N. C Master

NORCEN GAS STORAGE FEASIBILITY STUDY

DALY AREA - MANITOBA

GEOLOGICAL AND PETROPHYSICAL REPORT

November, 1977

(Revision)

Prepared for

NORCEN ENERGY RESOURCES LIMITED

Prepared by

INTERCOMP RESOURCE DEVELOPMENT AND ENGINEERING LTD.

Report No. CGS-19-77-483

intercomp

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INTRODUCTION

In the second quarter of 1976, INTERCOMP undertook to commence studies on the proposed Norcen Gas Storage Project. The studies as per proposal were to progress in three stages:

I. Feasibility Studies

II. Development

III. Operations

This report, which represents part of Phase I, provides the results of the Petrophysical and Geological analysis based on the well control to date. Prior to the commencement of the evaluation program, the Duperow and Souris River nitrogen bearing reservoir units were considered to be prospective gas storage zones. Subsequent to the drilling of the first two evaluation wells, the Souris River Porosity zone was found to have all the favourable attributes from a gas storage standpoint within the proposed operational scheme. Additional feasibility studies on the Duperow were hence curtailed and advanced geological and petrophysical studies continued on the Souris River Porosity unit.

Although 3 to 5 delineation wells will ultimately be required to refine trap capacity estimates, data from four recently drilled delineation wells along with other offset well control has provided sufficient data to qualify the Souris

River Porosity as a potential storage horizon. Furthermore, the results of study to date indicate that further work under Phase II - Development is merited.

CONCLUSIONS

1. Caprock integrity has been confirmed at the top of the Souris River Porosity zone. Well control has indicated that anhydrites effectively seal this interval from overlying Souris River and Duperow porous developments.

2. A closure of roughly 100 feet has been proven to occur in the structure as outlined by the nitrogen gas accumulation in this reservoir unit.

3. At least two and possibly three individual separate reservoir elements are present in the Souris River Porosity unit. These reservoir units are separated by thin but laterally correlatable anhydrite beds and this separation is manifested by the presence of different nitrogen-water contacts in at least two of the three porous units.

4. Based on well control to date, the minimum trap capacity in terms of nitrogen gas is 32.4 Bcf GIP based on proven gas-down-to levels. This estimate is slightly conservative since no water level has been established in Zone 1 and defined within a 5 and 7 foot interval in Zones 2 and 3, respectively. Assuming a water-up-to level for Zones 2 and 3 and a gas-down-to for Zone 1, the trap capacity is calculated to be 34.4 Bcf.

5. Recognizing the uniformity of bedding in the Souris River Porosity unit, the proven differing water levels indicate that the nitrogen volumes contained are probably not spill-point controlled in all three zones. Hence, additional trap capacity may be available before spill would be effected through the structural saddle located at the southwest end of the Daly structure.

RECOMMENDATIONS

1. One additional well in the northeast sector of the structure would be valuable in refining structural regimen in this area.

2. Evaluation programs on any additional delineation wells need not necessarily include core. However, should core be cut, full diameter core analysis should be run. Full porosity log coverage in terms of FDC-CNL and Sonic are recommended in order to fully evaluate critical reservoir parameters throughout the Daly structure.

PETROPHYSICS

The evaluation of all special core data pertinent to the Souris River formation is now complete. Results are herein presented for the following petrophysical control parameters.

1. Porosity-Permeability
2. Formation Water Resistivity
3. Lithological-Saturation Indices

POROSITY-PERMEABILITY

Porosity

As outlined in the preliminary INTERCOMP report dated November 31, 1976 porosity control was previously derived from atmospheric core analysis data augmented where necessary by a full suite of open hole logging devices - namely the CNL-FDC and Borehole Compensated Sonic logs. The recently completed Special Core Analyses studies conducted at Shell Canada Resources Production Laboratory have confirmed an anticipated porosity reduction under simulated overburden conditions. Figure 2 illustrates the comparison of routine atmospheric to overburden measured porosities. Analysis of this plot indicates that a reduction of 1 porosity unit at 25% porosity can be expected. At lower porosities, in the order of 5-10%, the reduction is less severe, being only 0.5 porosity units. This reduction, however, is in the order of 5 percent of total pore volume at high porosities increasing to 10 percent of total pore volume at intermediate to low

porosities. Table 1 is presented to show the heterogeneity of the Souris River formation. Small plugs were cut from intervals previously analyzed by the whole core analysis method. The whole core method generally produced higher porosities but the trend was not totally consistent. Individual data points varied by as much as 6.6 percent but were generally within 1 to 2 percent of each other. Any future core analysis work in this formation should definitely be full diameter in nature.

Permeability

Differing porosity-permeability relationships are indicated for Zones 1 and 2 versus Zone 3. Figure 3 illustrates the pre-dominantly intercrystalline pore network present in Zones 1 and 2, while Zone 3 (Figure 4), which possesses significantly more secondary porosity, displays wide variations in permeability for any given porosity range. Figure 5 illustrates the effects of overburden pressure on permeability to water under overburden conditions.

The high fraction of secondary porosity present in Zone 3 has produced another predictable situation -- high gas trapping tendencies. Figure 6, presents initial-residual non wetting phase saturation relationships, clearly depicting this situation. At 80% initial gas saturation (a figure representative of average reservoir conditions) residual gas saturations are 40% for Zones 1 and 2 and 50% for Zone 3.

FORMATION WATER RESISTIVITY

Laboratory analyses of recovered waters from drillstem test #2 in Daly Gas #1 indicate a saturated salt water condition is present in the aquifer. Total solids were measured as high as 280,170 mg/litre. This is equivalent to a water resistivity at reservoir temperature of 0.033 ohm-meters. This value was used in all calculations of water saturation in Daly Gas #1 and 2.

LITHOLOGICAL-SATURATION INDICES

The formation resistivity factor (FRF) is a measurement of the ratio of the electrical resistivity, Ro, of a porous medium completely saturated with brine to the resistivity, RW, of the water in the pores. Figure 7 illustrates the relative insensitivity of this factor to overburden conditions. A simulated reservoir condition of 2500 psi net of external less internal pressure was used. The brine used was a synthetic brine containing:

102,000 ppm Sodium
168,000 ppm Chloride
5,100 ppm Calcium
800 ppm Magnesium
1,100 ppm Sulphate

The effect in this case was a negligible increase in FRF under overburden conditions. This is due in part to the extremely high conductivity of the saturating brine and possibly to some extent to the modest reduction in total porosity effected by the application of overburden pressure. Several low porosity points are anomalously off-trend. The cause of these spuriously low FRF values in the low porosity samples is not known. It is possibly related to microfracturing resulting in a short-circuiting of the normal electrical path thus producing anomalously low FRF values. It might also result from improper sample preparation permitting a brine film to act as a parallel conductance path along the outside of the plug. Normally, the application of reservoir pressure to these jacketed samples eliminates both the microfracturing and brine film problems. For purposes of this study the majority of the reservoir lies above 10% porosity and, as such, a lithological exponent m (the slope of the relationship of FRF and ϕ) of 1.71 was selected as representative of reservoir conditions. This value too is anomalously low; normal FRF relationships for dolomites range between an m of 2.0 and 2.4.

With the anticipated highly water wet nature of the Souris River Porosity reservoir a saturation index, n, of 2.0 was selected. The above mentioned variables were combined for solution of the standard Archie relationship for water saturation:

$$Sw^{-n} = Rt/Ro$$

where: Rt = True resistivity

Ro = FRF * Rw and,

$$FRF = 1/\phi^{m}$$

Thus:

$$Sw^{-2.0} = \frac{Rt}{0.033\ \phi^{-1.71}}$$

Results of the petrophysical evaluations of each well on the Daly Structure are contained in Appendix D herein.

GEOLOGY

GENERAL GEOLOGY

Based on well data arising out of the drilling of 7-18, 10-7, 11-19-10-27 W1M and 10A-12-10-28 W1M, a fairly definitive geologic/reservoir model has been established. Cross section (Figure 8) and structural contour map (Figure 9) illustrate the structural interpretation on top of the Souris River porosity. As was originally indicated by seismic, a structural high trending northeast-southwest exhibits some 100 to 125 feet of structural closure; this structure is the probable result of salt solution effects and consequent draping.

CAPROCK INTEGRITY

Drilling has confirmed the existence and integrity of a Souris River porosity seal in the Daly structure. Proof of caprock sealing quality is substantiated by three observations:

1) Core examinations have confirmed the presence of massive anhydrite beds immediately above the Souris River Porosity Zone; these anhydrites are correlatable both north-south as well as east-west across the field.

2) Based on log evaluations, some porous stringers above the sealing anhydrites and within the Souris River interval are water bearing above the gas intervals within the Souris River Porosity Zone. Such a situation

could not exist if vertical communicability were present.

3) Based on tests and log evaluation, separate water levels have been proven to occur in Zones 1 and 3. Zone 1 is gas bearing a minimum of 42 feet lower than proven water-up-to in Zone 3 (refer to the cross section Figure 8). Since a gas-down-to of 1947 feet subsea has been defined in Zone 1, and Zone 2 indicates a water level to occur in the interval 1949 to 1954 feet subsea, it is uncertain, based on present data, whether Zones 1 and 2 are separate or common reservoirs.

STRUCTURAL MAPPING

Since a number of wells drilled in the subject area do not penetrate the Souris River section, the seismically derived Bakken structure was assumed as a "base" structural horizon. Isopachs of the interval Bakken to top Souris River porosity were established for non-penetrating wells by correlation to nearest control and projection to Souris River level. An isopach interpretation was thus prepared, which, when added to the Bakken structure, resulted in the derivation of a structural contour map on top of the Souris River Porosity (Figure 9). Recognizing individual zone reservoirs, as per the foregoing discussion, a series of structural contour maps on top of Zones 2 and 3 (Figures 10 and 11) and base Zone 3 (Figure 12) were derived by isopach addition to the structure map on top of Zone 1 (Figure 9). Table 3 presents the tops summary utilized in this mapping phase.

VOLUMETRICS

On the basis of the petrophysical evaluation data shown on Table 2, the structural interpretations and the fluid level data derived from existing and recent drilling, a series of capacity maps were constructed. Figures 12, 14 and 15 incorporate the gas-down-to and water-up-to information in conjunction with structure to define the areal limits of nitrogen gas on a per zone basis. These porosity foot maps were planimetered to establish total pore volume per zone on a gas-down-to basis for all Zones; in Zones 2 and 3 a water-up-to capacity was established for comparison purposes. Since a finite water level has not been established for Zone 1, the gas pore volume shown for this zone is a minimum value.

Applying weighted average water saturation data on a per zone basis and a computed gas expansion factor, a proven gas-in-place was calculated and tabulated per zone. Table 4 provides the summary of gas-in-place per Souris River Porosity Zone. The critical reservoir parameters utilized were:

Pressure	1531 @ 1910 feet subsea
BHT	92^{o} F
Pc	492.8
Tc	227.3
Zi	0.98
Ei	99.9

BASIC DATA

All the basic data, both geological and petrophysical, were forwarded to Norcen on a continuous basis during the evaluation work of Phase I. In order to provide a complete dossier, a number of prepared data items previously provided have been assimilated and included in the Appendix herein.

REPORT PREPARATION

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T A B L E S

TABLE 1

FULL DIAMETER vs SMALL PLUG ANALYSES

SOURIS RIVER FORMATION

DALY GAS #1 7-18-10-27-W1

Zone	Interval Represented	Drilled From Whole Core No.	SMALL PLUG ANALYSIS Porosity %	SMALL PLUG ANALYSIS Permeability md	SMALL PLUG ANALYSIS Grain Density	WHOLE CORE ANALYSIS Porosity %	WHOLE CORE ANALYSIS Permeability md	WHOLE CORE ANALYSIS Grain Density
1	3525.4 - 3526.2	63	24.3	379	2.807	25.9	430.00	2.82
	3526.2 - 3527.7	64	28.8	-	2.798	26.5	676.00	2.82
	3527.7 - 3529.5	65	26.4	-	2.822	19.8	33.55	2.81
2	3536.1 - 3536.9	66	16.0	27.8	2.819	17.2	27.70	2.85
	3538.3 - 3539.1	68	12.1	-	2.831	22.9	21.80	2.83
	3539.1 - 3539.9	69	21.5	43.5	2.819	23.4	46.50	2.84
	3539.9 - 3540.6	70	27.0	141	2.806	29.4	131.00	2.83
3	3544.2 - 3545.6	72	5.3	-	2.840	9.2	1.43	2.80
	3546.7 - 3547.4	74	5.6	2.03	2.828	5.6	4.70	2.86
	3549.8 - 3550.8	78	14.0	-	2.829	12.2	29.40	2.81
	3551.7 - 3552.3	80	22.3	-	2.821	18.8	73.30	2.83
	3556.2 - 3557.1	85	15.4	405	2.838	14.8	68.30	2.83
	3558.7 - 3559.5	88	5.4	1.11	2.838	8.5	53.50	2.83
	3561.1 - 3562.0	91	5.1	0.01(1)	2.834	6.1	18.10	2.84
	3563.0 - 3564.0	93	20.4	322	2.833	20.3	184.00	2.81
	3566.4 - 3567.4	96	8.8	4.13	2.833	11.2	17.10	2.83
	3567.4 - 3568.4	97	13.5	56.9	2.847	17.2	134.00	2.83
	3569.4 - 3570.3	99	13.5	-	2.848	14.3	23.50	2.85
	3571.0 - 3571.9	101	23.4	-	2.846	26.6	120.00	2.82
	3573.2 - 3573.8	103	15.9	-	2.841	17.1	20.60	2.84
	3574.7 - 3575.6	105	16.0	-	2.834	15.5	18.70	2.83
	3575.6 - 3576.4	106	19.1	25.6(1)	2.828	14.5	15.50	2.85
	3576.4 - 3577.2	107	11.6	-	2.851	21.4	34.40	2.82
	3578.2 - 3579.1	109	9.5	0.820	2.840	11.8	4.60	2.83
	3581.0 - 3582.2	112	12.4	-	2.831	12.6	3.70	2.82

TABLE 2

PETROPHYSICAL SUMMARY SHEET

DALY AREA

SOURIS RIVER POROSITY

WELL	ZONE 1				ZONE 2				ZONE 3			
	Reservoir Development Ft.	Net Pay Ft.	Average Porosity %	Avg. Water Saturation %	Reservoir Development Ft.	Net Pay Ft.	Average Porosity %	Avg. Water Saturation %	Reservoir Development Ft.	Net Pay Ft.	Average Porosity %	Avg. Water Saturation %
10-7-10-27W1M	8.0	8.0	16.5	39	5.0	0.0	20.5	100	35.0	0	9.4	100
7-18-10-27W1M	9.5	9.5	19.2	12	4.5	4.5	21.7	16	38.9	0	13.0	100
15A-18-10-27W1M	8.0	8.0	18.9	*	4.0	4.0	19.5	*	34.0	34.0	17.7	19*
11-19-10-27W1M	9.4	9.4	17.2	19	3.8	3.8	25.9	32	35.3	0	16.6	100
10A-12-10-28W1M	9.0	9.0	15.8	17	5.0	5.0	20.0	17	32.0	0	17.9	100
8-14-10-28W1M	7.0	*	18.5	*	5.0	*	19.0	*	30.0	0	14.1	100

* Log type and resolution does not permit valid saturation calculations.

TABLE 3

DALY AREA

Souris River Porosity

Formation Tops Summary

WELL	KB	SOURIS RIVER POROSITY Zone 1 Top KB	Zone 1 Top SS	Zone 1 Base KB	Zone 1 Base SS	Zone 2 Top KB	Zone 2 Top SS	Zone 2 Base KB	Zone 2 Base SS	Zone 3 Top KB	Zone 3 Top SS	Zone 3 Base KB	Zone 3 Base SS	TD KB	TD SS
10-32-9-27W1	1625	3758E	2133E												
10-7-10-27W1	1605	3540	1935	3552	1947	3559	1954	3565	1960	3568	1963	3605	2000	3660	2055
07-18-10-27W1	1629	3516	1887	3528	1899	3536	1907	3540	1911	3543	1914	3581	1952	3624	1995
15-18-10-27W1	1620	3460	1840	3472	1852	3480	1860	3484	1864	3488	1868	3518	1898	5370	3750
11-19-10-27W1	1613	3537	1924	3550	1937	3558	1945	3562	1949	3566	1953	3601	1988	4093	2480
16-20-10-27W1	1601	3616E	2015E												
1-10-10-28W1	1653	3638E	1985E												
10-12-10-28W1	1629	3513E	1884E												
10A-12-10-28W1	1628	3504	1876	3518	1890	3524	1896	3530	1902	3533	1905	3568	1940	3640	2012
8-14-10-28W1	1636	3562	1926	3577	1941	3581	1945	3587	1951	3589	1953	3623	1987	3649	2013

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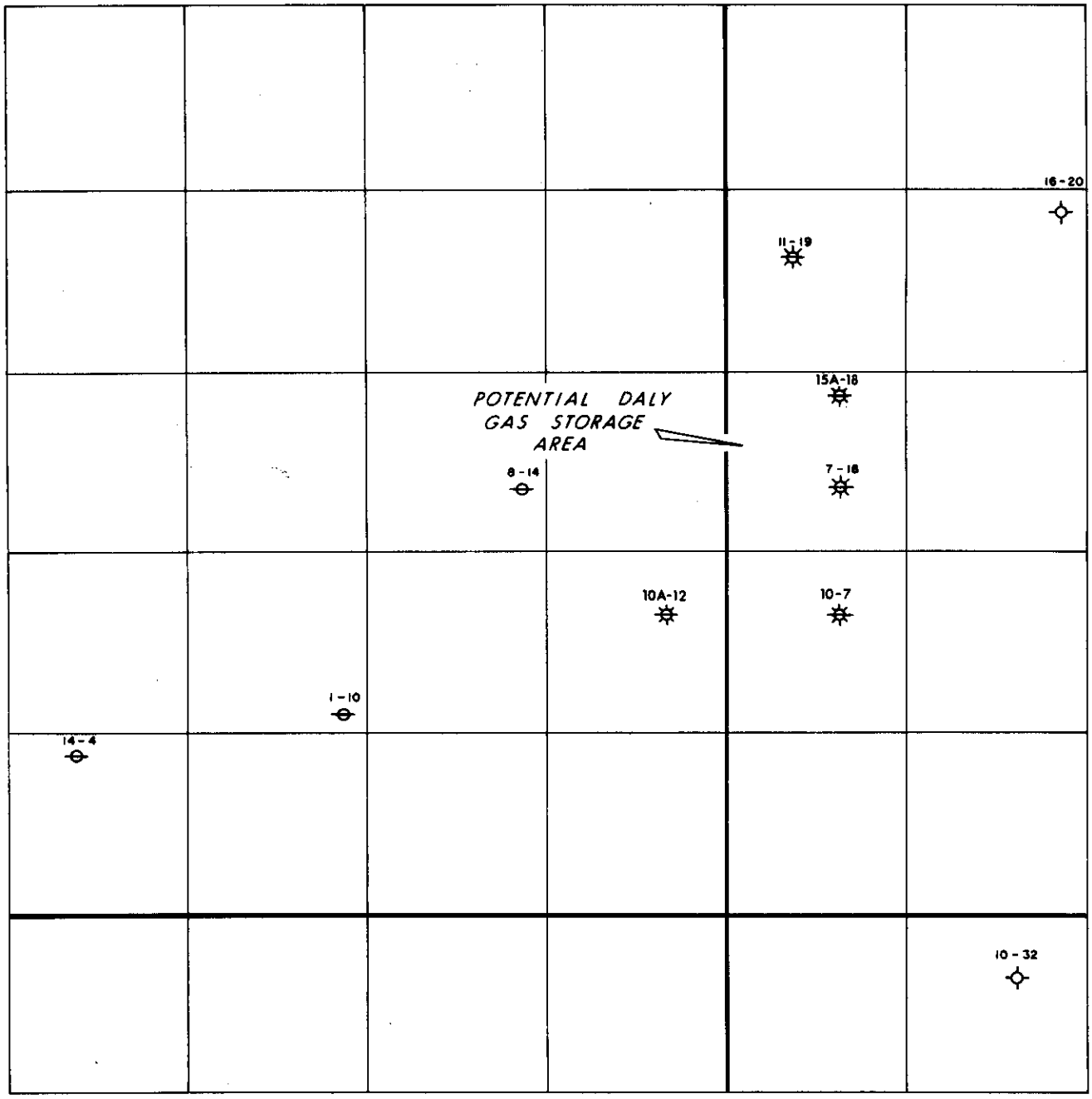
TABLE 4

PER ZONE SUMMARY OF NITROGEN RESERVES
DALY AREA - SOURIS RIVER RESERVOIR

Zone	Gas Areal Extent Acres	Gas Area Reservoir Pore Volume Acre-Ft.	Weighted Zone Water Saturation %	Gas Pore Volume Acre Ft.	Gas Volume Factor		Nitrogen In-Place Bcf
			BASED ON GAS-DOWN-TO				
1	3996	4994	21	3906	100		17.0
2	3044	2545	22	1985	100		8.6
3	789	1935	19	1567	100		6.8
						TOTAL	32.4
			BASED ON WATER-UP-TO				
1	-	-	-	-	-		-
2	3423	2947	22	2299	100		10.0
3	967	2099	19	1700	100		7.4

F I G U R E S



— INTERCOMP —

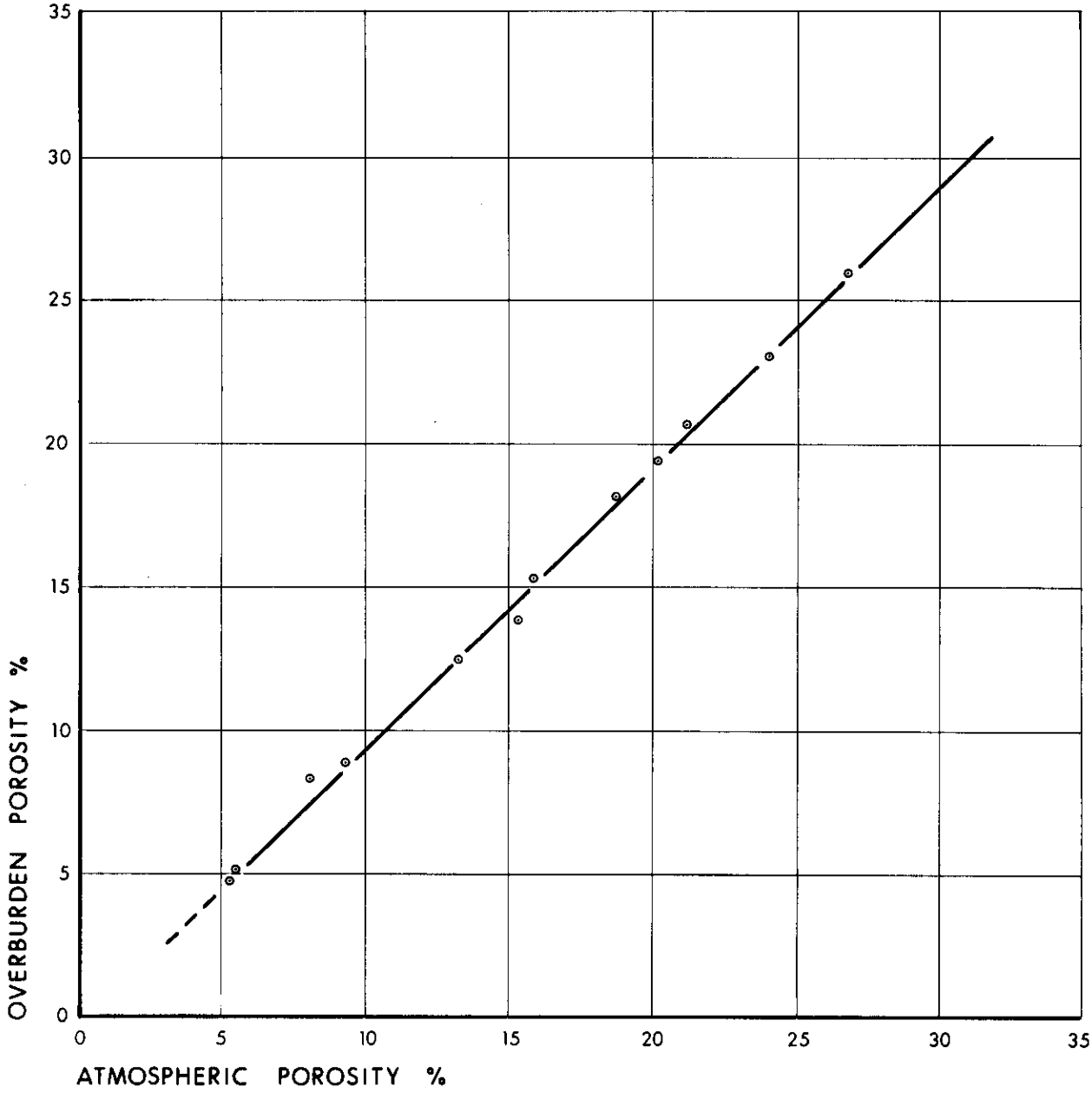
DALY AREA

LOCATION

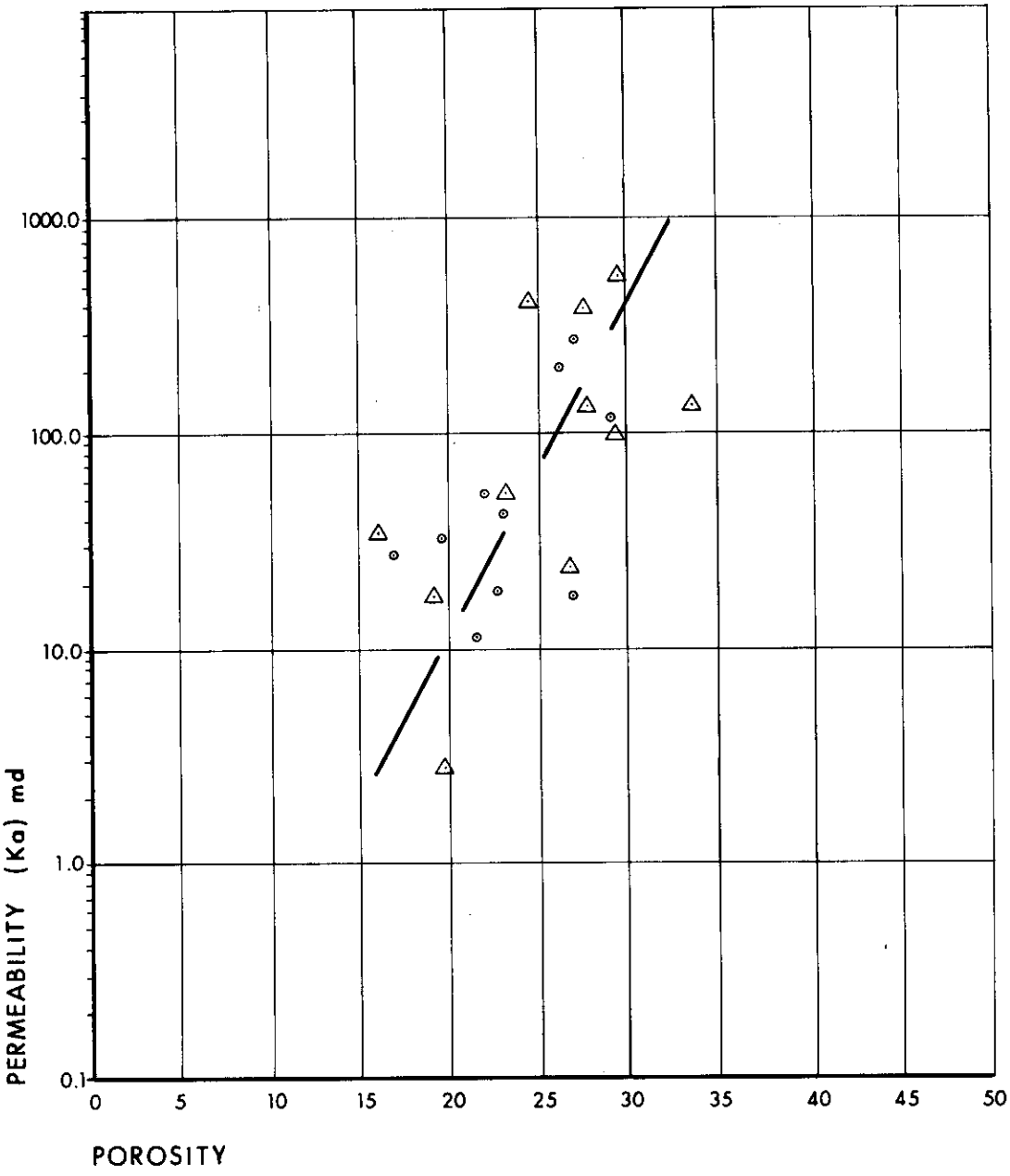
&

WELLSPOT BASE

DR. BY: N. THACHUK	DATE: DEC. 1976
REV. DATE: NOV. 1977	FIGURE NO. 1



- INTERCOMP -	
DALY GAS No. 1 (7-18-10-27 W1) OVERBURDEN vs ATMOSPHERIC CORE POROSITY	
DR. BY:	DATE: MARCH, 1977
	FIGURE No.: 2

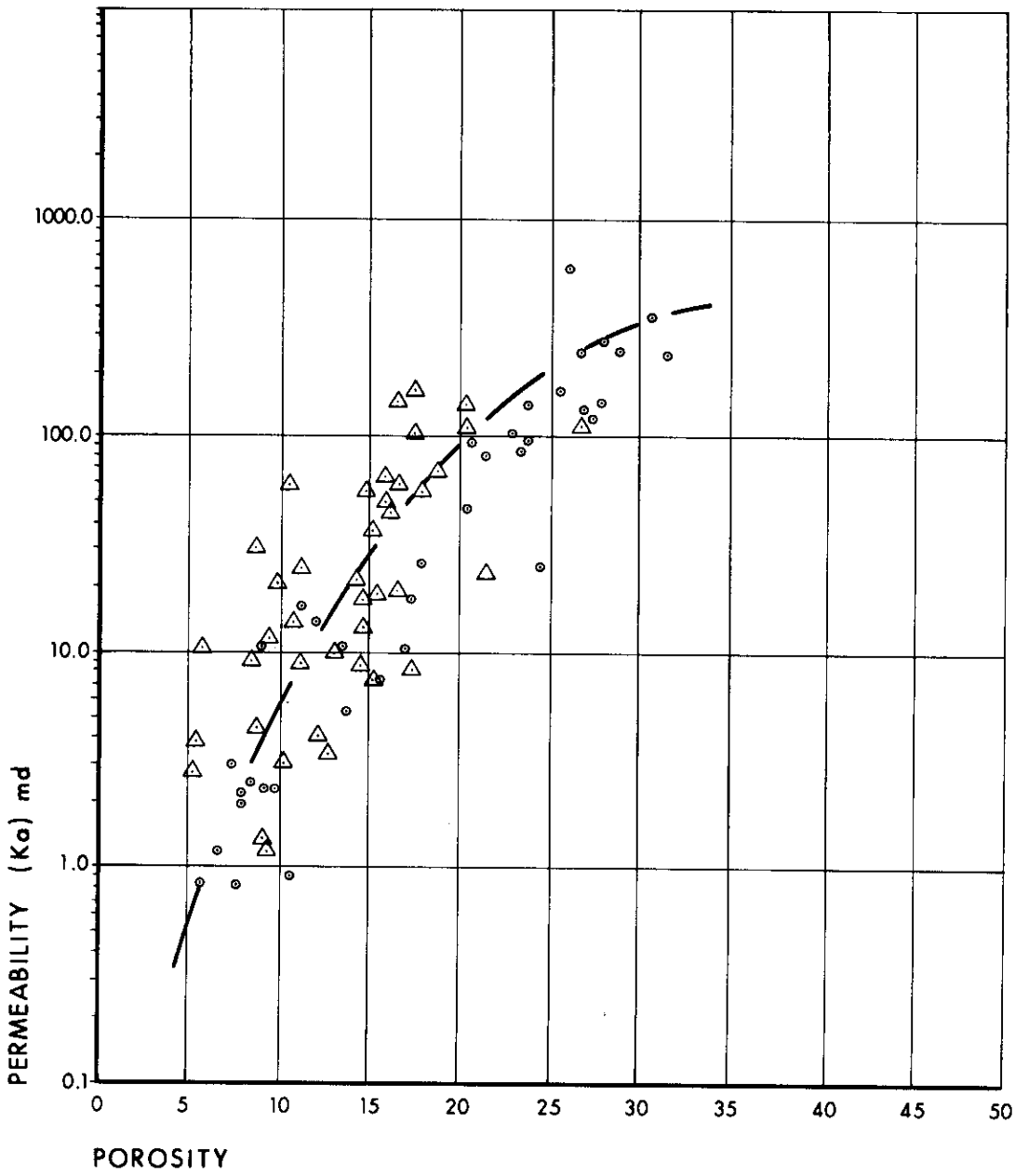


△ DALY GAS No. 1
⊙ DALY GAS No. 2

- INTERCOMP -

DALY GAS STORAGE LTD.
SOURIS RIVER FORMATION
Ka vs Ø ATMOS.
ZONES 1 & 2

DRAWN BY: CBA	DATE: MARCH, 1977
	FIGURE No.: 3

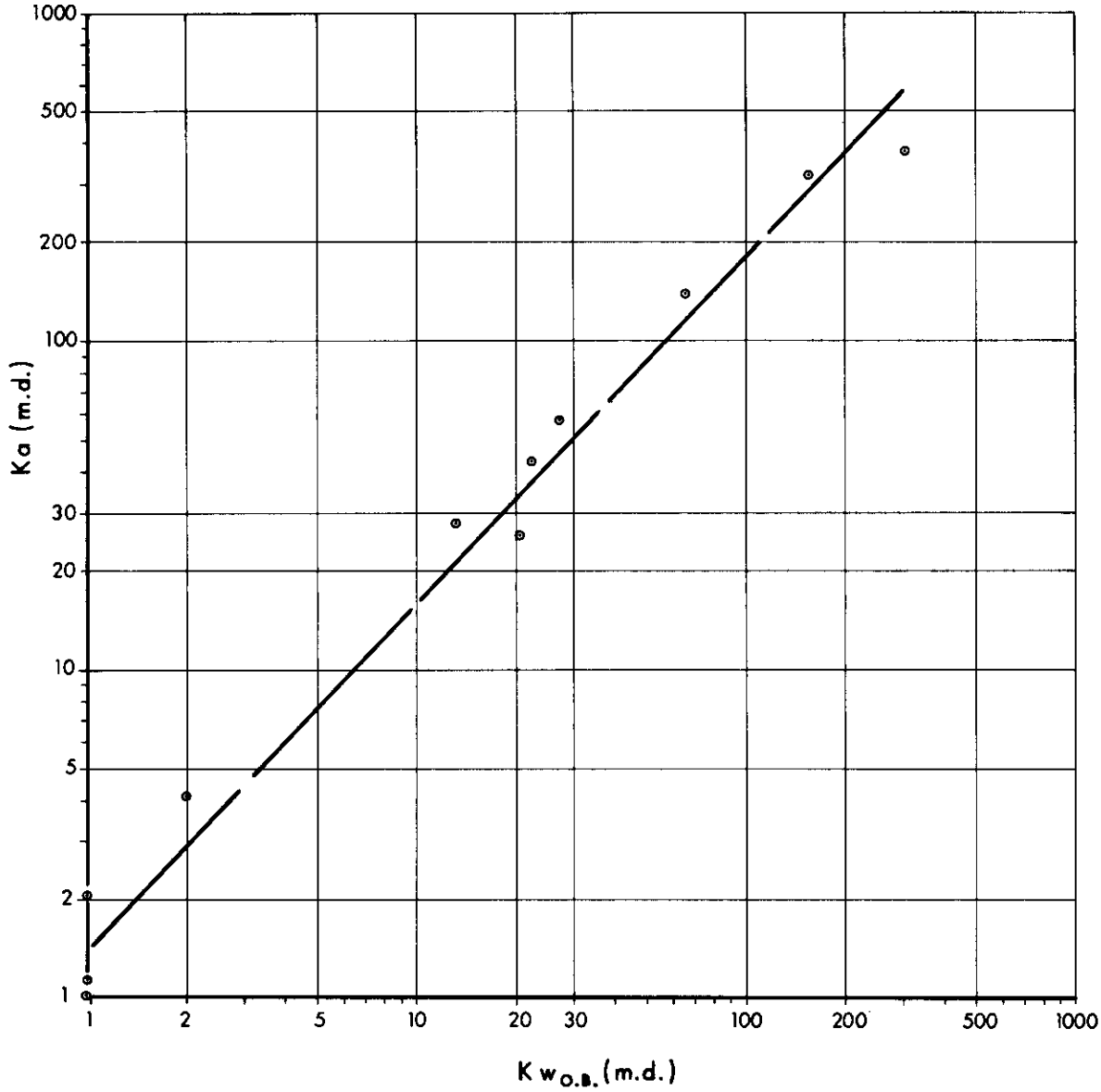


△ DALY GAS No. 1
⊙ DALY GAS No. 2

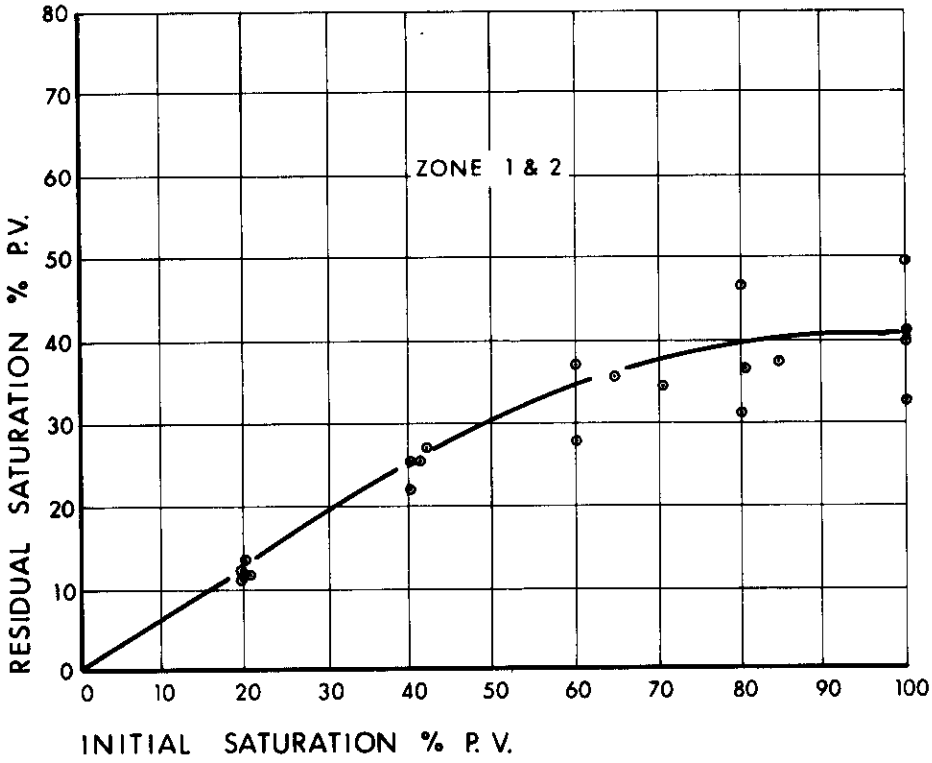
-INTERCOMP-

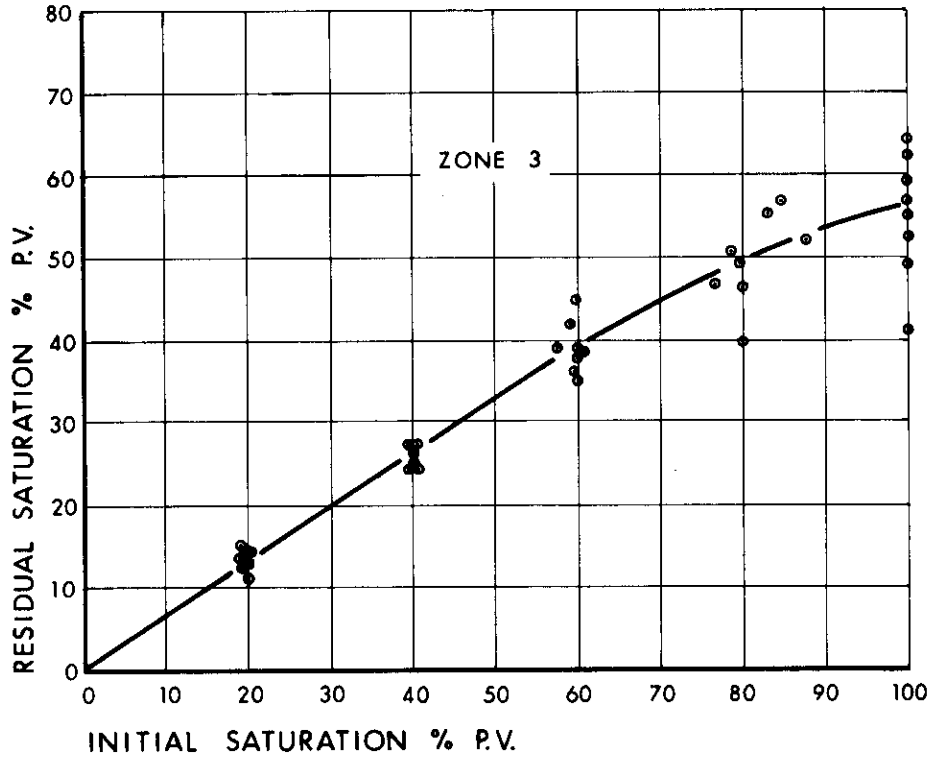
DALY GAS STORAGE LTD.
SOURIS RIVER FORMATION
Ka vs Ø ATMOS.
ZONE 3

DRAWN BY: CBA	DATE: MARCH, 1977
	FIGURE No.: 4



-INTERCOMP-	
DALY GAS No. 1 (7-18-10-27 W1) $K_{air_{atmos}}$ vs $K_{water_{O.B.}}$	
DR. BY:	DATE: MARCH, 1977
	FIGURE No.: 5

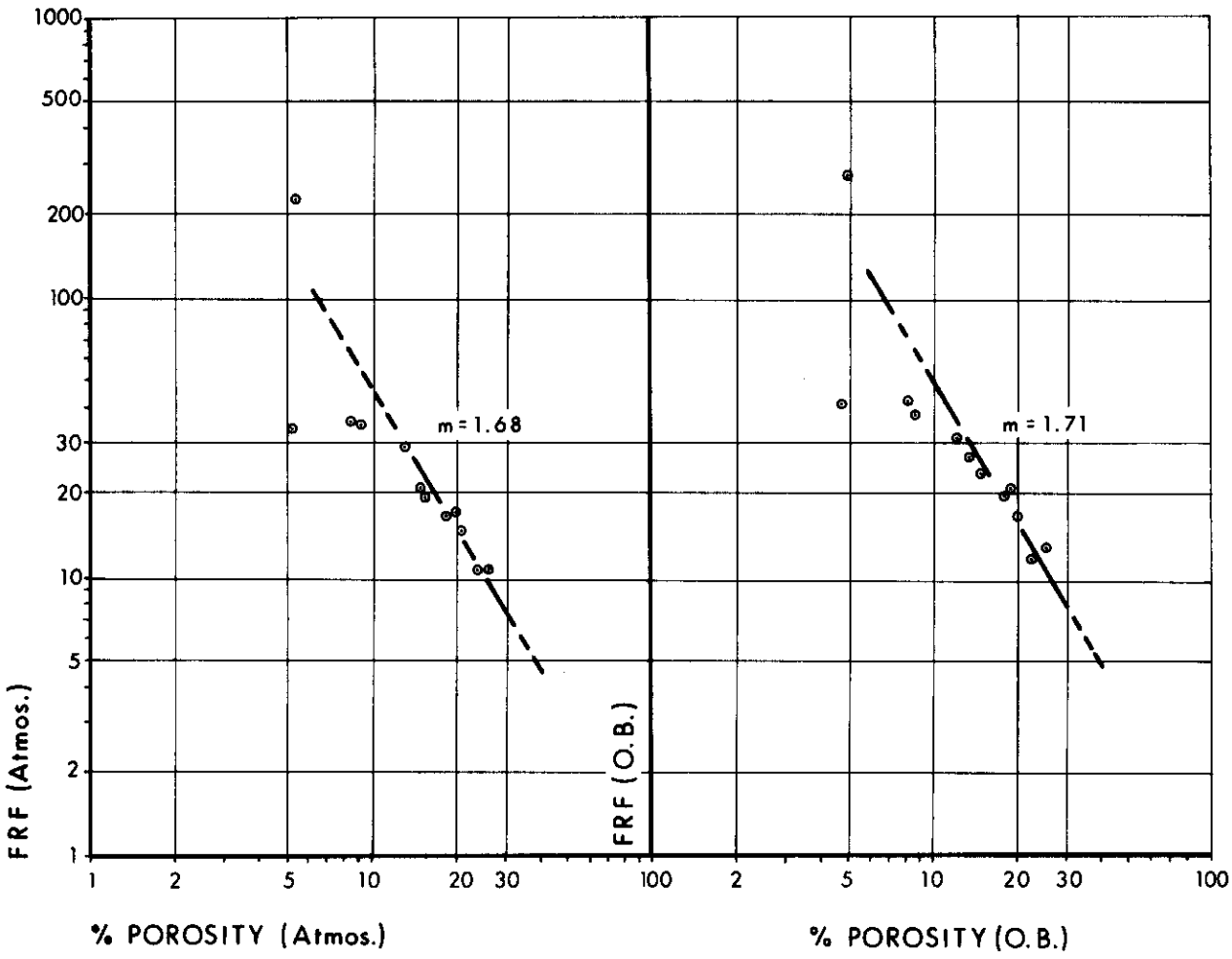




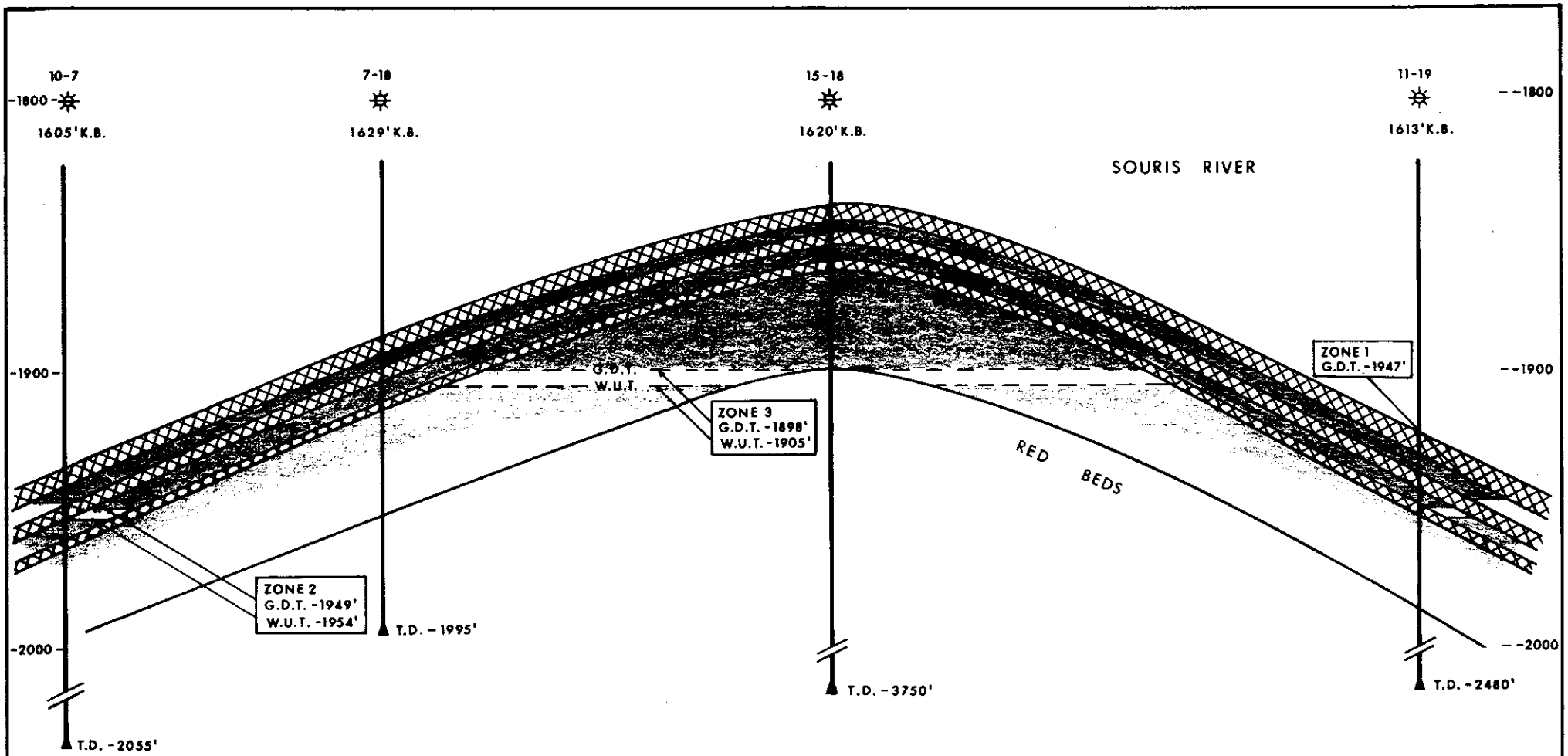
-INTERCOMP-

DALY GAS No. 1
AIR-LIQUID IMBIBITION
INITIAL / RESIDUAL SATURATION

DR. BY:	DATE: MARCH, 1977
	FIGURE No. 6



- INTERCOMP -	
DALY GAS No. 1 (7-18-10-27 W1) ATMOSPHERIC - OVERBURDEN FRF vs POROSITY	
DR. BY:	DATE: MAR. 1977
	FIGURE No. 7



LEGEND

GAS

WATER

ANHYDRITE

1900
1620
3520

— INTERCOMP —

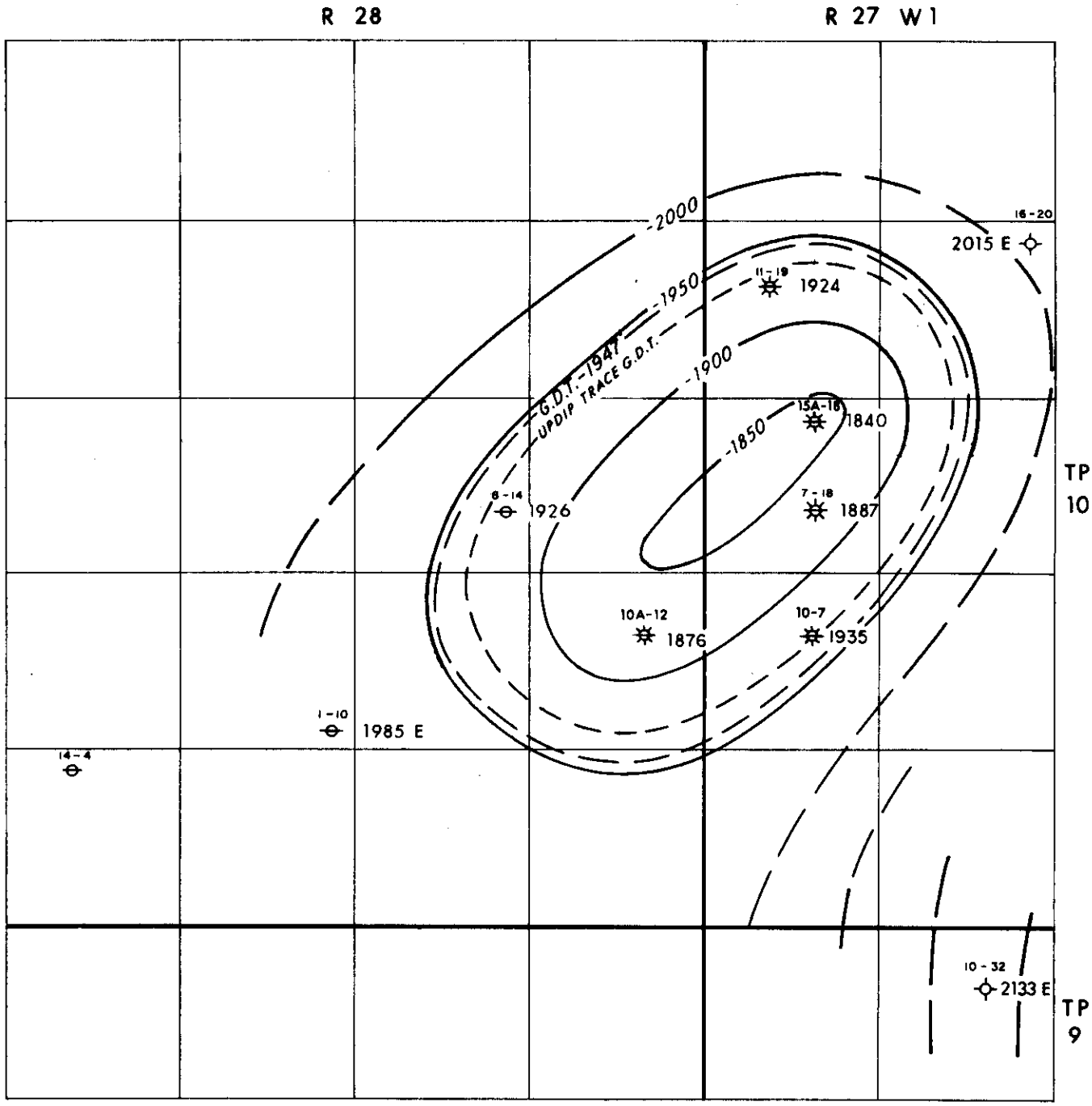
DALY AREA

TWP 10 R 27 W 1

STRUCTURAL X-SECTION

SOURIS RIVER POROSITY

DR. BY: N. THACHUK	DATE: DEC. 1976
REV. DATE: NOV. 1977	FIGURE NO. 8



LEGEND

⊖ 1925 DEPTH SUBSEA TOP SOURIS RIVER POROSITY

N.P. NOT PENETRATED

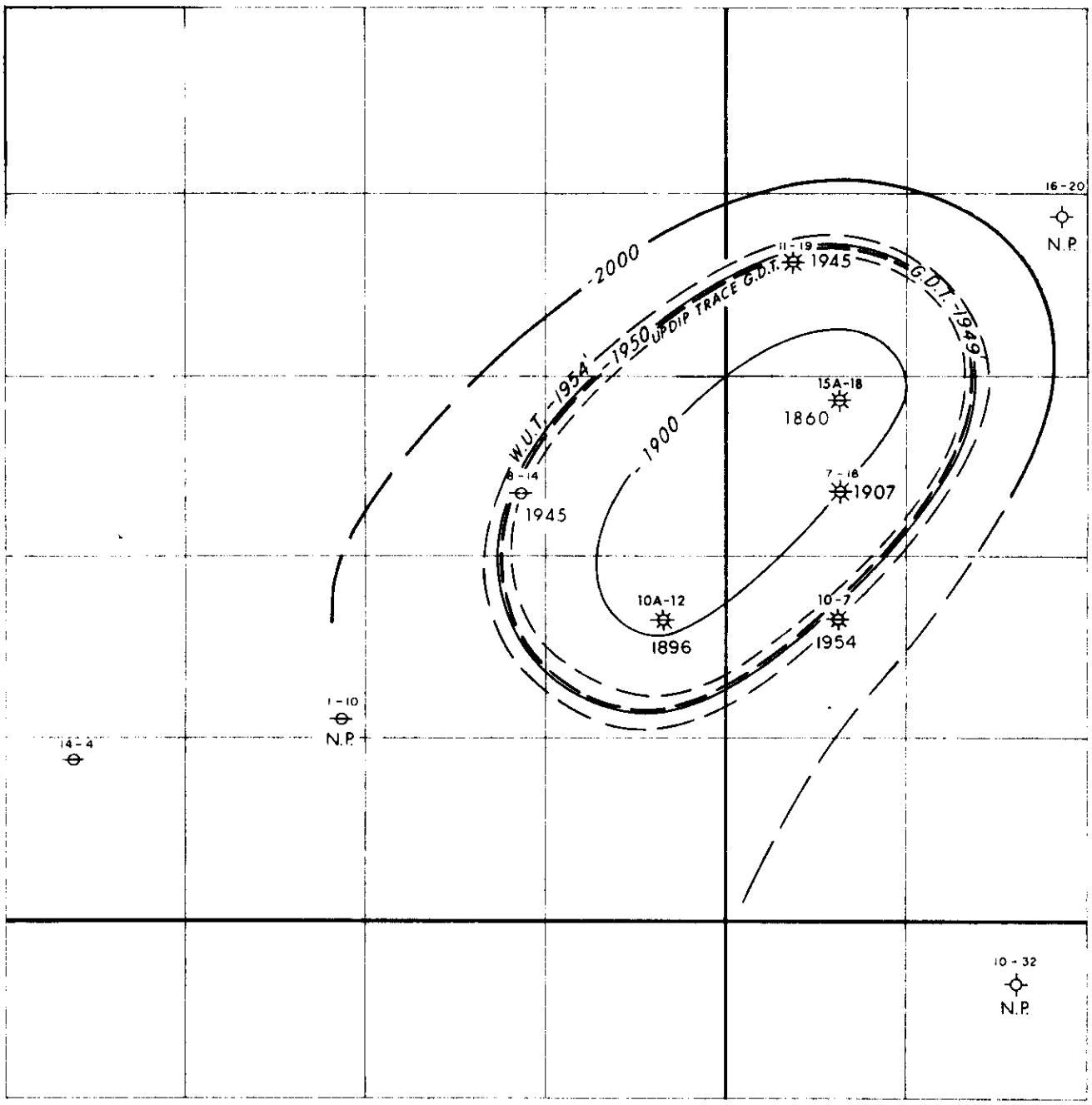
E ESTIMATED VALUE

— INTERCOMP —

DALY AREA

STRUCTURAL CONTOUR MAP
TOP ZONE 1
SOURIS RIVER POROSITY

DR. BY: N. THACHUK	DATE: DEC. 1976
REV. DATE: NOV. 1977	FIGURE NO. 9



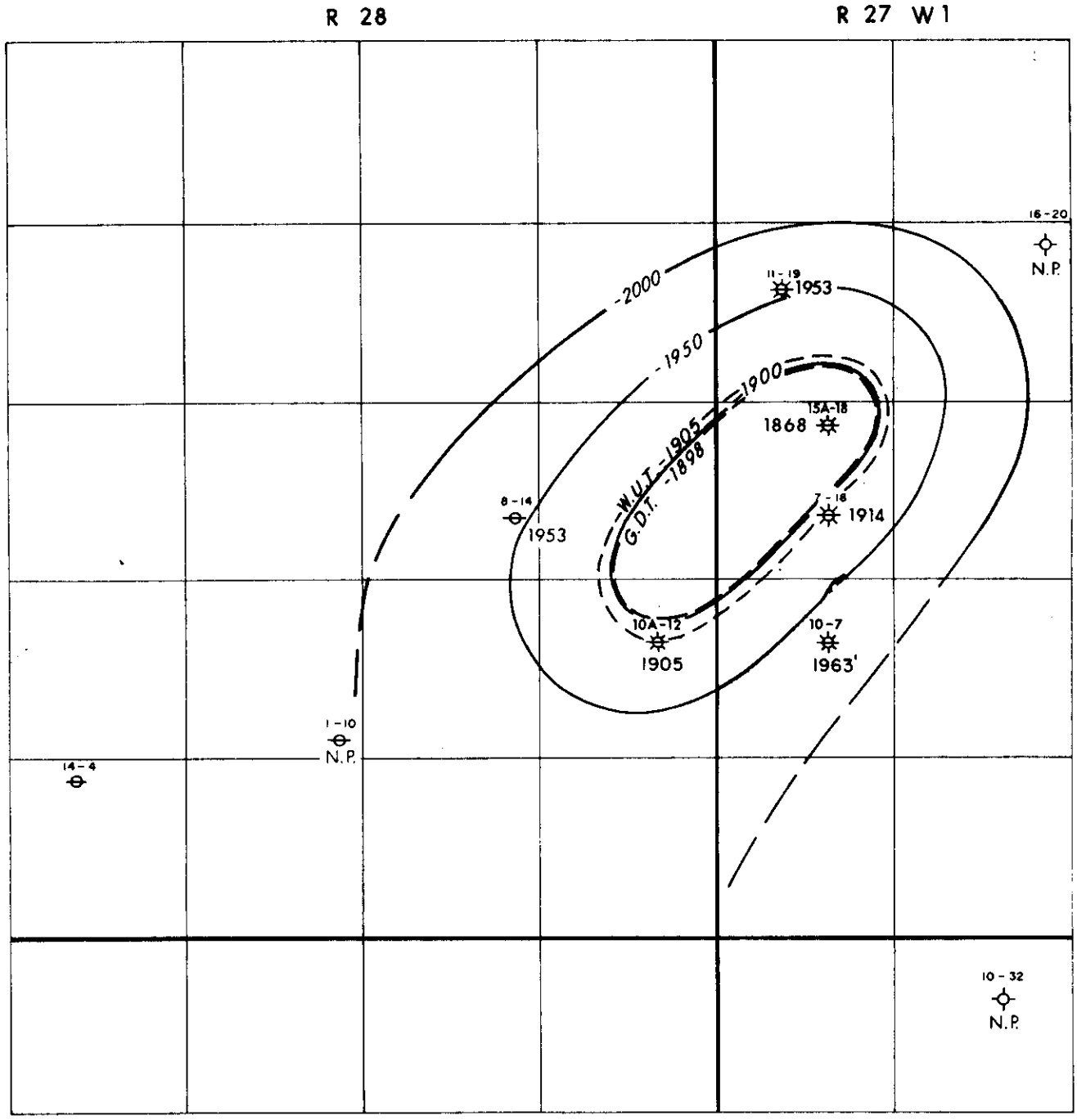
LEGEND

⊖ 1925 DEPTH SUBSEA SOURIS RIVER – ZONE 2 POROSITY

N.P. NOT PENETRATED

E ESTIMATED VALUE

— INTERCOMP —	
DALY AREA STRUCTURAL CONTOUR MAP TOP ZONE 2 SOURIS RIVER POROSITY	
DR BY: N THACHUK	DATE: DEC. 1976
REV. DATE: NOV. 1977	FIGURE NO. 10



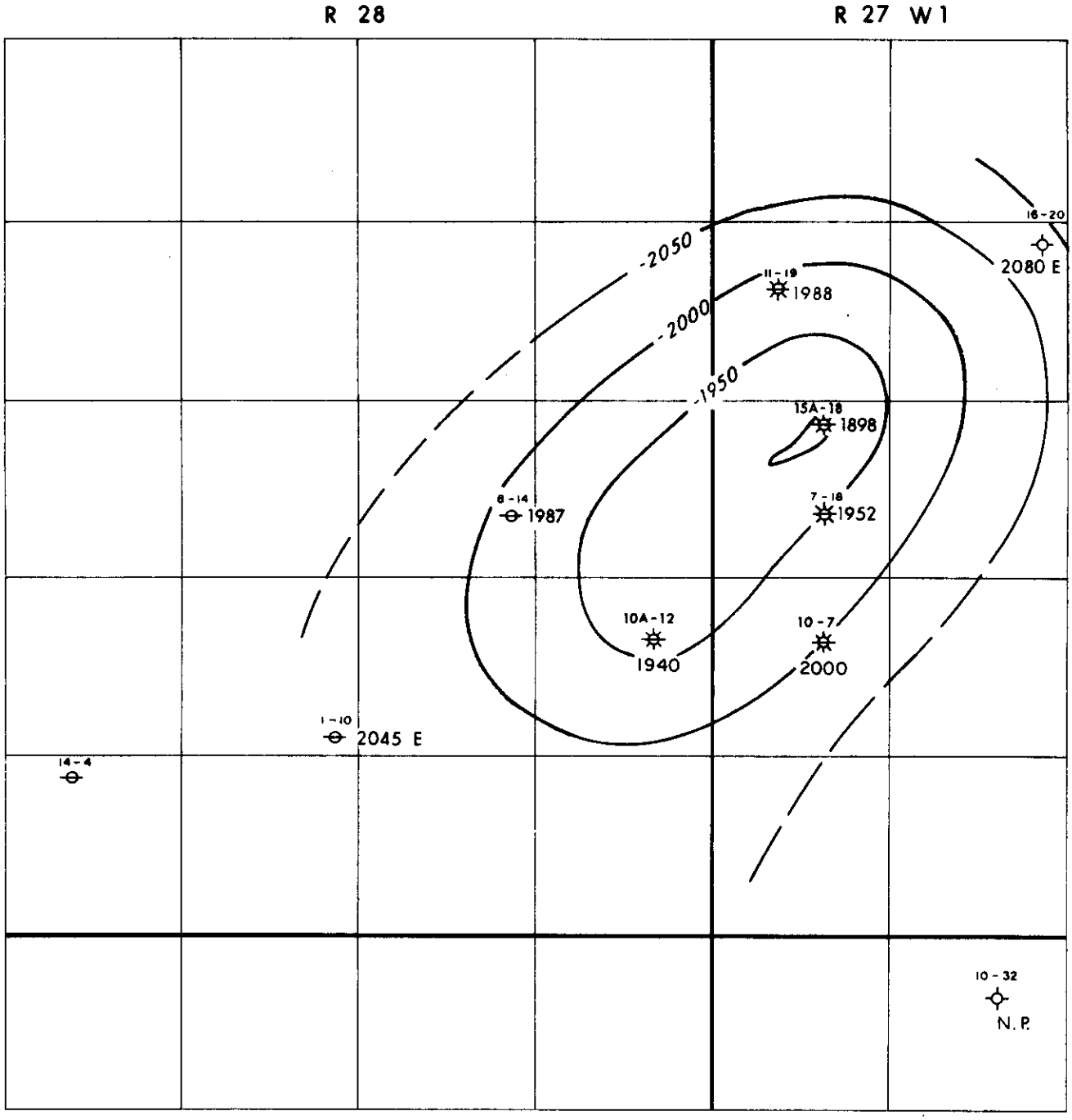
LEGEND

⊖ 1925 DEPTH SUBSEA SOURIS RIVER – ZONE 3 POROSITY

N.P. NOT PENETRATED

E ESTIMATED VALUE

— INTERCOMP —	
DALY AREA STRUCTURAL CONTOUR MAP TOP ZONE 3 SOURIS RIVER POROSITY	
DR. BY: N. THACHUK	DATE: DEC. 1976
REV. DATE: NOV. 1977	FIGURE NO. 11



LEGEND

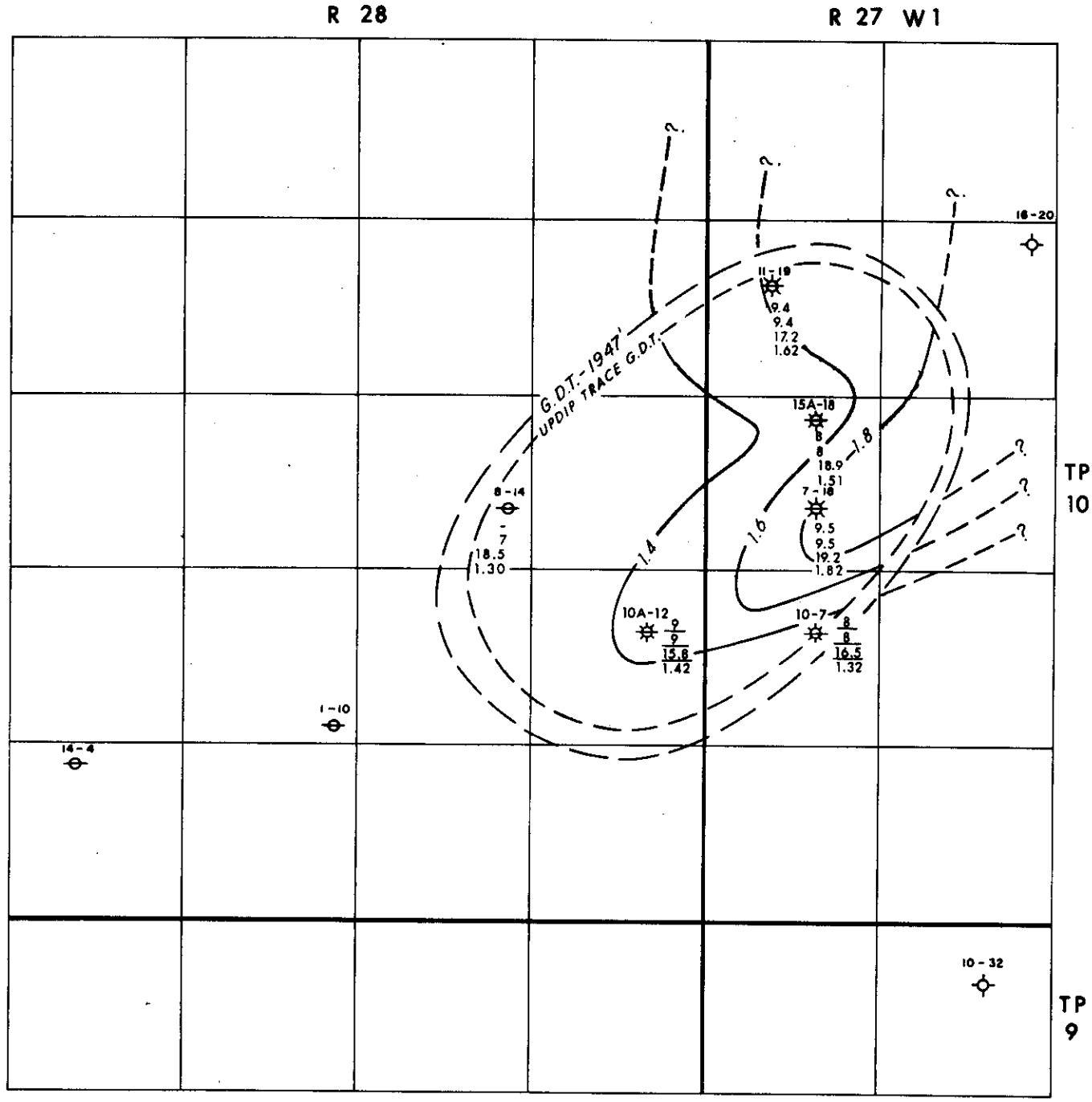
⊖ 1925 DEPTH SUBSEA BASE SOURIS RIVER POROSITY
N.P. NOT PENETRATED
E ESTIMATED VALUE

— INTERCOMP —

DALY AREA

STRUCTURAL CONTOUR MAP
BASE SOURIS RIVER POROSITY

DR. BY: N. THACHUK	DATE: DEC. 1976
REV. DATE: NOV. 1977	FIGURE NO. 12



LEGEND

9.5	NET PAY (FT.)
9.5	TOTAL RESERVOIR DEVELOPMENT (FT.)
19.2	AVERAGE POROSITY (%)
1.82	POROSITY (FRACTIONAL) × FT. RESERVOIR DEVELOPMENT

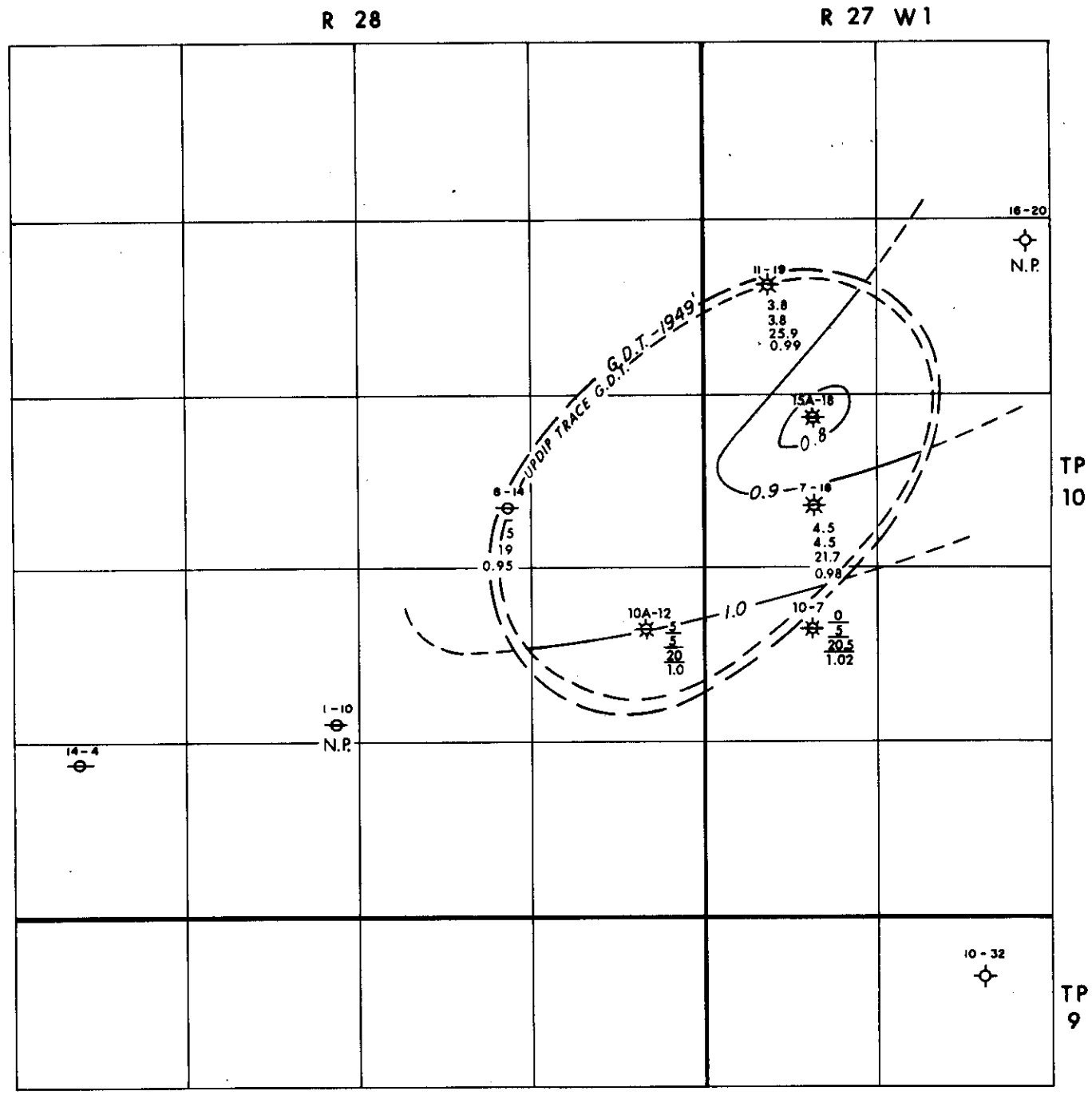
——— NET PAY × POROSITY (FRACTIONAL)

— — — POROSITY × FEET OF TOTAL RESERVOIR DEVELOPMENT BELOW GAS-DOWN-TO-LEVEL

— INTERCOMP —

DALY AREA
POROSITY FOOT MAP
ZONE 1
SOURIS RIVER POROSITY

DR. BY: N. THACHUK	DATE: DEC. 1976
REV. DATE: NOV. 1977	FIGURE NO. 13



LEGEND

4.5 NET PAY (FT.)
4.5 TOTAL RESERVOIR DEVELOPMENT (FT.)
21.7 AVERAGE POROSITY (%)
0.98 POROSITY (FRACTIONAL) × FT. RESERVOIR DEVELOPMENT

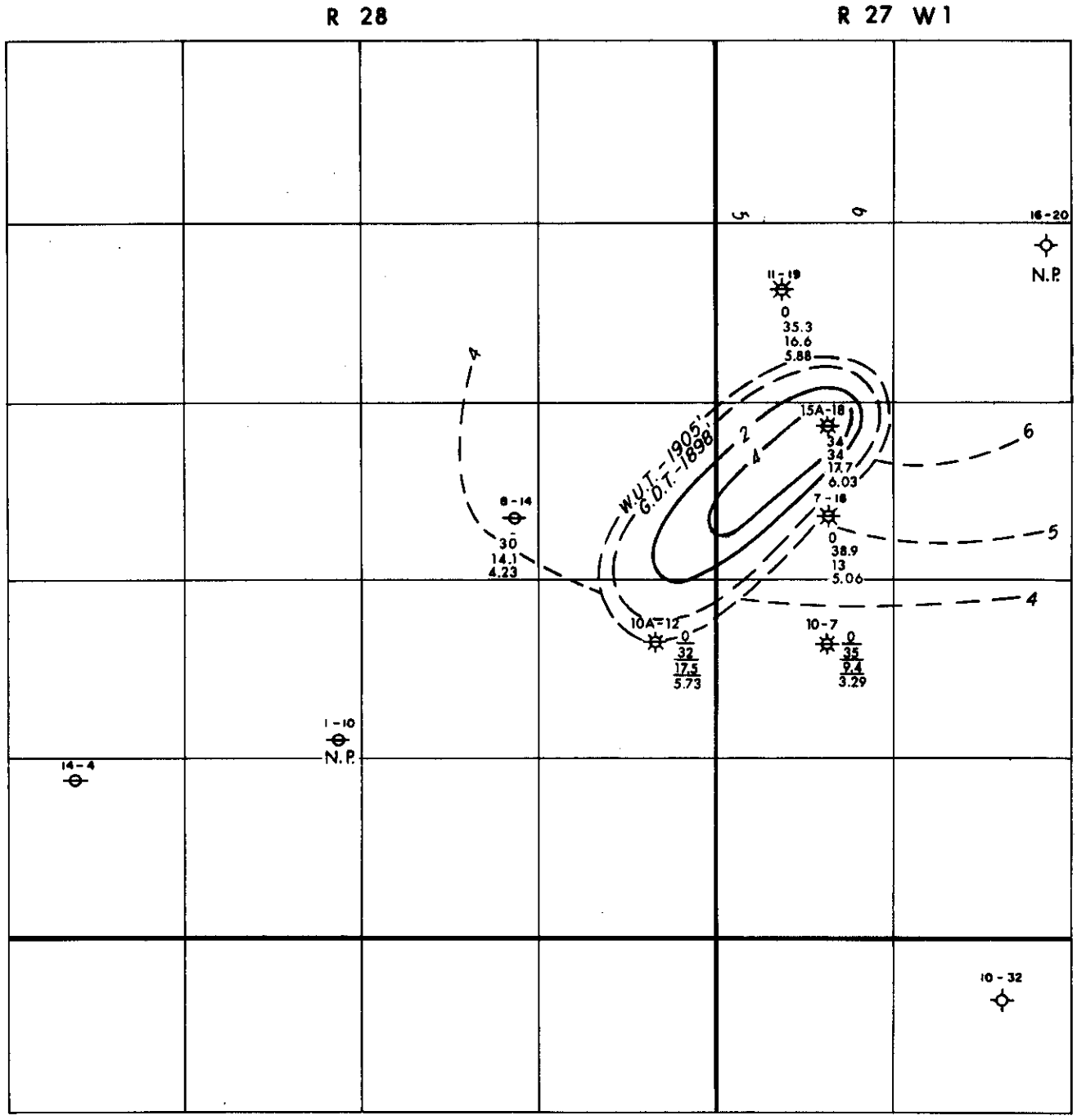
——— NET PAY × POROSITY (FRACTIONAL)

— — — POROSITY × FEET OF TOTAL RESERVOIR DEVELOPMENT BELOW GAS-DOWN-TO-LEVEL

— INTERCOMP —

DALY AREA
POROSITY FOOT MAP
ZONE 2
SOURIS RIVER POROSITY

DR. BY: N. THACHUK	DATE: DEC. 1976
REV. DATE: NOV. 1977	FIGURE NO. 14



LEGEND

34	NET PAY (FT.)
34	TOTAL RESERVOIR DEVELOPMENT (FT.)
17.7	AVERAGE POROSITY (%)
6.03	POROSITY (FRACTIONAL) × FT. RESERVOIR DEVELOPMENT

——— NET PAY × POROSITY (FRACTIONAL)

– – – POROSITY × FEET OF TOTAL RESERVOIR DEVELOPMENT BELOW GAS-DOWN-TO-LEVEL

— INTERCOMP —

DALY AREA
POROSITY FOOT MAP
ZONE 3
SOURIS RIVER POROSITY

DR. BY: N. THACHUK	DATE: DEC. 1976
REV. DATE: NOV. 1977	FIGURE NO. 15

A P P E N D I C E S

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COMPANY	WELL NAME	DIVISION	FIELD OR AREA	LAG TIME	PAGE	MUD PROPERTIES TYPE	WT.	VIS.	WL.	CAKE THICK.	% OIL
Norcen	Daly Gas No.1		Virden	16/17	1	KCl					

LOCATION	K.B. ELEVATION	DATE	EXAMINER	MARKERS
7-18-10-27WPM	1628.6	23/10/76	W. M. Mitchell	Mississippian 2173(-544) Crinoidal Mkr 2320(-691)

DEPTH	DRILL. TIME MIN/FT.	SHALE %	CARBONATES %	LITH.	TYPE	XL SIZE	POROSITY	ARG. CONT.	SANDSTONES %	GRAIN SHAPE	GRAIN SIZE	CEMENT TYPE	CONSOLIDATION	POROSITY	OTHERS %	NAME	SHOWS STAIN	FLUOR.	CUT.	CUT FLUOR.	GAS	COMMENTS
2150		TRIP SAMPLE MOSTLY CAVINGS																				
60	1.4	70	GREEN &	RED	GREY	SILTY			10	SA SR	VAF	SIL	CONS	NVP	20	SILTST	NS					TR SHELL FRAG CRINOID STEM
70				EARTHY																		
80	318	60	30	DOL	SUCROSIC		BUFF/BN		SUCROSIC		HAS	SOME	VUGGY Ø		Ø VUGS IN EARTHY			INFILLED	10%	SLT		TR SHELL FRAG
90	9110	60	40	DOL	EARTHY	BUFF/BN	30%					SHALE	GY GN -		GN-RED GY GN		SH	CALC				SEVERE CAVINGS
2200	5.5	70	30			AA								AA				AA				AA
10	5.0	60	40			AA								AA				AA				AA
20	7.0	70	30			AA			TR	SILT/VFSDST				AA				AA				AA
30	5.7	90	10			AA			SAMPLE ALMOST ALL CAVINGS													
40	7.2	80	10			AA			10	ANHYDR												
50	8.7	80							20	ANHYDR WHITE				SHALE MOSTLY CAVINGS								
60	5.2	50	10			AA			20	ANHYDR WH/W PURPLE MOTTLED PORTIONS					10	CHERT BN/RDBN						SHALE-CAVINGS
70		40	20			AA	MOTTLED BUFFY/PUR		30	DOL	SUCROSIC		BUFF		TR	AA			MINOR PPØ			AA SUGARY DOL OIL STAINED
80		30	20		AA		AA		40	AA		BUFF MOTTLED			TR	AA			AA			AA "
90		60	10	LMY	DOL	BUFF/MOTTLED			30	AA									AA			AA "
2300		70	10		AA				20		AA											AA "
10		80	20		AA				TR		AA				TR	AA						SHALE-CAVINGS
20		90	10		AA				TR		AA				TR	AA						AA
30		70	30		AA				TR		AA	CRINOID FRAG MINOR		PPØ				30%	DOL STRAINED			AA
40		70	10		AA				20		AA		AA			AA		SUCROSIC DOL STAIN				AA
50		80	10		AA				10		AA		AA			AA		VERY LITTLE STAIN				AA
60		40	40	LMY/ DOL	DOL/ LST	BUFF	MOTTLED		20		AA					AA		TR ST IN SUCR DOL				AA
70		30	60	LST	BUFF	MOTTLED			10	SILTY LST		RED										
80		20	70		AA				10		AA											
90		30	40		AA				30		AA					SAMPLE MOSTLY CAVINGS						
2400		40	60		AA				TR		AA											
05		50	50		AA				TR		AA											
10		60	40		AA				TR		AA											
15		40	60		AA				TR													

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COMPANY	WELL NAME	DIVISION	FIELD OR AREA	LAG TIME	PAGE	MUD PROPERTIES: TYPE	WT.	VIS.	WL.	CAKE THICK.	% OIL
					2						

LOCATION	K.B. ELEVATION	DATE	EXAMINER	MARKERS
				BAKKEN 2557 (-928)

DEPTH	DRILL. TIME MIN/FT.	SHALE %	CARBONATES %	CARBONATES LITH.	CARBONATES TYPE	CARBONATES XL SIZE	CARBONATES POROSITY	CARBONATES ARG. CONT.	SANDSTONES %	SANDSTONES GRAIN SHAPE	SANDSTONES GRAIN SIZE	SANDSTONES CEMENT TYPE	SANDSTONES CONSOLIDATION	SANDSTONES POROSITY	OTHERS %	OTHERS NAME	SHOWS STAIN	SHOWS FLUOR.	SHOWS CUT.	SHOWS CUT FLUOR.	SHOWS GAS	COMMENTS
2415		40	60	LST	WH	PINK	EARTHY															
20		20	80	LST	WH/	PINK	EARTHY/XLINE		TR	DOL	SUCROSIC			STAINED								CRINOID FRAGMENTS
25		20	80	LST	COH	MOTTLED PINK&PURPLE	EARTHY/FRAGM		TR	DOL				AA								
30		30	70		AA												MORE	FRAG LST				AA
35		10	90	LST	AA																	AA
40		TR	100	LST	PINK/WHITISH PINK XLINE		DOLOMITIC															
45		TR	100	LST	WHITISH PINK/PINK		EARTHY/XLINE															
50		10	90	LST	PINK	EARTHY/XLINE				TR	WH MOTTLED LST											
55		20	80	LST	AA																	
60		TR	80	LST	AA					20	WHITISH PINK EARTHY LST											
65		TR	60	LST	PINKISH WH EARTHY					40	ANHYDRITE PINK											CRINOID FRAG
70			70		AA					30		AA										AA
75			70		AA					10		AA			20	XLINE DOL						AA
80		M	60		AA					30		AA			10		AA					AA
85			70			COLOUR CHANGE TO MORE WHITE COLOR				30					TR							AA
90			70		AA					20		AA			10	DOL LST XLINE				10	CHERT WH	
95			60	LST	WH/TR BUFF EARTHY					TR					20					20	CHERT WH	
2500			80		AA					TR					TR					20	AA	
05			90			AA														10	AA	
10		TR	90		AA					TR		AA			TR		AA			10	AA	
15		TR	100		AA															TR	AA	CRINOID FRAG
20			100							TR		AA			TR		AA			TR		AA
25			70		AA										TR		AA			30	AA	AA
30			100		AA										TR		AA			TR	AA	
40			100		AA																	
45			100		AA															TR	AA	
50		10	90		AA																	SHALE GY GN
55		40	60		AA										SHALE		GN &	GY GN		SILTY		
60																						

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COMPANY	WELL NAME	DIVISION	FIELD OR AREA	LAG TIME	PAGE
					3

MUD PROPERTIES					
TYPE	WT.	VIS.	WL.	CAKE THICK.	% OIL

LOCATION	K.B. ELEVATION	DATE	EXAMINER	MARKERS
				DEVONIAN (THREE FKS) 2595 (-966) NISKU 2650 (-1021)

DEPTH	DRILL. TIME MIN/FT.	SHALE %	CARBONATES						SANDSTONES						OTHERS		SHOWS					COMMENTS
			%	LITH.	TYPE	XL SIZE	POROSITY	ARG. CONT.	%	GRAIN SHAPE	GRAIN SIZE	CEMENT TYPE	CONSOLIDATION	POROSITY	%	NAME	STAIN	FLUOR.	CUT.	CUT FLUOR.	GAS	
2560		80	20	LST	WH/PINK EARTHY											SHALE GN	& GY	GN SILTY				
65		80	20			AA											AA					
70		80	10			AA			10	SILTSTONE							AA					
75		70	30			AA			TR	AA							AA					
80		70	20			AA			TR	AA							AA					10% SOFT RED SHALE
85		50	20			AA											AA					30 AA
90		70	20			AA																10 AA
95		10	10			AA																80 AA
2600		10	TR			AA																90 AA
05			30	LST	WH/BUFF EARTHY/XLINE																	70 AA
10		TR	10		AA																	90 AA
15		TR	20		AA																	80 AA
20		TR	30		AA																	70 AA
25		10	20		AA																	70 AA
30			30	DOL FX SUCROSIC WH/PR																		70 AA
35			50		AA																	50 AA
40		SAMPLE MISSING																				
45		TR	10		AA																	90 AA
50		TR	30		AA SUCROSIC/XLINE																	70 AA
55			90	XLINE BUFF DOL					MINOR		PPØ				10	ANHYDRITE						TR AA
60			70		AA										20	AA						10 AA
65			100	LST XLINE BUFF					MINOR		PPØ											TR AA
70		10	80		AA										10	AA						TR AA
75		TR	90		XLINE/SUCROSIC BUFF										10	AA						TR AA
80			80		AA				MINOR		PPØ				20	AA						
85			70		AA				PPØ	20% of SAMPLE					30	AA						
90			80		AA				PPØ	ABUNDANT					20	AA						TR AA
95			70		AA					AA					30	AA						
2700																						

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COMPANY	WELL NAME	DIVISION	FIELD OR AREA	LAG TIME	PAGE	MUD PROPERTIES: TYPE	WT.	VIS.	WL.	CAKE THICK.	% OIL
					4						

LOCATION	K.B. ELEVATION	DATE	EXAMINER	MARKERS
				DUPEROW 2770 (-1141)

DEPTH	DRILL. TIME MIN/FT.	SHALE %	CARBONATES %	LITH.	TYPE	XL SIZE	POROSITY	ARG. CONT.	SANDSTONES %	GRAIN SHAPE	GRAIN SIZE	CEMENT TYPE	CONSOLIDATION	POROSITY	OTHERS %	NAME	SHOWS STAIN	FLUOR.	CUT.	CUT FLUOR.	GAS	COMMENTS
2700			40	LST	BUFF	XLINE	MINOR	Ø	30	DOL	BUFF	SUCROSIC	GPP	Ø	30	ANHYDRITE						
05			20		AA				60	AA Ø on 90% of chips					20	AA						
10			10		AA				80	AA					10	AA						
15			20		AA				70	AA					10	AA						
20			60		AA				20	AA					20	AA						
25			80		AA				10	AA					10	AA						
30			100		AA				TR													
35			100		AA																	
40			100		AA																	
45			100		AA																	
50			100		AA																	CRINOIL FRAG
55			100		AA				TR		AA	TR	PPØ									
60			100		AA				TR		AA		"									
65			80	DOLTC	LST	BUFF	XLINE		TR		AA				20	LST XLINE/EARTHY BUFF						RED COLORING SHALE
70		30	70		AA										TR							RED SILTY SHALE
75		30	70		AA																	RED & GY GN SILTY SH
80		40	50		AA										10	ANHYDR						AA
85		50	40		AA										10	AA						AA
90		40	40		AA				10		AA				10	AA						AA
95		20	70		AA				10		AA				TR	AA						MOSTLY GY GN SH
2800		40	60		AA	EARTHY/XLINE									TR	AA						"
05		30	70		AA										TR							"
10		40	60		AA																	"
15		50	20		AA				30	DOL LST		GY SUCROSIC										"
20		70	20		AA				10		AA											"
25		80	20		AA				TR		AA				TR	AA						"
30		40	40		AA				30		AA				TR	AA						"
35		40	30		AA				30		AA											"
40																						

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COMPANY	WELL NAME	DIVISION	FIELD OR AREA	LAB TIME	PAGE	MUD PROPERTIES: TYPE	WT.	VIS.	WL.	CAKE THICK.	% OIL
					5						

LOCATION	K.B. ELEVATION	DATE	EXAMINER	MARKERS

DEPTH	DRILL. TIME MIN/FT.	SHALE %	CARBONATES %	CARBONATES LITH.	CARBONATES TYPE	CARBONATES XL SIZE	CARBONATES POROSITY	CARBONATES ARG. CONT.	SANDSTONES %	SANDSTONES GRAIN SHAPE	SANDSTONES GRAIN SIZE	SANDSTONES CEMENT TYPE	SANDSTONES CONSOLIDATION	SANDSTONES POROSITY	OTHERS %	OTHERS NAME	SHOWS STAIN	SHOWS FLUOR.	SHOWS CUT.	SHOWS CUT FLUOR.	SHOWS GAS	COMMENTS
2840		20	50	DOL LST	EARTHY/XLINE			GY	30	DOL	LST EARTHY			BUFF	TR	ANHYDRITE						
45		20	40		AA				40		AA											
50		10	70		AA	EARTHY			20		AA											
55		10	80		AA				10		AA				TR	AA						
60		TR	80		AA				10		AA				10	AA						
65		20	70	DOL	AA	EARTHY/SUCR		BF	TR	DOL	LST GY				10	AA						
70		30	60		AA										10	AA						
75		20	80		AA	MINOR	PPØ		TR	VUGS												
80		20	60		AA		AA		AA						20	DOL LST EARTHY/SUCR GY						
85		10	30		AA		AA								60		AA	MINOR PPØ GY/BFF				TR ANHYDRITE
90		10	30		AA		NVP								50		AA		AA TR VUGS			10 AA
95		20	60	DOL LST	AA										20		AA		AA		AA	TR AA
2900		TR	100		AA										TR							
05			100		AA	MINOR	PPØ	TR VUGS														
10			100		AA		AA	✓														
15		TR	70		AA		✓	✓							20	DOL XLINE GY						10 ANHYDRITE
20		TR	60		AA		✓	✓							20		AA					20 AA
25			20		AA			60	DOL LST	BUFF/BN	SUCROSIC				20		AA					TR ✓
30			60		AA			20		AA					10		AA					10 AA
35			20		AA			70		AA	MINOR	PPØ	TR	VUGS								10 AA
40			20		✓			80		AA	✓	✓		✓								TR ✓
45			10		✓			90		AA												
50			40		✓	MINOR	PPØ	60		AA	✓	✓		✓								
55			20		✓		✓	80		AA	FAIR	PPØ				TR VUGS						
60			60		✓			40		AA												
65			70		AA		✓	30		AA	MINOR	PPØ				TR VUGS						
70			60	LST	EART/XLINE		BUFF	40		AA	✓			✓								
75			70		AA			30		aa												
80																						

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COMPANY	WELL NAME	DIVISION	FIELD OR AREA	LAG TIME	PAGE	MUD PROPERTIES: TYPE	WT.	VIS.	WL.	CAKE THICK.	% OIL
					6						

LOCATION	K.B. ELEVATION	DATE	EXAMINER	MARKERS

DEPTH	DRILL. TIME MIN/FT.	SHALE %	CARBONATES %	CARBONATES LITH.	CARBONATES TYPE	CARBONATES XL SIZE	CARBONATES POROSITY	CARBONATES ARG. CONT.	SANDSTONES %	SANDSTONES GRAIN SHAPE	SANDSTONES GRAIN SIZE	SANDSTONES CEMENT TYPE	SANDSTONES CONSOLIDATION	SANDSTONES POROSITY	OTHERS %	OTHERS NAME	SHOWS STAIN	SHOWS FLUOR.	SHOWS CUT	SHOWS CUT FLUOR.	SHOWS GAS	COMMENTS
2980			80	DOL LST XLINE/EARTHY BUFF											20	DOL LST	SUCROSIC BUFF/BN	MINOR	PPØ	TR ANHYDRITE		
85			20		AA										80		AA		✓		✓	
90			TO		AA				80	DOL XF GRANULAR GY					10		AA					
95			30		AA				50		AA				20		AA		✓		✓	
3000			~~TRIP TO CORE #1 and 2 DUPPEROW~~																			
3115			80	20	AA																	~~TRIP SAMPLES~~
20			70	30	AA																	
25			10	90	LST EARTHY GY/BUFF																	
30			70	80		AA	TR	PPØ	10	DOL LST EARTHY/SUCR BUFF												CRINOLD FRAG
35				60		AA			40		AA											
40				50		✓			50		✓											AA
45				40		✓			60		✓											✓
50			30	30		✓			70		✓				TR	ANHYDRITE						
55				50		✓			50		✓				TR	✓						
60				70		✓			30		✓				TR	✓						
65				60		✓			30		✓				TR				10	Sucrosic		DOL LST PPØ
70				70		✓			10		✓				TR	✓			20	SUCR/XLINE	✓	✓
75				70		✓			TR		✓								30		✓	✓
80				40		✓			10		✓								50		AA	✓ ✓
85				20		✓			30		✓								50		✓	✓ ✓
90				10		✓			40		✓								50		✓	✓ ✓
95				40	DOL LST EARTH/XLINE				40		✓								20		✓	✓ ✓
3200				10		✓			50		✓				TR	ANHYDRITE			40		✓	✓ ✓
05				20	AA	XLINE	TR	PPØ	60		✓								20		✓	✓ ✓
10				20	AA		✓	✓	50		✓	PPØ				GASTLO BDS			30		✓	✓ ✓
15				10	✓				50		✓				TR	Anhydrite			40		✓	✓ TR VUGS
20				30	✓				60		✓				TR	✓			10		✓	✓ ✓
25																						

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COMPANY	WELL NAME	DIVISION	FIELD OR AREA	LAG TIME	PAGE
					7

MUD PROPERTIES					
TYPE	WT.	VIS.	WL.	CAKE THICK.	% OIL

LOCATION	K.B. ELEVATION	DATE	EXAMINER	MARKERS
				SOURIS RIVER 3290 (-1621)

DEPTH	DRILL. TIME MIN/FT.	SHALE %	CARBONATES						SANDSTONES						OTHERS		SHOWS					COMMENTS
			%	LITH.	TYPE	XL SIZE	POROSITY	ARG. CONT.	%	GRAIN SHAPE	GRAIN SIZE	CEMENT TYPE	CONSOLIDATION	POROSITY	%	NAME	STAIN	FLUOR.	CUT.	CUT FLUOR.	GAS	
3225			20	XLINE	FOL	LDY	BUFF	TRØ	TRVUGS	20		EARTHY	LST	BUFF/BN		60	SUCROSIC/XLINE		DOL		LST	PPØ & TR VUGS
30			30		AA					10			AA			60		AA				TR ANHYDRITE
35			40		AA					10						50		AA				TR ✓
40			20		AA					TR		AA				60		AA			20	LIMEY DOL GY SUC/XLINE
45			40		AA		CRIN FRAG			TR		AA				50		AA	LIMEY DOL		10	AA
50			30		AA											60		AA			10	AA
55			20		AA					10	ANHYD					50		AA	DOL LST		20	AA
60			30		AA					10	✓					60		AA			TR	AA
65			30		AA					TR	✓					70		AA			TR	AA
70			20		AA					10	✓					70		AA			TR	✓
75			20		AA											80		AA				
80			10		AA											90		AA				
85			TR		AA											80		AA			20	DOL LST GY SUC/XLINE
90																20		AA			80	AA
95			100	DOL	LST	XLINE	GY															
3300			60		AA					40	EARTHY	LST	BUFF									
05			40		AA					40		AA				20	SUCROSIC/XLINE		BUFF		DOL LST	
10			20		AA					50		AA				30		AA				
15			30		AA					30		AA				40		AA				
20			50		AA					20		AA				30		AA				
25			30		AA					20		AA				50		AA				TR ANHYDRITE
30			20		AA					40		AA				40		AA				AA
35			40		AA					20		AA				40		AA				AA
40		10	30		AA					30		AA				20		AA				10 AA
45		TR	30		AA					20						30		AA				20 AA
50			10		AA					40		AA				50		AA	TR		PPØ & MUGSTR	AA
55			TR							20						80						TR AA
60			10							20						40						30 AA
65																						

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COMPANY	WELL NAME	DIVISION	FIELD OR AREA	LAG TIME	PAGE 8	MUD PROPERTIES: TYPE	WT.	VIS.	WL.	CAKE THICK.	% OIL

LOCATION	K.B. ELEVATION	DATE	EXAMINER	MARKERS

DEPTH	DRILL. TIME MIN/FT.	SHALE %	CARBONATES %	CARBONATES LITH.	CARBONATES TYPE	CARBONATES XL SIZE	CARBONATES POROSITY	CARBONATES ARG. CONT.	SANDSTONES %	SANDSTONES GRAIN SHAPE	SANDSTONES GRAIN SIZE	SANDSTONES CEMENT TYPE	SANDSTONES CONSOLIDATION	SANDSTONES POROSITY	OTHERS %	OTHERS NAME	SHOWS STAIN	SHOWS FLUOR.	SHOWS CUT.	SHOWS CUT FLUOR.	SHOWS GAS	COMMENTS
3365		10	60	LST	EARTHY BUFF										30	ANHYD						
70		10	20		AA				60	DOL	SUCROSIC/XLINE			BN	10	✓						
75		30	10						40						20	✓						POOR SAMPLE CARINGS
80		TR	20		AA				80		AA			BUFF	TR	✓						
85		TR	70		AA				20		AA				10	✓						
90		TR	10		AA				80	DOL	LST AA				10	✓						DIRTY SAMPLE
95			40		AA				40		AA				20	✓						
3400			70		✓				20		✓				10	✓						SHALE LT/DK GY
05			40		✓				60		✓				TR	✓						
10		20	40		✓				40		✓		TRØ &	VUGS	TR	✓						TR COAL
15		40	30						30		✓			/	TR	✓						
20		30	10		✓				50		✓			/	10	✓						
25		10	TR		✓				80		✓			/	10	✓						
30		10	TR		✓				90		✓				TR	✓						
35		30	10		✓				60		✓				TR	✓						
40		10	70		✓				20		✓				TR	✓						
45		10	30		✓				50		✓				10	✓						
50		40	10		✓				50		✓				10	✓						
55		60	TR		✓				40		✓				TR	✓						
60		70	TR		✓				30		✓				TR	✓						
65		80	TR		✓				20		✓	TR Ø &	VUGS		TR	✓						
70		70	10		✓				20		✓				TR	✓						5% GLAUC SHALE
72		CUT	CORES #3 & 4		3472 - 3592				REC 120'													
3592		90	TR	SUCROSIC	DOL LST BN				10	DOL	LST XLINE			BUFF/BN		TR	ANHYDRIDE					
3595		80	TR		✓				20		AA											TR PINK COLOR
3600		40	TR		✓				10		AA								20	DOL LST	EARTHY	BUFF
05		20	TR		✓				TR		AA								80			
10		TR							30		AA		GY/GN						60			
15		TR	30	DOL	LST XLINE		BUFF/BN		50		AA		/			TR	/		20		/	
20		TR	20						40		AA		/			TR	/		40		/	

C.P. -179

SIDEWALL SAMPLES AND CORES
HYDROCARBON SHOWS

Type Sampler		Logging Job No./Run No. Core #1	Interval	Well Name
		Sidewall Gun Run No.	3000-	Daly Gas No. 1
Date	Examiner	Recovery 60 of 60' shots	3060	7-18-10-27wlm

	Depth *	Rec. **	HYDROCARBON SHOWS: % Oil Stain	H.C. Odor	Fluorescence: %	Fluorescence: Intens.	Fluorescence: Color	Cut: Color of Cut	Cut: Cut Fluor.	Show No. Avg.	Lith. Description and Remarks
1	3000-										Dolomite XF/VF grained anhydrite
2	3003.2										infilled large coral inclusion
3											@ 3002 Several smaller corals
4											@ 3001.7 Visible vugs in Calc
5											infill & @ 3002.3 - 3003.2
6	3008.2										Grey Xline sucrosic dol
7	4.8										Visible vugs 3003.5 - 3004. Churned
8	3004.8										Anhydrite W/Minor inclusions
9	30016.7										Xline dense dolomite clear/BN
10											External core color is grey.
11	30016.7-										Interbedded BN earthy/Xline dol
12											LST & Grey dol. Beds> 1cm to 2 cm
13											Increasing in thickness to btm
14											Fracture @ ≈ 60° to hole from
15											17.8 → 19.4. Bedding displacement
16											≈ ½ cm. Porous Bed @ 20.6 to
17											20.8
18	3021.7										Xline/Sucrosic dol LST visible
19	39.5										vugs ≈ ¼ → ½ cm scattered
20											throughout. Brach? @ 22.5 No
21											definite bedding churned
22											appearance possibly bored
23											Bedding Planes apparent @
24											3026.6 - 6.9, 28.1 - 28.3, 3030,
25											31.7 - 32
26	3039.5-										Anhydrite slightly dol
27	42.5										
28											
29											
30											

* UNLESS OTHERWISE NOTED DEPTH IS SAME AS RESISTIVITY LOG (eg. DIL OR DLL)

** RECOVERY CODE: INCHES OF RECOVERY, or
MF - MISFIRED
SO - SHOT OFF
MT - EMPTY
RR - RUBBLE

C.P. -179

SIDEWALL SAMPLES AND CORES
HYDROCARBON SHOWS

Type Sampler		Logging Job No./Run No. Core #1	Interval 3000-3060	Well Name Daly Gas No. 1 7-18-10-27wlm
Date	Examiner	Sidewall Gun Run No.		
		Recovery 60 of 60' shots		

	Depth *	Rec. **	HYDROCARBON SHOWS: % Oil Stain	H.C. Odor	Fluorescence: %	Fluorescence: Intens.	Fluorescence: Color	Cut: Color of Cut	Cut: Cut Fluor.	Show No. Avg.	Lith. Description and Remarks
1	3042.5-										Anhydrite & Doltc LST. Appears
2	45.4										to be churned zone. No distinct
3											bedding. LST Xline/Sucrosic Buff/
4											BN
5	3045.4-										Interbedded Grey Sucrosic/XLINE LST
6	48.6										Buff/BN XLINE/SUCR DOL LST. Bottom
7											1' churned Dol LST W/Anhydrite
8											Inclusions
9	3048.6-										Buff/BN Dol LST & DK BN Anhydrite
10	50										No apparent bedding. Increase in
11											Anhydrite towards base
12	3050-										Sucrosic LST Buff/BN minor
13	56.7										bedded anhydrite. Some porosity
14											apparent @ 3050 - 51,
15											3054 - 3055, 3056 - 56.7
16	3056.7-										Churned anhydrite & dol LST
17	58.4										LST %age increases towards
18											Base
19	3058.4										Anhydrite W/Minor beds of
20	-60										Dol LST up to 1 cm thick.
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

* UNLESS OTHERWISE NOTED DEPTH IS SAME AS RESISTIVITY LOG (eg. DIL OR DLL)

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SIDEWALL SAMPLES AND CORES
HYDROCARBON SHOWS

Type Sampler		Logging Job No./Run No. Core #2	Interval	Well Name
Date	Examiner	Sidewall Gun Run No.	3060-3120	Daly Gas No. 1 7-18-10-27w1
		Recovery 60 of 60' shots		

	Depth *	Rec. **	HYDROCARBON SHOWS: % Oil Stain	H.C. Odor	Fluorescence: %	Fluorescence: Intens.	Fluorescence: Color	Cut: Color of Cut	Cut: Cut Fluor.	Show No. Avg.	Lith. Description and Remarks
1	3060-										Finely laminated Anhydrite
2	60.8										and dol. LST beds more dolomitic
3											towards base
4	3060.8-										Chalky dolomite Gy w/40% anhydrite
5	61.3										inclusions
6	3061.3-										Churned earthy limey dolomite (BN)
7	62.6										and anhydrite up to 60% anhydrite.
8	3062.6-										Dol LST sucrosic w/major anhydrite
9	67.1										inclusions @ 64, 64.5, 65.2
10											65.5 - 66 and 66.3
11	3067.1-										Finely bedded dol LST earthy/
12	68										sucrosic ½" Bed @ top has
13											some vuggy ø
14	3068-				70		Yellow	N	N		Dol sucrosic stained yellow fluor
15	70.7										No cut or CF minor anhydrite incl.
16	3070.7-						AA	✓	✓		60 sucrosic 40 earthy dol LST
17	73.6										Sucrosic LST stained & exhibits fluor
18											as noted. Large cabbage strom
19											@ 72.75 - 73.2. Appears churned
20	3073.6-				100		AA	✓	✓		sucrosic dol LST BN minor
21	74.5										anhydrite inclusions
22	3074.5-										Finely bedded sucrosic dolomite
23	76.3				90		AA				LST Minor anhydrite interbeds
24	3076.3										Sucrosic/XLINE BN/GyGn Dolomite LST
25	77.6										finely bedded becoming churned
26											@ base ends a styolite @ 77.6
27	3077.6-										Dol LST top 3" churned GyGn w/Bn
28	80.2										incl. No distinct bedding features
29											In Bn sucrosic LST. Some P.P ø on
30											broken surface.

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SIDEWALL SAMPLES AND CORES
HYDROCARBON SHOWS

Type Sampler		Logging Job No./Run No.	Interval	Well Name
Date	Examiner	Sidewall Gun Run No.		
		Recovery of shots		

	Depth *	Rec. **	HYDROCARBON SHOWS: % Oil Stain	H.C. Odor	Fluorescence: %	Fluorescence: Intens.	Fluorescence: Color	Cut: Color of Cut	Cut: Cut Fluor.	Show No. Avg.	Lith. Description and Remarks
1	3080.2-						Yellow	N	N		Gy Gn/Bn churned XLINE dol LST
2	81										PP ø & small vugs apparent.
3	3081 -						Nil	/	/		Fuff/Bn earthy/sucrosic dolomite LST
4	82.6										Tr Xul infilled vugs and PP ø on
5											broken surface.
6	3082.6-										Earthy fossiliferous LST Many
7	85.4										crinoids on face broken @ 83.5
8	3085.4-										Sucrosic Bn dol LST contains
9	86.4										mainly strom frag which
10											exhibit good vuggy ø.
11	3086.4										Earthy/sucrosic LST minor
12	89										anhydrite laminar VF bedding
13											some vuggy porosity throughout.
14	3089 -										Earthy/XLINE dol LST. Distinct
15	91										bedding
16	3091 -										Earthy/sucrosic dolLST
17	96.6										Distinct bedding visible
18	3096.6-						Light Yellow	N	N		sucrosic Bn Dol LST. No
19	99.9										distinct bedding. Minor anhydrite
20											inclusions. Mottled LT and DK BN
21	3099.9-						Nil	✓	✓		sucrosic dol LST Dk Bn @ top
22	3103.3										to alternate LT and Dk Bn. Minor
23											brachs
24	3103.3-										Sucrosic dolomite LST AA
25	04.5										
26	3104.5-				60		Yellow	✓	✓		XLINE/sucrosic limey dol mottled
27	8.8										Gy Bn/Dk Bn Minor PPø and small
28											vugs visible on broken surfaces
29	3108.8-				70		Light Yellow	✓	✓		sucrosic/XLINE dol LST mottled
30	9.8										No porosity visible.

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SIDEWALL SAMPLES AND CORES
HYDROCARBON SHOWS

Type Sampler		Logging Job No./Run No.	Interval	Well Name
Date	Examiner	Sidewall Gun Run No.		
		Recovery of shots		

	Depth *	Rec. **	HYDROCARBON SHOWS								Lith. Description and Remarks
			% Oil Stain	H.C. Odor	Fluorescence %	Fluorescence Intens.	Fluorescence Color	Cut Color of Cut	Cut Cut Fluor.	Show No. Avg.	
1	3109.8-						Nil	N	N		Earthy dol LST 40% Earthy/sucrosic
2	11.9										dol LST 60%. Latter Dk Bn
3	3111.9-						✓	✓	✓		earthy/sucrosic dol LST.
4	16.5										
5	3116.5-										Banded Lt grey and Dk Gy Gn XLINE
6	31.20										LST.
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
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29											
30											

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SIDEWALL SAMPLES AND CORES
HYDROCARBON SHOWS

Type Sampler		Logging Job No./Run No. Core #3	Interval	Well Name
Date	Examiner	Sidewall Gun Run No.	3472-3532	Daly Gas No. 1 7-18-10-27wlm
		Recovery 60 of 60' shots		

	Depth *	Rec. **	HYDROCARBON SHOWS: % Oil Stain	H.C. Odor	Fluorescence: %	Fluorescence: Intens.	Fluorescence: Color	Cut: Color of Cut	Cut: Cut Fluor.	Show No. Avg.	Lith. Description and Remarks
1	3472 -										Dk green slightly dolomitic anhydrite
2	72.7										
3	3742.7-										Anhydrite brownish translucent
4	78.7										
5	3478.7-										Churned intermixed anhydrite
6	79.9										and XLINE dolomite
7	3479.9-										Anhydrite Bn Translucent
8	80.6										
9	3480.6-			84 - 85	10%	Bitumen		No Fluor			Dolomitic limestone Buff/Dk Bn
10	85.6							Cut or Cut F			Laminar beds @ top massive beds for
11											most part. Large ripple @ 82.7 - 2.9
12				1 cm Black Shale Bed @ 83.73							XLINE/F sucrosic to 82.7 Dolomitic
13				Sacrosic LST exhibits Tr Vuggy ø							F sucrosic 82.7 - 85.6 Limestones
14	3485.6-										Grey green argillaceous dolomitic
15	3500.1										limestone. Anhydritic. Increasing
16											dolomitic anhydr towards base. Shale
17											beds @ 98.8-98.85 & 99.85-500.1
18											Shale Dk Grey waxy
19	3500.1-										Anhydrite gnish bn Massive
20	01.5										
21	3501.5-										Dolomitic limestone bedded XLINE
22	02.05										Stylolitic, anhydrite inclusions
23	3502.05-										Anhydrite brown massive
24	03										
25	3503 -										Dolomitic limestone XLINE bedded
26	04.9										apparent vugs near top completely
27											Anhydrite infilled. Anhydrite
28											filled fracture (Vert) 03.6 - 06.3
29	3504.9-										Dolomite XLINE green anhydritic ?
30	10.4										

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SIDEWALL SAMPLES AND CORES
HYDROCARBON SHOWS

Type Sampler	Logging Job No./Run No. Core #3	Interval 3472-	Well Name Daly Gas No. 1
Date / Examiner	Sidewall Gun Run No.	3537	7-18-10-27wlm
	Recovery 60 of 60' shots		

	Depth *	Rec. **	HYDROCARBON SHOWS: % Oil Stain	H.C. Odor	Fluorescence: %	Fluorescence: Intens.	Fluorescence: Color	Cut: Color of Cut	Cut: Cut Fluor.	Show No. Avg.	Lith. Description and Remarks
1	3510.4-										Interbedded Gn XLINE dol & tan earthy
2	11.7										dol LST 10.4-10.8, 10.8-11.1 Earthy
3											dol LST finely bedded, 11.1-11.7
4											Churned Dol LST AA Dk Bn w/Gn dol
5											inclusions.
6	3511.7-										Dolomite Gn XLINE V. argillaceous
7	16										
8	3516 -										16-17 earthy/XLINE dol LST buff/Bn
9	19.8										Minor anhydrite. Incl 17-18.7
10											Heavily worked dol LST earthy/sucr
11											Many strom fragm. Anhydrite incl
12											18.7-19.8 laminar bedded sucr dol
13											LST and anhydrite.
14	3519.8-										Anhydrite Bn Translucent.
15	22.9										
16	3522.9-										Dol LST BUFF/TAN sucrosic vugs visible
17	29										from 25.8-28 on 20% of core face.
18											Anhydrite infilled fractures (two
19											vert) 26.9-28.8
20	3529 -										Anhydrite Bn/Gn
21	30										
22	3530 -										Crystalline dolomitic limestone
23	32										Grey Bn/Grey Green No porosity
24											visible
25											
26											
27											ø 3522.9 - 29
28											
29											
30											

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SIDEWALL SAMPLES AND CORES
HYDROCARBON SHOWS

Type Sampler		Logging Job No./Run No. Core #4	Interval 3582-3592	Well Name Daly Gas No. 1 7-18-10-27wlm
Date	Examiner	Sidewall Gun Run No.		
		Recovery 60 of 60' shots		

	Depth *	Rec. **	HYDROCARBON SHOWS: % Oil Stain	H.C. Odor	Fluorescence: %	Fluorescence: Intens.	Fluorescence: Color	Cut: Color of Cut	Cut: Cut Fluor.	Show No. Avg.	Lith. Description and Remarks
1	3532 -										Interbedded anhydrite & earthy dol
2	32.8										LST XF
3	3532.8-										Anhydrite Bn translucent
4	34.3										
5	3534.4-										Interbedded VF sucrosic/earthy
6	35.3										dol LST and anhydrite
7	3535.3-										Dolomitic limestone sucrosic
8	39.3										VF brown minor beds earthy
9											Dol LST @ 3536.8-37. Minor anhy incl.
10	3539.3-										Anhydrite brown translucent
11	41.8										1 cm bed earthy/XLINE dol LST
12											@39.9 0.4' Gy Gn earthy dol
13											LST @ 40.8-41.1
14	3541.8-										Dol LST XFXLINE/sucrosic Buff/lt bn
15	43.3										41.8-42.7 Bedded w/Gn anhydritic
16											Dol and anhydrite inclusions becoming
17											more massive LST @ base
18	3543.3-						No Shows				Dark Bn/Blk Bituminous? Dolomite
19	44.										
20	3544 -				30%	Lt Yell or Fluor		NC	NCFYF		Sucrosic/XLINE dol LST Bn PPø. Some
21	45.4										laminar bedding apparent
22	3545.4-										Dolomitic limestone sucrosic/XLINE
23	46.9	Tr stain	Tr	Straw yellow fluor				NC	NCF		PPø 5% small vugs on chip sample vugs
24		68% yellow or Fluor									become apparent on core surface
25											46.5 5% of sample
26	3546.9-										XLINE/sucrosic dol LST gy/bn good
27	47.4										vuggy ø 20%
28	3547.4-										XLINE dol LST bn Tr sucrosic some
29	48.1										vuggy ø @ top. Bituminous shale @
30											47.5.

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SIDEWALL SAMPLES AND CORES
HYDROCARBON SHOWS

Type Sampler		Logging Job No./Run No. Core #4	Interval 3532-3592	Well Name Daly Gas No. 1 7-18-10-27wlm
Date	Examiner	Sidewall Gun Run No.		
		Recovery 60 of 60' shots		

	Depth *	Rec. **	HYDROCARBON SHOWS: % Oil Stain	H.C. Odor	Fluorescence: %	Fluorescence: Intens.	Fluorescence: Color	Cut: Color of Cut	Cut: Cut Fluor.	Show No. Avg.	Lith. Description and Remarks
1	3548.1-										Sucrosic/XLINE dol LST Tr PPø rare
2	48.5										vugs Bn anhydrite infills some
3											large vugs and a small ver fracture.
4	3548.5-										Mottled Bn and Buff Dolomitic
5	54										limestone VF Gr sucrosic buff
6											F Gr sucrosic Bn No large vugs
7											apparent. Abundant small vugs & PPø
8											on chip faces. Some small dolomite
9											replaced corals. Dolomite rhombs
10											abundant.
11	3554 -										Gy bn XLINE & bn sucrosic dol LST
12	61.4										extremely vuggy from 1cm to 3 or 4
13											in size. XLINE mat'l less visible ø
14											than sucrosic 5 & 20% respectively
15											becomes increasingly more sucrosic
16											towards base & anhyd. Infilled large
17											vugs increase w/depth.
18	3561.4-										Mottled Bn XLINE/sucrosic & buff
19	75.2										sucrosic dol limestone. XLINE/sucr
20											mat'l exhibits rare PPø & 5% vuggy
21											ø (small vugs) sucrosic mat'l
22											exhibit 10-15% small vuggy ø &
23											abundant PPø. Many large anhydrite.
24											Infilled vugs throughout.
25	3575.2-										Gy Bn XLINE/sucrosic dolomitic lime-
26	80.3										stone very rare vuggy ø on chip faces
27											very rare PPø.
28	3580.3-										Gy gn dense dol LST/limey dol. Some
29	92										bedding & churned appearance
30											apparent @ 80.3-81. Min anhyd incl throughout.

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CORE REPORT FORM

Company NORCEN Well Name & Location NORCEN DALY GAS #2 11-19-10-27 W1M

Date 18/11/76 Examiner N. M. Thachuk Elevation 1613' K.B. Field or Area Daly

Formation Souris R. Core No. 1 Interval 3489-3549.5 Recovery 60.5 Core Size 4"

From / To	ROCK DESCRIPTION (in following order) Lithology	Archie Descr.	Grain Size	Cement Type	Consol-idation	Porosity %	SHOWS (in following order) Stain	Fluor	Cut	Cut Fluor	Gas	STRUCTURE (in following order) Dip of Beds	FRACTURES Angle	Freq	Open or Closed	COMMENTS
3489 / 3490.5	Anhyd.											Horiz.				Dolomitic Anydrite having Brecciated internal structure.
3490.5 / 3493	Dolo. II, II/III		F-M			B20	nil					Horiz				Light brown chalky with scattered Anhydrite inclusions.
3493 / 3501	Anhyd.											Horiz	45°	1	closed	Mod to highly Argillaceous. Varies from laminated to brecciated.
3501 / 3505.5	Anhyd.											Horiz				White-tan massive containing bands of II Dolomite. Contorted to slump bedding as well as lithoclastic/ brecciated mixed dolomite-Anhydrite.
3505.5 / 3509.5	Dolo. II, III/II					B18-20						Horiz				Brown/tan dolomite showing relict calcarentic texture. Numerous small anhydrite blebs. Section grades downward into progressively increased shale content.
3509.5 / 3524	Shale											Horiz				Anhydrite grey green shale interbedded with thin bands of shaly anhydrite.
3524 / 3527.9	Shale / Anhydrite											Horiz				Interbedded grey-green shale and tan/brown anhydrite.

Note: GRAPHICAL PLOT OF DRILLING TIME ON 5 INCH TO 100 FT SCALE IS TO BE ATTACHED TO CORE REPORT

CORE REPORT FORM

Company NORCEN Well Name & Location NORCEN DALY GAS #2

Date _____ Examiner _____ Elevation _____ Field or Area _____

Formation Souris R. Core No. 1 Interval _____ Recovery _____ Core Size _____

From / To	ROCK DESCRIPTION (in following order) Lithology	Archie Descr.	Grain Size	Cement Type	Consol-idation	Porosity %	SHOWS (in following order) Stain	Fluor	Cut	Cut Fluor	Gas	STRUCTURE (in following order) Dip of Beds	FRACTURES Angle	Freq	Open or Closed	COMMENTS
3527.5 / 3528.5	Anhyd.											Horiz				Massive vitreous greenish/tan anhydrite.
3528.5 / 3631	L.S.											Horiz				Dolomitic tan limestone thinly bedded showing supratidal structures (borings and birdseye texture).
3531 / 3536.5	Shale											Horiz				Banded green shale and anhydritic shale interbedded with small bands of limestone.
3536.5 / 3537.5	Dolo.	II, II/III				B15						Horiz				Anhydritic dolomite containing lithoclasts of anhydrite and anhydritic shale.
3537.5 / 3542.5	Shale / Anhyd.											Horiz				Interbedded dark green/brown shale and tan anhydrite. Some brecciated structure. Massive anhydrite bed at base of section.
3542.5 / 3545.5	Limy Dolo. / Dolomitic L.S.	II				B20						Horiz				Buff/brown limy dolomite grading downward into zone of dolomitic banded algal plate and stromatoporoid limestone.
3545.5 / 3549	Anhyd.											Horiz				Green/grey anhydrite containing whisps and bands of calcareous bioclastic debri.
3549 / 3549.5	Dolo.	II, II/III				B20-25						Horiz				Buff-brown anhydritic dolomite.

Note: GRAPHICAL PLOT OF DRILLING TIME ON 5 INCH TO 100 FT SCALE IS TO BE ATTACHED TO CORE REPORT

CORE REPORT FORM

Company NORCEN Well Name & Location NORCEN DALY GAS #2 11-19-10-27 W1M

Date 20/11/76 Examiner N. M. Thachuk Elevation 1613 Field or Area Daly

Formation Souris R. Core No. 2 Interval 3549.5-3610 Recovery 59.2 Core Size 4"

From / To	ROCK DESCRIPTION (in following order) Lithology	Archie Descr.	Grain Size	Cement Type	Consol-idation	Porosity %	SHOWS (in following order) Stain	Fluor	Cut	Cut Fluor	Gas	STRUCTURE (in following order) Dip of Beds	FRACTURES Angle	Freq	Open or Closed	COMMENTS
3549.5 / 3555.5	Dolo.	II, II/III, III	F-M			B 20-30						Horiz				Tan/brown crystalline dolomite varying from chalky at top of section to medium grained xtalline dolomite at base.
3555.5 / 3561.5	Anhyd.											Horiz				Slightly argillaceous dolomitic anhydrite grey-green interbedded with thin zones of brown chalky dolomite. Section shows supratidal thin-bed character. A few thin laminae of shale are present and some minor slump features are evident.
3561.5 / 3566.5	Dolo.	II,II/III	F			B18-20						Horiz				Tan/brown dolomite containing intercrystalline porosity. A thin zone of stromatoproids occurs at the top of the interval.
3566.5 / 3569.5	Anhyd.											Horiz				Thinly banded translucent slightly dolomitic anhydrite interbedded with grey-green argillaceous anhydrite.
3569.5 / 3572.5	Dolo.	II	F			B15-20						Horiz				Tan/brown dolomite with stroms at top of section. Numerous anhydrite inclusions.

Note: GRAPHICAL PLOT OF DRILLING TIME ON 5 INCH TO 100 FT SCALE IS TO BE ATTACHED TO CORE REPORT

CORE REPORT FORM

Company NORCEN Well Name & Location NORCEN DALY GAS #2 11-19-10-27 W1M

Date _____ Examiner _____ Elevation _____ Field or Area _____

Formation _____ Core No. _____ Interval _____ Recovery _____ Core Size _____

From / To	ROCK DESCRIPTION (in following order) Lithology	Archie Descr.	Grain Size	Cement Type	Consol-idation	Porosity %	SHOWS (in following order) Stain	Fluor	Cut	Cut Fluor	Gas	STRUCTURE (in following order) Dip of Beds	FRACTURES Angle	Freq	Open or Closed	COMMENTS
3572.5 / 3588	Dolo.	II, II/III	VF-M			B18-25 C 2-3						Horiz				Dark brown crystalline dolomite varying from thinly laminated to massive. Scattered stroms and sections of bioclastic-lithoclastic material.
3588 / 3592.8	Dolo.	I,I/II				B 5-10 ~~D3~~ 4						Horiz				Argillaceous grey/tan dense dolomite containing some anhydrite infill and secondary vuggy porosity. Scattered stroms in section.
3592.8 / 3598.2	Dolo.	I,III/I				B 5-10 C5 D3						Horiz	90°	1	Inter	Mottled tan/brown anhydritic dolomite. Contains large (2-3cm) vugs of which 50-75% completely infilled with anhydrite. Relict bioclastic ruddite texture. Vertical fracture running length of section. Partially open with closures being affected by anhydrite xtalline overgrowth.
3598.2 / 3605.2	Dolo.	I	VF									Horiz				Dense dark grey/brown argillaceous dolomite. Patches of fossil void infilled by anhydrite. Mottled texture.
3605.2 / 3608.7	Shale											Horiz				(TOP RED BEDS) Mottled grey-green slightly dolomitic shale. Pseudo micro-boudinage internal structure.

Note: GRAPHICAL PLOT OF DRILLING TIME ON 5 INCH TO 100 FT SCALE IS TO BE ATTACHED TO CORE REPORT

DRILL STEM TEST REPORT

WELL NAME: Daly Gas No. 1 DATE: Nov. 2, 1976

LOCATION: 7-18-10-27wlm TEST NO.: 1

TESTING COMPANY: Johnston OPERATOR:

FORMATION: Duperow INTERVAL: 3050-3090

TYPE TEST: Straddle SIZE OF PACKERS: NO. OF PACKERS: 4

HOLE SIZE: $8\frac{3}{4}$ TOTAL DEPTH DRILLER: 3625 TOTAL DEPTH LOG: 3625

MUD WEIGHT: 10.0 VISCOSITY: 50 WATER LOSS: 20

JARS: Yes SAFETY JOINT: Yes PUMPOUT SUB: Yes

TIMES (MINUTES): PREFLOW: 5 INITIAL SHUT IN: 60

VALVE OPEN: 60 FINAL SHUT IN: 120

RECOVERY (FEET)	DESCRIPTION	GAS RATE MCF/DAY	MINUTES
	OIL		
360	WATER Mud Cut		
120	MUD		
480	TOTAL FLUID		

SAMPLE CHAMBER RECOVERY INFORMATION: Salt Water

GAS MEASUREMENT: BLOW ON PREFLOW Faint

GAS/FLUID TO SURFACE N/A

BLOW DURING FLOW PERIOD Faint

TIME	PRESSURE	PLATE SIZE	RATE	DESCRIPTION OF FLOW
	N A			

PRESSURES: (P.S.I.G.)

I.H.P. 1574 I.F.P. 90 I.S.I.P. 1369

F.H.P. 1574 F.F.P. 192 F.S.I.P. 1318

BOTTOM HOLE TEMPERATURE NA GRAVITY OF RECOVERED OIL: NA

PREFLOW: 130 P.P.M. CHLORIDES IN RECOVERED WATER 64,300 NaCl

MISCELLANEOUS INFORMATION: Four fluid samples taken @ 480' 28,600 ppm @ 240' 44,600 ppm @ Top tool 60,7000 ppm From MFE sampler 64,300 ppm NaCl.

DRILL STEM TEST REPORT

WELL NAME: Daly Gas No. 1 DATE: Nov. 3, 1976

LOCATION: 7-18-10-17wlm TEST NO.: 2

TESTING COMPANY: Johnston OPERATOR: _____

FORMATION: Souris River INTERVAL: 3545-3625

TYPE TEST: Bottom SIZE OF PACKERS: _____ NO. OF PACKERS: 2

HOLE SIZE: $8\frac{3}{4}$ TOTAL DEPTH DRILLER: 3625 TOTAL DEPTH LOG: 3625

MUD WEIGHT: 10.0 VISCOSITY: 50 WATER LOSS: 20

JARS: _____ SAFETY JOINT: _____ PUMPOUT SUB: _____

TIMES (MINUTES): PREFLOW: 5 INITIAL SHUT IN: 60

VALVE OPEN: 60 FINAL SHUT IN: 120

RECOVERY (FEET)	DESCRIPTION	GAS RATE MCF/DAY	MINUTES
_____	OIL		
2620'	WATER		
180'	MUD		
_____	TOTAL FLUID		

SAMPLE CHAMBER RECOVERY INFORMATION: Shipped to Corelab for analysis

GAS MEASUREMENT: BLOW ON PREFLOW Good

GAS/FLUID TO SURFACE None

BLOW DURING FLOW PERIOD Good

TIME	PRESSURE	PLATE SIZE	RATE	DESCRIPTION OF FLOW

PRESSURES: (P.S.I.G.)

I.H.P. 1800 I.F.P. 745 I.S.I.P. 1522

F.H.P. 1860 F.F.P. 1471 F.S.I.P. 1522

BOTTOM HOLE TEMPERATURE _____ GRAVITY OF RECOVERED OIL: _____

PREFLOW: _____ P.P.M. CHLORIDES IN RECOVERED WATER _____

MISCELLANEOUS INFORMATION: 3 samples of fluid rec'd for lab analysis. #1 midpoint recovery, #2 @ 1000' ablove tool, #3 60' above tool. NaCl count stabilized at approx. 250,000 ppm over bottom 1000 ft.

DRILL STEM TEST REPORT

WELL NAME: Daly Gas No. 1 DATE: Nov. 3, 1976

LOCATION: 7-18-10-27wlm TEST NO.: 3

TESTING COMPANY: Johnston OPERATOR:

FORMATION: Souris River INTERVAL: 3515-3540

TYPE TEST: Straddle SIZE OF PACKERS: 7 3/4" NO. OF PACKERS: 4

HOLE SIZE: 8 3/4 TOTAL DEPTH DRILLER: 3625 TOTAL DEPTH LOG: 3625

MUD WEIGHT: 10.0 VISCOSITY: 50 WATER LOSS: 20

JARS: Y SAFETY JOINT: Y PUMPOUT SUB: Y

TIMES (MINUTES): PREFLOW: 5 INITIAL SHUT IN: 60

VALVE OPEN: 90 FINAL SHUT IN: 180

RECOVERY (FEET)	DESCRIPTION	GAS RATE MCF/DAY	MINUTES
_____	OIL		
Approx 10	WATER Clean, sli saline	6730 mcf/d	
_____	MUD		
_____	TOTAL FLUID		

SAMPLE CHAMBER RECOVERY INFORMATION: Sent to Core Lab for analysis

GAS MEASUREMENT: BLOW ON PREFLOW Strong

GAS/FLUID TO SURFACE Gas to surface in 1 min.

BLOW DURING FLOW PERIOD 6.37 incr. to 6.73 in 35' - steady

TIME	PRESSURE	PLATE SIZE	RATE	DESCRIPTION OF FLOW
5:45 PM	142#	1 3/8	6.37 mm	Strong
7:00 PM	150#	1 3/8	6.73 mm	Strong, sli hint of water in blow

PRESSURES: (P.S.I.G.)

I.H.P. 1829 I.F.P. 1011 I.S.I.P. 1523

F.H.P. 1829 F.F.P. 1113 F.S.I.P. 1523

BOTTOM HOLE TEMPERATURE 92°F GRAVITY OF RECOVERED OIL:

PREFLOW: 1011 P.P.M. CHLORIDES IN RECOVERED WATER

MISCELLANEOUS INFORMATION: Rec'd 10' clear water. Tested w/Refractometer @ 55400 ppm NaCl.

COMPANY Daly Gas Storage Ltd.
WELL Daly Gas No. 4 10-7-10-27 WPM
COUNTRY Daly, Manitoba
KB 1605 BHT 92°F (Ext.)
at at
GL 1594 TOTAL DEPTH 3654

intercomp

PETROPHYSICAL DATA

ANALYST C. B. Austin
DATE November 6 1977
PAGE 1 OF 1

FORMATION INTERVAL (4)	FT.	POR. DEV.	NET PAY	RAW LOG DATA: SP	GR	ρ_b	µ sec.	SNP/CNL	CALCULATED POROSITY % from: ρ_b	µ sec.	SNP/CNL	EFF. ø %	ø h	øh Sw	RESISTIVITY: Ro	Rt	(3) FRF	(2) Rw	I	(5) Sw %	REMARKS: LITHOLOGY - DST - HYDROCARBON INDICATION - ETC
Main Souris River Porosity 3540 (-1935)																					
Zone 1																					DST #2 3540-3556 TO 5/60 SI 60/120
								%LS													Nitrogen Gas to surf. immed. on PF.
3540-3544	4	3	3**			2.63	67	20				12.5	—	—	2.1	2.1				74	Nitr. GTS on VO steady for 60' @ 125
3544-3547	3	0	0	Anhydrite																	psi on 1/5" orifice (6.95 MMCF/D)
3547-3550	3	3	3			2.43	78	19				21.5	0.64	.12	13	13				19	1.5' brackish water, 44,000 ppm PF 1017 SIP
3550-3552	2	2	2			2.55	71	18				15.0	0.30	.11	6	6				38	1511/1593 HMP 1830/1840 FP 1028/1100
3552-3559	7	0	0	Shale and Anhydrite																	Gas down to 3552 (-1947)
Zone 2																					
3559-3565	6	5	0			2.48	78	32				20.5			0.52	0.52				100	No Tests.
3565-3568	3	0	0	Anhydritic																	
Zone 3																					
3568-3571	3	3	0			2.70	58	21				9.2	.28		3.1	3.1				100	No Tests.
3571-3577	6	6	0			2.77	53	20				5.5	.33		4.5	4.5				100	
3577-3582	5	5	0			2.64	62	28				12.0	.60		1.4	1.4				100	
3582-3586	4	4	0			2.76	53	18				5.7	.23		6.	6.				100	
3586-3590	4	4	0			2.60	61	28				14.0	.56		1.3	1.3				100	
3590-3600	10	8	0			2.67	57	25				10.5	.84		1.9	1.9				100	
3600-3605	5	5	0			2.70	53.5	22				9.0	.45		3.5	3.5				100	
													3.29								

RESERVOIR SUMMARY

3540 ft. TO 3605 ft.

SOURIS RIVER POROSITY

	Zone 1	Zone 2	Zone 3
GROSS POROSITY DEVELOPMENT Ft.	8'	5'	35'
NET RESERVOIR (PAY) Ft.	8'**	0'	0'
AVERAGE POROSITY (NET) %	16.5	20.5%	9.4%
AVERAGE WATER SATURATION %	39	100%	100%

** The net pay figure shown includes a 3 foot stringer at the top of Zone 1. Although the Sw exceeds conventional cutoffs for net pay inclusion the zone does lie above the G/W for the zone and is simply exhibiting a capillary effect due to its low ø and proximity to the G/W contact.

Appendix D-1

PETROPHYSICAL CONTROL

(1) POROSITY CNL-FDC - Sonic
(2) FORMATION WATER Rw = 0.033 @ 92°F
(3) "FRF" RELATIONSHIP m = -1.71
(4) BASELOG FOR DEPTH DILL (ILS)
(5) I-Sw RELATIONSHIP -"n" n = -2.0

COMPANY Daly Gas Storage Ltd.
WELL Daly Gas #1 (7-18-10-27W1M)
COUNTRY Manitoba
KB 1629 BHT 92°F at at
GL 1616 TOTAL DEPTH 3625 Ft.

Mud pH - 9.5
Mud W.L. - 20.0cc
Mud Rmf - 0.283 @ 55°F
Bit Size - 8 3/4"

intercomp

PETROPHYSICAL DATA

ANALYST C. B. Austin
DATE March 1977
PAGE 1 OF 1

FORMATION INTERVAL (4)	FT.	POR. DEV.	NET PAY	RAW LOG DATA: SP	GR	ρ_b	μ sec.	SNP/CNL	CALCULATED POROSITY % from: ρ_b	μ sec.	SNP/CNL	EFF. φ %	φ h	φh Sw	RESISTIVITY: Ro	Ri	(3) FRF	(2) Rw	I	(5) Sw %	REMARKS: LITHOLOGY - DST - HYDROCARBON INDICATION - ETC
Main Souris River Porosity				3516 (-1887)				CNL													
Zone 1								LSTφ													
3516-3520	4	3.5	3.5			2.56	71	16				13.1	0.46	15.50	18		32	1.07	17	24	DST #3 3515-3540 TO 5/90 SO 60/180
3520-3524	4	0	0	Dense																	SAB on PF and VO. GTS in 1 min. on PF @
3524-3530	6	6	6			2.32	88	26				22.6	1.36	15.49	60		12.7	.42	143	8	6.37 MMCF/D. Incr. to 6.73 MMCF/D at end
3530-3536	6	0	0	Dense																	of VO period. Rec'd 10' clear water
		9.5	9.5										1.82	15.65							(57000 ppm NaCl) SIP 1523/1523 BHT - 92°F
Zone 2																					
3536-3541	5	4.4	4.5			2.38	88	24				21.7	0.98	241.0	17		13.6	.45	38	16	GAs-down-to 3541 KB (-1912)
3541-3543	2	0	0	Dense																	
		4.5	4.5										0.98	241.0							
Zone 3																					
3543-3550	7	6.5	0			2.63	64	22				10.4	0.68	49.21	10	*	48	1.6	6.3	40	Water-up-to 3543 KB (-1914)
3550-3557	7	7.3	0			2.57	64	27				15.2	1.11	535.4	3.7	*	25	.83	4.5	47	* Laterolog resistivity profile strongly
3557-3563	6	5.9	0			2.67	57.5	18				7.5	0.44	251.2	18	*	84	2.8	6.5	40	indicative of severe mud filtrate invasion.
3563-3577	14	14.2	0			2.57	67	27				16.0	2.28	1092.	3.2	*	23	.76	4.2	49	This zone is wet by DST#2 3545-3625.
3577-3582	5	5	0			2.65	60	21				11.0	0.55	26.3	7.2	*	44	1.44	5.0	45	TO 5/60, SI 60/120 GAB on PF and VO. No
																					fluid to surf. Rec'd 2620 ft. SW
																					(280170 ppm NaCl) 180 ft. mud. SIP 1522/1522
																					The relatively low water saturation
																					calculations are a result of a mixture
																					of mud filtrate and formation water - the
																					mud filtrate being more resistive. The
																					high water loss is the main cause.

RESERVOIR SUMMARY

3516 ft. TO 3582 ft.

MAIN SOURIS RIVER POROSITY

	Zone 1		Zone 2	Zone 3
GROSS POROSITY DEVELOPMENT	9.5	Ft.	4.5'	38.9'
NET RESERVOIR (PAY)	9.5	Ft.	4.5'	0'
AVERAGE POROSITY (NET)	19.2	%	21.7%	13.0%
AVERAGE WATER SATURATION	12	%	16%	100%

PETROPHYSICAL CONTROL

Appendix D-2

(1) POROSITY O. B. Core Analysis
(2) FORMATION WATER Rw = 0.033 @ 92°F
(3) "FRF" RELATIONSHIP m = -1.71
(4) BASELOG FOR DEPTH DLL
(5) I-Sw RELATIONSHIP -"n" n = -2.0(est)

COMPANY Daly Gas STorage Ltd.
WELL 15A-18-10-27WIM
COUNTRY Manitoba
KB 1620 BHT 92°F
GL 1607 TOTAL DEPTH 3628

intercomp

PETROPHYSICAL DATA

ANALYST N. M. Thachuk
DATE March 16 19 77
PAGE 1 OF 1

FORMATION INTERVAL (4)	FT.	POR. DEV.	NET PAY	RAW LOG DATA SP	GR	ρ_b	μsec.	SNP/CNL	CALCULATED POROSITY % from ρ_b	μsec.	SNP/CNL	EFF. ϕ %	ϕ h	ϕh Sw	RESISTIVITY Ro	Rt	(3) FRF	(2) Ro	I	(5) Sw %	REMARKS: LITHOLOGY - DST - HYDROCARBON INDICATION - ETC
Main Souris River Porosity 3460 (-1840)																					
																					* Values of Rt from E log
Zone 1																					dubious for accurate
3460-3461	1	0	0	Dense																	saturation control.
3461-3464	3	3	3				66					11	0.33			20*					
3464-3467	3	0	0	Dense																	
3467-3468.5	1.5	1.5	1.5				87					26	0.39			20					
3468.5-3470	1.5	1.5	1.5				77					19	0.29			20					
3470-3472	2	2	2				86					25	0.50			20					
3472-3480	8	0	0	Dense																	
			8.0										1.51								
Zone 2																					
3480-3481	1.0	1.0	1.0				76					20	0.20			20					
3481-3482	1.0	1.0	1.0				70					16	0.16			25					
3482-3484	2.0	2.0	2.0				77					21	0.42			25					
3484-3488	4	0	0	Dense																	
			4.0										0.78								
Zone 3																					
3488-3490	2	2	2				72					22	0.44			28	13.1	.43	65	.12*	
3490-3492	2	2	2				61					13	0.26			28	32.7	1.08	26	20*	
3492-3496	6	6	6				72					22	1.32			30	13.3	.44	68	12*	
3496-3504	8	6	6				64					16	0.96			30	22.9	.76	40	16*	
3504-3506	2	2	2				73					23	0.46			28	12.3	.407	63	12*	
3506-3510	4	4	4				70					20	0.80			20	15.7	.52	38	16*	
3510-3513	3	3	3				75					24	0.72			18	11.5	.38	48	15*	
3513-3517	4	4	4				61					13	0.52			16	32.7	1.09	15	26*	
3517-3522	5	5	5				58					11	0.55			12	43.5	.44	83	35*	
			34										6.03								

RESERVOIR SUMMARY

	Zone 1		Zone 2	Zone 3
ft. TO ft.				
GROSS POROSITY DEVELOPMENT	8.0	ft.	4.0	34
NET RESERVOIR (PAY)	8.0	ft.	40	34
AVERAGE POROSITY (NET)	18.9	%	19.5	17.7
AVERAGE WATER SATURATION	-	%	-	19*

Appendix D-3

PETROPHYSICAL CONTROL

(1) POROSITY Sonic/Core Wells 11-19 and 7-18
(2) FORMATION WATER
(3) "FRF" RELATIONSHIP .033
(4) BASELOG FOR DEPTH
(5) I-Sw RELATIONSHIP -"n"

COMPANY Daly Gas Storage Ltd.
WELL Daly Gas #2 (11-19-10-27W1)
COUNTRY Daly, Manitoba
KB 1613 BHT 92°F at at
GL 1600 TOTAL DEPTH 4078

Mud pH - N.A.
Mud W.L. - 5.0 cc
Mud Rmf - 0.29 @ 64°F
Bit Size - 8 3/4"

intercomp

PETROPHYSICAL DATA

ANALYST C. B. Austin
DATE March 1977
PAGE 1 OF 1

FORMATION INTERVAL (4)	FT.	POR. DEV.	NET PAY	RAW LOG DATA SP	GR	ρ_b	µsec.	SNP/CNL	CALCULATED POROSITY % from ρ_b	µsec.	SNP/CNL	Avg. Core EFF ϕ %	O.B. Core ϕ h	KH ϕh-Sw	RESISTIVITY Ro	Rt	(3) FRF	(2) Rw	I	(5) Sw %	REMARKS: LITHOLOGY - DST - HYDROCARBON INDICATION - ETC
Main Souris River Porosity 3537 (-1924)												O.B.		Atm.							
Zone 1								LST													
3537-3541	4	3.4	3.4			2.56	63	15				8.8	0.30	5.29	6.5	6.5	64	2.1	3.1	57	Core #1 3484-3544 (Adjusted Depths)
3341-3545	4	0	0	Dense																	Core #2 3544-3604 (Adjusted Depths)
3545-3551	6	6	6			2.30	81	14				22.0	1.32	1431.	45	45	13.3	.44	102	10	
3551-3558	7	0	0	Dense																	
		9.4	9.4										1.62	1436							
Zone 2 3558 (+1945)																					
3558-3562	4	3.8	3.8			2.30	83	23				25.9	0.99	278.	3.3	3.3	10.1	.33	9.9	32	
3562-3565	3	0	0	Dense																	
		3.8	3.8										0.99	278							
Zone 3 3565 (+1952)																					
3565-3568	3	3.2	0			2.60	58	23				8.7	0.28	7.7	1.9	1.9		2.1		100	
3568-3583	15	15.3	0			2.37	74	35				24.0	3.67	2836	0.35	0.35		.38		100	
3583-3597	12	11.7	0			2.63	56	20				13.3	1.56	788.2	2.7	2.7		1.04		62	
3597-3602	5	5.1	0			2.68	53	17				7.2	0.37	10.0	5.0	5.0		3.		77	
		35.3											5.88	3642							

Appendix D-4

RESERVOIR SUMMARY

3537 ft. TO 3602 ft.

MAIN SOURIS RIVER POROSITY

	Zone 1		Zone 2	Zone 3
GROSS POROSITY DEVELOPMENT	9.4	Ft.	3.8'	35.4'
NET RESERVOIR (PAY)	9.4	Ft.	3.8'	0 '
AVERAGE POROSITY (NET)	17.2	%	25.9%	16.6%
AVERAGE WATER SATURATION	19	%	32 %	100 %

PETROPHYSICAL CONTROL

(1) POROSITY O.B. Core Analysis
(2) FORMATION WATER Rw = 0.033 @ 92°F
(3) "FRF" RELATIONSHIP m = -1.71
(4) BASELOG FOR DEPTH DILL
(5) I-Sw RELATIONSHIP - "n" n = -2.0 (est.)

COMPANY Daly Gas Storage Ltd.
WELL Daly Gas No. 3 10A-12-10-28 WIM
COUNTRY Daly, Manitoba
KB 1628.2 BHT 92°F
GL 1617 TOTAL DEPTH 3640

intercomp

PETROPHYSICAL DATA

ANALYST C. B. Austin
DATE September 19 77
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FORMATION INTERVAL (4)	FT.	POR. DEV.	NET PAY	RAW LOG DATA: SP	GR	ρ_b	µ sec.	SNP/CNL	CALCULATED POROSITY % from: ρ_b	µ sec.	SNP/CNL	EFF. ϕ %	ϕ h	ϕh Sw	RESISTIVITY: Ro	Rt	(3) FRF	(2) Rw	I	(5) Sw %	REMARKS: LITHOLOGY - DST - HYDROCARBON INDICATION - ETC
Souris River Porosity 3504 (-1876)																					DST #1 3512-3532 TO 5/90 SI 60/180
Zone 1								%LS			%Dol.										Nitrogen Gas to surface. Steady @ 6.85
3504-3508	4	3.5	3.5			2.51	70	9			3.0	13.0	0.46	.13		14				28	MMCF/D on 1¼" choke. No water.
																					FP 893/864/884 SIP 1527/1527
3512-3518	6	5.5	5.5			2.38	81	9			3.0	17.5	0.96	.11		50				11	Mud RMF 0.58 @ 70°F.
3518-3524	6	0	0	Shale and Anhy																	
Zone 2																					
3524-3530	6	5	5			2.33	75	12			5.0	20.0	1.00	.17		17				17	
Zone 3	Net	14	14								Net	ϕh	2.42	.41							Rt/RILD = 0.83.
3533-3536	3	2	0			2.60	70	29				14.5			1.2	1.0				95	
3536-3543	7	7	0			2.48	72	35				21.0			0.6	0.5				98	
3542-3549	6	6	0			2.39	75	36				25.5			0.31	0.26				100	
3549-3552	3	3	0			2.52	70	31				18.8			0.7	0.6				100	
3552-3561	9	7	0			2.59	64	27				15.0			1.2	1.0				100	
3561-3568	7	7	0			2.65	57	22				12.0			2.7	2.3				100	

RESERVOIR SUMMARY

3504 ft. TO 3568 ft.

	Main Souris River Porosity Zone 1		Zone 2	Zone 3
GROSS POROSITY DEVELOPMENT	9	ft.	5'	32'
NET RESERVOIR (PAY)	9	ft.	5'	0'
AVERAGE POROSITY (NET)	15.8	%	20.0%	17.9%
AVERAGE WATER SATURATION	17	%	17%	100%

PETROPHYSICAL CONTROL

(1) POROSITY CNL-FDC - Corr. for Gas & Lith
(2) FORMATION WATER 0.033 @ 92°F
(3) "FRF" RELATIONSHIP m = -1.71
(4) BASELOG FOR DEPTH DILL
(5) I-Sw RELATIONSHIP - "n" n = -2.0

COMPANY Daly Gas Storage Ltd.
WELL 8-14-10-28WIM
COUNTRY Manitoba
KB 1636 BHT 92°F
at at
GL ____ TOTAL DEPTH 3642

intercomp

PETROPHYSICAL DATA

ANALYST N. M. Thachuk
DATE March 16 19 77
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FORMATION INTERVAL (4)	FT.	POR. DEV.	NET PAY	RAW LOG DATA SP	GR	ρ_b	μ sec.	CPS SNP/CNL	CALCULATED POROSITY % from ρ_b	μ sec.	SNP/CNL	EFF. ϕ %	ϕ h	ϕh Sw	RESISTIVITY Ro	Rt	(3) FRF	(2) Rw	I	(5) Sw %	REMARKS: LITHOLOGY - DST - HYDROCARBON INDICATION - ETC
Main Souris River Porosity (3562) Zone 1																					
3562-3565	3	0		Dense																	* Porosity values are tentative being
3565-3567	2	2						224				13*	0.26								based on dense anhydrite and
3567-3570	3	0		Dense																	core max porosities per zone indexed
3570-3573	3	3						185				22	0.66								to minimum/maximum zone readings in
3573-3575	2	0		Dense																	this well.
3575-3577	2	2						199				19	0.38								
		7											1.30								
Zone 2																					
3577-3582	5	0		Dense																	
3582-3584	2	2						199				19	0.38								
3584-3587	3	3						189				19	0.57								
3587-3589	2	0		Dense									0.95								
		5																			
Zone 3																					
3589-3594	5	4						217				15	0.60								
3594-3603	9	9						189				19	1.71								
3603-3606	3	3						242				11	0.33								
3606-3611	5	5						227				13	0.65								
3611-3614	3	0		Dense																	
3614-3616	2	2						217				15	0.30								
3616-3620	4	4						249				10	0.40								
3620-3623	3	3						259				8	0.24								
		30											4.23								

RESERVOIR SUMMARY

____ ft. TO ____ ft.	Zone 1	Zone 2	Zone 3
GROSS POROSITY DEVELOPMENT	7 ft.	5'	30'
NET RESERVOIR (PAY)	- ft.	-	-
AVERAGE POROSITY (NET)	18.5* %	19.0*%	14.1*%
AVERAGE WATER SATURATION	%		

PETROPHYSICAL CONTROL

(1) POROSITY ____
(2) FORMATION WATER ____
(3) "FRF" RELATIONSHIP ____
(4) BASELOG FOR DEPTH ____
(5) I-Sw RELATIONSHIP -"n" ____