NATIONAL PETROLEUM RESERVE IN ALASKA

GEOLOGICAL REPORT

SOUTH BARROW WELL NO. 17

HUSKY OIL NPR OPERATIONS, INC.
Prepared 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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GEOLOGIC SUMMARY

INTRODUCTION

The South Barrow No. 17 well is located in the NW 1/4 of protracted Section 30, T22N, R16W, Umiat Meridian, North Slope Borough, Alaska. The surveyor's plat locates the well 1625' FNL and 2150' FWL of the section (see Figures 1 & 2). The well was drilled in early 1978 in order to further evaluate the productive capability of the Lower Barrow gas sandstone, and provide additional gas capacity for the village of Barrow as well as to investigate the possibility of oil production in the Sag River Sandstone.

Drilling operations commenced on March 2, 1978. The well was completed in the Lower Barrow sandstone, after testing sandstones in the "Pebble Shale", Lower Barrow sandstone and the Sag River Sandstone. A later production test of the Upper Barrow sandstone achieved negative results. An Engineering Memorandum of May 17, 1979 (see Appendix D) concluded that the Upper Barrow sandstone, as penetrated in South Barrow No. 17, is not a commercially producible zone.

The thin sandstones in the "Pebble Shale" yielded gas, which was too small to measure. Chart interpretation indicated a limited, depleting reservoir. The Sag River Sandstone recovered gas (T.S.T.M.) and 18 barrels of a black, oil-mud emulsion. Again, chart interpretation indicated a depleting reservoir. South Barrow No. 17 was then completed in the Lower Barrow gas sandstone, achieving an AOF of 6.50 MMCFGPD with approximately 200 BWPD (see Appendix D).

In each of the South Barrow wells drilled after South Barrow No. 13, an inhibitive mud system, containing calcium-chloride, was used after intermediate casing (9-5/8" to approximately 1,500 feet). This was done in order to minimize damage to the formation from interstitial swelling clays, which were known to exist in the Barrow sandstones and the Sag River Sandstone (this was determined by water susceptibility tests that were conducted on cores obtained in the U. S. Navy, South Barrow Nos. 12 and 13 wells). Below the 9-5/8" casing, the well was switched over to an inhibitive calcium-chloride lignosulfonate mud system. The high concentrations of calcium-chloride used in the section below the intermediate casing, necessitated running a dual laterolog below the casing, since the high calcium-and-chloride ion concentration in the mud adversely affects the measurement of conductivity by the dual induction log. The dual induction log was run in each well above the intermediate casing, since fresh-water-mud was used in that section of the hole.

PRE-DRILLING PROGNOSIS

The primary objctive in drilling South Barrow Well No. 17 was to further evaluate the Barrow sandstone in the East Barrow Gas Field. The sandstone had been proven to be productive in South Barrow Nos. 12

and 14. Equally important as an objective was the Sag River Sandstone, which contained good oil shows in South Barrow Nos. 12 and 14. An unsuccessful evaluation attempt to test the Sag River Sandstone was made on South Barrow No. 14.

A secondary objective in drilling South Barrow No. 17, was to test the oil or gas potential of several thin sandstones in the "Pebble Shale". These sandstones had exhibited good shows in South Barrow No. 14, and log analysis indicated the presence of hydrocarbons, probably gas. These sandstones were to be tested, "open hole", if possible.

POST-DRILLING SUMMARY

The secondary objective, sandstones in the "Pebble Shale" were tested on Drill-Stem Test No. 1, with a test interval of 1512-1715'. The test yielded gas-to-surface in 90 minutes, at a rate too small to measure. Gas production was proved in these sandstones, but their thin shaly nature, and their shallow depth, with attendant low pressures, probably precluded any significant production rates.

The Sag River Sandstone was conclusively tested at the South Barrow No. 17 location. Two drill-stem tests were conducted from 2212-2322' and from 2212-2345'. Both tests recovered gas-to-surface (25 minutes and 120 minutes, respectively), and 18 barrels of black, oil-mud emulsion (first test) and 24 barrels of gas- and slightly oil-cut mud (second test). Pressure draw-down information on the charts indicated the probability of a limited, depleting reservoir in both cases.

South Barrow No. 17 was first completed as a suspended gas well in the Lower Barrow sandstone. The sandstone was drill-stem tested "on the way down" on a test from 2105-2147'. This test had gas-to-surface in 8 minutes at a stabilized rate of 1.09 MMCFGPD with 700 psi surface pressure (see Appendix C for details on all drill-stem tests). A later production test in cased hole, yielded a calculated absolute open flow potential of 6.50 MMCFGPD from a perforated interval of 2101-2127' (see appendix). This test also had water production, with a final ratio of .031 barrels/MCF, which figures to about 200 barrels/day at the rate of 6.5 MMCFGPD. This is excessive water production and may be due to the well's low structural position.

A decision was made to reenter the well and attempt a completion in the Upper Barrow sandstone. This was done in March and April of 1979. An engineering memorandum of May 17, 1979 concluded that the Upper Barrow sandstone was a non-commercial gas reservoir at this location (see Appendix D).

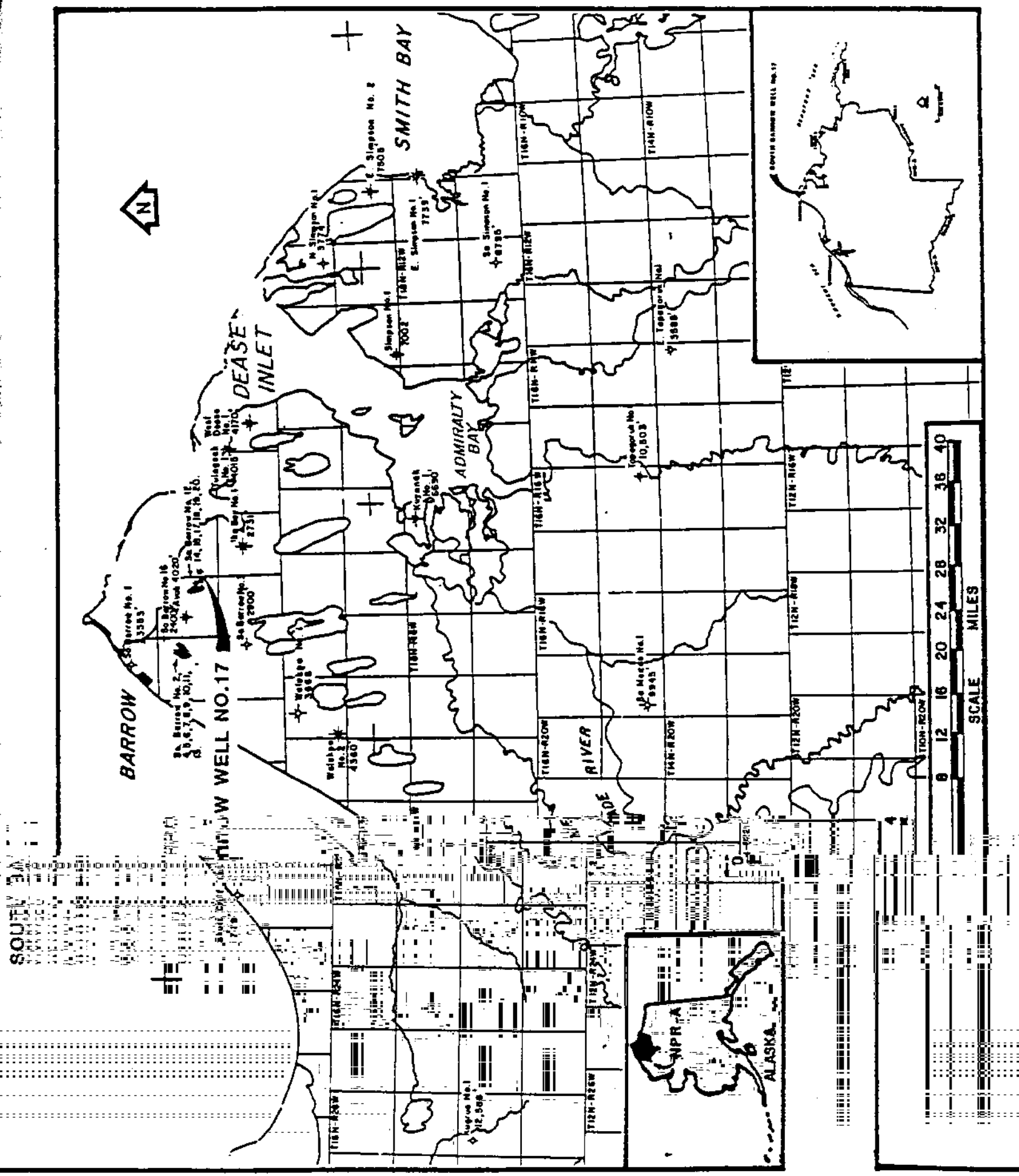
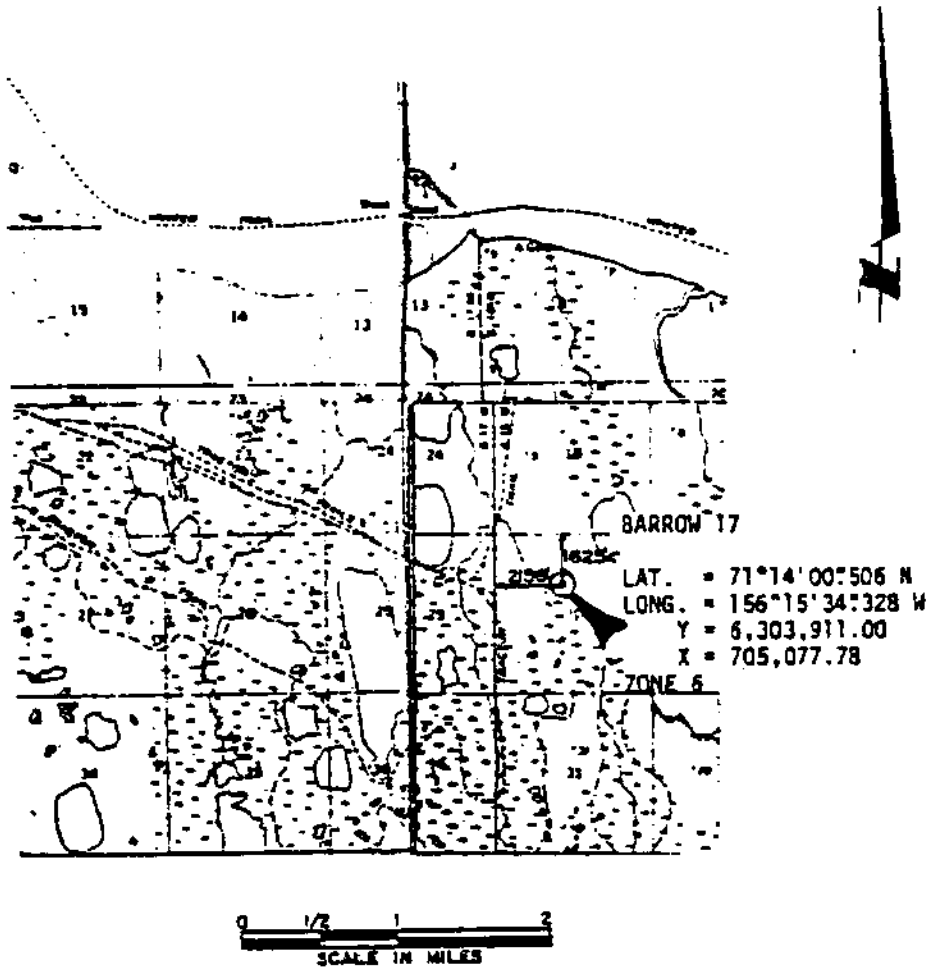


FIGURE 1 - LOCATION MAP - SOUTH BARROW WELL NO. 17



CERTIFICATE OF SURVEYOR

I hereby certify that I am properly registered and licensed to practice land surveying in the State of Alaska and that this plat represents a location survey made by me or under my supervision, and that all dimensions and other details are correct.

August 17, 1977

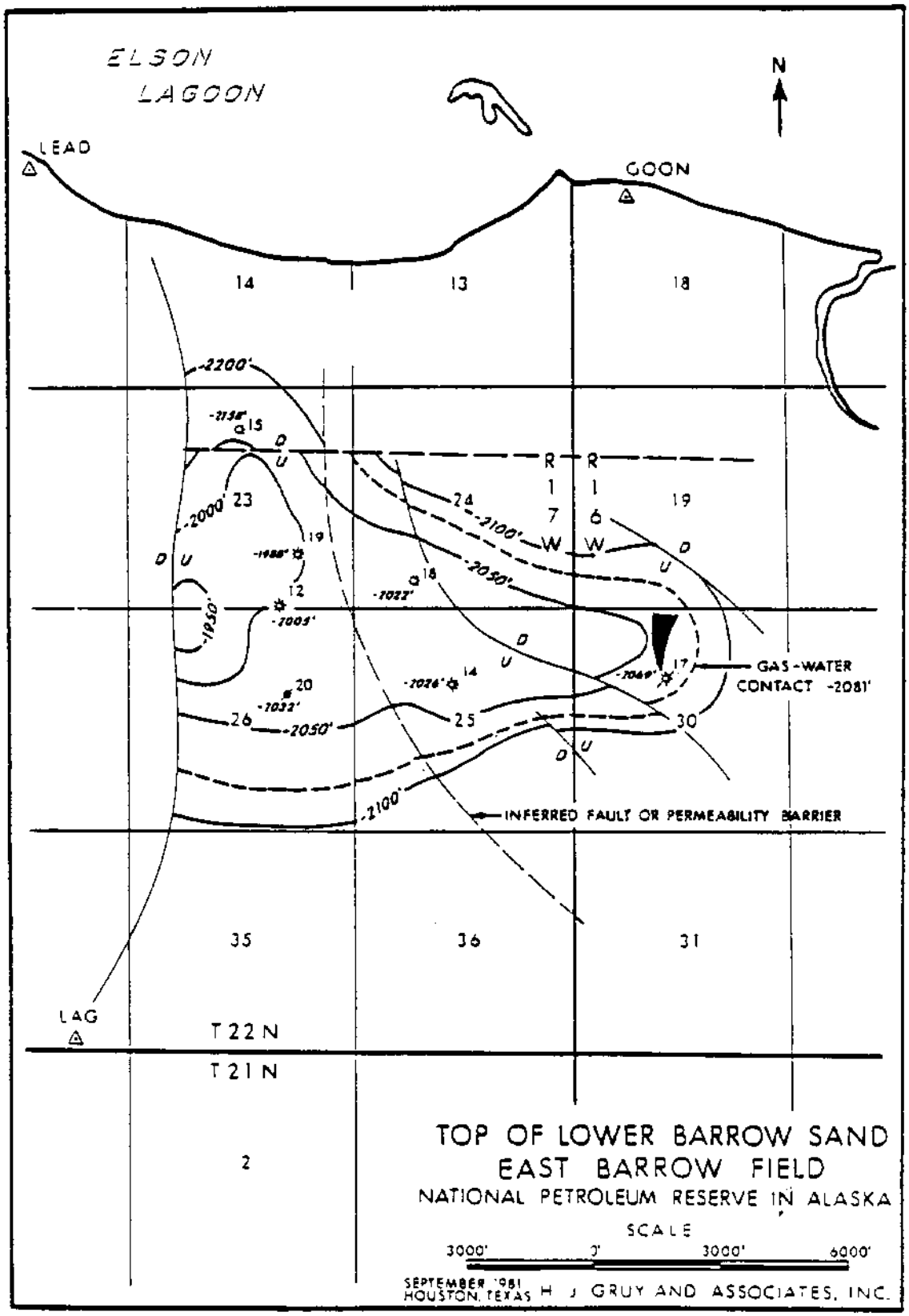
STATE OF ALASKA
No. 953-S

AS STAKED
BARROW 17
LOCATED IN
NW 1/4 PROTRACTED SEC 30 T 22 N, R16W UMIAT MERIDIAN, AK

Surveyed for
HUSKY OIL
N.P.R. OPERATIONS INC.

Surveyed by
Bell, Herring and Associates
ENGINEERS AND LAND SURVEYORS
801 West Fireweed, Suite 102
ANCHORAGE, ALASKA 99503

FIGURE 2 - CERTIFICATE OF SURVEYOR - SOUTH BARROW WELL NO. 17



Revised after H. J. Gruy

FIGURE 3 - STRUCTURE, TOP OF LOWER BARROW SAND

WELLSITE GEOLOGIST'S REPORT
BY: DAVE YOUNG
EDITED BY: GORDON W. LEGG

INTRODUCTION

South Barrow Well No. 17 was drilled as a one-mile step-out to the east of South Barrow Well No. 14 (shut-in gas well). The Barrow gas sand was the primary objective, with secondary objectives being the Sag River Sandstone, and several thin but persistent sandstones in the "Pebble Shale". The well was drilled to a total depth of 2382', penetrating sediments of Recent to Triassic age and terminating in argillite of Pre-Carboniferous age. The well was completed as a shut-in gas well from the Lower Barrow sandstone, with a calculated AOF of 6.50 MMCFGPD. Water production accompanied the gas at a calculated rate of about 200 BWPD which is probably too excessive for sustained gas production.

STRATIGRAPHY

WIRELINE TOPS

No samples caught	0-100'
CRETACEOUS	
Torok Formation	98'
"Pebble Shale"	1408'
JURASSIC	
Kingak Formation	1748'
Upper Barrow sandstone	2040'
Lower Barrow sandstone	2103'
TRIASSIC undifferentiated	2180'
Sag River Sandstone	2277'
INDETERMINATE	
Argillite	2344'

CRETACEOUS

Torok Formation: 100-1408'

The top of the Torok was picked at 98' on the basis of a sharp electric log break representing a change from sandstone to claystone. Paleontological determinations indicate an age of Early Cretaceous (Albian-Aptian), AWA Zone F-10, from 100' (first samples caught) to 1000'.

The lithology over this interval is predominantly medium gray claystone, with thin beds of siltstone and sandstone. A pebble bed approximately 30' thick was encountered at 190', with varicolored orange, green, brown, and black pebbles, and with large pyrite inclusions. Cuttings gas was noted

virtually from the start of mud logging at 100'. At 325', a gas reading of 130 units was recorded, being mostly methane with traces of ethane and propane. It is speculated that gas hydrates may be trapped in thin sand zones which, when drilled, yield gas to the mud system.

From 650' to 760', the lithology is predominantly sandstone. The sandstone is light gray, fine to medium grained, well rounded, carbonaceous, clean and friable to highly argillaceous and tight. The bedding characteristics of this sandstone interval, coupled with the presence of carbonaceous material, indicates probable channel-type deposition. The lithology from 1000-1408' is predominantly shale. A

ies unknown, was found at 1210'. A 73-unit gas neritic foraminifera, spec
2'; however, no sand or potential reservoir rock reading was noted at 134
was noted in the samples.

minations place the interval 1000-1450' in Albian Paleontological age deter
The environment of deposition for the Torok age (AWA Zone F-11).
have been marine neritic to possibly channel Formation is thought to
distributary.

approximately: shale - 75%; siltstone - 17%; and Lithology bulk volume is
sandstone - 8%.

8' "Pebble Shale": 1408-174

picked, for consistency, on a high gamma-ray The "Pebble Shale" is
roughout the immediate South Barrow area. Age response that is found th
aleontological data indicate Early Cretaceous determinations from p
(Neocomian).

440' contains a brown, flaky, laminated to fissile The interval from 1408-1
hard, tight, tan limestone, containing pelecypod shale, with a stringer of
fragments.

inger at 1440-1445' which is fine grained, poorly There is a sandstone str
, with good sample fluorescence and chloroethane consolidated, and friable
cut.

d quartz "floaters" are fairly common. Below 1550', loose, froste

several thin sandstone beds gave gas readings of Between 1590' and 1680',
sample fluorescence and chloroethane cuts were up to 895 units. Good
ones. These sandstones were tested, collectively, observed in these sandst
productive. Test results indicate that they are to see if they might be
is compiled under "Oil and Gas Indications". not. Further information

thology is medium gray, firm, and slightly pyritic From 1680 to 1748', the l
siltstone.

sition (Anderson, Warren & Associates, Inc.) was The environment of depo
eritic waters. probably turbid marine, r

69%; siltstone - 21%; sandstone - 10%. Bulk lithology is shale - 6

JURASSIC

Kingak Formation: 1748-2180'

The Kingak Formation was sidewall cored at 1754', 1800' and 1900'. The lithology was shale, which was dark gray-brown, firm, fissile, and slightly flaky.

Shales predominate in the Kingak Formation. There are also claystones and siltstones present interbedded with the shales. The interval from 2040-2147' comprises the gross interval of the Upper and Lower Barrow sandstones and are described separately. Below the Lower Barrow sandstone and continuing down to the Triassic (2147-2180'), the Kingak shales are principally siltstone with some interbedded claystone Kingak shales are mostly brown and black, firm, fissile, micaceo exhibit some bioturbation; the claystones are light to medium gray bentonitic, micaceous and contain frequent fine grained coal inclusion siltstones are gray, soft, typically sandy and very argillaceous, mostly to shale and occasionally to sandstone.

Age determinations for the interval 1748-1820 is identified as Cre (Neocomian) to Jurassic. The interval from 1820-2170' is Jurassic Zones F-17 to R-18). For the purposes of this report the Formation is picked in the interval 1748-2180'.

Upper Barrow sandstone: 2040-2080'

The Upper Barrow is an argillaceous, fine grained, light gray san with common fossil wood, and lignite. It has good gas odor, stainin fluorescence throughout. Much of this sandstone contains silt and s clays in the matrix.

Lower Barrow sandstone: 2103-2127'

The Lower Barrow sandstone shows the best clean sand development thus far in the East Barrow area. The sand was cored in its e The sandstone is fine to very fine grained, brown, clean, well sorte rounded, friable, and, in part, with thin shale partings. Fossil wo glauconite are common. Bioturbation is present, and it probably r all evidence of crossbedding. The environment of deposition is pro central bar, high-energy marine. Good gas odor, staining, bright fluorescence, and milky-white cut fluorescence occur througho sandstone.

The interval (2105-2147') was open-hole drill-stem tested and flowed a stabilized rate of 1.09 MMCFGPD. More detailed information is pr under "Oil and Gas Indications".

The interval from the base of the Lower Barrow, 2127' down to 214 also cored (Core No. 2, 2126-2147'). The lithology consisted interbedded sequence of siltstone, argillaceous sandstone, and sha 2137', a highly concentrated shell bed occurs, containing fossil wo pyrite inclusions. This sequence appears to be somewhat cycl nature.

TRIASSIC

Rocks of Triassic age were encountered in the interval from 2180-2344'. The upper portion of the Triassic, above the Sag River Sandstone, is primarily siltstone which is light gray, medium hard, sandy, carbonaceous and slightly calcareous; interbedded with the siltstone is claystone which is light gray, soft, slightly carbonaceous and slightly calcareous. Some sandstone is also present and is tan-brown, fine grained, argillaceous, well sorted and well rounded.

Paleontological determinations place the top of the Triassic at 2180'.

Sag River Sandstone: 2277-2344'

The Sag River Sandstone was encountered at 2277'. The top of the formation is sandstone which is brown, medium hard, fine grained, glauconitic, fossiliferous, calcareous, and grading in part to argillaceous sandstone.

Core No. 3 was cut in the Sag River from 2295-2322'. Only 5.5' of core was recovered due to a jammed core barrel. The core consisted of a sandy biocalcarenite, made up mostly of pelecypod and echinoid shell fragments. Soft amorphous glauconite is common in disseminated and thin bed form.

Sidewall cores shot over the missing core interval recovered brown, very fine grained, argillaceous, silty, friable, calcareous, fossiliferous sandstone, which exhibits swelling-clay damage in fresh water.

Core No. 4 was cut from 2322' to 2345'. The bottom one foot of the core consisted of the argillite basement. The core consisted mainly of interbedded biocalcarenite, and calcareous sandstone, increasingly hard and tight with depth; black, tarry residual oil filled the intergranular porosity in the biocalcarenite. In the 2 feet above the argillite, fragments and angular pebbles of black and green argillite occur.

The environment of deposition for the Sag River Sandstone is considered to be inner to middle neritic, based on paleontological determinations. The age is Triassic (AWA Zone F-19).

INDETERMINATE

Argillite: 2344-2382'

The argillite in Core No. 4 is black, hard, brittle, slightly graphitic with a large quartz-filled, vertical fracture. No open fractures or hydrocarbon indications were observed. From 2370', the argillite is increasingly foliated and graphitic, with finely disseminated euhedral pyrite and thin quartz lenses.

The age of the argillite is indeterminate.

OIL AND GAS INDICATIONS

Torok Formation

Hydrocarbons were noted virtually from the start of mud logging at 100'. Gas in cuttings started from the first samples collected at 100'. The first gas readings on the "hot wire" were at 160', with 80 units indicated.

At 325', in the Torok Formation, a 130-unit reading was recorded, mostly methane, with the first indications of ethane and propane. No reservoir potential is indicated from samples, or from log analysis.

At 650' to 760' a sandstone sequence is present with a "clean" sandstone from 650-675'. This sandstone, although porous, had no shows of either gas or visual stain.

From a depth of 1070' down to 1342', background gas gradually increased from 30 units to 100 units, mostly methane, with traces of ethane and propane.

At a depth of 1342', a gas reading of 736 units was recorded. No potential reservoir rock was noted on the logs or in the samples at this depth.

"Pebble Shale"

From 1410', gas increased steadily from 300 units up to a maximum of 1,408 units in the interval 1440-1445'. The gas analyzer indicated 130,000 ppm methane, 2,000 ppm ethane, and a trace of propane. This gas reading came from the top of the "Pebble Shale". A thin bed of light gray, fine grained, friable sandstone, with yellow fluorescence, and an immediate yellow-white cut, was noted in the sample interval from 1420' to 1450'. The electric log shows this sandstone to occur at 1443-1445'.

Several thin stringers of sandstone occur between 1450' and 1500'. These sandstones have bright yellow fluorescence and streaming milky-white to light yellow cuts.

The sandstone stringers above 1512' were not tested, and are considered to be too thin to be of economic significance.

Lost-circulation was encountered at 1530', with approximately 60 barrels of drilling mud being lost to the formation. A sharp drilling break, for a 5' interval, occurs at this point. No sample was recovered, and no gas show was observed.

A sharp gas increase was encountered at 1595', going from 30 units up to 896 units. This was from a thin (2') sandstone stringer.

From 1614' to 1621', a sandstone bed which is persistent in most South Barrow wells is developed. This sandstone has oil stain, bright yellow fluorescence, and immediate yellow-white cut fluorescence. The gas increased from 150 units up to 480 units while drilling the sandstone.

A second sandstone bed also commonly developed in South Barrow wells is developed from 1650' to 1664'. The upper 10' of this sandstone, although argillaceous, has good yellow fluorescence and traces of oil stain. The lower 4' is cleaner with good stain, fluorescence and cut. This interval had a gas reading of 480 units, with gas composition as follows: methane 96,000 ppm; ethane 6,000 ppm; and traces of propane.

Drill-Stem Test No. 1 was run from the 9-5/8" casing shoe at 1512', down to 1715', covering the better developed sandstone beds of the "Pebble Shale". A 500 psi nitrogen cushion was used. Only one flow period and one shut-in period were used. Gas came to the surface in 90 minutes with less than 1 psi wellhead pressure through a 1/4" surface choke. Maximum flowing pressure was approximately 10 psi on a 1/4" choke at 110 minutes, decreasing to less than 5 psi at the shut-in time of 150 minutes. Circulated out gas-cut drilling mud. Charts indicate that the test was mechanically successful, with low productivity, and a depleting reservoir. Pressures recorded from the bottom bomb at 1674' are as follows:

IHP	922 psi
IFP	666 psi
FFP	323 psi
ISIP	537 psi
FHP	922 psi
Temp	55° Fahrenheit

No other gas increases, or potential reservoir sands, were noted in the "Pebble Shale".

Kingak Formation

The first indication of hydrocarbons in the Kingak was in the top of the Upper Barrow sandstone at 2040'. Gas increased from a background of 70 units to 240 units, then increasing to 486 units at 2060'. The chromatograph readings are as follows: methane 68,000 ppm; ethane 2,800 ppm; and propane 300 ppm.

Good gas odor, stain, sample fluorescence, and immediate yellow-white cut fluorescence are present throughout the Upper Barrow. Water susceptibility tests run on sidewall cores from the Upper Barrow show that swelling clays are present in the matrix of the sandstone over much of this interval.

The Lower Barrow sandstone was cored in its entirety. The sandstone has good visible porosity, staining, odor, yellow fluorescence and immediate milky-white cut fluorescence. Log derived porosities average 24%, with calculated water saturations ranging between 32% at the top and 56% at the base (courtesy of well log analyst, Armour Kane).

Drill-Stem Test No. 2 was run in the open hole from 2105' to 2147'. The test was run with one flow period, and one shut-in period, using a 500 psi nitrogen cushion. Tool opened with a steady pressure increase, and with

gas to the surface in 8 minutes. Gas flowed through a 1/4" choke, with a stabilized pressure of 700 psi, at a calculated rate of 1.09 MMCFGPD. Pressure charts indicate a successful test. After unseating the packer, mud was lost in the hole (390 barrels) while trying to circulate. These losses may have been to the previous loss zone at 1530', rather than to the Barrow sandstone.

Drill-Stem Test No. 2 Pressures Bottom Bomb 2143'

IHP	1,240 psi
IFP	606 psi
FFP	891 psi
ISIP	983 psi
FHP	1,240 psi
Temp.	60°F actual

Argillaceous and silty sands, with thin shale, siltstone and shell beds occur below the Lower Barrow sandstone and have fair gas odor, stain, spotty gold-yellow fluorescence and immediate milky-white cut fluorescence.

Sag River Sandstone

The most porous interval of the Sag River Sandstone, from 2300' to 2311', has a calculated average porosity of 16.6%, with average water saturation of 43% (courtesy Armour Kane, well log analyst). Sidewall cores from this interval consist of very fine grained, brown, argillaceous, silty, friable, slightly calcareous, and fossiliferous sandstone. Good oil stain, odor, gold fluorescence and brown-tea chloroethane cuts persist throughout the formation. The bottom 6' of the Sag River is a biocalcarenite, with black, highly viscous oil trapped in interparticle shelter porosity.

Very little gas was indicated by the hot-wire. The peak gas reading in the Sag River was at 2335', where 62 units were recorded; gas chromatograph readings were: methane 11,000 ppm, ethane 600 ppm, with no heavier gasses recorded.

Drill-Stem Tests Nos. 3 and 4 were run on the Sag River Sandstone. Drill-Stem Test No. 3 was run from the 7" casing shoe at 2212' to 2322', using a 500 psi nitrogen cushion, and using only one flow period and one closed-in period. Gas flowed to the surface in 25 minutes, with rat-hole mud to the surface in 55 minutes, and gas- and slightly oil-cut emulsified mud in 65 minutes. The well was closed-in after 90 minutes, with a well-head pressure of 255 psi on a 1/4" choke. The well was unloading spurts of emulsified gas- and oil-cut drilling mud (estimated less than 1% oil) at that time. Pressure charts show a mechanically successful test, and are interpreted to indicate a depleting reservoir, based on analysis of flowing pressure curve.

Drill-Stem Test No. 3 Pressures Bottom Bomb 2298'

IHP	1,287 psi	
IFP	602 psi	
FFP	794 psi	(peak of 915 psi)
ISIP	1,029 psi	
FHP	1,448 psi	(increased mud weight before pulling out of hole)

Drill-Stem Test No. 4 was run from 2212' to 2345' which covered the Sag River and the top 1' of the argillite. The same test conditions that were used on Drill-Stem Test No. 3 were used. Gas flowed to the surface in 120 minutes with less than 1 psi well-head pressure. Closed well in after 180 minutes with less than 1 psi well-head pressure (weak blow). Reversed out 24 barrels of gas- and very slightly oil-cut mud. Pressure charts indicated a mechanically successful test with some plugging during the flow period.

Drill-Stem Test No. 4 Pressures Bottom Bomb 2319'

IHP	1,395 psi	
IFP	623 psi	
FFP	1,051 psi	
ISIP	1,158 psi	
FHP	1,395 psi	

illing operations were completed, 7" casing was run to 2212' and a on test was conducted in the Lower Barrow sandstone (perforations 7'). The sandstone attained an AOF of 6.50 MMCFGPD, but also d water at a ratio of 0.031 barrels/MCF, or about 200 barrels/day AOF rate (see Appendix D). This water production is probably too e for sustained gas production. The well was left as a suspended

arrow Well No. 17 was reentered for a workover attempt in March ril of 1979. The Upper Barrow sandstone was perforated from 8, 2054-2065', 2080-2088' and then flow tested. The results were nting and an engineering memorandum of May 17, 1979 concluded e Upper Barrow sandstone in the South Barrow No. 17 was mercial (see Appendix D).

SIONS

e complete sedimentary section above the argillite was penetrated l evaluated at this location.

e "Pebble Shale" sandstone stringers are gas bearing at this ation; however, clay and silt in the matrix reduce the permeability the point where these sands are not economically producible.

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3. The well has probably defined the down-dip productive limits of the Lower Barrow sandstone.

4. The Sag River Sandstone is not producible at this location, but oil and gas indications are encouraging. The formation may prove to be productive where a cleaner reservoir is developed.

5. The argillite showed no indication of hydrocarbons or open fracturing.

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SUMMARY OF PERTINENT DATA *

WELL NAME:	South Barrow Well No. 17
API NO.:	50-023-20011
OPERATOR:	Husky Oil NPR Operations, Inc.
LOCATION:	1625' FNL, 2150' FWL, NW 1/4, protracted Section 30, T22N, R16W, Umiat Meridian, North Slope Borough, Alaska
COORDINATES:	Latitude: 71°14'00.506"N Longitude: 156°15'34.328"W X = 705,077.78 Y = 6,303,911.00 Zone 6
ELEVATION:	33' Kelly Bushing, 7' Ground
DATE SPUDDED:	March 2, 1978
TOTAL DEPTH:	2382' (driller) 2380' (Schlumberger) 2162' (PBTD)
DATE REACHED TOTAL DEPTH:	April 1, 1978
RIG RELEASED:	April 13, 1978
STATUS:	Suspended Gas Well
CASING:	13-3/8" @ 80' 9-5/8" @ 1512' 7" @ 2212'

LOGGING RECORD:

DIL/SP	100-1520'
DLL/SP	1512-2210'
	2209-2365'
BHC/GR/CAL	100-1524'
	1512-2220'
BHC/GR	2209-2375'
CNL/FDC/GR/CAL	1512-2221'
	2209-2380'
MLL	2207-2379'
PML	1513-2222'
HDT	1512-2222'
	2209-2379'

LOGGING RECORD: (Continued)

HDT Arrow Plot	1526-2213'
	2227-2372'
CBL/VDL	1130-2173'
GR-CCL	1100-2163'
CCL/Perf	2054-2065'
	2038-2048'
	2080-2088'
Saraband	1522-2367'
Mudlog	100-2382'
Geologist's Lithology Log:	100-2382'

SIDEWALL CORES: ** Run No. 1, 44 shot, 42 recovered.
Run No. 2, 26 shot, 15 recovered.

CONVENTIONAL CORES:

No.	Interval	Recovery	Rock Unit
1	2096-2126'	30.0'	Barrow sandstone
2	2126-2147'	21.0'	Barrow sandstone
3	2295-2322'	5.5'	Sag River Sandstone
4	2322-2345'	23.0'	Sag River Sandstone and argillite

DRILL-STEM TESTS:
DST No. 1, 1512-1715' (see Appendix C)
DST No. 2, 2105-2147' (see Appendix C)
DST No. 3, 2212-2322' (see Appendix C)
DST No. 4, 2212-2345' (see Appendix C)
Production Test, 2101-2147'
(see Appendix D)
Production Test, 2038-2048' and 2054-2065'
(see Appendix D)

WELLSITE GEOLOGIST: Dave Young

LOG ANALYST: Armour Kane

DRILLING CONTRACTOR: Brinkerhoff Signal, Inc., Rig 31

MUDLOGGERS: Borst and Giddens

BIOSTRATIGRAPHIC ANALYSIS: Anderson, Warren & Associates, Inc.

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

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

** Sidewall cores were utilized for various analyses, including: lithology, paleontology, and geochemistry.

SOUTH BARROW WELL NO. 17
DRILL CUTTINGS AND CORE DESCRIPTIONS
BY: DAVE YOUNG

DRILLED DEPTH (FEET BELOW KELLY BUSHING)	
0- 100	No samples collected.
100- 190	Claystone: light to medium gray, soft, gummy, lumpy.
190- 220	Conglomerate: varicolored orange, brown, black, and green, subrounded, large purple inclusions.
220- 370	Claystone: medium gray, soft to medium hard, finely disseminated carbonaceous material; stringers of Sandstone: medium to fine grained, and Siltstone: tan, gray, calcareous.
370- 400	Siltstone: as above.
400- 580	Claystone: medium gray, soft, gummy, finely disseminated carbonaceous material.
580- 670	Claystone: as above; thin siltstone and conglomerate stringers.
670- 730	Sandstone: fine to medium grained, light gray, well rounded, clean, friable, grading to fine grained sandstone, highly argillaceous, tight, carbonaceous.
730- 790	Sandstone: fine to medium grained, light gray, well rounded, well sorted quartz; friable, in part, clay filled, rare chert pebbles; thin siltstone and claystone stringers.
790- 850	Claystone: medium gray, soft, finely disseminated carbonaceous material, with stringers of siltstone and very fine grained sandstone.
850- 970	Claystone: as above.
970-1030	Claystone: becoming brown-gray, soft, sticky, slightly silty.
1030-1090	Sandstone-Conglomerate: very coarse grained, grading to pebbles, varicolored, orange, clear, brown, and green; some angular, some rounded, unconsolidated, interbedded with Claystone: firm, brown-gray, lumpy; and Claystone: gray, soft, gummy.

1090-1120	Claystone: brown, soft, gummy, slightly silty.
1120-1150	Sandstone-Conglomerate: coarse grained to pebble, loose, varicolored, as above.
1150-1240	Claystone: light to medium gray-brown, soft, slightly silty, finely disseminated carbonaceous material, microfossils of neritic forams.
1240-1270	Sandstone: fine grained, light gray, argillaceous, friable, dull yellow fluorescence, slow yellow-white cut, coarse grained; Sandstone-Conglomerate: as above.
1270-1300	Claystone: gray-brown, soft, gummy.
1300-1360	Sandstone: as above, interbedded Siltstone: tan, firm, and Claystone: as above; yellowish-gold fluorescence in 20% of sample, with slow yellow-white cut.
1360-1390	Claystone: brown-gray, soft, bentonitic.
1390-1420	Siltstone: light gray, finely carbonaceous, dull yellow fluorescence, slight cut.
1420-1520	Shale: brown, medium hard to soft, flaky, fissile, laminated; trace of kaolinite; trace of Chlorite: dark green, clayey; interbedded stringers of Limestone: tan, hard, tight; Sandstone: fine to medium grained, poorly consolidated, friable, few large, clear, well rounded quartz grains and pebbles; 20% of sample with bright yellow fluorescence, immediate streaming yellow-white cut; pyritic inclusions, and rare pelecypod fragments.
1520-1550	Siltstone: brown-gray, highly argillaceous.
1550-1580	Claystone: brown, soft, slightly silty.
1580-1590	Sandstone: fine grained, white quartz; slightly calcareous, argillaceous, interbedded with Claystone: as above.
1590-1620	Sandstone: fine grained, clean, clear, white, and black, well sorted, well rounded, bright yellow fluorescent oil stain, immediate yellow-white cut fluorescence.
1620-1640	Shale: brown, slightly silty, slightly fissile, firm.
1640-1650	Sandstone: as above, in part, clay filled, yellow fluorescence, slow cut, trace of spotty oil stain.
1650-1680	Siltstone: brown-gray, grades to Shale: soft, brown-gray, slightly micaceous.

1680-1700	Shale: brown, soft, slightly silty, slightly fissile, micaceous, fossil fragments, pelecypods; trace of limestone.
1700-1750	Siltstone: medium gray, firm, noncalcareous, slightly pyritic, with stringers of Sandstone: fine grained, light gray-brown, oil stain, yellow cut fluorescence.
1750-1770	Siltstone: as above, with common, loose, medium to coarse grained pebble quartz, and Chert: clear, white, and black, with Shale: black, hard, bulky, slightly pyritic.
1770-1780	Claystone: light gray, soft, kaolinitic, with disseminated coal.
1780-1790	Shale: brown, flaky, fissile, firm, slightly calcareous, micaceous, with stringers of Limestone: tan, micritic, hard.
1790-1810	Shale: as above, with Limestone stringers: as above.
1810-1830	Claystone: light gray-tan, with finely disseminated coal.
1830-1870	Shale: light gray, soft, micaceous, with Shale: dark gray-brown, firm, slightly laminated, with pyrite-filled bioturbations.
1870-1890	Shale: light gray, firm, platy, slightly laminated.
1890-1930	Claystone: light to medium gray, soft, bentonitic, gummy, micaceous.
1930-1970	Claystone: light to medium gray, firm, slightly silty, micaceous, with stringers of light gray siltstone, and with Sandstone: light gray, fine grained, clay-filled.
1970-2010	Siltstone: light gray, soft, with finely disseminated, angular quartz grains, grades to claystone and argillaceous sandstone.
2010-2040	Shale: light gray-tan, firm, micaceous, slightly carbonaceous, finely disseminated pyrite, interbedded with siltstone and light gray, argillaceous sandstone.
2040-2050	Sandstone: fine grained, light gray, clear, white, and green, argillaceous, slightly micaceous, firm to friable; 20% dull gold fluorescence, slow cut, blue-white cut fluorescence.
2050-2080	Sandstone: fine grained, light gray, highly argillaceous, hard, tight, in part, friable, good gassy odor, 70% fluorescence, spotty oil stain.

2080-2096	Siltstone: gray, soft, sandy, interbedded with Shale: brown-red, lignitic, fossil wood, with Sandstone stringers: as above.	
2096-2126	Core No. 1 - Cut 30', Recovered 30'	
	2096.0-2096.5' (0.5')	Siltstone: dark gray, hard, tight, noncalcareous.
	2096.5-2098.0' (1.5')	Siltstone: with shale partings, 10° dip on partings; bleeding oil.
	2098.0-2099.0' (1.0')	Sandstone: very fine grained, clean, hard, light gray, clear, white, and dark grains, tight, in part, with clay matrix, good odor, yellow-white fluorescence.
	2099.0-2100.5' (1.5')	Sandstone: very fine grained, brown, well sorted, well rounded, clean, hard, in part, argillaceous, streaky porosity, good odor.
	2100.5-2102.0' (1.5')	Sandstone: as above, shaly patches.
	2102.0-2105.0' (3.0')	Sandstone: fine grained, brown, friable, clean, clear, white, and black, well sorted, well rounded, fair to good porosity, good odor, 100% yellow fluorescence, immediate milky-white cut fluorescence.
	2105.0-2106.0' (1.0')	Sandstone: fine grained, as above, hard, less friable, good visible porosity.
	2106.0-2114.0' (8.0')	Sandstone: fine grained, tan to brown, well sorted, well rounded, friable, fair to good visible porosity, light stain throughout, good odor, 100% fluorescence, yellow, milky-white cut fluorescence.
	2114.0-2115.0' (1.0')	Sandstone: fine grained, brown, hard, tight, possible hematite cement, good fluorescence.
	2115.0-2116.0' (1.0')	Sandstone: fine grained, brown, hard, becomes friable, clean, well sorted, well rounded, clear, white,

		and black, light green in part, slightly argillaceous, thin shale beds, good odor, stain, and fluorescence, good cut.
	2116.0-2119.0 (3.0')	Sandstone: fine grained, brown, clean, friable, bright yellow fluorescence, good odor, stain, and cut.
	2119.0-2123.0 (4.0')	Sandstone: very fine grained, brown, hard, tight, becomes argillaceous, bioturbation and shaly patches; Sandstone: very fine to fine grained, medium hard, slightly argillaceous, with thin partings, glauconite becomes common, good odor, stain, fluorescence and cut.
	2123.0-2125.5 (2.5')	Sandstone: fine grained, clean, clear, white, black, and green, friable, well rounded, well sorted.
	2125.5-2126.0 (0.5')	Sandstone: light gray-brown, fine grained, argillaceous, with shale patches and partings, bioturbation, glauconitic, good odor, stain, cut and fluorescence.

2126-2147 — Core No. 2 - Cut 21', Recovered 21'

2126.0-2128.0' (2.0')	Sandstone: fine grained, light gray-brown, argillaceous, friable, clear, black, glauconitic, fine silt and clay in matrix, good odor, stain, bright yellow fluorescence, good milky-white cut fluorescence.
2128.0-2129.0' (1.0')	Sandstone: as above, with few brown clay lumps.
2129.0-2130.0' (1.0')	Sandstone: very fine grained, light gray-brown, argillaceous, friable to hard, probable pelecypod fossil.
2130.0-2132.0' (2.0')	Sandstone: as above, increased clay in matrix, common glauconite, good odor and stain, bright yellow fluorescence.

2132.0-2134.0' (2.0')	Shale: brown, highly silty to sandy patches of Sandstone: fine grained, brown, argillaceous, tight, trace of fluorescence, poor odor.
2134.0-2136.5' (2.5')	Sandstone: fine grained, brown, hard, tight, clear, black, argillaceous with streaks of porous clean sandstone, common shale patches and partings, bioturbation, gold fluorescence in sandstone, good saturation, good milky-white cut fluorescence.
2136.5-2138.5' (2.0')	Sandstone: fine grained, brown, highly argillaceous, with highly concentrated pelecypod shells in assemblages, pyritic inclusions, fossil wood fragments, gold-yellow fluorescence.
2138.5-2139.0' (0.5')	Shale: dark gray, hard, silty, noncalcareous.
2139.0-2141.5' (2.5')	Siltstone: dark gray, hard, poor odor, poor stain, spotty fluorescence.
2141.5-2142.0' (0.5')	Sandstone: fine grained, argillaceous, hard, poor odor, gold fluorescence, very silty, yellow cut fluorescence.
2142.0-2145.5' (3.5')	Siltstone: dark gray, hard; Sandstone: thin, argillaceous stringers, spotty fluorescence.
2145.5-2147.0' (1.5')	Siltstone: dark gray, hard, pelecypod shells, fossil wood fragments, pyritized; Sandstone: thin stringers, poor stain, spotty fluorescence, spotty bleeding oil.
2147-2195	Siltstone: medium gray, soft, sandy, carbonaceous, slightly calcareous, interbedded with Claystone: light gray, soft, with disseminated carbon and very fine quartz grains.
2195-2200	Sandstone: tan-brown, fine grained, medium hard, argillaceous, well sorted, well rounded, clear, white, and black, with dull gold fluorescence, no cut, no stain, no odor.

2200-2230	Interbedded Siltstone and Claystone, as in 2147-2195'.
2230-2250	Siltstone: light gray, medium hard, sandy, carbonaceous, slightly calcareous.
2250-2275	Claystone: light gray, soft, slightly carbonaceous, slightly calcareous.
2275-2280	Sandstone: brown, hard, fine to medium grained, subrounded, poorly sorted, argillaceous, glauconitic, silty, clay-filled matrix; trace of oil stain; trace of chert.
2280-2285	Claystone: light gray-green, kaolinitic, soft.
2285-2295	Sandstone: brown, medium hard, clear, white, and green, calcareous, glauconitic, spotty black oil stain.
2295-2322	Core No. 3 - Cut 27', Recovered 5.5'
	2295.0-2296.0' (1.0') Sandstone: fine grained, hard, calcareous, glauconite, fossils, pelecypods, poorly friable to dense, gold, orange fluorescence, immediate yellow gold cut fluorescence, good odor, fair stain, bleeding oil.
	2296.0-2298.0' (2.0') Sandstone: coquina, brown, medium hard, thin bed glauconite, calcareous, pelecypod, good odor, stain, fluorescence.
	2298.0-2300.5' (2.5') Sandstone: gray, hard, tight, glauconite, calcareous, poor oil stain, bleeding oil; interlaminated with coquina, good odor and stain, and with thin beds of Shale: gray, hard, silty, containing very thin, horizontal glauconite zones.
	2300.5-2322.0' (21.5') No recovery.
2322-2345	Core No. 4 - Cut 23', Recovered 23'
	2322.0-2325.5' (3.5') Sandstone: very fine grained, silty, calcareous, slightly friable, medium hard, oil stain, dull gold, orange fluorescence, gold cut fluorescence.

2325.5-2328.0' (2.5')	Sandstone: interbedded, fine grained, brown, calcareous, argillaceous, fossiliferous; Limestone: biocalcarenite, sandy, thin shale laminations dipping 10°-15°, poor intergranular porosity, good oil stain, residual oil in pore space, bleeding oil and gas, spotty dull gold fluorescence.
2328.0-2332.0' (4.0')	Sandstone: white, gray, hard, argillaceous, calcareous, silty, clay matrix, fair oil stain, good odor, spotty dull gold fluorescence, good gold cut fluorescence.
2332.0-2333.0' (1.0')	Limestone: biocalcarenite, sandy, argillaceous, oil stain.
2333.0-2335.0' (2.0')	Sandstone: very fine grained, hard, brown, green, argillaceous, silty, calcareous, clay matrix, few oil stains, vertical hairline fractures.
2335.0-2336.0' (1.0')	Limestone: biocalcarenite, sandy, green, argillaceous matrix, worm borings with sandstone infillings, spotty intergranular oil stain, dull gold fluorescence, few vertical hairline fractures.
2336.0-2338.0' (2.0')	Sandstone: very fine grained, as above, increase in tightness and hardness.
2338.0-2342.0' (4.0')	Limestone: biocalcarenite, sandy, fossiliferous with pelecypod fragments, spines, echinoid plates, poor porosity filled with black tarry oil, few vertical and random oil-stained hairline fractures, yellow fluorescence, immediate gold yellow cut fluorescence.
2342.0-2344.0' (2.0')	Limestone: biocalcarenite, sandy, as above, fair oil stain, green and black argillite pebbles, spotty yellow fluorescence.
2344.0-2345.0' (1.0')	Argillite: black, hard, brittle, slightly graphitic, large filled vertical fractures, no oil show.

2345-2370	Argillite: black, hard, brittle, trace of graphite, very finely disseminated pyrite, white quartz veins.
2370-2382	Argillite: black, hard in part, foliated, graphitic, pyritic, quartz laminae, no cut, odor, or stain.

2,382 Feet Total Depth

HUSKY

DRILL STEM TEST REPORT FORM

WELL NAME South Barrow Well No. 17 DST. NO. 1 DATE 3/10/78

Formation Tested "Pebble Shale" Sandstone

Test Interval 1512-1715'

Total Depth 1715'

Choke Size: Surface 1/4" Bottom Hole 3/4"

Hole Size 8½" open hole; 9 5/8" cased hole

Drill Collar Length 125' I.D. 6¼ O.D.

Drill Pipe Length 1255' I.D. 3½ O.D.

Packer Depth(s) 1477 Ft.

Depth Tester Valve 1454 Ft.

Cushion Type nitrogen Amount 1454'@ 500 psi

TEST DATA

Tool open at 1400 hrs.
Initial flow period 150 min.
Initial shut-in period 320 min.
Final flow period unseat packer @ 2150 hrs min.
Final shut-in period ____ min.
Unseated packer at ____ hrs.

RESISTIVITY-CHLORIDE DATA

	Resistivity	Chloride Content
Recovery Water	@ ____ °F.	____ ppm
Recovery Mud	@ ____ °F.	____ ppm
Recovery Mud Filtrate	@ ____ °F.	____ ppm
Mud Pit Sample	@ ____ °F.	____ ppm
Mud Pit Sample Filtrate	@ ____ °F.	____ ppm
Mud Weight ____ vis ____ cp		

Description of initial flow period Open tool with 500 psi nitrogen; no flow; open valve to bleed-off; 0 psi in 18 min; open to bubble bucket with slight blow, incr to strong in 60 min; 0 psi, GTS in 90 min - 0 psi; approximately 10 psi in 110 min., decreased to 5-0 psi at shut-in.

Description of final flow period ____

PRESSURE DATA

TEMPERATURE	Gauge No. 1263 Depth: 1459 ft.	Gauge No. 982 Depth: 1674 ft.	Gauge No. Depth: ft.	TIME
	24 Hour Clock	24 Hour Clock	Hour Clock	Tool Opened A.M. / P.M.
Est. °F.	Blanked Off No	Blanked Off Yes	Blanked Off	Opened A.M. / Bypass P.M.
Actual 55 °F.	Pressures	Pressures	Pressures	Reported Minutes / Computed Minutes
	Field / Office	Field / Office	Field / Office	
Initial Hydrostatic	795	922		
First Flow: Initial	552	666		— —
First Flow: Final	241	323		
First Flow: Closed In	460	537		
Second Flow: Initial				— —
Second Flow: Final				
Second Flow: Closed In				
Third Flow: Initial				— —
Third Flow: Final				
Third Flow: Closed In				
Final Hydrostatic	795	922		— —

RECOVERY DATA

Cushion Nitrogen	Type	Amount	1454'	Depth Back Pres. Valve	Surface Choke 1/4"	Bottom Choke 3/4"
Recovered 1454'		~~Feet/bbl of~~	nitrogen cushion			
Recovered G.T.S. in 90 min		~~Feet/bbl of~~	T.S.T.M.			
Recovered 7 gallons		~~Feet/bbl of~~	gas and water cut mud 61,000 ppm chloride			
Recovered		Feet/bbl of				

Remarks Circulated out gas-cut drilling mud.
Chart interpretation indicates good test technically; an apparent depleting reservoir with low reservoir pressure. Took 4 gas bomb samples and 4 fluid samples.
Chlorides of fluid below tester valve was 61,000 ppm.

D.B. Young
Prepared by

C-1

11/78

U.S. GEOLOGICAL SURVEY/ONPRA

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DRILL STEM TEST REPORT FORM

WELL NAME South Barrow Well No. 17 DST. NO. 2 DATE 3/15/78

Formation Tested Barrow Sandstone

Hole Size 8 1/2" open hole; 9 5/8" cased hole

Test Interval 2105-2147'

Drill Collar Length --- I.D.

Total Depth 2147'

Drill Pipe Length --- I.D.

Choke Size: Surface 1/4" Bottom Hole ---

Packer Depth(s) --- Ft.

Depth Tester Valve --- Ft.

Cushion Type nitrogen Amount 500 psi

TEST DATA

Tool open at 0550 hrs.
Initial flow period 120 min.
Initial shut-in period 240 min.
Final flow period ___ min.
Final shut-in period ___ min.
Unseated packer at ___ hrs.

RESISTIVITY/CHLORIDE DATA

	Resistivity	Chloride Content
Recovery Water	@ °F.	ppm
Recovery Mud	@ °F.	ppm
Recovery Mud Filtrate	@ °F.	ppm
Mud Pit Sample	@ °F.	ppm
Mud Pit Sample Filtrate	@ °F.	ppm
Mud Weight	vis	cp

Description of initial flow period Open tool with 500 psi surface pressure; G.T.S. in 8 min; Max surface pressure of 800 psi after 19 min on 1/4" choke

Description of final flow period

PRESSURE DATA

TEMPERATURE	Gauge No. 1263 Depth: 2082 ft.		Gauge No. 985 Depth: 2143 ft.		Gauge No. Depth: ft.		TIME	
	24 Hour Clock		24 Hour Clock		Hour Clock		Tool	A.M.
Est. °F.	Blanked Off ---		Blanked Off ---		Blanked Off		Opened	P.M.
Actual 60 °F.	Pressures		Pressures		Pressures		Opened	A.M.
							Bypass	P.M.
	Field	Office	Field	Office	Field	Office	Reported Minutes	Computed Minutes
Initial Hydrostatic	1242		1240					
First Flow Initial	668		696				—	—
First Flow Final	852		891					
First Closed In	968		983					
Second Flow Initial							—	—
Second Flow Final								
Second Closed In								
Third Flow Initial							—	—
Third Flow Final								
Third Closed In								
Final Hydrostatic	1242		1240				—	—

RECOVERY DATA

			Depth Back Pres. Valve	Surface Choke	Bottom Choke
Cushion nitrogen Type	Amount 500 psi				
Recovered nitrogen	Feet/bbl of	cushion			
Recovered G.T.S.	Feet/bbl of	in 8 min. at rate of 1.09 MMCFPD at 700# surf. press.			
Recovered 3 gallons	Feet/bbl of	mud and mud filtrate			
Recovered	Feet/bbl of				

Remarks (1) Pressure stabilized @ 700 psi for last 45 min of test
(2) The flame during test was clean orange, no steam, and no black, oily smoke
(3) Collected 4 gas samples (1000 cc), 15 min. prior to shut-in @ 700 psi, 42° F temp
(4) Lost-circulation after unseating packer (390 bbls); cured with L.C.M. and P.O.H. with test string @ 0800 hours, 16 March, 1978.

D.B. Young
Prepared by

11-78

HUSKY

DRILL STEM TEST REPORT FORM

WELL NAME South Barrow Well No. 17 DST. NO. 3 DATE 3/29/78

Formation Tested Sag River Sandstone

Hole Size 5 5/8"

Test Interval 2212-2322

Drill Collar Length --- I.D.

Total Depth 2322

Drill Pipe Length --- I.D.

Choke Size Surface 1/4" Bottom Hole 1/2"

Packer Depth(s) Ft.

Depth Tester Valve Ft.

Cushion Type nitrogen Amount 500 psi

TEST DATA

Tool open at 0440 hrs.
Initial flow period 90 min.
Initial shut-in period 240 min.
Final flow period min.
Final shut-in period min.
Unseated packer at hrs.

RESISTIVITY/CHLORIDE DATA

	Resistivity	Chloride Content
Recovery Water	@ °F.	ppm
Recovery Mud	@ °F.	ppm
Recovery Mud Filtrate	@ °F.	ppm
Mud Pit Sample	@ °F.	ppm
Mud Pit Sample Filtrate	@ °F.	ppm
Mud Weight	vis	cp

Description of initial flow period Open with steady decrease in pressure; @ 0455-40 psi; @ 0500-0 psi; G.T.S. in 25 min - 0 psi; press incr. to 20 psi @ 0525; rat-hole mud to surf, 140 psi @ 0535; oil & gas-cut mud @ 0545 - 200 psi; @ 0600 - 255 psi; closed-in at 0610 - 255 psi;

Description of final flow period unloading black oil-mud emulsion in spurts when closed in.

PRESSURE DATA

TEMPERATURE	Gauge No. 1263 Depth: 2187 ft.		Gauge No. 982 Depth: 2298 ft.		Gauge No. Depth: ft.		TIME	
	24 Hour Clock		24 Hour Clock		Hour Clock		Tool Opened	A.M. P.M.
Est. °F.	Blanked Off No		Blanked Off Yes		Blanked Off		Opened Bypass	A.M. P.M.
Actual -- °F.	Pressures		Pressures		Pressures		Reported Minutes	Computed Minutes
	Field	Office	Field	Office	Field	Office		
Initial Hydrostatic	1231		1287				—	—
First Flow Initial	575		602					
First Flow Final	771		794					
First Closed In	1002		1029				—	—
Second Flow Initial								
Second Flow Final								
Second Closed In							—	—
Third Flow Initial								
Third Flow Final								
Third Closed In							—	—
Final Hydrostatic	1379		1448				—	—

RECOVERY DATA

			Depth Back Pres. Valve	Surface Choke	Bottom Choke
Cushion	nitrogen Type	Amount 500 psi		1/4"	1/2"
Recovered	nitrogen cushion	Feet/bbl of			
Recovered	G.T.S. in 25 min	Feet/bbl of			
Recovered	18	Feet/bbl of black, oil-mud emulsion			
Recovered		Feet/bbl of			

Remarks Collected 4 gas samples; 4 oil-mud emulsion samples from below DCIP valve

Notes: Final hydrostatic higher than initial, due to increase of mud weight prior to P.O.H.
Mud losses to formation and reverse out = 110 bbl.
Chart interpretation indicates a depleting reservoir. Chart of flow pressure indicates a drop of 121 psi from peak at time of close-in.

D.B. Young
Prepared by

11/78

HUSKY

DRILL STEM TEST REPORT FORM

WELL NAME South Barrow Well No. 17 DST. NO. 4 DATE 3/31/78

Formation Tested Sag River Sandstone

Interval Tested 2212-2345'

Total Depth 2345'

Choke Size: Surface 1/4" Bottom Hole 1/2"

Hole Size 5 5/8" open hole; 7" casing

Drill Collar Length --- I.D.

Drill Pipe Length --- I.D.

Packer Depth(s) 2195' Ft.

Depth Tester Valve Ft.

Cushion Type nitrogen Amount 500 psi

TEST DATA

Tool open at 1255 hrs.
Initial flow period 180 min.
Initial shut-in period 410 min.
Final flow period min.
Final shut-in period min.
Unseated packer at 1045 hrs.

RESISTIVITY CHLORIDE DATA

	Resistivity	Chloride Content
Recovery Water	@ °F.	ppm
Recovery Mud	@ °F	ppm
Recovery Mud Filtrate	@ °F.	ppm
Mud Pit Sample	@ °F.	ppm
Mud Pit Sample Filtrate	@ °F.	ppm
Mud Weight	vis	cp

Description of initial flow period Open tool with 500 psi nitrogen cushion; decr to 0 psi @ 0117; variable weak to strong blow - 0 psi; G.T.S. @ 0255 @ 0 psi; closed-in @ 0355 - 0 psi with very weak blow.

Description of final flow period

PRESSURE DATA

TEMPERATURE	Gauge No. 1263 Depth: 2177 ft.		Gauge No. 982 Depth: 2319 ft.		Gauge No. Depth: ft.		TIME	
	24 Hour Clock		24 Hour Clock		Hour Clock		Tool Opened	A.M. P.M.
Est. °F.	Blanked Off ---		Blanked Off ---		Blanked Off		Opened Bypass	A.M. P.M.
Actual --- °F	Pressures		Pressures		Pressures		Reported Minutes	Computed Minutes
	Field	Office	Field	Office	Field	Office		
Initial Hydrostatic	1300		1395					
Initial FLOW Final	552		623				—	—
Closed In	956		1051					
Initial FLOW Final	1071		1158				—	—
Closed In								
Initial FLOW Final							—	—
Closed In								
Final Hydrostatic	1300		1395				—	—

RECOVERY DATA

				Depth Back Pres. Valve	Surface Choke	Bottom Choke
Cushion	nitrogen Type	Amount	500 psi			
Recovered	nitrogen cushion	Feet/bbl of				
Recovered		Feet/bbl of	Reversed out 24 bbls of gas & slightly oil-cut mud; 2 gals			
Recovered		Feet/bbl of	of oil & gas-cut mud from subs below DCIP under 455 psi			
Recovered		Feet/bbl of				

Remarks Chromatograph analysis of gas to surface indicates C_1 and C_2 only.

Collected fluid samples from subs below DCIP valve.

D.B. Young
Prepared by

11-78

ENGINEERING MEMORANDA

SOUTH BARROW WELL NO. 17

PRODUCTION TEST NO. I
April 7-13, 1978

This memoranda is a presentation of the reservoir data gathered and reservoir calculations from the production test of the Barrow Sand in the South Barrow Well No. 17. Table I presents basic well and formation data. Table II is a listing of primary analysis results. These are original gas in place, back-pressure analysis, pressure buildup analysis, and pressure gradient test analysis. Presented next is a discussion of each analysis. Conclusions and recommendations are followed by data, graphs, and example calculations.

TABLE I - WELL AND FORMATION DATA

1.	Barrow Sandstone, early-middle Jurassic.	
2.	Perforations 2101 to 2127 feet at 4 spf.	
3.	Gross sand thickness	l = 26 feet
4.	Net pay thickness	h = 10 feet
5.	Bulk porosity in net pay	ϕ_B = 26.6%
6.	Effective porosity in net pay	ϕ_e = 21.9%
7.	Average water saturation in net pay	S_w = 53.7%
8.	Gas gravity	ϱ_g = 0.572
9.	Critical temperature	T_c = 343.6 ^oR
10.	Critical pressure	P_c = 669.4 psia
11.	Reservoir temperature	T_i = 527 ^oR
12.	Initial reservoir pressure	P_i = 997.8 psia
13.	Initial gas compressibility	z_i = 0.87

TABLE II - ANALYSIS OF TEST RESULTS

A. Volumetric Reserves:

Original gas in place = 341.18 McF/AcFt.

B. Backpressure Analysis:

Absolute open flow = AOF = 6.50 MMcF/D
Back pressure slope = n = .615
Back pressure constant = C = .0013307 $\frac{MMcF/D}{PSI^2}$

C. Pressure Buildup Analysis:

Initial reservoir pressure	P_i = 997.8 psia
Permeability thickness	kh = 493.80 md ft

Permeability	k = 49.38 md
Skin	S = .474
Skin pressure drop	ΔP_s = 29.86 psi
[illegible]	[illegible]
Flow efficiency	Ef = .942
Gas mobility	M = 4136.56 md/cp
Effective wellbore radius	r_w' = 2.40 inch
Approximate radius of investigation	r_{inv} = 524 ft
Initial gas water ratio	GWR_i = 10.50 MCF/bbl
Final gas water ratio	GWR_f = 32.16 MCF/bbl

D. Wellbore Pressure Gradient Survey:

BHP at 2092 ft	= 971.1 psia
Fluid level	= 1895 ft
WHP	= 844.0 psia
Fluid gradient	= .457 psi/ft
BHP at 2109	= 978.9 psia

DISCUSSION OF DATA, ANALYSIS TECHNIQUE, AND RESULTS

Original Gas in Place

The porosity, water saturation, and reservoir temperature used in the calc tion of Original Gas in Place were derived from log analysis and are repre tative of the 10 feet of net pay selected between 2104 and 2114 feet. Th initial reservoir pressure was derived from the buildup analysis and corre to a depth of 2109 feet as indicated by the gradient survey. Gas properti were from laboratory analysis of produced samples.

The calculated value of Original Gas in Place is 341.18 McF/Ac ft. This i 14.4% higher than the assumed value of 298.2 McF/Ac ft in use for the Sout Barrow field. The primary cause of this difference is the porosity of 21. as opposed to the 16.0% in use as an average field porosity.

Four Point Backpressure Analysis

There were many mechanical problems, both before and during the four point which complicate the analysis. Among these were the production of free fo mation water in intermittent heads, repeated failures of the line heater, failure of alcohol injection equipment, failure and freezeoff of liquid pr duction metering devices, failure of the separator meter run straightening vanes, separator liquid carryover, flow line freezeoff, hydrate formation, finally the intermittent failure and eventual miscalibration of the Hewlet Packard continuous downhole pressure recorder. The result was a highly fluctuating flow-pressure history. As the pressure recorder used for anal was the Sperry-Sun 8-minute recorder hung at 2092 feet, correlation of exa wellhead flow rate to bottom hole pressure presented some difficulty.

However, it was assumed that the pressure tool was above the static fluid level during the flow periods and below the static fluid level during the shut-in

[illegible] bottom hole pressure [illegible]

ures read directly from the tool. The resultant back pressure curve
s an AOF of 6.5 MMcF/d with n = .615.

ure Buildup Analysis

uildup period selected for analysis was the shut-in period following the
al "6 hour" flow period. This selection was due to the fact that the pre-
g flow most closely approximated the theoretical criterion of constant flow
and that the pressure buildup was the "smoothest" of those measured.

uildup was analyzed on the basis of shut-in pressure vs log $\frac{T+\Delta T}{\Delta T}$. Point
ment was fair. The extrapolated reservoir pressure at $\frac{T+\Delta T}{\Delta T} = 1.0$ was
sia. However, as the gradient test indicated a static fluid level above
ool, the reservoir pressure was corrected to a depth of 2109 feet by
g 7.8 psi which is the equivalent of 17 feet of fluid at the indicated
ent.

esultant value of kh is 493.8 md ft. This is approximately 3 times as
as the kh value currently in use for the field and 1.5 times the value

tive wellbore radius of 2.40 inches indi-
mage.

e straight-forward. Fluid level was indi-

RECOMMENDATIONS

cteristics for the production of gas, it
producer of water. The initial indicated
0.095238 bbl/McF while the final observed
g the final ratio to be representative
he resultant initial gas and water rates
e reasons for this high rate of water pro-
ural position of the well and the over-
.

The skin value of 0.571 and the effec
cates a slight amount of formation da

Pressure Gradient Survey

The pressure gradient survey was quit
cated at 1895 feet.

CONSLUSIONS AND

Although the well exhibits good chara
also, unfortunately, is an excellent
ratio of water to gas production was
ratio was 0.031095 bbl/McF. Assumin
and an operational drawdown of 15%, t
would be 2960 McF/d and 92 bbl/d. Th
duction are felt to be the low struct
perforation of the gross pay interval

hole pressure tool. Modifications of equipment design and location and limiting the percentage drawdown and flow period lengths were indicated as being necessary. Such modifications were implemented in subsequent testing (i.e., So. Barrow No. 19) and proven valid.

DATA AND EXAMPLE CALCULATIONS

Attached are the data and calculations listed below.

1.	Graph I	Q vs T
2.	Example Calculation I	Original Gas in Place
3.	Graph II	$P_c^2-P_T^2$ vs Q
4.	Example Calculation II	Back Pressure Data
5.	Graph III	Pvs $T+\Delta T/\Delta T$
6.	Example Calculation III	Buildup Analysis
7.	Graph IV	P vs D
8.	Example Calculation IV	Gradient Analysis

Stephen K. Lewis
Reservoir Engineer

M E M O R A N D U M

May 17, 1979

TO: J. M. McCarthy

FROM: S. K. Lewis

SUBJ: Production Test, Upper Barrow Sand, South Barrow Well No. 17

The Upper Barrow Sand was perforated in Barrow No. 17 from 2038' to 2048', from 2054' to 2065', and from 2080' to 2088'. Perforations were at four shots per foot, using a 4" Hyperjet II gun.

After clean up, the well was tested. Testing consisted of an 8-hour Stabilized One-Point flow, a 24-hour buildup, an Equal Time Two-Point flow, and a 72-hour buildup.

Back pressure analysis was performed on the three flow periods.

Reservoir analysis was prepared on the stabilized drawdown. Data, calculations, and resultant calculated values are presented below.

Back Pressure Analysis

The backpressure slope was established from the Equal Time Two Point flow data. Absolute Open Flow was based on the Stabilized One-Point flow.

Backpressure Parameters

n = 0.659
AOF = 132 McF/D

Drawdown Analysis

The drawdown analysis technique was based on the semilog plot of Pwf vs log Tp and the pressure equation:

$$Pwf = P_i - \frac{28984\ q\ \mu g B g}{kh}\left[\log Tp + \log \frac{k}{\emptyset \mu g C_t r_w^2} - 3.2275 + 0.86859\ S\right]$$

Reservoir parameter analysis was based on test results and values of $\emptyset$, S_w, and h derived from the H. J. Gruy log analysis as published in the Reservoir Engineering and Geologic Study of the East Barrow Field on December 20, 1978.

Calculated Reservoir Parameters

Flow Capacity = kh = 1.233145 md.ft.
Permeability = k = 0.0616527 md
Skin Factor = S = -2.496
Productivity Index = J = 0.240 McF/d psi
Gas Mobility = M = 5.0727 md/cp
Effective Wellbore Radius = r_w^1 = 51.568 inch
Radius of Investigation = 20. 747 ft

Conclusions

Based on well performance while being tested and the attached test analysis, it is concluded that the Upper Barrow Sand, as penetrated in Barrow Well No. 17, is not a commercially producable zone.

All estimated ultimate Recoverable Reserves in the Upper Barrow Sand which have been assigned to Barrow No. 17 should be removed from current reserve estimates. Based on 640 acre spacing, this would result in a Recoverable Reserve cut of 1.440 BCF.

S. K. Lewis
Senior Engineer

Copy to: Bob Lantz

I. $Bg = z \frac{T}{T_{sc}} \frac{Psc}{\frac{P_i - P_{wf}}{2}}$

$P_i = 971.90$ psia
$T = 55.2^{\circ}F$
$P_c = 664$ psia
$T_c = 334^{\circ}F$
$P_{wf} = 548.85$

a. 1. $P_r = \frac{\frac{P_i - P_{wf}}{2}}{664} = \frac{\frac{971.9 + 548.85}{2}}{664} = \frac{760.375}{664} = 1.145$

2. $T_r = \frac{T}{T_c} = \frac{515.2}{334} = 1.543$

3. From Poettmann & Carpenter tables:

z at $T_r = 1.543$ & $P_r = 1.145$ $\quad Z = 0.899$

b. $\therefore B_g = .899 \frac{515.2}{560} \frac{14.65}{760.375}$

$B_g = 0.0159352$

II. μ_g from Carr et al

a. $\mu_g = \mu_1 \times \mu_{/\mu_1}$ $\quad \mu_1 = 0.01095$ $\quad \mu_{/\mu_1} = 1.11$

$\therefore \mu_g = 0.01095 \times 1.11 = 0.1021545$ cp

III. $C_t = S_g C_g + S_w C_w + C_f$

$S_g = .414$
$S_w = .586$
$C_w = 3.3 \times 10^{-6}$
$C_f = 3.3 \times 10^{-6}$

a. C_g from Trube

$C_g = \frac{C_{pr}}{P_c}$ $\quad$ at $P_r = 1.145$ & $T_r = 1.543$ $\quad C_{pr} = 1.02$

$\therefore C_g = \frac{1.02}{664} = .001536$

b. $C_t = (.414 \times .001536) + (.586 \times 3.3 \times 10^{-6}) + 3.3 \times 10^{-6} = .000641138$

IV. $kh = \frac{28984 \, q \, \mu_g B_g}{m}$

a. From flow test:

$q = 101.705$ McF/d

$m = 463$

b. $kh = \frac{28984\ (101.705)\ 0.0121545\ (0.0159352)}{463}$

$kh = 1.233145$ md ft

c. at $h = 20$ ft

$k = .0616572$ nd

V. $S = 1.1513 \left[\left(P_i - P_{1\ hr} \right) - \log \left(\frac{k}{\phi \mu\ C_t\ r_w^2} + 3.2275 \right) \right]$

a. $P_i = 971.9$ psi $P_{1\ hr} = 878$ psi

$k = 0.0616572$ nd $\quad \phi = .1544$

$\mu = 0.0121545$ cp $\quad C_t = 0.000641138$

$r_w = 135417$ $\quad m = 463$

b. $S = 2.495979$

VI. $J = \frac{q}{P_i - P_{wf}} = \frac{101.705}{(971.9 - 548.05)}$ McF/d psi

$J = 0.240$ McF/d/psi

VII. $M = \frac{k_g}{\mu_g} = \frac{.0616572}{.0121545} = 5.0727$ nd/cp

VIII. $r_w^{\ 1} = r_w\ e^{-s} = 4.25\ e^{2.495979} = 51.568$ inch

IX. $r_{inv} = \sqrt{\frac{0.00105\ k\ T_p}{\phi\ \mu\ C_t}} = 20.747$ ft $= 20.747$ ft

FIELD DATA SHEET

Completion Test
Stabilized 1 point

Type Test: ☐ Initial ☐ Annual ☒ Special — Test Date: 3/20/79 — Lease No. or Serial No.

Company: Husky Oil NPR Operations — Connection — Allottee

Field: East Barrow — Reservoir: Upper Barrow — Location — Unit

Completion Date: 3/16/79 — Total Depth: 2382 — Plug Back TD: 2090 — Elevation: 35' KB — Farm or Lease Name

Csg. Size: 7" — Wt.: 38 — d: 5.920 — Set At: 2212 — Perforations: From: 2034-44, 2054-65, 2080-86 — To — Well No.: Barrow #17

Tbg. Size: 2 7/8 — Wt.: 6.5 — d: 2.441 — Set At: 2086 — Perforations: From — To — Sec.: 30 — Twp – Rlk: 22N — Rge – Sur: 16W UM

Type Completion (Describe): Single Zone Gas Well — Packer Set At: None — County or Parish: North Slope

Producing Thru: Annulus — Reservoir Temp. F: 56 @ 2260 — Mean Annual Temp. F: 11.5 — Baro. Press. – P_a: 30.48" H_g P_a = 15.3 — State: Alaska

L: 2063 — H: 2063 — G_g: 0.571 — % CO_2: — — % N_2: 3.53 — % H_2S: — — Prover: 2" — Meter Run — Taps

DATE Time of Reading	ELAP. TIME Hrs.	WELLHEAD WORKING PRESSURE Tbg. Psig	Csg. Psig	Temp. F	METER OR PROVER Pressure Psig	Diff.	Temp. F	Orifice	REMARKS (Include liquid production data: Type – API Gravity – Amount)
12:20	0	900	925					6/64	
13:20	1	740	775	35	760		10	/	Oil, 30.81° API, Trace
14:20	2	694	675	35	661		10		
15:20	3	622	590	35	581		10		
16:20	4	575	546	36	531		11		
17:20	5				500				
18:20	6	537	495	38	483		13	/	
19:20	7	520	485	40	472		15		
20:20	8	526	485	42	472		16	6/64	

PAGE 1 OF 1 DATA BY SKL

Form BPT 1

ONE-POINT BACK-PRESSURE TEST REPORT

Completion Test

Type Test: ☐ Initial ☐ Annual ☒ Special — Test Date 3/20/79	Lease No. or Serial No.
Company Husky Oil NPR Operations Inc — Connection	Allottee
Field East Barrow — Reservoir Upper Barrow — Location	Unit
Completion Date 3/16/79 — Total Depth 2382 — Plug Back TD 2090 — Elevation	Farm or Lease Name
Csg. Size 7" — Wt. 38 — d 5.920 — Set At 2212 — Perforations: From 2038-49, 2054-65, To 2080-88	Well No. Barrow #17
Tbg. Size 2 7/8 — Wt. 6.5 — d 2.441 — Set At 2086 — Perforations: From — To	Sec. 30 — Twp-Blk 22N — Rge-Sur 16W UM
Type Completion (Describe) Single Gas — Packer Set At —	County or Parish North Slope
Producing Thru Annulus — Reservoir Temp. F 566 @ 2060 — Mean Annual Temp. F. 11.5 — Baro. Press. - P_a 30.48" B_a = 15.3	State Alaska
L 2063 — H 2063 — C_s 0.571 — % CO_2 — % N_2 3.55 — % H_2S — Prover 2" — Meter Run — Taps	

NO.	FLOW DATA: Prover Line Size	X	Choke Orifice Size	Press. psig	Diff. h_w	Temp. F	TUBING DATA: Press. psig	Temp. F	CASING DATA: Press. psig	Temp. F	Duration of Flow, Hr.
SI							900		925		
1.	2	x	6/64	472		18	526		485	43	8

NO.	Coefficient (24-Hour)	$\sqrt{h_w P_m}$	Pressure P_m	Flow Temp. Factor, F_t	Gravity Factor, F_g	Super Compress. Factor F_{pv}	Rate of Flow Q, Mcfd
1.	0.1446		487.3	1.043	1.323	1.046	101.705

NO.	P_r	Temp. R	T_r	Z
1.	.734	474	1.431	.914

Gas Liquid Hydrocarbon Ratio — Mcf/bbl
API Gravity of Liquid Hydrocarbons 30.81 deg.
Specific Gravity Separator Gas .571 x x x x x x x x x x
Specific Gravity Flowing Fluid x x x x x
Critical Pressure 664 psia — psia
Critical Temperature 334 R — R

P_c 940.3 P_c^2 884164.09 — P_f 966.767 P_f^2 934638.4 *323

NO.	P_t	P_t^2	$P_c^2-P_t^2$	P_w	P_w^2	$P_c^2-P_w^2$	P_s	P_s^2	$P_f^2-P_s^2$
1.	500.3	250300.0	633864				545.853	301239.62	633398.9167

$$\left[\frac{P_c^2}{P_c^2-P_w^2}\right] = \left[\frac{\quad}{\quad}\right] = \_\_\_\_\_ \qquad \log\left[\frac{P_c^2}{P_c^2-P_w^2}\right] = \_\_\_\_\_$$

$$\left[\frac{P_c^2}{P_c^2-P_w^2}\right]^n = \_\_\_\_\_ \qquad n\log\left[\frac{P_c^2}{P_c^2-P_w^2}\right] = \_\_\_\_\_$$

$$AOF = Q\left[\frac{P_c^2}{P_c^2-P_w^2}\right]^n$$

If subsurface pressure data are used, substitute P_f for P_c and P_s for P_w in above formulas.

AOF _____ Mcfd
n _____
_____
(Source of n)

Commission _____
Company _____
Others _____

Form BPT 6

* Sperry Sun subsurface Pressure Recorder

FIELD DATA SHEET

Equal time
4 Point

Type Test: ☐ Initial ☐ Annual ☒ Special — Test Date: 3/21/79 — Lease No. or Serial No.

Company: Husky Oil NPR Operations — Connection — Allottee

Field: East Barrow — Reservoir: Upper Barrow — Location — Unit

Completion Date: 3/16/79 — Total Depth: 2362 — Plug Back TD: 2090 — Elevation: 32' KB — Farm or Lease Name

Csg. Size: 7" — Wt.: 36 — d: 5.972 — Set At: 2212 — Perforations: From: 2034-45, 2054-65, 2050-54 — To — Well No.: Barrow #17

Tbg. Size: 2⅜ — Wt.: 6.5 — d: 2.441 — Set At: 2066 — Perforations: From: — — To — Sec.: 30 — Twp – Rlk: 22N — Rge – Sur: 16W U.M.

Type Completion (Describe): Single Zone Gas Well — Packer Set At: None — County or Parish: North Slope

Producing Thru: Annulus — Reservoir Temp. F: 56.6 @ 2066 — Mean Annual Temp. F: 11.5 — Baro. Press. – P: 30.57 B=15.3 — State: Alaska

L	H	G_g	% CO_2	% N_2	% H_2S	Prover	Meter Run	Taps
2063	2067	0.571	—	3.55	—	2"		

DATE Time of Reading	ELAP. TIME hrs.	WELLHEAD WORKING PRESSURE Tbg. Psig	Csg. Psig	Temp. F	METER OR PROVER Pressure Psig	Diff.	Temp. F	Ori-fice	REMARKS (Includes liquid production data: Type – API Gravity – Amount)
20:05	0	370	965					4/64	
21:45	1.0	542	800	43	787		13	〃	Oil, 30.8°API, Trace
22:30	1.5	510	762	34	772		9	〃	
22:45	2.0	460	737	34	742		9	4/64	
22:47	0							6/64	
23:25	0.6	717	665	30	644		05	〃	Oil, 30.8°API, Trace
00:15	1.47	630	580	29	575		04	〃	
00:45	1.93	600	542	27	535		04	〃	
00:49	2.0	599	536	27	537		04	6/64	
									Test terminated due to Excessive Drawdown

PAGE 1 OF ____ DATA BY ____

Form BPT 1

MULTIPOINT BACK-PRESSURE TEST REPORT

Type Test: ☐ Initial ☐ Annual ☒ Special — Test Date 9/21/79	Lease No. or Serial No.
Company Plasky Oil NPR Operations Inc — Connection	Allottee
Field East Barrow — Reservoir Upper Barrow — Location	Unit
Completion Date 3/16/79 — Total Depth 2382 — Plug Back TD 2060 — Elevation 37' KB	Farm or Lease Name
Csg. Size 7" — Wt. 28" — d 5.920 — Set At 2212 — Perforations: From 2035-45, 2054-65, To 2080-55	Well No. Barrow #17
Tbg. Size 2 7/8 — Wt. 6.5 — d 2.441 — Set At 2086 — Perforations: From — To —	Sec. 30 — Twp-Blk 22N — Rge-Sur 16W UM
Type Completion (Describe) Single Gas — Packer Set At	County or Parish North Slope
Producing Thru Annulus — Reservoir Temp. F 566 @ 2060 — Mean Annual Temp. F. 11.5 — Baro. Press.-P 30.57 Pa-15.94	State Alaska
L 2063 — H 2063 — G_g 0.571 — % CO_2 — % N_2 3.55 — % H_2S — Prover 2" — Meter Run — Taps	

NO.	FLOW DATA: Prover Line Size	X Choke Orifice Size	Press. psig	Diff. h_w	Temp. F	TUBING DATA: Press. psig	Temp. F	CASING DATA: Press. psig	Temp. F	Duration of Flow, Hr.
SI	2"					900		905		
1.		4/64	745		9	800		752	34	2
2.		6/64	537		4	593		548	29	2
3.										
4.										
5.										

NO.	Coefficient (24-Hour)	$\sqrt{h_w P_m}$	Pressure P_m	Flow Temp. Factor, F_t	Gravity Factor, F_g	Super Compress. Factor F_{pv}	Rate of Flow Q, Mcfd
1.	0.06569		760.34	1.053	1.323	1.085	75,496
2.	0.1446		552.34	1.053	1.323	1.057	118,278
3.							
4.							
5.							

NO.	P_r	Temp. R	T_r	Z
1.	1.122	469	1.404	0.850
2.	0.809	464	1.389	0.895
3.				
4.				
5.				

Gas Liquid Hydrocarbon Ratio _____ Mcf/bbl
API Gravity of Liquid Hydrocarbons _____ deg.
Specific Gravity Separator Gas _____ x x x x x x x x x x
Specific Gravity Flowing Fluid x x x x x x _____
Critical Pressure 664 psia _____ psia
Critical Temperature 334 R _____ R

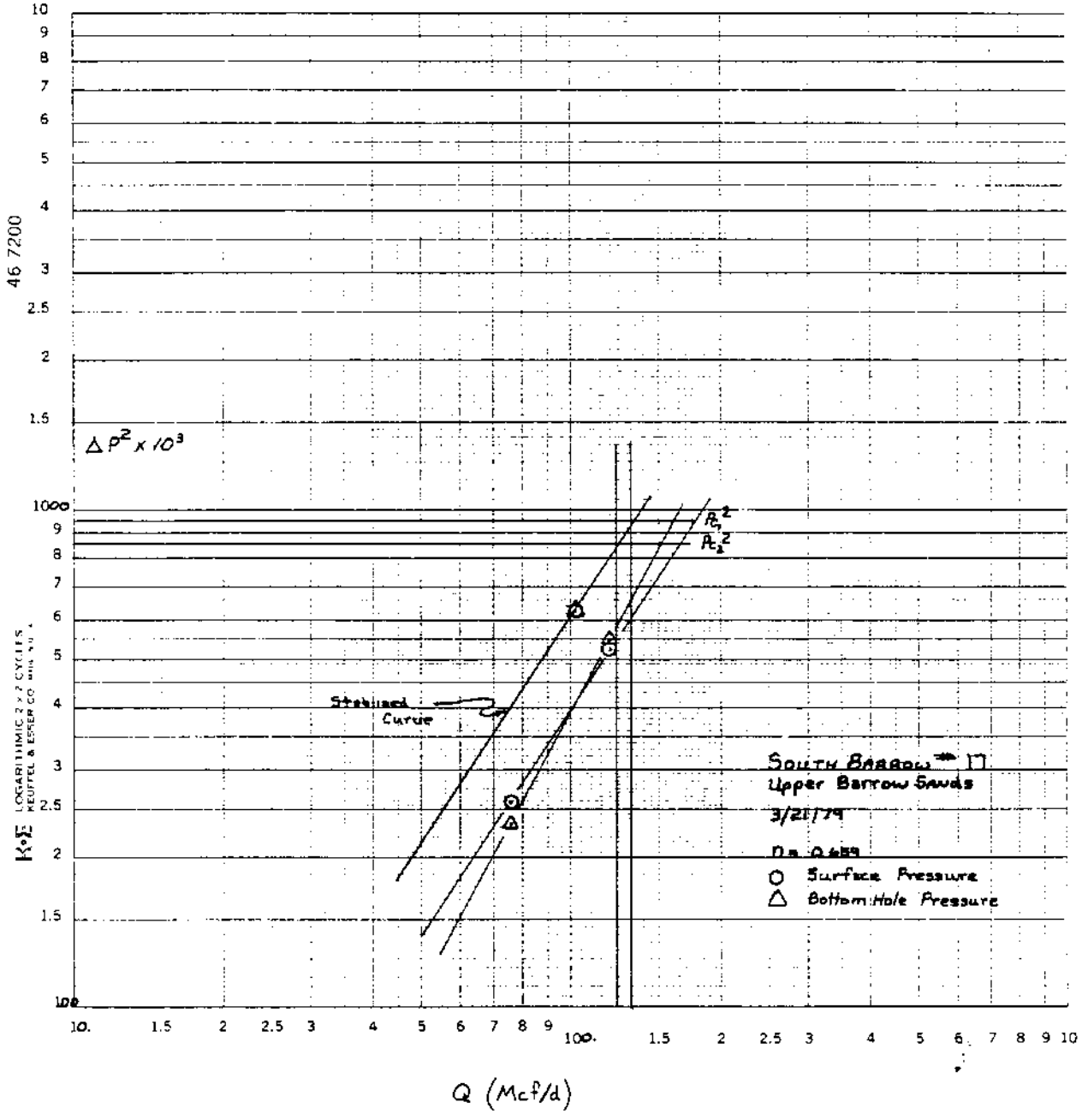
P_c 920.34 P_c^2 847025.7156 P_f 971.944 P_f^2 944675.1391

NO.	P_t	P_t^2	$P_c^2-P_t^2$	P_w	P_w^2	$P_c^2-P_w^2$	P_s	P_s^2	$P_f^2-P_s^2$
1.	767.34	588810.6756	258215.0				843.664	711768.9449	232906
2.	563.34	317351.9556	529673.76				629.509	396251.55	548394
3.									
4.									
5.									

AOF 132.0 Mcfd
n .659

Commission _____
Company SK Lewis
Others _____

Form BPT 5


46 7200
$\Delta p^2 \times 10^3$
$P_{t_1}^2$
$P_{t_2}^2$
Stabilized Curve
South Barrow #17
Upper Barrow Sands
3/21/79
Surface Pressure
Bottom Hole Pressure
Q (Mcf/d)

M E M O R A N D U M

March 31, 1978

TO: G. W. Legg

FROM: A. Kane

SUBJ: Log Analysis - South Barrow Well No. 17

Water resistivity in the Barrow gas sand was computed from the 20 MV positive SP which resulted in a salinity of 60,000 ppm and resistivity of 0.11. Using this value of Rw, the following results were obtained:

	Ø	Sw
2106-12	27%	32%
2118-22	22%	53%
2124-27	24%	56%

It would appear the sand could be successfully perforated from 2104' to 2127' without water production. Net sand is in the order of 18 feet.

The two sands from 1614-20 and 1658-64 show some anomalous log results which are difficult to explain, namely the very high formation resistivities of 240 ohms at 1618 and 2000 ohms at 1662 while the density porosities are 18% and 19%. These values would result in water saturation values impossibly low, especially in view of the poor results of the DST. The microlog indicates low porosity. One possible explanation of the high resistivity could be that sands have no fluid and this would also result in a higher density porosity and a decrease in Neutron porosity. This theory is certainly open to question.

Armour Kane

Log Analysis

COMPANY: HUSKY OIL/NPR OPERATIONS, Inc.
WELL: BARROW #17
FIELD: NORTH SLOPE
COUNTY:
STATE: ALASKA

DEPTH	RT	ϕ_D	ϕ_N	ΔT	ϕ_S	S_W							REMARKS
2277	18	16	27	105	33	53							
2288	14	17	26	SKIPPING	-	57							
2290	17	17	25	106	34	51							
2300-04	25	15	24	89	21	48							
2304-11	30	16	24	89	21	41							
2313	45	9	20	80	19	60							
2324	30	9	21	85	20	73							
2328	20	15	22	85	20	54							
2339	90	5	17	91	10	86							

Log Analysis

ARMOUR KANE

Formation Evaluation

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

April 14, 1978

Mr. Gordon W. Legg
Husky Oil/NPR Operations, Inc.
2525 C Street
Anchorage, Alaska 99503

Dear Mr. Legg:

Final log runs on Barrow #17 were made on April 2, 1978 at total depth of 2382. Schlumberger ran Dual Laterolog, Neutron-Density, Compensated Sonic, Microlaterolog and Dipmeter and recovered 15 of 26 sidewall cores. Log quality was generally good although the DLL had to be run twice because the first pass was "hashy". The first attempt with the core gun was shot off depth and required a second attempt which was successful.

The Sag River sand was topped at 2275 and the Argillite at 2344. A sandy, shaly limestone was encountered at 2336 with a very low porosity. The Sag River looks silty and shaly but with about 17 feet of porosity averaging 16% with water saturations from 41% to 57%. The best interval is 2300-2311 indicating an average porosity of 16.6% and average water saturation of 43%. However, because of the shale and silt content the permeability may be too low for production. Water resistivity was computed from the 20MV positive SP at .13 or 55,000 ppm which is in good agreement with the 60,000 ppm calculated in the Barrow Gas sand. However, water which has been produced along with the gas from the Barrow sand has been measured at .45 @ 71° or about 13,000 ppm. This would result in Sw values greater than 100% and the log whould have displayed a positive SP of over 60MV. Sw figures in excess of 100% would preclude the possibility of hydrocarbon production and yet the well is making gas. The original computations based on an Rw of 0.11 indicated an average Sw of about 50% which would result in gas production with some water cut and this is the well's performance to date. It appears that more research and analysis is necessary to establish true water salinity in this area.

Very truly yours,

Armour Kane

Armour Kane

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
TELEPHONE (907) 279-4514 P.O. BOX 4-1276 4643 Business Park Blvd.
ANCHORAGE, ALASKA 99509

CORE ANALYSIS REPORT

Company Husky Oil Company Date March 16, 1978 Lab. No. 7523
Well No. South Barrow No. 17 Location
Field NPR #4 Formation
County Depths
State Alaska Drilling Fluid

LEGEND
C—Creek P—Pressure H—Horizontal O—Open
NP—No Pressure
IS—Insufficient Sample
S—Silent St—Strata V—Vertical Vu—Vugs

SAMPLE NO.	LEGEND	DEPTH, FEET	EFFECTIVE POROSITY PERCENT	PERMEABILITY MILLIDARCIES HORIZONTAL	PERMEABILITY MILLIDARCIES VERTICAL	SATURATIONS % PORE SPACE RESIDUAL OIL	SATURATIONS % PORE SPACE TOTAL WATER	CONNATE WATER	SOLUBILITY MUD ACID	SOLUBILITY 15 % ACID
				CORE NO. 1						
1.		2096-97	18.2	2.26	2.00	Trace	48.8			
2.		2097-98	17.7	2.46	2.09	Trace	55.5			
3.		2098-99	16.7	2.37	3.08	Trace	58.6			
4.		2099-2100	18.3	2.39	2.00	1.31	58.3			
5.		2100-01	16.7	0.85	1.76	Trace	53.2			
6.		2101-02	17.6	1.48	0.63	Trace	49.3			
7.		2102-03	24.3	96	104	Trace	49.0			
8.		2103-04	25.1	305	241	0.96	58.4			
9.		2104-05	22.9	75	75	1.05	61.1			
10.		2105-06	21.9	128	110	1.10	55.8			
11.		2106-07	18.7	45	42	1.95	59.0			
12.		2107-08	23.6	637	583	2.07	61.2			
13.		2108-09	21.6	325	254	2.26	63.8			
14.		2109-10	18.9	202	172	2.00	50.2			
15.		2110-11	25.3	1159	1074	1.93	48.6			
16.		2111-12	23.4	1146	950	3.11	56.0			
17.		2112-13	25.8	888	804	2.83	55.9			
18.		2113-14	23.9	671	661	4.10	56.7			
19.		2114-15	22.8	46	38	3.21	57.5			
20.		2115-16	19.5	12	4.11	2.52	61.4			
21.		2116-17	25.4	180	129	1.93	57.8			
22.		2117-18	18.6	102	81	2.62	62.1			
23.		2118-19	19.4	50	46	2.53	50.2			
24.		2119-20	22.2	180	172	2.20	58.1			
25.		2120-21	23.6	126	97	3.02	60.3			
26.		2121-22	21.4	123	32	3.41	64.2			
27.		2122-23	20.8	63	33	3.60	60.6			
28.		2123-24	25.0	340	279	1.96	56.0			
29.		2124-25	27.9	382	296	2.02	57.1			
30.		2125-26	18.5	15	14	1.29	56.8			

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ANCHORAGE, ALASKA 99509

CORE ANALYSIS REPORT

Company Husky Oil Company Date March 15, 1978 Lab. No. 7523
Well No. South Barrow No. 17 Location
Field NPR #4 Formation
County Depths
State Alaska Drilling Fluid

LEGEND
C—Crack
F—Fracture
H—Horizontal
O—Open
NP—No Pressure
IS—Insufficient Sample
S—Slight
St—Strong
V—Vertical
Vu—Vugs

SAMPLE NO.	LEGEND	DEPTH, FEET	EFFECTIVE POROSITY PERCENT	PERMEABILITY MILLIDARCIES HORIZONTAL	PERMEABILITY MILLIDARCIES VERTICAL	SATURATIONS % PORE SPACE RESIDUAL OIL	SATURATIONS % PORE SPACE TOTAL WATER	CONNATE WATER	SOLUBILITY MUD ACID	SOLUBILITY 12 % ACID
				CORE NO. 2						
31.		2126-27	19.3	103	89	0.93	53.6			
32.		2127-28	18.6	555	500	1.92	66.0			
33.		2128-29	18.9	228	216	Trace	65.8			
34.		2129-30	19.3	15	13	1.24	65.3			
35.		2130-31	19.4	7.79	11	1.20	66.4			
36.		2131-32	16.6	2.58	1.58	Trace	64.3			
37.		2132-33	5.6	4.76	1.12	Trace	87.8			

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ANCHORAGE, ALASKA 99509

CORE ANALYSIS REPORT

Company Husky Oil Company Date March 22, 1978 Lab. No. 7542
Well No. South Barrow No. 17 Location
Field NPR #4 Formation
County Depths
State Alaska Drilling Fluid

LEGEND
C—Crack F—Fracture H—Horizontal O—Open
NF—No Fracture
IS—Insufficient Sample
S—Slight St—Stain V—Vertical Vu—Vugs

SAMPLE NO.	LEGEND	DEPTH, FEET	EFFECTIVE POROSITY PERCENT	PERMEABILITY MILLIDARCIES HORIZONTAL	PERMEABILITY MILLIDARCIES VERTICAL	SATURATIONS % PORE SPACE RESIDUAL OIL	SATURATIONS % PORE SPACE TOTAL WATER	CONNATE WATER	SOLUBILITY MUD ACID	SOLUBILITY 15 % ACID
			SIDEWALL CORES							
1.		1616	21.6	303						
2.		1617	22.0	488						
3.		1618	21.3	500						
4.		1619	18.6	58						
5.		1620	24.6	64						
6.		1660	19.0	13						
7.		1661	20.3	265						
8.		1662	22.1	311						
9.		1663	26.2	244						
10.		2044	16.3	0.92						
11.		2046	14.6	0.34						
12.		2049	18.1	6.88						
13.		2052	19.2	14						
14.		2056	16.7	2.98						
15.		2063	19.1	10						
16.		2064	18.4	7.62						
17.		2066	17.0	3.34						
18.		2067	19.4	39						
19.		2068	16.6	1.80						
20.		2070	18.2	12						
21.		2072	15.1	2.62						
22.		2074	18.3	6.41						
23.		2092	19.0	1.84						
24.		2191	20.6	44						
25.		2192	10.2	0.33						
26.		2193	8.4	0.17						

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CORE ANALYSIS REPORT

Company Husky Oil Company Date April 5, 1978 Lab. No. 7645
Well No. South Barrow No. 17 Location
Field NPR #4 Formation
County Depths 2322-2345
State Alaska Drilling Fluid

LEGEND
C—Crack, F—Fracture, H—Horizontal, O—Open
NF—No Fracture
IS—Insufficient Sample
S—Slight, St—Stain, V—Vertical, Vg—Vugs

SAMPLE NO.	LEGEND	DEPTH, FEET	EFFECTIVE POROSITY PERCENT	PERMEABILITY MILLIDARCIES HORIZONTAL	PERMEABILITY MILLIDARCIES VERTICAL	SATURATIONS % PORE SPACE RESIDUAL OIL	SATURATIONS % PORE SPACE TOTAL WATER	CONNATE WATER	SOLUBILITY MUD ACID	SOLUBILITY 15 % ACID
		CORE NO. 4 (2322-45)								
1.		2322-23	18.1	24	16	2.9	57.7			
2.		2323-24	10.3	1.10	0.82	5.0	86.1			
3.		2324-25	15.0	10	6.88	1.7	60.7			
4.		2325-26	10.9	3.05	1.79	4.7	66.3			
5.	VF	2326-27	19.1	52	40	9.5	60.5			
6.		2327-28	8.8	23	22	Trace	70.6			
7.		2328-29	10.0	14	8.85	7.8	60.0			
8.		2329-30	17.4	16	10	2.9	57.4			
9.		2330-31	12.2	6.10	5.96	2.1	62.3			
10.		2331-32	10.7	6.79	6.30	3.4	56.6			
11.		2332-33	13.1	2.78	0.88	2.0	50.9			
12.		2333-34	12.1	1.68	0.76	8.6	80.8			
13.		2334-35	17.5	22	15	7.4	59.6			
14.		2335-36	18.3	15	15	4.3	69.2			
15.	VF	2336-37	17.5	64	17	8.7	53.3			
16.		2337-38	11.6	6.80	0.08	8.9	72.8			
17.		2338-39	9.8	6.23	5.56	8.0	58.9			
18.		2339-40	9.9	3.89	3.20	2.6	51.2			
19.		2340-41	9.1	1.66	1.40	2.9	56.1			
20		2341-42	10.2	5.88	5.37	Trace	58.9			
21.		2342-43	8.5	7.34	7.28	3.0	60.1			
22.		2343-44	8.7	2.07	1.89	Trace	59.7			
23.		2344-45	5.6	1.10	0.87	Trace	85.4			

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ANCHORAGE, ALASKA 99509

CORE ANALYSIS REPORT

Company Husky Oil Company Date April 5, 1978 Lab. No. 7646
Well No. South Barrow No. 17 Location
Field NPR #4 Formation
County Alaska Depths
State Drilling Fluid

LEGEND
C—Crack
V—Vertical
Vx—Vugs
H—Horizontal
S—Slight
St—Stain
NF—No Fracture
I.S—Insufficient Sample

SOLUBILITY

SAMPLE NO.	LEGEND	DEPTH, FEET	EFFECTIVE POROSITY PERCENT	PERMEABILITY MILLIDARCIES HORIZONTAL	PERMEABILITY MILLIDARCIES VERTICAL	SATURATIONS % PORE SPACE RESIDUAL OIL	SATURATIONS % PORE SPACE TOTAL WATER
		SIDEWALL CORES					
1.		2275#22	5.2	0.46			
2.		2301#11	16.6	17			
3.		2301#12	18.0	16			
4.		2303#9	21.3	14			
5.		2303#10	22.6	20			
6.		2305#7	28.4	28			
7.		2307#6	26.3	62			
8.		2309#3	30.1	104			
9.		2309#4	24.6	15			
10.		2313#1	32.3	41			
11.		2313#2	28.6	22			

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC. TELEPHONE (907) 338-1911
P.O. BOX 4-1278 ANCHORAGE, ALASKA 99509 4649 BUSINESS PARK BLVD.

ANALYTICAL REPORT

From Husky Oil Company **Product** Crude/Water
Address Anchorage, Alaska **Date** April 12, 1978
Other Pertinent Data

Analyzed by JP **Date** April 21, 1978 **Lab No.** 7695

REPORT OF ANALYSIS
DRILL STEM TEST SAMPLES
SOUTH BARROW NO. 17
NPR NO. 4, ALASKA

Samples received April 12, 1978

SAMPLE	DEPTH	BS&W-%	OIL SPECIFIC GRAVITY @60°F	API°
DST No. 3	2212-2322	75	1.0518	3.0
DST No. 4	2212-2345	98	1.0522	3.0

NOTE:
Insufficient sample for further analysis.

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

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ANCHORAGE, ALASKA 99509

WATER ANALYSIS REPORT

OPERATOR Husky Oil Company
WELL NO. South Barrow No. 17
FIELD NPR #4
COUNTY
STATE Alaska

DATE April 21, 1978 LAB NO. 7693-1
LOCATION
FORMATION
INTERVAL
SAMPLE FROM Production Test No. 1

REMARKS & CONCLUSIONS: Sample No. 1 - Clear, Rust colored precipitate, precipitate slightly effervescent with addition of acid.

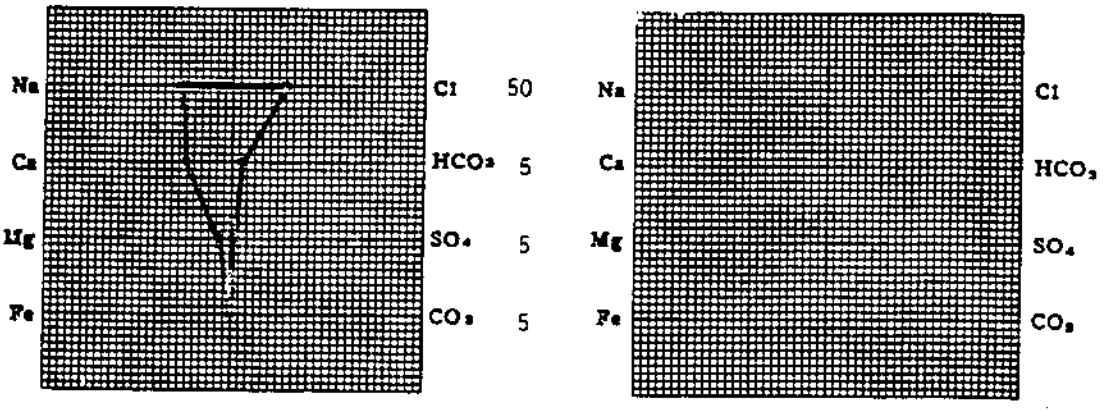
Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	7666	333.51	Sulfate	Trace	--
Potassium	Trace	--	Chloride	13000	366.60
Calcium	620	30.94	Carbonate	0	--
Magnesium	100	8.22	Bicarbonate	370	6.07
Iron	Present	--	Hydroxide	--	--
Total Cations		372.67	Total Anions		372.67

Total dissolved solids, mg/l	21569	Specific resistance @ 68°F.:	
NaCl equivalent, mg/l	21555	Observed	0.45 ohm-meters
Observed pH	6.5	Calculated	0.39 ohm-meters

WATER ANALYSIS PATTERN

Sample above described

Scale
MEQ per Unit



(No values in above graphs include Na, K, and Li)
NOTE: Mg/l = Milligrams per liter Meq/l = Milligram equivalents per liter
Sodium chloride equivalent by Dunlap & Havenhorst calculation from components

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

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WATER ANALYSIS REPORT

OPERATOR Husky Oil Company DATE April 21, 1978 LAB NO. 7693-2

WELL NO. South Barrow No. 17 LOCATION

FIELD NPR #4 FORMATION

COUNTY INTERVAL

STATE Alaska SAMPLE FROM Production Test No. 1

REMARKS & CONCLUSIONS: Sample No. 2 - Clear, Iron precipitate

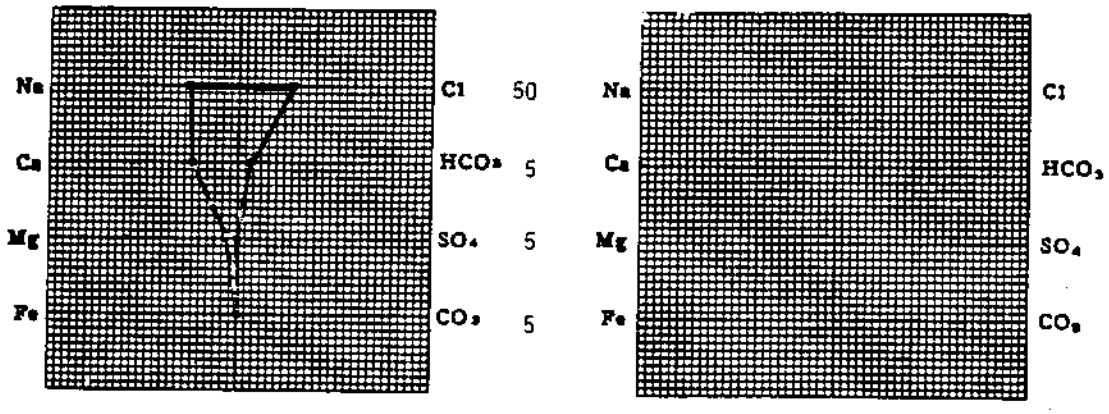
Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	7698	334.82	Sulfate	Trace	--
Potassium	Trace	0	Chloride	13000	366.60
Calcium	620	30.94	Carbonate	0	--
Magnesium	100	8.22	Bicarbonate	450	7.38
Iron	Present	--	Hydroxide	-	--
Total Cations		373.98	Total Anions		373.98

Total dissolved solids, mg/l	21640	Specific resistance @ 68°F.:	
NaCl equivalent, mg/l	21655	Observed	0.47
Observed pH	5.45	Calculated	9.39

WATER ANALYSIS PATTERN

Sample above described

Scale MEQ per Unit



(Na value is above graph includes Na, K, and Li)

NOTE: Mg/l = Milligrams per liter Meq/l = Milligram equivalents per liter

Sodium chloride equivalent by Dunlap & Havenhorst calculation from components

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

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WATER ANALYSIS REPORT

OPERATOR	Husky Oil Company	**DATE** April 21, 1978	**LAB NO.** 7693-3
WELL NO.	South Barrow No. 17	**LOCATION**	
FIELD	NPR #4	**FORMATION**	
COUNTY		**INTERVAL**	
STATE	Alaska	**SAMPLE FROM**	Production Test No. 1

REMARKS & CONCLUSIONS: Sample No. 3 - Clear, Iron precipitate

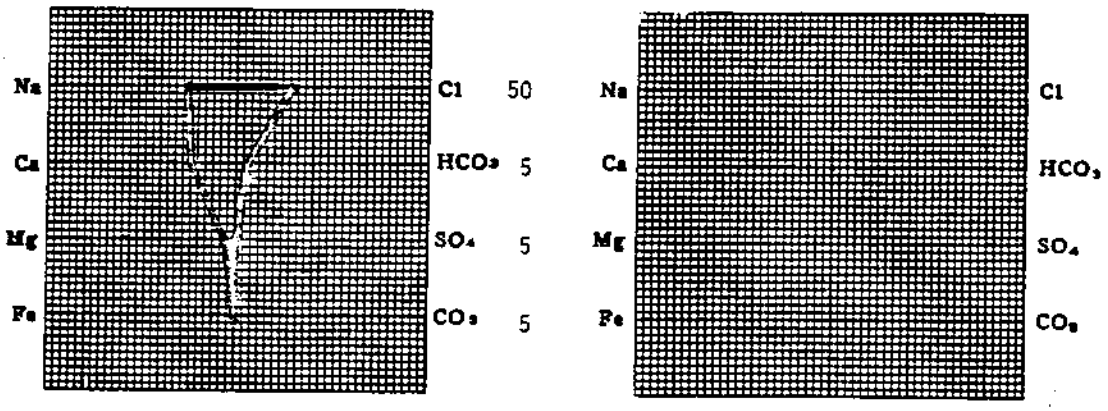
Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	7698	334.84	Sulfate	Trace	--
Potassium	Trace	--	Chloride	13000	366.60
Calcium	600	29.94	Carbonate	0	--
Magnesium	100	8.22	Bicarbonate	390	6.40
Iron	Present	--	Hydroxide	-	--
Total Cations		373.00	Total Anions		373.00

Total dissolved solids, mg/l	21589	Specific resistance @ 68°F.:	
NaCl equivalent, mg/l	21572	Observed	0.45 ohm-meters
Observed pH	6.5	Calculated	0.39 ohm-meters

WATER ANALYSIS PATTERN

Sample above described

Scale MEQ per Unit



(No value in above graphs includes No. K, and Li)
NOTE: Mg/l = Milligrams per liter Meq/l = Milligram equivalents per liter
Sodium chloride equivalent by Dunlap & Hawthorne calculation from components

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

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ANCHORAGE, ALASKA 99509

WATER ANALYSIS REPORT

OPERATOR Husky Oil Company **DATE** April 21, 1978 **LAB NO.** 7693-4
WELL NO. South Barrow No. 17 **LOCATION**
FIELD NPR #4 **FORMATION**
COUNTY **INTERVAL**
STATE Alaska **SAMPLE FROM** Production test No. 1

REMARKS & CONCLUSIONS: Sample No. 4, Clear, Iron precipitate

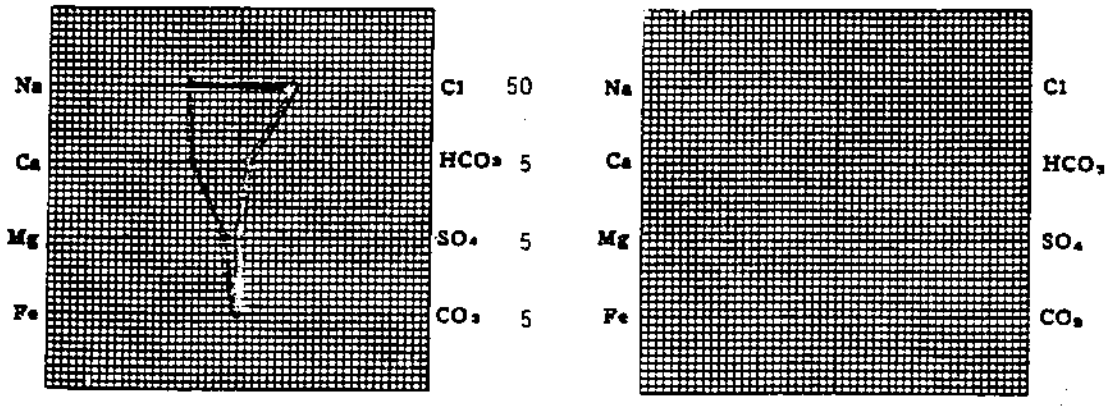
Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	7715	335.51	Sulfate	Trace	--
Potassium	Trace	---	Chloride	13000	366.60
Calcium	580	28.94	Carbonate	0	--
Magnesium	100	8.22	Bicarbonate	370	6.07
Iron	-	---	Hydroxide	-	---
Total Cations		372.67	Total Anions		372.67

Total dissolved solids, mg/l	21577	Specific resistance @ 68°F.:	
NaCl equivalent, mg/l	21591	Observed	0.48 ohm-meters
Observed pH	6.5	Calculated	0.39 ohm-meters

WATER ANALYSIS PATTERN

Sample above described

Scale MEQ per Unit



(No value is shown for cations including Na, K, and Li)
NOTE: Mg/l = Milligrams per liter Meq/l = Milligram equivalents per liter
Sodium chloride equivalent by Dunlap & Kaveler's calculation from components

HA - 1 (2/2/68)

GAS ANALYSIS
REPORT OF ANALYSIS

F. S. - 15891 M.S. N-67893 •H 0.12 OBS. PRES. 59.5 CAL. PRES. 63.8

STATE- ALASKA COUNTY- NORTHWESTERN

FIELD- BARROW E WELL NAME- WELL NO. 17

LOCATION- NOT GIVEN 1625' FNL, 2150 FWL Sec 30, T. 22N, R 16W OWNER- HUSKY OIL NPR OPERATIONS INC

DATE COMPLETED- NOT GIVEN 13 April, 1978 DATE SAMPLED- 01/17/80

SAMPLED BY- NICHOLLS & CRANE

NAME OF PRODUCING FORMATION- NOT GIVEN Barrow Sand

DEPTH IN FEET- NOT GIVEN ±2100 THICKNESS IN FEET- NOT GIVEN 20'

SHUT IN WELLHEAD PRES., PSIG- 1000 OPEN FLOW, MCF/D- NOT GIVEN 2,960 MCFPD + 92 BWPD

CHECK OF DATA-
THE WELL DATA ARE ACCURATE, (_____) WITHOUT CORRECTION, (_____) AS CORRECTED ABOVE.

REMARKS-

ANALYSIS-

METHANE	94.9	%	NORMAL PENTANE	0.1	%	OXYGEN	TRACE	%
ETHANE	0.9	%	ISOPENTANE	0.0	%	ARGON	TRACE	%
PROPANE	0.3	%	CYCLOPENTANE	0.1	%	HYDROGEN	0.0	%
NORMAL BUTANE	0.2	%	HEXANES PLUS	0.2	%	H2S *	0.0	%
ISOBUTANE	0.1	%	NITROGEN	3.1	%	CO2	TRACE	%
SPECIFIC GRAV 0.587						HELIUM	0.13	%
						TOTAL	100.00	%

CALCULATED GROSS BTU/CU. FT., DRY AT 60 DEG. F AND 30 IN. MERCURY- 1014

* DUE TO THE ABSORPTION OF H2S DURING SAMPLING, THE REPORTED RESULTS MAY NOT BE RELIABLE

PERMISSION FOR RELEASE:

Permission is hereby granted for the Bureau of Mines to release the above data, together with similar data released by other operators as public information and as parts of a series of papers on analyses of gases from various fields, states, or regions.

COMPANY U.S. Geological Survey

BY Robert J. Crane

TITLE Geologist

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014 P.O.BOX 4-1276 4649 BUSINESS PARK BLVD.
ANCHORAGE, ALASKA 99509

GAS ANALYSIS REPORT

Company Husky Oil Company Date March 22, 1978 Lab. No. 7497-1
Well No. South Barrow No. 12 Location
Field NPR #4 Formation Okpikrauk
County Depth 1512-1715
State Alaska Sampling point DST No. 1
Line pressure ____ psig; Sample pressure 10 psig; Temperature ____ ° F; Container number
Remarks Sample No. 1 March 10, 1978

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	1.83	
Carbon dioxide	Trace	
Hydrogen sulfide	--	
Methane	96.25	
Ethane	1.27	
Propane	0.41	0.113
Iso-butane	0.08	0.026
N-butane	0.08	0.025
Iso-pentane	0.04	0.015
N-pentane	0.03	0.011
Hexanes	0.01	0.004
Heptanes & higher	Trace	--
Total	100.00	0.194

GPM of pentanes & higher fraction 0.030

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1013
Specific gravity (calculated from analysis) 0.576
Specific gravity (measured) 0.577

Remarks:

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

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ANCHORAGE, ALASKA 99509

GAS ANALYSIS REPORT

Company Husky Oil Company Date March 22, 1978 Lab. No. 7497-2
Well No. South Barrow No. 17 Location
Field NPR No. 4 Formation Okpikrauk
County Depth 1512-1715
State Alaska Sampling point DST No. 1
Line pressure ____ psig; Sample pressure 10 psig; Temperature ____ ° F; Container number
Remarks Sample No. 2, March 10, 1978

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	0.64	
Carbon dioxide	Trace	
Hydrogen sulfide	--	
Methane	97.16	
Ethane	1.77	0.077
Propane	0.28	0.016
Iso-butane	0.05	0.016
N-butane	0.05	0.011
Iso-pentane	0.03	0.007
N-pentane	0.02	--
Hexanes	Trace	--
Heptanes & higher	Trace	
Total	100.00	0.127

GPM of pentanes & higher fraction 0.018

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1025
Specific gravity (calculated from analysis) 0.570
Specific gravity (measured) 0.571

Remarks:

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ANCHORAGE, ALASKA 99509

GAS ANALYSIS REPORT

Company Husky Oil Company Date March 22, 1978 Lab. No. 7497-3
Well No. South Barrow No. 17 Location
Field NPR No. 4 Formation Okpikrauk
County Depth 1512-1715
State Alaska Sampling point DST No. 1
Line pressure psig; Sample pressure 10 psig; Temperature ° F; Container number
Remarks Sample No. 3, March 10, 1978

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	0.96	
Carbon dioxide	0.61	
Hydrogen sulfide	--	
Methane	96.75	
Ethane	1.24	
Propane	0.24	0.066
Iso-butane	0.06	0.020
N-butane	0.08	0.025
Iso-pentane	0.04	0.015
N-pentane	0.02	0.007
Hexanes	Trace	--
Heptanes & higher	Trace	--
Total	100.00	0.133

GPM of pentanes & higher fraction 0.022

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1012
Specific gravity (calculated from analysis) 0.575
Specific gravity (measured) 0.575

Remarks:

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GAS ANALYSIS REPORT

Company Husky Oil Company Date April 17, 1978 Lab. No. 7595-1
Well No. South Barrow No. 17 Location
Field NPR No. 4 Formation Barrow Sand
County Depth 2105-2147 (DST No. 2)
State Alaska Sampling point Choke Manifold
Line pressure psig; Sample pressure 700 psig; Temperature 42 ° F; Container number
Remarks Sample No. 1 Taken March 15, 1978

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	2.10	
Carbon dioxide	0.10	
Hydrogen sulfide	--	
Methane	96.95	
Ethane	0.50	
Propane	0.05	0.014
Iso-butane	0.02	0.007
N-butane	0.12	0.038
Iso-pentane	0.08	0.029
N-pentane	0.05	0.018
Hexanes	0.02	0.008
Heptanes & higher	0.01	0.005
Total	100.00	0.119

GPM of pentanes & higher fraction 0.119

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1001
Specific gravity (calculated from analysis) 0.572
Specific gravity (measured) 0.570

Remarks:

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ANCHORAGE, ALASKA 99509

GAS ANALYSIS REPORT

Company Husky Oil Company Date April 17, 1978 Lab. No. 7595-2
Well No. South Barrow No. 17 Location
Field NPR No. 4 Formation Barrow Sand
County Depth 2105-2147 (DST No. 2)
State Alaska Sampling point Choke Manifold
Line pressure psig; Sample pressure 700 psig; Temperature 42 ° F; Container number
Remarks Sample No. 2 taken March 15, 1978

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	2.00	
Carbon dioxide	0.09	
Hydrogen sulfide	--	
Methane	96.98	
Ethane	0.62	
Propane	0.04	0.011
Iso-butane	0.05	0.016
N-butane	0.13	0.041
Iso-pentane	0.03	0.011
N-pentane	0.04	0.014
Hexanes	0.02	0.008
Heptanes & higher	Trace	--
Total	100.00	0.101

GPM of pentanes & higher fraction 0.033

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1001
Specific gravity (calculated from analysis) 0.571
Specific gravity (measured) 0.570

Remarks:

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GAS ANALYSIS REPORT

Company Husky Oil Company Date April 17, 1978 Lab. No. 7595-3
Well No. South Barrow No. 17 Location
Field NPR No. 4 Formation Barrow Sand
County Depth 2105-2147 (DST No. 2)
State Alaska Sampling point Choke Manifold
Line pressure ____ psig; Sample pressure 700 psig; Temperature 42 ° F; Container number
Remarks Sample No. 3 taken March 15, 1978

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	2.12	
Carbon dioxide	0.11	
Hydrogen sulfide	---	
Methane	96.90	
Ethane	0.44	
Propane	0.08	0.022
Iso-butane	0.08	0.026
N-butane	0.14	0.044
Iso-pentane	0.04	0.015
N-pentane	0.06	0.022
Hexanes	0.02	0.008
Heptanes & higher	0.01	0.005
Total	100.00	0.142

GPM of pentanes & higher fraction 0.050

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1001
Specific gravity (calculated from analysis) 0.573
Specific gravity (measured) 0.570

Remarks:

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GAS ANALYSIS REPORT

Company Husky Oil Company Date April 17, 1978 Lab. No. 7694-1
Well No. South Barrow No. 17 Location
Field NPR No. 4 Formation Sag River
County Depth 2212-2322
State Alaska Sampling point Choke Manifold
Line pressure ____ psig; Sample pressure 255 psig; Temperature -- ° F; Container number
Remarks
Sample No. 1 Taken March 29, 1978

Component	Volume %	Gallons per MCF	Mole % or
Oxygen	0		
Nitrogen	1.59		
Carbon dioxide	Trace		
Hydrogen sulfide	--		
Methane	97.24		
Ethane	0.86		
Propane	0.15	0.041	
iso-butane	0.04	0.013	
N-butane	0.06	0.019	
iso-pentane	0.02	0.007	
N-pentane	0.03	0.011	
Hexanes	0.01	0.004	
Heptanes & higher	Trace	---	
Total	100.00	0.095	

GPM of pentanes & higher fraction 0.022

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1007
Specific gravity (calculated from analysis) 0.569
Specific gravity (measured) 0.570

Remarks:

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
ANCHORAGE, ALASKA 99509

GAS ANALYSIS REPORT

Date April 17, 1978 Lab. No. 7694-2
Location
Formation Sag River
Depth 2212-2322
Sampling point Choke Manifold
psig; Temperature -- ° F; Container number
9, 1978

Company Husky Oil Company
Well No. South Barrow No. 1u
Field NPR No. 4
County
State Alaska
Line pressure psig; Sample pressure 255
Remarks Sample No. 2 taken March 2

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	1.50	
Carbon dioxide	Trace	
Hydrogen sulfide	--	
Methane	97.51	
Ethane	0.72	
Propane	0.10	0.027
Iso-butane	0.04	0.013
N-butane	0.06	0.019
Iso-pentane	0.03	0.011
N-pentane	0.03	0.011
Hexanes	0.01	0.004
Heptanes & higher	Trace	--
Total	100.00	0.085

on 0.026

psia (dry basis) 1006
analysis) 0.568
0.570

GPM of pentanes & higher fracti

Gross btu cu. ft. @60° F. & 14.
Specific gravity (calculated from
Specific gravity (measured)

Remarks:

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GAS ANALYSIS REPORT

Company Husky Oil Company Date April 17, 1978 Lab. No. 7694-3
Well No. South Barrow No. 17 Location
Field NPR No. 4 Formation Sag River
County Depth 2212-2322
State Alaska Sampling point Choke Manifold
Line pressure ____ psig; Sample pressure 255 psig; Temperature ---° F; Container number
Remarks Sample No. 3 taken March 29, 1978

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	1.52	
Carbon dioxide	Trace	
Hydrogen sulfide	--	
Methane	97.34	
Ethane	0.78	0.036
Propane	0.13	0.010
Iso-butane	0.03	0.025
N-butane	0.08	0.011
Iso-pentane	0.03	0.022
N-pentane	0.06	0.008
Hexanes	0.02	0.005
Heptanes & higher	0.01	
Total	100.00	0.117

GPM of pentanes & higher fraction 0.046

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1009
Specific gravity (calculated from analysis) 0.569
Specific gravity (measured) 0.569

Remarks:

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GAS ANALYSIS REPORT

Company Husky Oil Company Date April 18, 1978 Lab. No. 7725-1
Well No. South Barrow No. 17 Location
Field NPR #4 Formation
County Depth
State Alaska Sampling point Wellhead
Line pressure psig; Sample pressure 844 psig; Temperature --- ° F; Container number
Remarks
Sample No. 1 taken 4-11-78

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	0.92	
Carbon dioxide	0.04	
Hydrogen sulfide	---	
Methane	98.57	
Ethane	0.35	
Propane	0.06	0.016
Iso-butane	0.01	0.003
N-butane	0.03	0.009
Iso-pentane	0.01	0.004
N-pentane	0.01	0.004
Hexanes & Higher	Trace	
Total	100.00	0.036

GPM of pentanes & higher fraction 0.008

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 985
Specific gravity (calculated from analysis) 0.570
Specific gravity (measured) 0.570

Remarks:

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GAS ANALYSIS REPORT

Company Husky Oil Company Date April 18, 1978 Lab. No. 7725-2
Well No. South Barrow No. 17 Location
Field NPR #4 Formation
County Depth
State Alaska Sampling point Wellhead
Line pressure psig; Sample pressure 844 psig; Temperature --- ° F; Container number
Remarks Sample No. 2 taken 4-11-78

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	0.90	
Carbon dioxide	0.06	
Hydrogen sulfide	---	
Methane	98.48	
Ethane	0.41	
Propane	0.04	0.011
Iso-butane	0.01	0.003
N-butane	0.03	0.009
Iso-pentane	0.01	0.004
N-pentane	0.04	0.014
Hexanes	0.02	0.008
Heptanes & higher	Trace	--
Total	100.00	0.049

GPM of pentanes & higher fraction 0.026

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1007
Specific gravity (calculated from analysis) 0.563
Specific gravity (measured) 0.565

Remarks:

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GAS ANALYSIS REPORT

Company: Husky Oil Company
Well No.: South Barrow No. 17
Field: NPR #4
County:
State: Alaska

Date: April 18, 1978 Lab. No. 7725-3
Location:
Formation:
Depth:
Sampling point: Wellhead
Line pressure: psig Sample pressure 844 psig Temperature °F Container No.
Remarks: Sample No. 3" taken 4-11-78

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	0.022
Nitrogen	0.90	0.013
Carbon dioxide	Trace	0.025
Hydrogen sulfide	---	0.011
Methane	98.50	0.018
Ethane	0.31	0.004
Propane	0.08	---
Iso-butane	0.04	
N-butane	0.08	0.093
Iso-pentane	0.03	
N-pentane	0.05	
Hexanes	0.01	
Heptanes & higher	Trace	
Total	100.00	

GPM of pentanes & higher fraction: 0.033

Gross btu. cu. ft. @60° F. & 14.7 psia (dry basis): 1010
Specific gravity (calculated from analysis): 0.564
Specific gravity (measured): 0.566

Remarks:

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GAS ANALYSIS REPORT

Company Husky Oil Company Date April 18, 1978 Lab. No. 7725-4
Well No. South Barrow No. 17 Location
Field NPR #4 Formation
County Depth
State Alaska Sampling point Wellhead
Line pressure psig; Sample pressure 844 psig; Temperature --- ° F; Container number
Remarks

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	0.99	
Carbon dioxide	0.08	
Hydrogen sulfide	---	
Methane	98.23	
Ethane	0.34	
Propane	0.09	0.025
Iso-butane	0.02	0.007
N-butane	0.11	0.035
Iso-pentane	0.04	0.015
N-pentane	0.08	0.029
Hexanes	0.02	0.008
Heptanes & higher	Trace	
Total	100.00	0.119

GPM of pentanes & higher fraction 0.052

Gross btu cu. ft. @60° F. & 14.7 psia (dry basis) 1010
Specific gravity (calculated from analysis) 0.566
Specific gravity (measured) 0.568

Remarks: