quartz with scattered chert grains, fine grained, subangular, poorly sorted, well consolidated, siliceous matrix, no shows, very rare glauconite grains, trace of dark brownish-gray shale with scattered glauconite grains; scattered pyrite and pyritized worm casts.

- 8390- 8400 Shale: as above, dark gray and dark brownish-gray, platy to fissile; trace of gray, "salt and pepper" sandstone, in part with some mafic minerals; scattered marcasite and pyrite; trace of calcite.
- 8400- 8410 Shale: gray to dark gray, platy, in part silty; trace of pyrite and marcasite; some clear quartz nodules, abundant cavings.
- 8410- 8420 Shale: gray and brownish-gray to dark gray and dark brownish-gray; in general the dark shale is less silty, with a smoother texture; shale is micromicaceous, platy; trace of glauconite grains in a green shale; scattered marcasite.
- 8420- 8430 Shale: as above, gray to dark gray, in part with a brownish tinge, rough texture, blocky to platy, faint brown fluorescence and a faint whitish-yellow cut fluorescence.
- 8430- 8440 Shale: as above; some dark, carbonaceous specks in the dark gray shale.
- 8440- 8450 Shale: gray, rough texture, platy, silty, with minor dark gray shale; faint cut fluorescence.
- 8450- 8460 Shale: as above; gray shale is softer, more silty; dark gray shale is more fissile, in part micromicaceous; faint brown fluorescence, faint cut fluorescence.
- 8460- 8470 Shale: silty, gray, as above, and smoother, dark gray shale, platy to fissile.
- 8470- 8480 Shale: gray to brownish-gray, rough texture, platy, silty, faint brown fluorescence, faint cut fluorescence; there appears to be irregular, siltier lenses in the shale; trace of carbonaceous streaks and specks in the shale.
- 8480- 8490 Shale: as above, but more fissile.
- 8490- 8500 Shale: as above; in part the gray shale has some glauconite grain inclusions; trace of bentonite.

- 8500- 8510 Gray Shale: as above, with less of a brown tinge; some carbonaceous streaks; trace of dark gray shale; trace of bentonite.
- 8510- 8520 Shale: as above, blocky to platy, with a faint brown fluorescence and faint cut fluorescence.
- 8520- 8530 Shale: as above, but more silty in part; rare, scattered glauconite grains and some dark, carbonaceous specks in the shale; a piece of very argillaceous siltstone, bleeding gas.
- 8530- 8540 Shale: as above, more silty, grading to a fine siltstone; trace of siltstone, with a streaming brown cut; in part the shale contains glauconite grain inclusions; trace of conglomerate with quartz and chert grains in a pyrite matrix; scattered Inoceramus prisms.
- 8540- 8550 Shale: silty, brownish-gray, as above, with fluorescence and cut fluorescence, as above.
- 8550- 8560 Shale: silty, grading to a fine siltstone, with fluorescence, as above; trace of glauconite grains in the silty shale; small amount of darker gray shale.
- 8560- 8570 Shale: as above; increased darker gray, more fissile, 15%.
- 8570- 8580 Shale: gray, silty, with fluorescence, as above, in part with rare, scattered glauconite grains; small amount of fissile, dark gray shale.
- 8580- 8590 Shale: as above, more dark, brownish-gray, more fissile; trace of dark gray siltstone.
- 8590- 8600 Shale: as above, darker gray and brownish-gray, fissile, still with a faint cut fluorescence.
- 8600- 8610 Shale: medium to dark gray, blocky to fissile, silty; small amount of Siltstone: light brownish-gray, "salt and pepper", argillaceous.
- 8610- 8630 Shale: brownish-gray, platy to fissile, silty, faint brown fluorescence, faint cut fluorescence; trace of dark gray, fissile shale, smoother texture.
- 8630- 8640 Shale: dark brownish-gray, blocky to fissile, in part silty, faint yellowish-white cut fluorescence; trace of light brown, silty shale; trace of calcite; abundant cavings.
- 8640- 8650 Shale: as above, but dark gray, in part silty; trace of pyrite.

- 8650- 8660 Shale: as above; trace of very fine grained, "salt and pepper" sandstone, with some carbonaceous streaks.
- 8660- 8670 Shale: as above; small amount of brownish-gray, silty, grading to a fine siltstone; trace of silty, gray shale, with rare glauconite grain inclusions.
- 8670- 8680 Shale: dark brownish-gray, blocky to platy, in part silty; rare, scattered glauconite grain inclusions; rare carbonaceous streaks; trace of dark gray, carbonaceous shale.
- 8680- 8690 Shale: as above; small amount of gray, argillaceous siltstone; increased dark gray, fissile shale; trace of marcasite.
- 8690- 8700 Shale: brownish-gray, as above, siltier, grading to a fine, argillaceous siltstone; trace of dark gray shale.
- 8700- 8710 Shale: gray, silty, grading to an argillaceous siltstone; trace of glauconite grains.
- 8710- 8720 Shale: dark brownish-gray; Siltstone: dark brownish-gray, argillaceous, with rare glauconite grains, faint cut fluorescence when crushed.
- 8720- 8730 Shale: dark brownish-gray to brownish-gray, mainly silty, rough texture, grading to a fine, argillaceous siltstone.
- 8730- 8740 Shale: as above, but less silty, more platy; reduced siltstone, 25%.
- 8740- 8750 Shale: as above, silty, more fissile; some dark gray, carbonaceous shale; trace of coal; minor Sandstone: "salt and pepper", quartz and chert grains, fine, subangular, very well sorted, well consolidated, noncalcareous, very faint cut fluorescence.
- 8750- 8760 Shale: brownish-gray, as above; small amount of dark gray, carbonaceous shale; trace of siltstone; scattered pyrite and marcasite.
- 8760- 8770 Shale: brownish-gray, more platy; some dark gray, carbonaceous shale; trace of coal.
- 8770- 8780 Shale: dark gray and dark brownish-gray, in part silty; small amount of dark gray, carbonaceous shale; trace of very fine grained, evenly sorted sandstone.

- 8780- 8790 Shale: as above, but lighter gray, grading to an argillaceous siltstone, 65-35%, with a faint cut fluorescence; small amount of carbonaceous shale; trace of coal; some fossil wood fragments.
- 8790- 8800 Shale and Siltstone: as above, 75-25%; in part the silty shale has larger grains of clear quartz scattered throughout; traces of small, carbonaceous patches in the shale; scattered marcasite.
- 8800- 8810 Shale: dark brownish-gray, in part very silty, platy; some dark gray, carbonaceous shale; trace of pyrite.
- 8810- 8820 Shale: brownish-gray, in part silty; increased dark gray, carbonaceous shale, with a smoother texture; Siltstone: gray, argillaceous, 15%; trace of silty shale, with some coarser scattered quartz grains; minor shale, with finely disseminated pyrite.
- 8820- 8830 Shale: as above, but with less brownish-gray, more gray to dark gray; siltstone, 20%; trace of pyrite; faint cut fluorescence.
- 8830- 8840 Shale: as above, platy to fissile, silty; trace of dark gray, carbonaceous shale; scattered pyrite.
- 8840- 8850 Shale: brownish-gray to dark brownish-gray, platy, in part silty; trace of dark gray, carbonaceous shale.
- 8850- 8860 As above; increased dark gray shale.
- 8860- 8870 As above; trace of finely crystalline pyrite.
- 8870- 8880 Shale: brownish-gray, in part silty, platy to fissile; Shale: dark gray, carbonaceous, platy to fissile, 15%; trace of pyrite and marcasite.
- 8880- 8890 Shale: brownish-gray, as above; Siltstone: gray to dark gray, "salt and pepper", indurated, calcareous, argillaceous, with rare, rounded, coarser quartz grains, faint cut fluorescence; trace of calcite; rare Inoceramus prisms.
- 8890- 8900 Shale: brownish-gray, as above; Siltstone: gray to dark gray, argillaceous, as above, 5%; trace of sandstone, mainly quartz, with rare, scattered glauconite, fine grained, subangular, fairly well sorted, well consolidated, siliceous matrix, in part slightly argillaceous, tight, no shows.

- 8900- 8910 Sandstone: gray to darker gray, fine grained, subangular, some chert grains, in part with finely disseminated pyrite in the matrix; widely scattered yellowish-green fluorescence, slight crushed cut fluorescence.
- 8910- 8920 Sandstone: gray to dark gray, "salt and pepper", quartz and chert grains, with rare scattered glauconite grains, poor porosity, scattered yellowish-green fluorescence and good cut fluorescence, 50%.
- 8920- 8930 Sandstone: as above, ranging from mainly quartz to mainly chert grains; scattered fluorescence as above, 65%; Shale: brownish-gray, less silty.
- 8930- 8940 Sandstone: as above, slightly calcareous, 65%; the darker sandstone may have some hornblende; Shale: brownish-gray, smooth texture, platy to fissile; trace of pyritized worm casts.
- 8940- 8950 Sandstone: as above; thin bands of darker mineralization in the sandstone, possibly hornblende; Shale: brownish-gray, platy to fissile.
- 8950- 8960 Sandstone: as above, from light gray and mainly quartz to dark gray with mainly chert and mafic minerals, all with rare scattered glauconite grains, fine grained, subangular, well sorted.
- 8960- 8970 Sandstone: as above; trace of Siltstone: dark gray, hard, argillaceous, noncalcareous; Shale: dark gray, smoother texture, slightly dolomitic, abundant cavings.
- 8970- 8980 Shale: brownish-gray, smooth texture, platy; Shale: gray to dark gray, smooth texture, platy to blocky, slightly dolomitic; trace of dark gray, carbonaceous shale; Siltstone: gray, argillaceous, slightly dolomitic; trace of finely crystalline pyrite; rare shell fragments, possibly pecten; trace of coarse grained sandstone, mainly clear quartz with rare glauconite grains.
- 8980- 8990 Shale and Siltstone: as above, in part with a brownish cast; trace of Limestone: white to light gray, cryptocrystalline, finely brecciated and recemented, a calcarenite; the shale and siltstone are more calcareous; trace of a pyritized shell fragment.
- 8990- 9000 Shale: gray, smooth texture; small amount of dark gray, carbonaceous shale; siltstone grading to a fine grained Sandstone: "salt and pepper", quartz and chert with glauconite grains, subangular, poorly sorted, well consolidated, calcareous matrix, fair porosity, no shows; trace of argillaceous Limestone: as above.

- 9000- 9010 Shale: brownish-gray and gray, as above; trace of dark gray shale; Sandstone: as above, calcareous, in general finer, more argillaceous; trace of pyrite.
- 9010- 9020 Shale: brownish-gray and gray, platy, slightly dolomitic; some dark gray, smooth to rough texture, platy to blocky, slightly dolomitic; trace of glauconitic Sandstone: as above; minor argillaceous, cryptocrystalline Limestone: as above.
- 9020- 9030 Shale: as above; trace of Sandstone: in part glauconitic; increased limestone, 3%; some dark gray Shale: rough texture.
- 9030- 9040 Limestone: white to dark brownish-gray, brecciated, in part subtranslucent, a calcarenite; siltstone, 40%; Shale: as above.
- 9040- 9050 Limestone: white to dark brownish-gray, brecciated and recemented, with some subtranslucent intraclasts in an opaque matrix; some laminations with thin shale partings; a calcarenite, 40%; Shale: gray and brownish-gray to dark gray, in part silty, platy to blocky, calcareous; trace of pecten.
- 9050- 9060 Limestone: brecciated, very argillaceous, in part with some dark lutite fragments; some laminations with rare coquina layers, 60%; the limestone has a reasonably high detrital input containing numerous brachiopod fragments; trace of lingula; Shale: gray and brownish-gray, platy, slightly dolomitic; Shale: dark gray, blocky, in part silty, calcareous; trace of pecten in the shale.
- 9060- 9070 Shale: gray to dark gray, in part with a slight brownish cast, in part silty, blocky to platy; reduced limestone, 20%; trace of chalky limestone; scattered phosphate pellets.
- 9070- 9080 Limestone: 25%, white, to dark gray, in part mottled, cryptocrystalline, fairly well consolidated, finely brecciated and recemented, a calcarenite; Shale: gray to dark gray, in part silty, calcareous.
- 9080- 9090 Limestone: as above, in part buff and less argillaceous, in part very argillaceous; Shale: as above, platy to fissile.
- 9090- 9100 Limestone: as above, reduced to 15%, in part more argillaceous, in part silty; more laminites; Shale: as above.

- 9100- 9110 Limestone: argillaceous, brecciated, as above, 40%; the limestone has a high silt content; Shale: brownish-gray to dark gray, platy to fissile, slightly dolomitic.
- 9110- 9120 Limestone: white to dark brownish-gray, cryptocrystalline, finely brecciated and recemented, a calcarenite, argillaceous, silty, fossiliferous, with some pecten; common laminites; high detrital input; suggests shallow, intratidal environment; some rounded skeletal grains; abundant brachiopods; Shale: as above.
- 9120- 9130 Limestone and Shale: as above, 40-60%; calcite common in the limestone.
- 9130- 9140 Limestone: as above, argillaceous, silty; suggests deposition in shallow, turbulent waters; some irregular calcite veinlets in the limestone; limestone is very fossiliferous; some pecten and a fossil with the appearance of atrypa; Shale: gray and brownish-gray to dark gray, in part silty, slightly dolomitic.
- 9140- 9150 Limestone: as above, more argillaceous, 40%; trace of rounded; phosphatic pellets; Shale: brownish-gray, slightly dolomitic; Shale: gray to dark gray, in part silty, calcareous; limestone is fossiliferous; trace of dentalium.
- 9150- 9160 Limestone and Shale: as above, 20-80%; trace of calcareous siltstone.
- 9160- 9170 As above; limestone grades into a very fine, very limy sandstone; sandstone, 10%; Shale: as above.
- 9170- 9180 Limestone: white to dark gray, in part mottled, cryptocrystalline, a calcarenite, argillaceous, silty, consisting in part of dark, rounded intraclasts in a light limestone matrix, in part consisting of laminites, 35%; some phosphate pellets; Shale: gray to dark gray, in part silty, particularly in the darker portion, calcareous.
- 9180- 9190 Shale: as above, brownish-gray and slightly dolomitic, dark gray and calcareous.
- 9190- 9200 Limestone: reduced, 10%; Shale: as above; trace of Sandstone: "salt and pepper", quartz and chert, fine grained, subangular, poorly sorted, well consolidated, calcareous matrix; trace of dark gray, calcareous siltstone.
- 9200- 9210 Limestone: as above, 5%; increased Siltstone: gray to dark gray, argillaceous, calcareous; trace of sandstone;

- Shale: gray to dark gray, in part silty; trace of calcite; scattered pyrite; some phosphatic pellets; limestone is fossiliferous with some brachiopods.
- 9210- 9220 Limestone: more silty, 30%; increased siltstone, grading to a fine Sandstone: calcareous, 10%; some laminite with some coquinoid layers; some siltstone with very rare red grains, possibly arkosic.
- 9220- 9230 Sandstone: gray to dark gray, "salt and pepper", quartz and chert grains with some mafic minerals, fine to medium grained, subangular, poorly sorted, well consolidated, calcareous, with a faint, yellowish-white cut fluorescence when crushed, 60%; Shale: gray to dark gray, smooth texture, slightly dolomitic; small amount of Limestone: as above.
- 9230- 9240 Shale: gray and brownish-gray to dark gray, smooth texture, slightly dolomitic, 60%; Siltstone: gray to dark gray, argillaceous, calcareous; trace of siltstone containing rounded glauconite grains.
- 9240- 9250 Shale: as above; trace of dark gray, carbonaceous shale; siltstone, grading to a fine sandstone, in part subrounded, 20%; small amount of Limestone: light gray, silty, less argillaceous.
- 9250- 9260 Siltstone to a very fine grained Sandstone: light gray to gray, with minor dark gray, mainly quartz with some chert and rare, scattered glauconite grains, subangular, well sorted, well consolidated, slightly calcareous; some finely disseminated pyrite in the sandstone; Shale: gray to dark gray and dark brownish-gray, smooth texture, slightly dolomitic; trace of limestone, in part chalky with some coquina.
- 9260- 9270 Sandstone: light gray, "salt and pepper"; quartz, with scattered chert and rare glauconite grains, fine grained, subangular, well sorted, well consolidated, calcareous, tight, no shows, 75%; rare disseminated pyrite in the sandstone; Shale: gray to dark gray and dark brownish-gray, smooth texture, blocky to platy, slightly dolomitic.
- 9270- 9280 Sandstone: as above, in part cleaner with some patchy, poor porosity; Shale: as above, with increased dark gray, carbonaceous shale, 20%; trace of Limestone: soft, in part chalky.
- 9280- 9290 Sandstone: as above, mainly quartz with rare chert, fine grained, clean,, poor patchy porosity, faint crush cut fluorescence, 90%; trace of coarser sandstone, almost a

- quartz conglomerate, light gray to gray, angular to subangular, poorly sorted, siliceous cement; Shale: as above, 10%; trace of argillaceous limestone.
- 9290- 9300 Sandstone: as above, but more argillaceous and slightly finer; trace of coarser sandstone, in part argillaceous; some Sandstone: coarse, clear quartz grains, subrounded in very thin beds the thickness of the grain diameters; Shale: as above, 10%; trace of light green, silty shale; small amount of very argillaceous limestone.
- 9300- 9310 Sandstone: light gray to light brownish-gray, mainly quartz with rare scattered Glauconite grains: very fine to fine grained, subangular, well sorted, well consolidated, calcareous, in part indurated, very faint cut fluorescence; trace of conglomeritic Sandstone: dark gray, poorly sorted, quartz and chert grains; some of the larger quartz grains are clear; Shale: as above, with increased dark gray shale having a brown streak.
- 9310- 9320 Sandstone: as above; trace of conglomeritic sandstone; some Shale: as above; trace of Limestone: dark gray and dark brownish-gray, subtranslucent, a dark Lutite: finely brecciated.
- 9320- 9330 Sandstone: as above, but finer, slightly more argillaceous; increased shale, 35%; trace of marly limestone; trace of compressed silica flour.
- 9330- 9340 Sandstone: light gray, mainly quartz grains, with some darker bands of mafic mineral concentrations, including hornblende; the bands have diffused boundaries; trace of arkosic sandstone, mainly quartz grains, with scattered pink orthoclase and rare hornblende; Shale: as above, mostly brownish-gray, with some dark gray.
- 9340- 9360 Sandstone: as above, with increased shale.
- 9360- 9365 Sandstone, mainly quartz, with scattered chert, light gray to light brownish-gray, in part slightly argillaceous; trace of clean, clear quartz sandstone; some light pink sandstone; Shale: as above, 90%.
- 9365- 9370 Sandstone: as above, with a light yellowish-green fluorescence, faint yellowish-white cut fluorescence, matrix mainly siliceous, very faint staining around the grains, poor porosity, indurated, 30%; Shale: as above.
- 9370- 9380 Sandstone, clear quartz with rare chert grains, siliceous matrix, in part with indistinct grain boundaries and a fused appearance, almost an orthoquartzite; some angular,

- white tripolite fragments in the sandstone; some dark gray, argillaceous sandstone; sandstone, 20%; Shale: brownish-gray and dark gray with a brownish streak.
- 9380- 9390 Sandstone: as above, with the same fluorescence; increased Shale: as above.
- 9390- 9395 Sandstone: as above, with some white, opaque chert grains, fine grained, subangular, poorly sorted, scattered yellowish-green fluorescence; trace of darker sandstone with some dark chert grains; in part the sandstone grains are outlined by finely disseminated pyrite; Shale: as above, with increased dark gray Shale: rough texture, carbonaceous.
- 9395- 9400 Sandstone, with mixed clear and milky quartz grains, poorly sorted; in part the grain boundaries are very diffused; Shale: as above; trace of Siltstone: light gray, indurated, slightly argillaceous.
- 9400- 9405 Sandstone: as above, with some tripolite fragments; some fragments of smoky chert in a light gray sandstone, with some scattered biotite grains; trace of siltstone; scattered tripolite.
- 9405- 9410 Shale: brownish-gray to dark gray; trace of Sandstone: as above.
- 9410- 9415 Sandstone: clear, as above; trace of Sandstone: gray, argillaceous, in general finer; Shale: as above; some of the shale is rounded and reworked.
- 9415- 9420 Sandstone: gray, very fine grained; scattered pyrite in the sandstone; some clear quartz sandstone; trace of Siltstone: light gray and light brownish-gray; Shale: as above; trace of light brownish-gray, subtranslucent chert.
- 9420- 9430 As above; trace of finely crystalline pyrite.
- 9430- 9440 Sandstone: small amount, as above, fine grained, subangular, poorly sorted, well consolidated, siliceous matrix but slightly dolomitic, in part clear quartz with indistinct grain boundaries, almost with a fused appearance; the sandstone has a trace of biotite; Shale: dark gray to dark brownish-gray, in part carbonaceous; partly rounded and reworked shale.
- 9440- 9450 Sandstone: as above, very fine to fine grained, mainly quartz with rare, scattered, smoky chert grains, 30%; Shale: as above.

- 9450- 9455 Sandstone: as above; trace of finely crystalline pyrite.
- 9455- 9460 Sandstone: as above, with rare kaolinitic infilling, 25%; trace of hornblende and biotite; Shale: as above.
- 9460- 9470 Sandstone: 30%, as above, mainly clear quartz grains, poorly sorted, siliceous matrix; trace of Siltstone: light gray to gray, mainly quartz grains; Shale: as above, with some disseminated pyrite.
- 9470- 9480 Sandstone: clear quartz, as above, with rare, scattered biotite; Shale: as above, mostly brownish-gray; trace of light greenish-gray Shale: siliceous, nonbentonitic.
- 9480- 9485 Sandstone: as above, with indistinct grain boundaries; trace of light gray siltstone; Shale: as above; the brownish-gray shale is more silty; the dark gray shale is carbonaceous.
- 9485- 9490 Sandstone: as above, 50%; trace of siltstone, in part with disseminated pyrite; Shale: as above; considerable reworked shale.
- 9490- 9495 Sandstone: as above, with indistinct grain boundaries and a fused appearance, 40%; trace of dark gray sandstone with mafic minerals; some gray Siltstone: argillaceous; Shale: mostly brownish-gray, in part silty.
- 9495- 9500 Sandstone: as above, with scattered biotite, 50%; minor gray siltstone; trace of buff Dolomite: massive, cryptocrystalline, in part limy; Shale: as above.
- 9500- 9505 Sandstone: as above, tending toward an orthoquartzite, 55%; Shale: dark brownish-gray to dark gray, blocky to platy, in part silty, with faint crushed cut fluorescence; trace of Dolomite: pinkish-buff, cryptocrystalline, in part finely brecciated and recemented.
- 9505- 9510 Sample missing.
- 9510- 9515 Sandstone: as above; Sandstone: light apple green, mainly quartz with very rare, weathered orthoclase grains, fine grained, subangular, poorly sorted, well consolidated, siliceous matrix, very slightly dolomitic, tight, 15%; trace of Shale: brick-red, lateritic, silty, grading to a shaly, lateritic siltstone; some light gray, indurated siltstone; Shale: as above, dark brownish-gray to dark gray, rougher texture, more blocky, in part slightly dolomitic.

- 9515- 9520 Sandstone: light green, as above, in part with kaolinitic infilling, very fine; some light gray sandstone; sandstone, 20%; slight increase in silty, lateritic, brick-red shale; Shale: as above, in part silty and carbonaceous; minor Siltstone: as above; trace of calcite.
- 9520- 9525 Sandstone: light green, as above, grading to siltstone, more kaolinitic; increase in lateritic, silty shale; Shale: as above; trace of lighter brown shale.
- 9525- 9530 Sandstone: very light gray, mainly quartz with scattered biotite, fine grained, subangular, poorly sorted, well consolidated, matrix mainly siliceous, with some patchy kaolin, in part darker gray, argillaceous, tight, very rare, weathered feldspar, scattered pale yellowish-green fluorescence, with a faint crushed cut fluorescence; Shale: as above, 10%.
- 9530- 9535 Sandstone: as above, light gray, with more biotite and some scattered hornblende, scattered yellowish-green fluorescence; trace of light green sandstone; Shale: as above, mostly dark gray, carbonaceous, in part silty, 5%.
- 9535- 9540 Sandstone: as above, "salt and pepper", with scattered smoky to black chert grains, some biotite and some hornblende, less kaolinitic, with scattered yellowish-green fluorescence, in part the sandstone has indistinct grain boundaries; small amount of Shale: as above.
- 9540- 9545 Sandstone: as above, slightly darker gray; Shale: as above, with a trace of dark gray shale.
- 9545- 9550 Sandstone: as above, in general darker, more argillaceous, with yellowish-green fluorescence in 15% of the sandstone; slight increase in shale; some compressed silica flour.
- 9550- 9565 Sandstone: as above, in general finer grained, slightly more argillaceous; sandstone has more kaolinitic infilling in patches; rare, thin bands of sandstone with anastomosing networks of thin shale partings; trace of gray, indurated siltstone; trace of Shale: as above; some compressed silica flour.
- 9565- 9570 Sandstone: as above, with some smoky chert and rare hornblende grains; trace of shale; scattered pyrite; some silica flour.
- 9570- 9575 Sandstone: as above, mostly light gray with some gray; minor shale; trace of kaolinite; some silica flour.

- 9575- 9580 Sandstone: as above, with increased chert; trace of shale.
- 9580- 9585 Sandstone: as above, increased chert; small amount of fine to medium grained, clear quartz sandstone, with scattered chert, poorly sorted; trace of shale.
- 9585- 9590 Sandstone: as above, with increased chert grains and in part more argillaceous, in part slightly friable; trace of gray, opaque chert; Shale: as above, 10%.
- 9590- 9595 Sandstone: as above, with increased chert and hornblende, fine to medium grained; trace of pyrite in the matrix; increased shale, 30%; trace of light gray, siliceous shale; some silver gray Shale: fissile, almost schistose; trace of white quartz Siltstone: kaolinitic.
- 9595- 9600 Sandstone: as above, fine to medium grained, subangular to angular, with possible porosity, scattered yellowish-green fluorescence; dark gray Shale, 5%; some silver-gray shale; trace of Dolomite: light brownish-gray, highly siliceous.
- 9600- 9605 Sandstone: "salt and pepper", as above; trace of white chert, a tripolite; minor Dolomite: as above; trace of light gray tuffaceous material.
- 9605- 9610 Sandstone: as above, "salt and pepper", fine to medium grained, angular to subangular, poorly sorted, slightly friable, with possible fracture porosity, scattered yellowish-green fluorescence, faint crushed cut fluorescence; some coarser conglomeritic sandstone with larger chert fragments; trace of silver-gray shale; some silica flour.
- 9610- 9615 Sandstone: as above, "salt and pepper", in general finer grained, with reduced chert grains; trace of silver-gray, fissile shale; some silica flour.
- 9615- 9620 Sandstone: as above, in general finer grained, some kaolinitic patches in the sandstone; trace of Shale: as above.
- 9620- 9625 Sandstone: as above; trace of very fine grained sandstone with a greenish tinge; some light gray, slightly silty shale, in part with scattered pyrite; scattered pyrite and marcasite; some silica flour.
- 9625- 9630 Sandstone: as above, with less chert grains; trace of light green, very fine siltstone; some Shale: brownish-gray to dark gray, partly light gray, silty; trace of gray chert.

- 9630- 9635 Sandstone: as above, with scattered biotite and hornblende; trace of silver-gray shale.
- 9635- 9640 Sandstone: as above; traces of pinkish-buff, dolomitic sandstone in the clearer quartz sandstone; Shale: dark brownish-gray to dark gray, 15%; trace of light gray shale.
- 9640- 9645 Sandstone: as above; Shale: as above; trace of light green, silty shale.
- 9645- 9650 As above; in part the sandstone is coarser; increased light gray shale.
- 9650- 9655 Sandstone: clear quartz, as above, with scattered biotite and hornblende, fine grained, subangular, fairly well sorted, well consolidated, siliceous matrix; rare, scattered fluorescence; trace of light green sandstone; Shale: as above, 35%; trace of light green bentonitic shale with a slightly waxy luster.
- 9655- 9660 As above; shale, 25%.
- 9660- 9665 Sandstone: as above; some patches of pink sandstone; Shale: as above, 20%; trace of light gray sandstone.
- 9665- 9670 Sandstone: as above; increased pink sandstone; Shale: dark gray, blocky, light gray, fissile.
- 9670- 9675 Sandstone: mainly clear quartz with some frosted quartz grains and scattered smoky chert and traces of biotite and hornblende, rare pyrite, fine to medium grained, subangular, poorly sorted, well consolidated, siliceous matrix, with rare scattered, greenish-yellow fluorescence; increased pink sandstone; Shale: light brownish-gray and dark gray, 20%.
- 9675- 9680 Sandstone: as above, more angular, more poorly sorted; small amount of sandstone with pink staining; shale, 10%; some of the brownish-gray shale has finely disseminated pyrite crystals.
- 9680- 9685 Sandstone: as above, in part coarser; trace of pink staining; some sandstone with a very light green staining; trace of Shale: brick-red, silty, lateritic; Shale: as above, with less light gray and increased dark gray, in part silty, 10%; trace of light green, silty shale.
- 9685- 9690 Sandstone: as above, in part finer; trace of scattered, light iron staining, some kaolinitic infilling; Shale: as above, 15%; trace of light gray and light green, silty shale; scattered finely crystalline pyrite.

- 9690- 9695 Sandstone: as above; scattered, small patches of pink and light green sandstone; Shale: as above, 15%; increased light gray shale.
- 9695- 9710 Sandstone: as above, more uniformly sorted; reduced pink staining; Shale: as above, 10%.
- 9710- 9715 Sandstone: "salt and pepper", quartz and chert grains with scattered biotite, fine grained, subangular, poorly sorted, well consolidated, siliceous matrix, tight; Sandstone: as above, but light green in color, with rare, scattered, weathered orthoclase grains; sandstone, 40%; Shale: dark brownish-gray and dark gray, rough texture, blocky to platy, 50%; Shale: brick-red, lateritic, silty, grading to a lateritic siltstone, in part with coarse, rounded quartz grain inclusions, 10%; trace of light brownish-gray, indurated shale; scattered rounded quartz nodules, in part light green; trace of subangular to subrounded, smoky chert nodules.
- 9715- 9720 Sandstone: light gray and light green, as above; increased lateritic shale, grading to siltstone, 30%; some alternate bands of light gray and brick-red siltstone; Shale: as above, 40%; some finely disseminated pyrite in the dark gray shale.
- 9720- 9725 Sandstone: mainly light green, grading to a Siltstone: light green, light gray and light purplish-gray; lateritic siltstone and Shale: as above, 30%; Shale: dark gray and dark brownish-gray, in part pyritic, 45%; some dark green shale with a waxy luster.
- 9725- 9730 Shale: brick-red, lateritic, grading to a siltstone, 50%; Sandstone: as above, in part light green, 10%; some conglomeritic sandstone, with increased chert, 5%; Shale: as above, 30%; Siltstone: light gray, 5%; trace of pyrite and pyritized wood; scattered rounded quartz and chert nodules.
- 9730- 9735 Shale: brick-red, lateritic, silty, grading to a lateritic siltstone, 60%; Sandstone: light gray, mainly quartz, fine to medium grained; Sandstone: light green, finer than the light gray; trace of conglomeritic sandstone; sandstone, 10%; Siltstone: light gray, 10%; Shale: as above, 20%; trace of chert nodules and clear quartz nodules.
- 9735- 9740 Siltstone, sandstone and Shale: lateritic, as above.
- 9740- 9745 Lateritic material, coarser, grading to a fine sandstone, in part with a lighter red color; small amount of Sandstone: as above, in part light green; trace of light and dark gray shale.

- 9745- 9750 Sandstone: light to medium gray, with rare pink and light green, quartz with scattered hornblende and smoky chert, subangular, well sorted, well consolidated, siliceous matrix, tight; Siltstone, grading to a fine Sandstone: lateritic, less staining, 3%; Shale: dark brownish-gray to dark gray, blocky; trace of light gray, indurated quartz siltstone; common quartz and smoky to black chert nodules, subangular to rounded; some of the quartz is green stained with glauconite; trace of dark green nodules, hard, with a fairly high luster; trace of granite fragments with clear quartz, orthoclase and biotite.
- 9750- 9755 Sandstone: mainly clear quartz with increased mafics, fine to coarse grained, subangular to angular, poorly sorted, siliceous matrix; small amount of conglomeritic sandstone with quartz and chert grains; trace of red, lateritic, very fine grained sandstone; some dark Shale: as above; trace of dark brown, tuffaceous material, with small vesicles.
- 9755- 9760 Sandstone: as above, in general slightly finer, slightly friable; trace of lateritic siltstone; trace of arkosic sandstone.
- 9760- 9765 Sandstone: as above, fine to medium grained, slightly more friable; small amount of very faint pink sandstone; trace of light green sandstone; some finely disseminated pyrite in the matrix; minor lateritic, shaly siltstone; trace of dark brownish-gray shale.
- 9765- 9770 Sandstone: as above, clear quartz, smoky to black chert and hornblende grains, fine to coarse grained, subangular, poorly sorted, well consolidated, siliceous matrix, with scattered, finely disseminated pyrite; trace of lateritic siltstone and dark shale; some clear quartz and chert nodules: angular to subrounded.
- 9770- 9775 Sandstone: as above, fine to coarse grained, with some euhedral orthoclase crystals; Shale: as above, 10%; some light gray shale; lateritic siltstone, 5%; some angular quartz fragments, clear to frosted; some angular chert fragments and black, rounded chert nodules.
- 9775- 9780 Sandstone: as above, light gray to gray, fine to medium grained; lateritic siltstone, 5%; light gray to gray, indurated siltstone; shale, 5%; trace of finely crystalline pyrite.
- 9780- 9785 Shale: lateritic, grading to a siltstone, 60%; increased light gray to gray shale, 20%; sandstone: as above, in part darker gray, more argillaceous, 10%; Shale: dark gray, as above, 10%.

- 9785- 9790 Shale: laterite, 80%; some light green siltstone, weathered in part to brick-red; Shale: dark gray, as above, 10%; light gray shale, 5%; small amount of sandstone, as above, in part with disseminated pyrite.
- 9790- 9795 Siltstone: light green, weathering to a brick-red, soft, shaly in part, with weathered halos and patches, 45%; Shale: dark brownish-gray and dark gray, 50%; small amount of sandstone, clear quartz with scattered, angular chert fragments.
- 9795- 9800 Shale: dark brownish-gray to dark gray, 65%; the dark gray shale is very carbonaceous; in part the shale has very finely disseminated pyrite; variegated Shale: light green and brick-red, grading to a siltstone, 30%; small amount of light gray, indurated shale; small amount of Sandstone: fine to medium grained, with scattered chert and hornblende grains.
- 9800- 9805 Sandstone: fine to medium grained, light gray to gray, light green and brick-red; the color appears to be in the matrix, although some of the quartz grains are stained; it is subangular, poorly sorted, well consolidated, siliceous matrix, tight; Shale: dark brownish-gray and dark gray, 5%; small amount of brick-red, lateritic siltstone and shale; trace of light gray and light brownish-gray Shale: smooth texture, platy to fissile.
- 9805- 9810 Sandstone: as above; trace of brick-red, lateritic shale grading to siltstone; trace of dark and light gray shale; some kaolinitic patches in the sandstone.
- 9810- 9820 Sandstone: as above, slightly finer grained, more friable, with some multicolored red and green; some of the quartz grains are amber colored; increased kaolinitic material; some Shale: as above; trace of creamy, limy Dolomite: massive, cryptocrystalline.
- 9820- 9830 Sandstone: as above, light gray, light red and light green.
- 9830- 9840 Sandstone: variegated pink and green, as above, no visible porosity; some white opaque, angular tripolite grains in the sandstone; some kaolinitic infilling; trace of dark Shale: as above.
- 9840- 9850 Sandstone: as above, but coarser in part; sample loaded with lost circulation material.
- 9850- 9860 Sandstone: as above, light gray, with some pink and light green, quartz and chert, fine grained, subangular, poorly sorted, well consolidated, siliceous matrix, in part

- argillaceous and kaolinitic, in part slightly friable but with no visible porosity; trace of light gray to gray Shale: fissile.
- 9860- 9865 Sandstone: argillaceous, as above, finer grained, with rare, scattered hornblende.
- 9865- 9870 Sandstone: as above, finer grained, grading to a gray Siltstone: more argillaceous, in part kaolinitic, poorly sorted.
- 9870- 9875 Sandstone: as above, softer, finer grained, more kaolinitic, with fewer dark minerals.
- 9875- 9880 Sandstone: as above, dark gray, more argillaceous, softer, more kaolinitic; Shale: dark brownish-gray and dark gray, blocky to platy, 10%; trace of light gray shale, in part with a smooth texture.
- 9880- 9885 Sandstone: as above; increased shale, as above, 15%.
- 9885- 9895 Sandstone: as above, kaolinitic; reduced shale, 5%; trace of light gray and light brownish-gray Shale: smooth texture, in part with a waxy luster.
- 9895- 9900 Sandstone: very fine to fine grained, soft, argillaceous, in part kaolinitic; increased light gray to light brownish-gray Shale: smooth texture; Shale: dark brownish-gray to dark gray, 5%.
- 9900- 9910 Sandstone: as above; Shale: light gray, fissile, micromicaceous, and Shale: dark brownish-gray to dark gray, blocky to platy; shale, 30%.
- 9910- 9915 Shale: brownish-gray to dark gray, 75%; Shale: light gray and light brownish-gray, 5%; Siltstone: light gray, 3%; Sandstone: fine to medium grained, as above, some finely disseminated pyrite; trace of Shale: dark gray, blocky, calcareous; rare quartz nodules.
- 9915- 9920 Sandstone: light gray, "salt and pepper", fine grained, subangular, well sorted, well consolidated, siliceous matrix, in part kaolinitic, tight; Shale: dark brownish-gray to dark gray, 5%; trace of Shale: light gray, micromicaceous, fissile; scattered quartz nodules.
- 9920- 9925 Sandstone: as above, more argillaceous; small amount of lateritic Siltstone: brick-red; trace of dark gray shale.
- 9925- 9930 Sandstone: as above, more argillaceous; Shale: gray and brownish-gray, smooth texture, blocky to platy; trace of lateritic siltstone.

- 9930- 9935 Sandstone: gray, argillaceous, "salt and pepper", in part kaolinitic; Shale: light gray, light brown, brown and minor dark brown, 5%.
- 9935- 9940 Siltstone: gray, "salt and pepper", argillaceous, 80%; trace of yellowish-gray, calcareous siltstone, grades to a gray, silty shale; minor gray, "salt and pepper" sandstone, as above; small amount of rounded quartz nodules; small amount of rounded chert nodules; some angular, smoky chert fragments.
- 9940- 9945 Siltstone: as above, grading into a gray Shale: silty to slightly silty, trace of brownish-gray shale, with smoother texture; some dark gray, dolomitic Shale: blocky; some subrounded to round, black chert nodules; some angular chert fragments.
- 9945- 9950 Sandstone: as above, grading through siltstone to a silty shale, 70-30%; trace of brownish-gray and dark gray shale; small amount of rounded quartz nodules; trace of black chert nodules.
- 9950- 9955 Siltstone grading to a silty shale, 30-70%; small amount of brownish-gray shale; trace of quartz with biotite inclusions; some quartz with light green staining; some quartz nodules, subrounded; trace of chert nodules.
- 9955- 9960 Siltstone, grading to shale, 50-50%; small amount of quartz and chert nodules; scattered marcasite; trace of creamy-pink aragonite, possibly a shell fragment.
- 9960- 9965 Siltstone: grading to a sandstone: as above, 35-65%; trace of sandstone, clear quartz with scattered chert grains; minor light and dark brown shale; trace of Limestone: light brown, massive, cryptocrystalline.
- 9965- 9970 Siltstone, grading to a shale, 40-60%; small amount of dark gray, carbonaceous Shale: blocky to platy; trace of Limestone: as above.
- 9970- 9975 Siltstone, grading to a Shale: gray, 30-70%; trace of lateritic siltstone; trace of Limestone: buff, microcrystalline, dolomitic.
- 9975- 9980 Shale: gray, fairly smooth texture, in part slightly silty, 80%; Siltstone: gray, in part "salt and pepper", 20%; trace of dark gray Shale: as above; clear quartz sandstone; trace of brown, mottled limestone, with a brachiopod imprint; rare aragonite.
- 9980- 9985 Shale: as above; Siltstone, 5%; small amount of dark gray shale.

- 9985- 9990 Shale: as above, in part silty, 70%; Siltstone: as above, 30%; trace of dark gray and dark brown shale.
- 9990- 9995 Shale: gray, in part silty, 55%; Siltstone: gray, argillaceous, "salt and pepper", 35%; Sandstone: in part clean, in part argillaceous, 10%; in part the shale, siltstone and sandstone are carbonaceous; trace of Dolomite: dark gray, argillaceous, a dolilutite.
- 9995-10,000 Shale: as above; in part with a smooth texture, 80%; siltstone, 20%; trace of dark gray, slightly dolomitic shale; minor brown, microcrystalline limestone; trace of Sandstone: argillaceous; some black chert and quartz nodules; trace of pelecypods.
- 10,000-10,005 Shale: as above, 70%; Sandstone: dark gray, quartz with rounded, carbonaceous grains, very fine grained, 20%.
- 10,005-10,010 Shale: as above, in part silty, 80%; Sandstone: as above; some Siltstone: less argillaceous; trace of quartz and chert nodules.
- 10,010-10,015 Siltstone: as above, 55%; shale, 40%; sandstone, 5%; trace of dark gray shale; some loose quartz nodules.
- 10,015-10,020 Shale: as above, in part with a slight brownish cast, in part silty; Sandstone: gray, "salt and pepper", with numerous carbonaceous specks, 10%; trace of Siltstone: as above; some loose quartz grains.
- 10,020-10,025 Siltstone, 50%; Shale: as above, 35%; sandstone, with considerable biotite, 20%.
- 10,025-10,030 Shale: gray, and light brownish-gray, smooth texture, platy, and Shale: gray, silty, rough texture, 30%, siltstone, 50%; Sandstone: as above, 20%.
- 10,030-10,035 Shale, 20%; Siltstone, 70%; Sandstone, 10%.
- 10,035-10,040 Shale: light gray to gray, platy to fissile, in part silty, 55%; Siltstone: light gray to gray, 45%; trace of Sandstone: as above, in part slightly dolomitic; some Dolomite: creamy-buff, cryptocrystalline, limy; trace of Dolomite: dark gray, very argillaceous.
- 10,040-10,045 Shale, siltstone and Sandstone: as above, 55-40-5%.
- 10,045-10,050 Shale and Siltstone: as above, 60-40%; trace of dark gray, carbonaceous shale, in part with thin beds of marcasite; some Dolomite: buff, cryptocrystalline, trace of Dolilutite: dark brownish-gray, argillaceous; trace of clean sandstone, slightly dolomitic; rare brachiopods.

- 10,050-10,055 Siltstone, 55%; trace of Sandstone: dark gray, with considerable biotite; trace of dark brownish-gray dolomite.
- 10,055-10,060 Shale: as above, light brownish-gray to gray, blocky to platy, 65%; Siltstone: as above, gray, "salt and pepper", argillaceous, 30%; Sandstone: light gray, "salt and pepper", fine grained, subangular, well sorted, well consolidated, slightly dolomitic, 5%; trace of dark gray, carbonaceous shale.
- 10,060-10,065 Shale: as above, 60%; siltstone, 35%; trace of dark and light gray sandstone; the shale, siltstone, and sandstone are slightly dolomitic; trace of dark gray, carbonaceous shale.
- 10,065-10,070 Shale, 60%, and Siltstone: as above; small amount of Sandstone: light gray to gray, mainly quartz grains, slightly dolomitic; dark gray, very carbonaceous shale, 2%; trace of light gray Limestone: cryptocrystalline, a calcilutite.
- 10,070-10,075 Shale and Siltstone: as above, 70-30%; the shale is more blocky; trace of cleaner sandstone; some dark gray, carbonaceous shale; trace of Limestone: buff, microcrystalline, occurring in very thin beds; scattered chert nodules.
- 10,075-10,080 Shale and Siltstone: as above; trace of sandstone; dark gray, carbonaceous shale; trace of light gray shale, with a slight greenish tinge, nonbentonitic; increased chert nodules; scattered quartz nodules and angular fragments.
- 10,080-10,085 Shale, 80%, and Siltstone: as above; increased dark gray, carbonaceous shale; increased Dolomite: dark brownish-gray, in part mottled, crypto-microcrystalline, argillaceous, 4%; trace of pyrite; increased chert and quartz nodules.
- 10,085-10,090 Shale and siltstone, 50-50%; small amount of sandstone; reduced dolomite; trace of dark gray shale; rare chert and quartz nodules.
- 10,090-10,095 Shale: as above, 65%; Siltstone, 25%; Sandstone, 10%; increased quartz fragments.
- 10,095-10,100 Shale: as above, 40%, grading to a very fine grained Sandstone: subangular, well sorted, well consolidated, slightly dolomitic, with increased mafic minerals.
- 10,100-10,110 Shale, 60%; Siltstone, 20%; Sandstone, 20%; trace of dark gray, carbonaceous shale, and brownish-gray dolomite.

- 10,110-10,120 Shale, 80%, more fissile; Siltstone: gray, argillaceous; trace of dark gray, carbonaceous shale.
- 10,120-10,130 Shale: as above; trace of dark gray, carbonaceous shale; trace of cleaner quartz sandstone; small amount of Dolomite: brownish-gray, cryptocrystalline, argillaceous to silty.
- 10,130-10,135 Shale: gray, as above, 35%; siltstone, 20%; Sandstone: light gray, "salt and pepper", quartz and scattered chert, rare mafic grains, fine grained, subangular, well sorted, well consolidated, siliceous and slightly dolomitic matrix; trace of coarser, more rounded sandstone, with glauconite grains; trace of Dolomite: brownish-gray, argillaceous to silty, a dolilutite.
- 10,135-10,140 Sandstone: as above, in part argillaceous, with increased mafic minerals; some poor, intergranular porosity with scattered greenish-yellow fluorescence; some Sandstone: light green, with scattered glauconite grains; Dolomite: light brownish-gray, microcrystalline, argillaceous to silty, a dolarenite, 10%; trace of light gray dolomite, with a trace of pyrobitumen and some heavy, tarry, residual oil flecks; trace of dark dolilutite; Shale: gray, as above, 30%.
- 10,140-10,150 No returns.
- 10,150-10,155 Sandstone: gray, "salt and pepper", quartz and chert with scattered glauconite, fine grained, subangular, poorly sorted; Shale: mainly brownish-gray, fissile; trace of chalky limestone; sample mostly cavings.
- 10,155-10,160 Sandstone: "salt and pepper", quartz and chert with scattered glauconite, very fine to fine grained, subangular, well sorted, well consolidated, calcareous matrix, 60%; Shale: as above, 40%.
- 10,160-10,170 Sandstone: as above, dark gray, glauconitic, very argillaceous; trace of Shale: as above, mostly dark brownish-gray.
- 10,170-10,175 Sandstone: as above, dark gray, glauconitic, fine grained, subangular, well sorted, well consolidated, slightly calcareous matrix, very argillaceous; Shale: as above, mostly brownish-gray, fissile.
- 10,175-10,180 Sandstone: as above, darker gray, more argillaceous, glauconitic, with fine pyrite cubes and finely disseminated pyrite; some Shale: as above; trace of Shale: light gray, bentonitic, with scattered pyrite.

- 10,180-10,185 Sandstone: as above, mostly dark gray, glauconitic, very argillaceous, with increased pyrite; small amount of Shale: as above.
- 10,185-10,190 Sandstone: as above, fine grained, subangular, well sorted, very glauconitic, very pyritic, very argillaceous; small amount of shale.
- 10,190-10,195 Sandstone: as above, gray to very dark gray, very fine to fine grained, with numerous pyrite cubes and octahedrons and some finely disseminated pyrite, partly fine to medium grained, slightly dolomitic matrix; pyrite makes up 25% of the sandstone; some hornblende in the sandstone; trace of Sandstone: lighter gray, with subangular, clearer, coarser quartz grains, very calcareous matrix.
- 10,195-10,200 Sandstone: as above, fairly well sorted, gray to dark gray; some Shale: as above; trace of clear dolomite rhombs.
- 10,200-10,205 Sandstone: as above; trace of shale.
- 10,205-10,210 Sandstone: as above; trace of light gray shale and brownish-gray shale.
- 10,210-10,220 Sandstone: as above, dark gray, quartz and chert with hornblende grains common, scattered pyrite cubes, octahedrons and disseminated pyrite, reduced glauconite; trace of Shale: gray, brownish-gray and dark gray; trace of Dolomite: light brown, microcrystalline, limy.
- 10,220-10,225 Sandstone: as above, in part light gray; Shale: as above, 20%; trace of light gray, microcrystalline dolomite.
- 10,225-10,230 Sandstone: as above, 50%; Dolomite: light gray, dense, massive, cryptocrystalline to finely crystalline, with some pyrobitumen between crystals; some clear, coarsely crystalline dolomite; some clear dolomite rhombs; some clear, euhedral quartz crystals.
- 10,230-10,235 Dolomite: as above, crypto to finely crystalline, very rare intercrystalline porosity, with scattered pyrobitumen between crystals, 70%; in part the dolomite is bioclastic, a dolarenite; the cementing material is partly limy; Shale, 30%; some coarse, clear dolomite rhombs; trace of clear calcite and quartz grains.
- 10,235-10,240 Dolomite: as above, more bioclastic, in part subtranslucent, 85%; some of the dolomite is cemented with a calcareous cement; some of the pieces are mixtures

- of dolomite and limestone; Shale: as above, 15%; small amount of angular chert fragments, smoky to white and opaque; trace of chalky limestone.
- 10,240-10,245 Dolomite: as above; increased Limestone: as above, in part finely brecciated and recemented, a calcarenite, in part intermixed with the dolomite, 30%; in part the limestone is lighter gray, more opaque; some chalky limestone; Shale: as above, 10%, possible cavings; trace of finely crystalline pyrite.
- 10,245-10,250 Limestone: 60%, white, cryptocrystalline, massive; trace of light brownish-gray, subtranslucent; some nonskeletal intraclasts in a white, opaque matrix; trace of limestone, with varying sizes of oolitic structures; Dolomite: as above, mostly light gray, with some clear, 40%; trace of Shale: as above; trace of calcite; some chalky limestone; in part the limestone is slightly dolomitic.
- 10,250-10,255 Limestone: as above, 90%; dolomite, 10%; trace of shale; trace of finely crystalline pyrite.
- 10,255-10,260 Limestone: as above, 90%; slight increase in light brown, subtranslucent limestone; some nonskeletal and skeletal intraclasts, in part with colored outer rims; Dolomite: as above, 10%.
- 10,260-10,265 Limestone: as above, in part dolomitic; reduced dolomite; some skeletal intraclasts, with dark colored outer rims, in part with calcite centers.
- 10,265-10,270 Limestone: as above, light to medium gray, cryptocrystalline, finely brecciated and recemented, a calcarenite, in part slightly argillaceous and dolomitic; reduced light brownish-gray calcilutite; reduced skeletal intraclasts; some oolitic limestone; trace of Dolomite: as above.
- 10,270-10,275 Limestone: as above, in general more argillaceous, in part dolomitic; reduced intraclasts; small amount of chert.
- 10,275-10,280 Limestone: as above; with some light to medium gray and light brownish-gray and subtranslucent; some skeletal intraclasts; small amount of clear dolomite with a high silica content and scattered glauconite grains.
- 10,280-10,285 Limestone: as above, less argillaceous, lighter colored.
- 10,285-10,290 Limestone: as above, in part slightly more crystalline; trace of Amphipora; traces of sparry calcite outlining grains.

- 10,290-10,300 Limestone: as above, white with a dull luster and light brownish-gray, subtranslucent, cryptocrystalline, in part slightly dolomitic.
- 10,300-10,310 Limestone: white, dull luster, cryptocrystalline, and light brownish-gray, subtranslucent, cryptocrystalline; trace of Dolomite: clear, limy, siliceous, with scattered glauconite grains; Dolomite: gray, crypto to microcrystalline, with some irregular fractures containing pyrobitumen, 10%; trace of angular, bluish-gray, subtranslucent chert fragments.
- 10,310-10,320 Limestone: as above; some pyrobitumen in minute fractures; some calcite healing minute fractures in the limestone.
- 10,320-10,330 Limestone: as above, white and light brownish-gray, a calcilutite, occurring in thin beds, platy; trace of limestone with scattered glauconite grains; some fractures healed with clear calcite; rare, rounded detrital grains, with dark pyrobitumen outlines.
- 10,330-10,340 Limestone: white, dull luster, cryptocrystalline, and light brownish-gray to gray, subtranslucent, a calcilutite; trace of Chert: subtranslucent.
- 10,340-10,350 Limestone: white to gray, cryptocrystalline, finely brecciated and recemented, a calcarenite; small amount of light brownish-gray, subtranslucent, a calcilutite; trace of limestone, with some dendritic stromatoporoids; trace of dolomite, with coarse, clear, euhedral crystals.
- 10,350-10,360 Limestone: as above; trace of chalky limestone.
- 10,360-10,370 Limestone: white, and brownish-gray, subtranslucent, cryptocrystalline, a calcilutite; Limestone: gray, cryptocrystalline, finely brecciated and recemented, a calcarenite; trace of glauconite grains in the limestone; some smoky blue, subtranslucent, angular chert fragments.
- 10,370-10,380 Calcilutite and Calcarenite: as above; some softer, chalky limestone, with a duller luster; some angular chert fragments.
- 10,380-10,390 Limestone: as above; some nonskeletal intraclasts, angular, subtranslucent, in an opaque matrix; some chalky limestone; very rare glauconite in the limestone; trace of Chert: as above.

- 10,390-10,400 Limestone: as above; some brownish-gray fragments cemented with calcite; some calcite healing fractures in the gray calcarenite; increased white Limestone: softer; some cryptocrystalline limestone; trace of coral detritus.
- 10,400-10,410 Limestone: white, cryptocrystalline, in part finely brecciated and recemented, a calcilutite grading to a calcarenite; some subtranslucent Limestone: light brownish-gray, cryptocrystalline, in part almost lithographic, a calcilutite; trace of light green limestone, in part with weathered glauconite grains, cryptocrystalline, more dolomitic than above; trace of pyrobitumen along old fracture planes; some softer, chalky limestone; trace of angular chert fragments.
- 10,410-10,420 Limestone: as above; in part the white limestone has a higher luster; reduced light green limestone; some angular, bluish-gray, subtranslucent chert fragments.
- 10,420-10,430 Limestone: as above; trace of limestone with scattered glauconite grains; increased chert.
- 10,430-10,440 Limestone: as above; increased white limestone, less argillaceous; small amount of darker gray limestone; small amount of light brownish-gray, subtranslucent calcilutite; more fossiliferous; trace of Chert: as above.
- 10,440-10,450 As above, with very rare pyrobitumen; less fossiliferous.
- 10,450-10,460 Limestone: as above, white and light brown, subtranslucent, with a small amount of light green limestone; the light brown limestone is platy; small amount of Chert: as above.
- 10,460-10,470 Limestone: as above; increased chert, bluish-gray, subtranslucent, and white, opaque, tripolite, 15%; Shale: mostly dark gray, platy, with some gray, 10%.
- 10,470-10,480 Limestone: as above, with some darker gray, more argillaceous; Chert: as above, mostly light bluish-gray, subtranslucent, 5%; increased shale but may be the result of the wiper trip.
- 10,480-10,490 Limestone: white to gray, in part finely brecciated, a calcilutite grading to a calcarenite; subtranslucent chert and tripolite, 10%; trace of Amphipora: dark, in a calcitic matrix.
- 10,490-10,500 Limestone: as above, light to medium gray, with some light brownish-gray, subtranslucent, in general more argillaceous than above.

- 10,500-10,510 Limestone: as above, in part darker gray; one piece has angular, white limestone fragments in a pyrobitumen matrix; Chert: as above, 10%.
- 10,510-10,520 Limestone: as above, bioclastic; increased chert, in part frosted, 20%.
- 10,520-10,530 Limestone: white to light gray, finely brecciated, a calcarenite; trace of light brownish-gray, subtranslucent limestone; some limestone with a greenish tinge; reduced Chert: as above, 10%; trace of light green shale.
- 10,530-10,540 Limestone: white to light gray, brecciated and lesser Limestone: light gray, subtranslucent; Chert: as above, opalescent to smoky, with rare tripolite, 15%.
- 10,540-10,550 Limestone: as above, mostly a calcarenite; some angular, nonskeletal, subtranslucent intraclasts in a softer, opaque matrix; Chert: as above, 10%; trace of light green shale.
- 10,550-10,560 Limestone: white, dull luster, in part chalky; Limestone: white to gray, cryptocrystalline, finely brecciated and recemented, a calcarenite; minor light brownish-gray, subtranslucent calcilutite; Chert: as above, 15%; in some cases the siliceous replacement of the limestone is not complete; trace of light green shale; some gray, fissile shale.
- 10,560-10,570 Limestone: as above; chert, 10%; trace of glauconite in the limestone; some of the light brownish-gray limestone is very dolomitic; trace of light green and gray shale; rare gastropods.
- 10,570-10,580 Limestone: brecciated, as above, with reduced gray, in part chalky; Limestone: light brownish-gray, subtranslucent, in part dolomitic, with a high content of almost colloidal silica; Chert: as above, 5%.
- 10,580-10,589 Limestone: as above, duller luster, more chalky; increased chert, 10%.
- 10,589-10,600 Limestone: as above, white to gray, in part with larger brecciation; reduced light brownish-gray limestone; small amount of light bluish-gray, translucent Limestone: finely brecciated and recemented, dolomitic, a calcarenite; very rare glauconite grains in a clear, dolomitic limestone; reduced chert; trace of light green and light gray shale.
- 10,600-10,613 Limestone: as above; the brecciated pieces are larger and less well sorted; rare pyrite in the limestone; reduced calcilutite.

- 10,613.0-10,615.2'  
(2.2') Limestone: light gray, microcrystalline, finely brecciated and recemented, a calcarenite, with some angular, nonskeletal, subtranslucent fragments in a light gray matrix, some barely discernable light gray portions following former fractures, rare chert nodules, limestone is very hard, siliceous and has pronounced vertical fracturing, faint brownish-yellow to yellow fluorescence, fair yellow crush cut fluorescence.
- 10,615.2-10,615.4'  
(0.2') Dolomite: dark gray, hard, siliceous, cryptocrystalline, a dolilitite, with a subconchoidal fracture.
- 10,615.4-10,618.4'  
(3.0') Limestone: dark brownish-gray, cryptocrystalline, a calcilutite, subconchoidal fracture, highly siliceous, strong vertical fracturing and rare fracturing along bedding planes.
- 10,618.4-10,620.4'  
(2.0') Limestone: as above, microcrystalline, in part dolomitized.
- 10,620.4-10,624.0'  
(3.6') Limestone: poorly sorted, rounded algal pellets in a gray, cryptocrystalline calcarenite, at 10" the pellets are much less rounded and poorly sorted (10,623'), at 10,623', 10" still algal nodules but more broken up with some very dark, very small inclusions, almost like stains.
- 10,624.0-10,624.3'  
(0.3') Calcilutite: gray, in part dolomitic, highly siliceous, micritic, with scattered, finely rounded, well sorted algal nodules.
- 10,624.3-10,626.8'  
(2.5') Calcilutite: dark brownish-gray, cryptocrystalline, with dark gray and brownish-gray, minute, rounded scattered spots, some irregular fractures healed with calcite, strong vertical fracturing.

10,626.8-10,628.0' No recovery.  
(1.2')

- 10,628-10,640 Limestone: white to gray, cryptocrystalline, finely brecciated, a calcarenite; Limestone: brownish-gray, cryptocrystalline, a calcilutite; Chert: subtranslucent, 10%; trace of light green Shale: in part slightly silty; cavings common in the sample.
- 10,640-10,650 Limestone: white to gray, a calcarenite; increased light brownish-gray, subtranslucent, siliceous calcilutite; trace of bluish-gray to smoky, subtranslucent chert; some dark, skeletal intraclasts in a lighter matrix.
- 10,650-10,660 Limestone: as above, white to gray, in part mottled, finely brecciated and recemented, a calcarenite; Limestone: brownish-gray, as above; trace of Chert: as above; sponge spicules(?).
- 10,660-10,670 Limestone: as above, in general darker, more argillaceous; trace of light gray, subtranslucent limestone; increased chert, 5%.
- 10,670-10,680 Limestone: light to dark gray, in part mottled, with subangular to subrounded, nonskeletal intraclasts in a lighter matrix, a calcarenite; some white limestone, with very light brownish-gray, subangular intraclasts in a chalky matrix; trace of chert.
- 10,680-10,690 Calcarenite: white to gray, as above, in part argillaceous; increased Calcilutite: light brownish-gray, subtranslucent, 25%; trace of dark Amphipora in a micritic matrix.
- 10,690-10,700 Calcarenite: as above, less argillaceous; slight increase in light brownish-gray calcilutite; trace of smoky, angular chert fragments; a crinoid fragment.
- 10,700-10,710 Calcarenite and Calcilutite: as above; trace of chert; trace of green to light green shale.
- 10,710-10,720 Calcarenite: as above, white to gray, with indeterminate, badly altered fossils; reduced calcilutite; rare calcite filling minor fractures; trace of light green shale.
- 10,720-10,730 Calcarenite: as above, more highly brecciated; some darker skeletal intraclasts in a lighter matrix; small amount of brownish-gray calcilutite.

- 10,730-10,740      Calcarenite: as above; rare calcilutite; Chert: bluish-gray to light brown and smoky, translucent to subtranslucent, angular fragments, 40%; some softer, white, chalky limestone.
- 10,740-10,750      Calcarenite: as above; flood of Amphipora, mostly dark but some light brown, with abundant sparry calcite in the matrix; suggests a relatively high energy environment; Chert: as above, 5%.
- 10,750-10,760      Limestone, reduced Amphipora; some seems to be in a micritic matrix, and some of the orientation of the calcite axes suggests calcite replacement of the micrite rather than sparry calcite; trace of algal pellets; small amount of brownish-gray, subtranslucent calcite; trace of light green, silty shale; some dark gray shale cavings.
- 10,760-10,770      Limestone, increased light brown Amphipora in a sparry calcite matrix; trace of concentric algae rings replaced by calcite; some brownish-gray, subtranslucent calcilutite; trace of chert, bluish-gray and smoky brown, subtranslucent.
- 10,770-10,780      No returns.
- 10,780-10,790      Limestone: as above; trace of Amphipora; small amount of brownish-gray calcilutite; trace of light green shale; trace of bluish-gray chert.
- 10,790-10,800      Limestone: as above, light gray to gray, cryptocrystalline, finely brecciated and recemented, a calcarenite; Limestone: white, in part chalky, with some light brown, subtranslucent, nonskeletal intraclasts; small amount of light brownish-gray, subtranslucent calcilutite; trace of Amphipora; trace of bluish-gray and brown, subtranslucent chert; some darker shale appears to be cavings.
- 10,800-10,810      Limestone: as above; abundant cream, in part microcrystalline, softer than above, almost friable, a calcarenite; the light brownish-gray calcilutite is platy in part; trace of Chert: as above; some light green shale.
- 10,810-10,820      Limestone: cream to light brownish-gray, crypto to microcrystalline, finely brecciated and recemented, a calcarenite; some nonskeletal, angular, light brown, subtranslucent intraclasts; some recrystallized calcite in the matrix; minor light gray to gray calcarenite; trace of light brownish-gray, subtranslucent calcilutite.

- 10,820-10,830 Limestone: cream to light gray, crypto to microcrystalline, in part chalky, finely brecciated and recemented, a calcarenite; minor light brownish-gray to gray calcilutite; trace of chert; trace of stylolitic partings with a low amplitude.
- 10,830-10,840 Limestone: light to medium gray, a calcarenite; some Calcilutite: as above; trace of pyrobitumen in fractures, in a light gray, subtranslucent limestone; shale, 5%; trace of minute calcite, rod-like structures in a creamy matrix; trace of low amplitude stylolitic partings.
- 10,840-10,850 Limestone: white and light brownish-gray to darker gray, cryptocrystalline, finely brecciated and recemented, a calcarenite; some disseminated pyrite in the limestone; trace of Amphipora, in part replaced by pyrobitumen; minor calcilutite; trace of chert, in part a siliceous replacement of a calcarenite; increased Shale: gray to dark gray, rough texture, irregular fracture, 15%; trace of light green shale; some reworked shale makes up 15% of the sample.
- 10,850-10,860 Calcarenite: as above, darker, more argillaceous; small amount of brownish-gray and gray calcilutite; Shale: as above, 15%.
- 10,860-10,870 Limestone: buff, cryptocrystalline, a calcarenite; small amount of brownish-gray calcilutite; Shale: gray to dark gray, silty, 10%; trace of brown, smoky chert.
- 10,870-10,880 Limestone: buff, light gray and dark gray, a calcarenite, grading into buff and light gray calcilutite; an inclusion of sandstone, with mafic minerals in the limestone; trace of chert.
- 10,880-10,890 Calcarenite; in general the limestone is more argillaceous; some dark, skeletal intraclasts; trace of pyrobitumen; increased shale, 20%.
- 10,890-10,900 Calcarenite: with considerable light gray Limestone: subtranslucent with some translucence; minor calcilutite; Shale: as above, 10%; trace of chert.
- 10,900-10,910 Limestone: buff to dark gray, a calcarenite, with abundant Amphipora, mainly dark gray, in a sparry calcite; some light brownish-gray, subtranslucent, angular fragments in a micritic matrix; some brownish-gray calcilutite; trace of light translucent limestone; increased light bluish-gray, subtranslucent chert, 10%.

- 10,910-10,920      Calcarenite and Calcilutite: as above.
- 10,920-10,930      Limestone: as above; slight reduction in Amphipora; increased transparent to translucent limestone.
- 10,930-10,940      Limestone: cream, light to dark gray, crypto to microcrystalline, a calcilutite grading to a calcarenite; rare glauconite grains in the darker limestone; some calcite inclusions, in part following old fractures; some minute rod-like structures replaced by calcite; trace of subtranslucent chert; some Shale: gray to dark gray, silty, in part platy.
- 10,940-10,950      Limestone: as above, with increased Calcilutite: cream and light gray; trace of chert, with Amphipora.
- 10,950-10,960      Limestone: ss above, with increased calcarenite; trace of Amphipora; trace of chert.
- 10,960-10,970      Calcarenite, increased light to dark gray; small amount of Amphipora in a sparry Calcite: light brown and dark gray.
- 10,970-10,980      Calcarenite: as above, in part dark gray, very argillaceous; some skeletal intraclasts; trace of Amphipora in sparry calcite; rare calcilutite; slight increase in chert.
- 10,980-10,990      Calcarenite: as above, in part more argillaceous; considerable dark gray Amphipora in a sparry calcite, often replaced by chert; some nonskeletal angular intraclasts; some colonial, septate corals; trace of gray, microcrystalline limestone, in part slightly silty; minor chert; some gray to dark gray shale; trace of clear, angular quartz fragments.
- 10,990-11,000      Limestone: buff and light to dark gray, mostly a calcarenite, with minor calcilutite; trace of light green shale; Shale: dark brown to dark gray, silty, possible cavings.
- 11,000-11,010      Limestone: as above, more argillaceous; some Amphipora, in part dark and in part light brown, in a sparry calcite; slight increase in calcilutite; Shale: as above, 15%; slight increase in Chert: mostly milky.
- 11,010-11,020      Calcarenite and minor Calcilutite: as above, buff to light gray and dark gray, mainly argillaceous; rare Amphipora; some chert; trace of regularly spaced dark specks in a light matrix, probably an echinoderm.

- 11,020-11,030      Calcarenite: buff, light brownish-gray, light and dark gray, finely brecciated and recemented; small amount of calcilutite, mostly gray; trace of clear, angular dolomite fragments; trace of milky quartz.
- 11,030-11,040      Calcarenite: as above; numerous Amphipora and other dendritic stromatoporoids, mainly in a sparry calcite, but with some of the matrix consisting of poorly oriented fine calcite crystals; trace of clear, subhedral dolomite crystals; trace of light buff and light gray calcilutite; some Chert: in part milky.
- 11,040-11,050      Calcarenite: as above, with increased dark gray; small amount of Amphipora; trace of calcilutite; trace of chert; considerable Shale: dark brown and dark gray, 25%.
- 11,050-11,060      Calcarenite: as above, with rare Amphipora; some calcilutite; trace of chert; Shale: as above, 15%.
- 11,060-11,070      Calcarenite: as above, with a trace of calcilutite; some thin wafers of clear dolomite, in part limy; Shale: as above, 10%.
- 11,070-11,080      Calcarenite: as above; trace of buff calcarenite; scattered Amphipora in a sparry calcite; some pearly chert; minor calcite; trace of shale.
- 11,080-11,090      Calcarenite: as above, with some light gray, subtranslucent limestone; some angular, frosted chert fragments and some subrounded nodules; trace of clear, siliceous dolomite; rare calcilutite; trace of Amphipora.
- 11,090-11,100      Calcarenite: as above; trace of darker lutite with some algal pellets; increased light brown to light gray calcilutite; trace of buff, microcrystalline limestone.
- 11,100-11,110      Limestone: as above, light gray to dark gray, with some buff, cryptocrystalline to microcrystalline, fine to more coarsely brecciated and recemented, a calcarenite; trace of Amphipora; small amount of calcilutite; in part showing a mottling, suggesting weak turbidity currents; trace of calcite.
- 11,110-11,120      Calcarenite: as above, slightly lighter gray, more finely brecciated, less microcrystalline; less calcilutite; some white calcite; trace of chert; rare Amphipora.
- 11,120-11,130      Limestone: buff to light gray, with rarer darker gray, mainly a calcarenite with lesser calcilutite, in part subtranslucent; trace of translucent dolomite, with some glauconite grains, in part highly siliceous; trace of

- translucent limestone, with glauconite inclusions; rare Amphipora; some algal nodules in the calcarenite; chert, subtranslucent, angular fragments.
- 11,130-11,140      Calcarenite: as above, in general more argillaceous; numerous Amphipora in a sparry calcite; some algal nodules; Chert: as above, 10%.
- 11,140-11,150      Calcarenite: as above, with increased buff, less dark gray, in part microcrystalline; scattered Amphipora; mostly dark gray; trace of algal nodules; some calcilutite.
- 11,150-11,155      Calcarenite: as above, with increased subtranslucent; some dolomitic limestone; trace of dolomite; rare Amphipora; some algal pellets; increased chert, 5%.
- 11,155-11,160      Calcarenite: as above; increased subtranslucent limestone; some gray Limestone: cryptocrystalline to microcrystalline; reduced chert.
- 11,160-11,170      Calcarenite: as above, darker gray, more argillaceous; less subtranslucent limestone; some gray, microcrystalline, dolomitic limestone; small amount of calcilutite; some clear Dolomite: in part with weathered glauconite grains; increased chert, 5%.
- 11,170-11,180      Calcarenite: buff to light gray and light brownish-gray; trace of Amphipora; some algal pellets; trace of pyrobitumen; some calcilutite; Chert, 5%.
- 11,180-11,185      Calcarenite, with lesser Calcilutite: light buff and light brownish-gray; some transparent fragments, very siliceous, slightly dolomitic; increased chert, 10%.
- 11,185-11,190      Calcarenite: as above, but more argillaceous, in part microcrystalline; reduced chert; shale appears reworked.
- 11,190-11,200      Calcarenite: light gray to gray, with rare buff; small amount of Limestone: silty to finely sandy, mottled, light gray and pink; trace of Siltstone: in part light green, but mainly weathered brick-red; increased Chert: white to gray, subtranslucent, 20%; trace of light green limestone.
- 11,200-11,210      Calcarenite: as above; some gray, crypto to microcrystalline limestone; trace of chert; reduced pink and light green siltstone; reduced lateritic siltstone.
- 11,210-11,220      Calcarenite: increased buff, pink and gray, with rare light green, mottled limestone; some algal pellets; small amount of gray, microcrystalline dolomite; trace of Chert: as above.

- 11,220-11,230 Calcarenite: variegated, grading to a Calcirudite: pink, green, buff and light gray, with dolomite fragments, limestone fragments and some quartz fragments; some of the quartz is clear, arkosic, with pink orthoclase crystals; light green Limestone: crypto to microcrystalline, grading from a calcilutite to a calcarenite; trace of Shale: silty, brick-red, lateritic; trace of Chert: as above; some light brown Amphipora and algal pellets.
- 11,230-11,235 Calcirudite: as above, but with reduced calcilutite; in part the brick-red color is in the matrix and outlines the irregularly sized fragments; some green, silty limestone with concentrations of glauconite grains; trace of lateritic, silty shale.
- 11,235-11,240 Calcirudite: as above; the rudite has some angular quartz fragments and some limestone fragments in a calcareous matrix; Chert: mostly bluish-gray, subtranslucent, 25%.
- 11,240-11,245 As above, with less color, in part silty.
- 11,245-11,250 Chert: bluish-gray, subtranslucent, 70%; silty, buff and gray limestone.
- 11,250-11,255 Chert, 10%; Limestone: as above, buff, with some red staining in the matrix; trace of light green limestone; some gray, microcrystalline dolomite; trace of light green shale.
- 11,255-11,260 Calcarenite: buff, grading to a calcirudite; Limestone: light gray to gray, with some light green, in part dolomitic, grading from a calcilutite to a calcarenite; Chert: as above, 5%.
- 11,260-11,265 Limestone: soft, buff, highly fractured, a calcarenite, with brown, nonpetroliferous staining in the fractures; some gray calcilutite; trace of green limestone, in part weathered red, in part microcrystalline; some chert; trace of arkosic quartz fragments.
- 11,265-11,270 Siltstone: pink to brick-red, lateritic, dolomitic to limy in part, 50%; small amount of light green siltstone, probably the unweathered portion of the red; some calcilutite; chert, 5%; trace of arkosic quartz fragments.
- 11,270-11,275 Chert: frosted to bluish-gray, subtranslucent, 50%; buff, soft, marly limestone, with minor red staining; trace of light gray to gray calcarenite.

- 11,275-11,280 Chert, 30%; increased light gray to gray Calcarenite: finely brecciated; reduced buff, marly limestone, in part silty.
- 11,280-11,285 Calcarenite: light gray to gray, with some algal pellets; reduced marly limestone; trace of lateritic siltstone; small amount of chert.
- 11,285-11,290 Calcarenite: light gray to gray calcarenite, with common Amphipora in sparry calcite and in some recrystallized micrite; some algal pellets; small amount of buff, marly limestone; small amount of chert.

## ARMOUR KANE

Well Log Analyst  
18360-6 Cantara St.  
Reseda, Ca. 91335  
(213) 993-0586

February 7, 1977

Mr. Gordon Legg  
Husky Oil-NFR Operations, Inc.  
3201 C. Street  
Anchorage, Alaska 99503

Dear Mr. Legg:

On January 28 and 29, 1977, Schlumberger ran the final logs on your South Harrison Bay Well No. 1. Logs included Dual- Induction, Sonic/Gamma Ray, Neutron-Density/Gamma Ray, Dipmeter, Cement Bond-Gamma Ray-Casing Collar Locator and sidewall cores from casing at 8369 to total depth of 11,290. No identifiable correlations with the Cape Halkett or Teshepuk Lake wells could be made in the upper part of the hole but from the top of the Sag River sand at 8900' correlations with the Teshepuk Lake well were very good. The Harrison Bay well runs 300-400' lower than Teshepuk to the top of the Kavik and then a thickened section puts Harrison Bay over 600' lower at the Echooka and Lisburne. At the top of the Keikiktuk Harrison Bay is 625' lower than Teshepuk.

Neutron-Density cross-plots in the Sag River result in porosities ranging from 10-15% and indicate the presence of both lime and dolomite. Water saturation ranges from 85-100% and invasion appears quite shallow.

Spot checks throughout the Sadlerochit indicate that it, too, is both limey and dolomitic with porosities ranging from about 5% to a high of about 15% and water saturations all prohibitively high due to the relatively low resistivities combined with the low porosities. Resistivity variations are due to porosity changes.

The Echooka and Lisburne are characterized by porosities averaging less than 3% with a high percentage of dolomite. These low porosities preclude the possibility of the formations constituting a productive reservoir.

Thank you for the opportunity of serving you.

Very truly yours,



Armour Kane

HUSKY OIL NPR 4 OPERATIONS

DRILL STEM TEST REPORT FORM

WELL NAME South Harrison Bay No. 1

Test Number DST #1 Hole Size 12 1/2" OH  
 Date 12/13/76 Drill Pipe (Size & Lgth) 4 1/2", 16.6#  
 Test Interval 7119-7207 Drill Collars (Size & Lgth) N/A  
 Total Depth 7207' Type of cushion fluid Water  
 Amount of cushion 6000'

TEST DATA:

1. Tool open at 6:25a.m. hours.
2. Initial open period 10 mins.
3. Initial shut-in period 30 mins.
4. Final flow period 60 mins.
5. Final shut-in period 60 mins.
6. Description of blow on initial open period very weak blow
7. Description of blow during test very weak blow, dead in 5 minutes of final flow.
8. G.T.S. - mins; O.T.S. - mins; Bottom hole choke size 3/4"  
 Surface choke size 1/4"
9. Flow Rate: Gas - C.F.P.D. Oil - B.P.H. G.O.R. -
10. Gravity of Gas - Gravity of Oil -
11. Total fluid recovery: TSTM - cushion fluid and very little rat-hole mud.
12. Resistivity of H<sub>2</sub>O - Chlorides of H<sub>2</sub>O - P.P.M.
13. Depth of top press bomb 7091', 7095' Bottom Bomb 7199', 7203'

PRESSURE DATE:

	<u>7091'</u>	<u>7095'</u>	<u>7199'</u>	<u>7203'</u>
Top Bomb:			Bottom Bomb:	
I.H.P.	<u>4028</u>	<u>4034</u>	I.H.P.	<u>4109</u> <u>4095</u>
I.S.I.P.	<u>2814</u>	<u>2829</u>	I.S.I.P.	<u>2907</u> <u>2884</u>
I.F.P.	<u>2611</u>	<u>2621</u>	I.F.P.	<u>2695</u> <u>2674</u>
F.F.P.	<u>2611</u>	<u>2621</u>	F.F.P.	<u>2695</u> <u>2674</u>
F.S.I.P.	<u>2834</u>	<u>2851</u>	F.S.I.P.	<u>2932</u> <u>2904</u>
F.H.H.	<u>3983</u>	<u>3985</u>	F.H.H.	<u>4060</u> <u>4045</u>
Temp	<u>170°F</u>	<u>170°F</u>	Temp	<u>170°F</u> <u>170°F</u>

SAMPLE CHAMBER DATA

1. Gas \_\_\_\_\_ C.F.
2. Oil \_\_\_\_\_ C.C.
3. H<sub>2</sub>O \_\_\_\_\_ C.C.
4. Mud \_\_\_\_\_ C.C.
5. B.O.R. \_\_\_\_\_ B.S. & W \_\_\_\_\_ %

REMARKS:

CONFIDENTIAL

HUSKY OIL NPR 4 OPERATIONS

DRILL STEM TEST REPORT FORM

WELL NAME South Harrison Bay No. 1

Test Number DST #2 Hole Size 9 5/8", 53.5#  
 Date 2/2/77 Drill Pipe (Size & Lgth) 4 1/2", 16.6#  
 Test Interval 7120 - 7290 Drill Collars (Size & Lgth) N/A  
 Total Depth 6315' PBD Type of cushion fluid Water  
 Pkr. set @7080' Amount of cushion 1000'

TEST DATA:

1. Tool open at 7:55 a.m. hours.
2. Initial open period 15 mins.
3. Initial shut-in period 30 mins.
4. Final flow period 120 mins.
5. Final shut-in period 123 mins.
6. Description of blow on initial open period No blow on initial flow.
7. Description of blow during test No blow, gradually increasing to very weak blow.
8. G.T.S. - mins: O.T.S. - mins; Bottom hole choke size 3/4"  
 Surface choke size -
9. Flow Rate: Gas - C.F.P.D. Oil - B.P.H. G.O.R. -
10. Gravity of Gas - Gravity of Oil -
11. Total fluid recovery: TSTM - water cushion with very small amount of rathole mud.
12. Resistivity of H<sub>2</sub>O - Chlorides of H<sub>2</sub>O - P.P.M.
13. Depth of top press bomb 7051', 7057' Bottom Bomb 7090'

PRESSURE DATE:

Top Bomb:	<u>7051'</u>	<u>7057'</u>	Bottom Bomb:	<u>7090'</u>
I.H.P.	<u>3950</u>	<u>3945</u>	I.H.P.	<u>3904</u>
I.S.I.P.	<u>647</u>	<u>635</u>	I.S.I.P.	<u>659</u>
I.F.P.	<u>546</u>	<u>537</u>	I.F.P.	<u>563</u>
F.F.P.	<u>549</u>	<u>542</u>	F.F.P.	<u>565</u>
F.S.I.P.	<u>3173</u>	<u>3169</u>	F.S.I.P.	<u>3131</u>
F.H.H.	<u>3936</u>	<u>3937</u>	F.H.H.	<u>3889</u>
Temp	<u>168°F</u>		Temp	<u>170°F</u>

SAMPLE CHAMBER DATA

1. Gas                      C.F.
2. Oil                      C.C.
3. H<sub>2</sub>O                      C.C.
4. Mud 2360 C.C.
5. B.O.R.                      B.S. & W                      %

REMARKS:

CONFIDENTIAL

HUSKY OIL NPR 4 OPERATIONS

DRILL STEM TEST REPORT FORM

WELL NAME South Harrison Bay No. 1

Test Number DST No. 3 Hole Size 8.5" (9 5/8, 53.5#)  
 Date 2/4/77 Drill Pipe (Size & Lgth) 4 1/2" x 16.6#  
 Test Interval 5680 - 5790 Drill Collars (Size & Lgth) N/A  
 Total Depth 6286 PBD Type of cushion fluid water  
 Pkr set @5628' Amount of cushion 1000'

TEST DATA:

1. Tool open at 4:15 a.m. hours.
2. Initial open period 15 mins.
3. Initial shut-in period 32 mins.
4. Final flow period 120 mins.
5. Final shut-in period 135 mins.
6. Description of blow on initial open period Very weak blow with very slight increase by end of initial flow.
7. Description of blow during test Blow very weak throughout final flow increasing slightly by end of flow period (2" H<sub>2</sub>O up to 6" H<sub>2</sub>O).
8. G.T.S. 0 mins; O.T.S. 0 mins; Bottom hole choke size 3/4"  
Surface choke size -
9. Flow Rate: Gas ISTM C.F.P.D. Oil - B.P.H. G.O.R. -
10. Gravity of Gas - Gravity of Oil -
11. Total fluid recovery: ISTM - Cushion fluid plus slight amount of rathole drilling mud.
12. Resistivity of H<sub>2</sub>O - Chlorides of H<sub>2</sub>O - P.P.M.
13. Depth of top press bomb 5608', 5614' Bottom Bomb 5737', 5741'

PRESSURE DATE:

Top Bomb:

I.H.P.	<u>3142</u>	<u>3140</u>
I.S.I.P.	<u>1879</u>	<u>1862</u>
I.F.P.	<u>515</u>	<u>519</u>
F.F.P.	<u>608</u>	<u>603</u>
F.S.I.P.	<u>2232</u>	<u>2220</u>
F.H.H.	<u>3142</u>	<u>3140</u>
Temp	<u>134°F</u>	<u>134°F</u>

Bottom Bomb:

I.H.P.	<u>3086</u>	<u>3279</u>
I.S.I.P.	<u>1845</u>	<u>1953</u>
I.F.P.	<u>537</u>	<u>550</u>
F.F.P.	<u>622</u>	<u>637</u>
F.S.I.P.	<u>2183</u>	<u>2312</u>
F.H.H.	<u>3086</u>	<u>3279</u>
Temp	<u>140°F</u>	<u>140°F</u>

SAMPLE CHAMBER DATA

1. Gas 0.2 C.F.
2. Oil tr. dead oil - C.C.
3. H<sub>2</sub>O - C.C.
4. Mud 2400 C.C. - 10.2 ppg (PH = 11 & Cl<sup>-</sup> 600)
5. B.O.R. - B.S. & W Z

REMARKS:

CONFIDENTIAL