

July 31, 1975

Manitoba Mineral Resources Ltd.  
603 - 491 Portage Avenue  
Winnipeg, Manitoba  
R3B 2E4

Attention: Mr. Albert A. Koffman  
President & General Manager

Dear Sir:

Re: Waskada Drilling Prospect

The following is our understanding of recent negotiations between Manitoba Mineral Resources Ltd. (herein referred to as "Mineral Resources") and Omega Hydrocarbons Ltd. (herein referred to as "Omega") regarding the well to be drilled in Lsd. 11-29-1-25 W1M (hereinafter referred to as "the well"):

1. Mineral Resources is planning to drill the well on or before August 31, 1975, for the production of petroleum substances.
2. Omega is interested in locating a source of water for its proposed waterflood scheme for the Waskada Oil Field.
3. In the event that Mineral Resources do not encounter petroleum substances in the well in commercial quantities and desire to abandon said well, Mineral Resources will promptly so notify Omega and make available to Omega all current well information, well logs and relevant information in respect to the well. In addition, Omega shall be permitted free access to the derrick rig floor. Following receipt of the foregoing notice, Omega shall have the right and option exercisable by notice in writing to Mineral Resources given within one day of receipt of notice of Mineral Resources' desire to abandon the well, to take over the operations of the well. In this event, Omega shall be responsible for all further costs and expenses in connection therewith, including abandonment and lease clean-up, provided however, that Mineral Resources shall, at its sole cost and expense, complete abandonment operations to the point of the water source zone.

The consideration for the foregoing option shall be the sum of \$10, now paid by Omega to Mineral Resources and other good and valuable consideration.

- agents*
- ① all info available
  - ② access & rig floor
  - ③ take over all operations - costs.

*MMR can't w/ Sedco will pay 12.  
over part of completion costs (by time).*

4. Upon Omega exercising the within option to take over the well, Mineral Resources will transfer all its right, title and interest in and to the well, well license, surface lease, the rights to ~~mineral which will allow~~ the production of formation water and well equipment (surface bowl and surface casing) located there on.
5. If, after take over of operations by Omega as contemplated in paragraph 4, petroleum substance in commercial quantities is found as a result of testing for water, Omega will immediately notify Mineral Resources. Mineral Resources will then have the right to take over well operations and thereupon reimburse Omega for all costs and expenses incurred from and after the time at which petroleum substances are so encountered since take over from Mineral Resources and relieve Omega of any further responsibilities herein assumed.
6. Omega herein warrants that all well information will be held confidential unless otherwise agreed to by Mineral Resources for a period of ~~six~~ <sup>12</sup> (6) months.
7. Liability for well operation will be the responsibility of Mineral Resources up to the time of take over and thereafter the responsibility of Omega.
8. Omega requests that all operations in connection with the well will be conducted in accordance with good oilfield practice and comply with all laws and regulations of the Province of Manitoba.

If the above terms and conditions correctly reflect your understanding, please have the duplicate copy signed and returned to the undersigned.

Yours very truly,

OMEGA HYDROCARBONS LTD.

  
T. J. Hall

AGREED AND ACCEPTED  
THIS \_\_\_\_\_ DAY OF AUGUST, 1975.

\_\_\_\_\_

\_\_\_\_\_

TJH/jm

Mo: 1  
No:

Clare Mosier.

Supplementary exploration targets.

- ① North Waskada: rec Tp. 2 Rge. 25, follow up on the 3-4-2-25 test and dependant on specific results of test. Good regional potential probably would justify at least one or two supplementary test holes.
- ② Central Waskada: rec. NE-21-1-25 - general location in the apparent central part of structure. Dependant on results of 6-2a test and playing similar prospects. Seismic studies could prove extremely useful.
- ③ South Waskada: rec. 6-8-1-25. To test MC-36 trap south west flank of structure, for entrapment comparable to Waskada Field. Whistler proposed 10-12-1-26 location for same type of play. Also could propose 15-12-1-2 location which could be same pressure basin. Whistler seismic maps, or maps in correct, could test structural high up dip from 13-18 former production (Both De Kalle & Whistler dates suggest seismic low just east of 15-18 location).
- ④ East Waskada: rec 14-11-1-25. Entrapment in the Waskada producing area (12-23 and 14-27) would seem to indicate some structural-stratigraphic or topographic closure that has prevented migration to the southeast. (The producing wells cannot be an isolated outcrop as suggested by Whistler, since this would have isolated these wells & prevented migration into such isolated area. The possible alternative is that the closure is at the south (rec 12-14) & oil has migrated into east Waskada from the north west. (between 10-27 and 4-35 ??) If this is the case accumulation could prove

Mc  
No:

Clare Master.

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- ② Central Waskada: rec. NE-21-1-25 - general location is the apparent 'central' part of structure. Dependant on results of 6-2a test and playing similar prospects. seismic studies only from extremely high.
- ③ South Waskada: rec. 6-8-1-25. To test MC-3b trap south west flank of structure, for entrapment comparable to Waskada Field. Whistler proposed 10-12-1-26 location for same type of play. Also could propose 15-12-1-2 location which could be same pressure basin. Whistler seismic maps, or maps in com. could test structural high up dip from 13-18 former problem (Both De Kalb & Whistler data suggest seismic low just east of 15-18 location).
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possible hole priority.

\* this could possibly explain why the 10-27 MC-1 test was dry - can be tested

continuous to the northwest towards the proposed 3-4-2-25 location.

⑤ Waslenda Field Extension: Extension to the northeast

possible and either the 13-30 or 14-30 locations are feasible. Accumulation can be limited either by structure / truncation of reservoir beds or by porosity loss due to facies change to evaporite. The 4-31 dry hole seems to result at least in part from facies effects, although correlation of the production interval is somewhat uncertain and reservoir truncation may also be a factor. If there is no northward porosity decrease, this would open up an extension area where the MC-3b subcrop trap could be productive (at the approximate MC-3 isopach interval, Fig. 2). The above location is thus more than just a field extension well but could open up a significant new exploration area.

Extension to the south and southwest is also possible. Southward extension will of course be severely limited by the truncation of the reservoir beds towards the 13-18 location. However, since the structural high continues to the west, westward extension parallel to structure well should be possible for at least a limited distance. The limiting factor will be the oil water interface in the MC-3b beds and possibly also the presence or absence of the Dando Evaporite seal for the MC-3b beds. (See 5-19-1-25 & 8-24-1-26).

Some oil shows are reported in the MC-3b beds west of the Waslenda field.

(6) Nopinka Area:

the 5-34-25 well encountered a pronounced structural high, truncated at the erosion surface & forming a window of Lodgepole strata within the MC-1 subcrop belt. The 5-3 well is the only ancient well in the area and the structure probably has the same origin as the Wasikada "dome" - that is, early salt collapse. In the case of the Nopinka structure, the truncated upper lodgepole beds are not reservoir strata, and the structure apparently does not form a barrier at the MC-1 subcrop edge. Any oil in MC-1 reservoir would probably have migrated past & around the structure without being trapped. There is no evidence of any paleotopographic relief or structure on the erosion surface.

Seismic data suggests that the 5-3 well is not located on the crest of the structure. The seismic line on the S side of the township shows higher elevations. Entrapment in Devonian beds over the structural high remains a possibility despite the lack of shows in the 5-3 test. Location of a follow up test would have to be based on further seismic studies. The thick Wiggins sequence indicates reef development along the Britton-Wasikada axis.

The gravity of control leaves open the possibility that if the structure should extend farther to the northeast, it could form a barrier on the MC-1 subcrop edge, in which case accumulation would be possible along the MC-1 subcrop edge north of Nopinka. (U NE 4-25 WPM).

(7) MC-1 Subcrop Edge - General: Commercial (?) production is known from only 2 areas - Tilsten and Goodlands. The entire subcrop edge should be examined more closely, especially where this edge is coincident with the B-W axis, to determine if potential closure exists. (Need also reservoir lithology to determine if <sup>effective</sup> permeability base is at base of MC-1 or above). Regional structure on MC-1 subcrop suggests closure to SE above approx -1150 to -1200' MSL. Specifically, some studies of Goodlands should be made, to determine cause

of accumulation. No explanation is evident that structure seems to be involved, and possibility exists that the producers could be related to larger scale structural trap not evident from available control.

- 2) Hartney Area: The Hartney structure is believed to be a crypto explosion crater - possibly resulting from meteor impact. Two separate producing fields are known to be associated with similar structures (Red Wing + Viewfield). One has obtained production from the central uplifted breccia pile and the other from structurally uplifted beds flanking the crater. The crater does not occur within an area where thick reservoir beds are present at or near outcrop, so a central breccia pile of reservoir beds is not to be expected. Furthermore, breccia beds known to date from core samples are extremely tight.

The possibility remains however that accumulation could occur in reservoir beds on the uplifted rim of the structure. Positive structural relief is known to exceed 3000 feet, and Lodgepole (Under Machine) beds and possible moss reservoir beds could form structural / strat traps on the flanks of the crater. Closer examination of well data and added seismic information would be necessary to define specific targets, the updip edge, i.e. SEG-2410PM is a possibility.

#### 9) Deep Tests - Winnipegosis - Winnipeg Prospects.

Two targets have been suggested: Birdtail (8-21-24) and Shortdale (13-26-27). These are chosen on the following basis:

- locations are with a favorable sand/shale facies of the Winnipeg Formation.

- locations fall along the trend of the Birdtail Washoda Axis and associated Winnipegosis reef trend.

- locations coincide with prominent <sup>local</sup> gravity anomalies.



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which appear to fall on the extension of the Churchill-Superior boundary anomaly trend. Data indicates some correlation of gravity anomalies with late Paleozoic Structural & facies development. (Other geophysical anomaly sites could be identified along this trend. Preliminary ground gravity survey should be run to specify exact location).

10) Oak River - Winnipeg Formation - Strat. Trap. (8-13-22 WPI)

Detailed examination of the sand distribution in the Winnipeg Formation has shown several locations where an dip pinchout of sands could give rise to entrapment. The best of these locations appears to be at Oak River, but even here entrapment is uncertain and will depend entirely on the detailed configuration of the sand edge relative to the regional structure contours. No other target horizons are known at this location other than the Winnipeg sand pinchout.

11) Mississippian Field Extensions:

- (a) Central Daly area. (trap present - depression into flood?).
- (b) Northwest Daly area.
- (c) Pierson area - MC-3 trend. (extensive area of oil shows).
- (d) Strip cut drilling. (Eber etc. - limited potential only).

Other General: Except for the B-W Axis, Hartney and Lake St. Martin, no appreciable structural anomalies known that could give rise to trap conditions. Except for Winnipeg Fm., other Ordovician Bed Shale beds are relatively uniform and each major facies changes, impermeable seal seals and cap rocks etc so that no specific targets can be defined, and I really question the existence of any such purely stratigraphic traps.

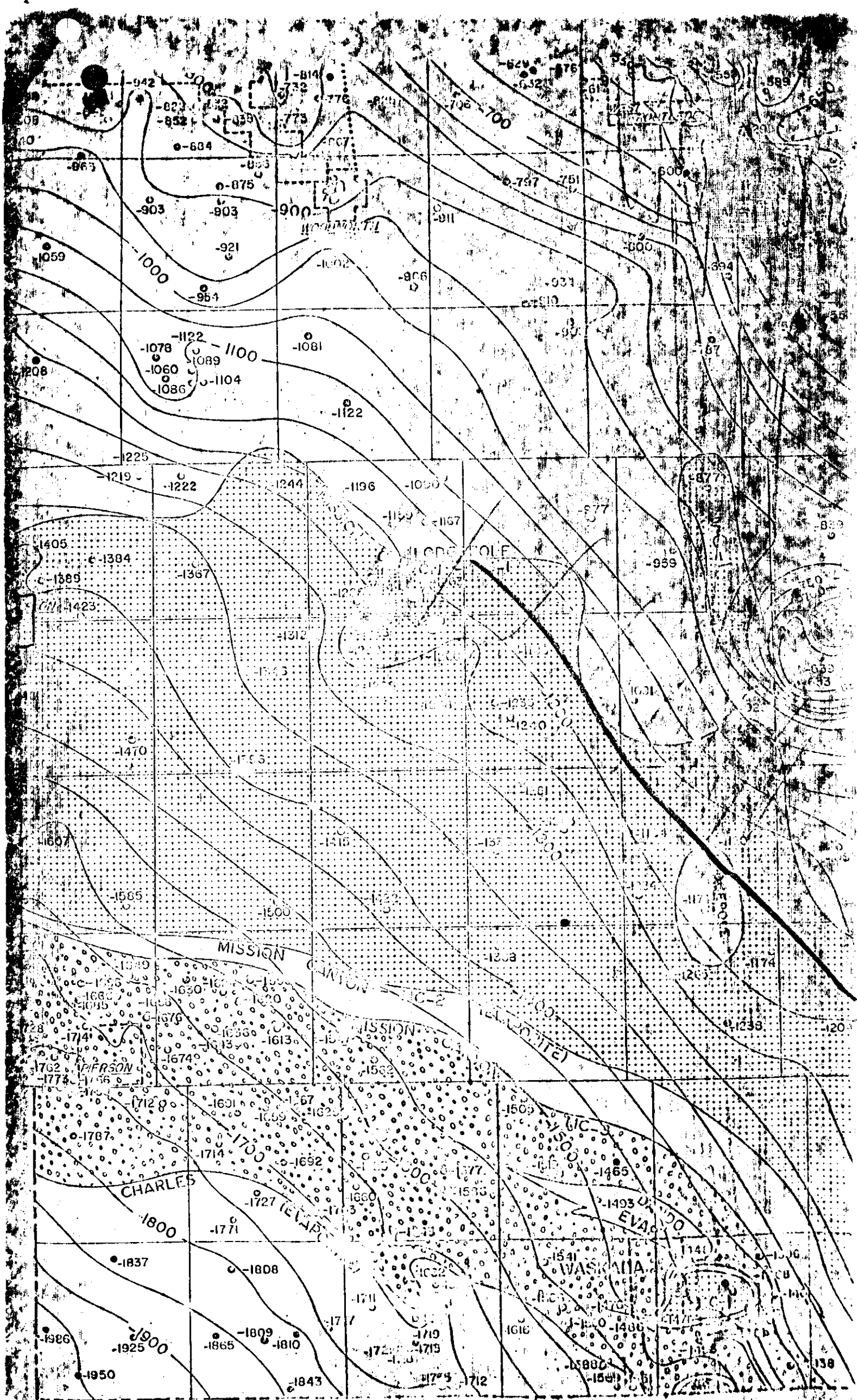


location would require detailed lithologic studies and potential is low unless there is coincident structure, associated fracturing etc. Here again, the B-W axis seems to offer best potential.

Unconformity traps could exist where reservoir beds subcrop beneath impermeable Devonian & Ordovician beds. Except for the extensive Mississippian subcrop traps presently producing, no other oil shows are known and there are only areas where structural/paleogeographic closure has been determined - the Mississippian escarpment southwest of Brandon and the high south of Riding Mtn Park. One very unfavorable factor is the pronounced structural rise of the outcrop-subcrop belt to the northwest. For example the Devonian subcrop rises from <sup>350</sup> ~~400~~ in the south to +800 in the northwest. Any structural antipogon relief would have to overcome this gradient to permit entrapment.

DM. 14 Feb/75





1150' Contour Line - Reservoirs and other features. Map

# inter-departmental memo

MC 38/74 - 5(a)(c)

425.25/  
10.1

To

Honourable Sidney Green, Q.C.  
Minister of Mines, Resources and  
Environmental Management

LB302

Date November 8, 1974

From Honourable Ben Hanuschak  
Chairman  
Management Committee of Cabinet

Subject Management Committee Meeting - November 5, 1974

The report of the above mentioned meeting includes the following minutes:

"5. (a) Oil Exploration Drilling Program (Waskada Area) (MC 37/74-5(a))

The Committee authorized allocation up to \$260,000 from Appropriation XII-8 for a Two-Well Oil and Gas Exploration Program, as requested by the Minister of Mines, Resources and Environmental Management in a submission dated October 4, 1974, in the Waskada Area. This is a component of the department's program for mineral exploration approved in 1974/75 estimates at a funding level of \$1 million.

(c) Forest Fire Suppression - Special Warrant of \$758,000

The Committee requested the Department of Finance to issue a Special Warrant in the amount of \$758,000 to be allocated to the following current expenditures, as requested by the Minister of Mines, Resources and Environmental Management in a submission dated October 31, 1974, for costs incurred on Forest Fire Suppression.

12-3A-2	Resources Management, Administration, Other Expenditures	\$728,000
12-3D-2	Resources Management, Eastern Region, Other Expenditures	\$ 30,000"

A copy of the submission regarding Item 5(a) will be forwarded to the Provincial Auditor and Item 5(c) to the Deputy Minister of Finance with a copy of this memorandum.

c.c. W.K. Ziprick  
S. Anderson  
C.D. McKenzie  
J.T. Cawley  
F.W. Stewart  
Dr. Ian Haugh

L.R. Pout  
D.C. Pensack  
G.R. Hastings  
W.J. Podolsky  
P.S. Kelly

*Ben Hanuschak*  
Ben Hanuschak

# inter-departmental memo

Honourable Ben Hanuschak,  
Chairman,  
Management Committee of Cabinet.  
Attention: Mr. Hans Schneider,  
Secretary.

Date

From Honourable Sidney Green, Q. C.,  
Minister of Mines, Resources and  
Environmental Management.

Subject

## SUBJECT:

A two-well oil exploration drilling program by the Province in the Waskada area (townships 1 and 2, range 25WPM).

## BACKGROUND:

Since 1969, oil production in Manitoba has shown a consistent rate of decline of about 5 per cent per year. No significant discoveries have been made since development of the Waskada Field in 1967/68, and no new wells were brought into production in either 1972 or 1973.

An evaluation of potential exploration targets in the Province has shown that the Waskada area offers the best potential for discovery of additional oil reserves. However, exploration companies presently holding the majority of the mineral rights in the Waskada target area have indicated that they are not willing to undertake exploration drilling at the present time. Because of the lack of exploration by the private sector, development of an exploratory drilling program in the Waskada target area will require direct initiative and action on the part of the Province.

Crown mineral rights acreage within the Waskada target area is limited (approximately 3,400 acres or 15%), and is not sufficient to protect a (Crown operated) drilling target, in the event of oil discovery. Consequently, it is necessary for the Crown to first acquire all available open freehold within the target area. This would be followed by an approach to companies presently holding mineral leases in the area with a view to developing a joint-venture exploration agreement for the entire block. For example, in return for drilling the two wells, the Crown might obtain an interest in the company lands; alternatively the companies may wish to contribute to the drilling and completion costs in return for an interest in the wells.

## RECOMMENDATION:

That the Province provide the financial and technical support required to carry out a two-hole exploration program for oil and gas in the Waskada area. Funding by the Province will be required for three items:

*Drill 1 well.  
Falls under Minerals  
sub government of P.C.  
G.D.A. (Ben Barb.  
Apr.)*

- a) land acquisition;
- b) drilling expenses;
- c) completion, in the event that commercial production is obtained.

The following figures are the estimates of the maximum total costs involved for each item, assuming no financial input from the companies holding mineral rights. In the event that company participation in the program can be obtained, some reduction in costs for items (b) and (c) could be anticipated. Alternatively the Crown might obtain a direct interest in company lands in return for these expenditures.

- a) Land acquisition: in order to protect the exploration targets in the event of oil discovery, mineral rights for up to 5,000 acres of freehold lands would be acquired for an estimated cost of \$10,000.
- b) Drilling costs: one test hole would be drilled to a maximum depth of 6,500 feet, to Precambrian basement, in order to test all formations and obtain the maximum possible amount of geological data. Estimated cost of hole to final abandonment - \$100,000. Of this, \$50,000 in costs would be written off against acquisition of basic geological data for those potential producing zones below the main Mississippian target horizon. A second hole would be drilled to a depth of 3,250 feet to test the Mississippian Formations, for an estimated cost to final abandonment of \$50,000.

Total drilling costs for two holes - \$150,000.

- c) Completion costs: in the event of oil discovery, additional cost for completion of two holes to the point of production, including casing, equipment, battery, etc., would be approximately \$50,000 per well.

Total completion costs - \$100,000.

Estimated maximum total cost to the Province of a two-well program, from land acquisition through to production - \$260,000.

Appendix I outlines the economic potential of a discovery well in the Waskada area, based on the performance of wells presently producing in the Waskada Field. For each new Mississippian pool encountered, a total of 8 to 12 producers can be expected.

In summary, therefore, it is recommended that approval be given to allocate up to \$260,000 of the \$1 million in the 1974/75 Supplementary Estimates (appropriation #12-8) for the purpose of undertaking a two-hole oil and gas exploration program in the Waskada area.

JUSTIFICATION:

Because of the decline in both oil exploration and oil production in Manitoba, direct Provincial input into oil exploration is deemed necessary in order to encourage a satisfactory level of exploration and production. It is anticipated that successful completion of one or more producing wells in the Waskada area will stimulate additional exploration for oil and gas by the private sector in Manitoba.

The reasons for proposing a two-hole program are both geologic and economic. Two principal locations can be defined within the general Waskada target area, and these will attempt to define two new oil pools. In addition, because of the high mobilization costs for a drilling rig, the cost per well for a two-hole program is considerably less than for a single test hole.

Sidney Green.

Date typed:  
October 4, 1974



## APPENDIX I

### ECONOMICS OF DRILLING, COMPLETING AND PRODUCING FOR A SINGLE CROWN WELL - WASKADA AREA

#### Expected Reservoir Parameters - Waskada Area

Porosity	12.4%
Permeability	23.4 millidarcies
Pay thickness	12 feet
Estimated primary producible reserves, basis 40 acre spacing -	75,000 bbls.
Estimated producing life	15 years

#### Production Economics - based on an average well for Waskada Field

March 31, 1974 well head price	\$3.37/bbl. net
April 1974 well head price	\$6.10/bbl. net
Expected pay-out period	5 years
Expected cumulative 5-year production:	37,214 bbls. (actual average 6 wells)

Gross revenue - 37,214 x \$6.10		\$227,035
Costs: drilling and completion	\$100,000	
operation @\$5,000/year	25,000	
Royalties* accruing to the Crown	79,691	
	<hr/>	
Total cost, 5-year operation	\$204,691	\$204,691
	<hr/>	
Net revenue after 5 years, including complete write off of costs		<u>\$ 22,344</u>

#### Expected total net revenue:

Total expected production, 75,000 bbls. @6.10		\$457,500
Costs: drilling and completion	\$100,000	
operating costs @\$6,000/year		
average	90,000	
Royalties* accruing to the Crown	139,962	
	<hr/>	
Total costs, 15 years operation	\$329,862	\$329,862
	<hr/>	
Net revenue for 15 year expected life of well		<u>\$127,638</u>

\* In the case of a well drilled on freehold land, the total gross royalties plus mineral tax would rise from about 35% to 41%. Freehold royalties would be 12%, and Crown mineral tax would be approximately 28% in the early stages of production but would decrease as producing rate decreases.

2 April/76

Preliminary Progress for North Waskada MMR 6-2-25 WPM.

Est. K.B. M 1925' per Bill.

		Depth.	Elev.
Cretaceous	Fossil	1535	+30
	Ashville	1620	-55
	Swan River	1952	-387
Jurassic		2098	-525 (±)
	Lime	2594	-1029
	Evap.	2732	-1167
	Red Beds	2845	-1280

Mississippian	MC-3	2965	-1400
	MC-2	3005	-1440
	MC-1	3035	-1470
	Lodgepole	3185	-1620

Devonian	Niskau	3825	-2260
	Ashern	4475	-3410

Proposed T.D. 3265 (-1700')

Alternative T.D. 3085 (-2320')

Alternative T.D. 5015 (-3450')

the above Mississippian marker tops (MC-2, MC-1, and Lodgepole) are minimum or

lowest possible estimates, providing for optimum preservation of MC-3 reservoir

beds. However, the location falls on the Birdtail-Waskada Axis, and local structural

highs may occur in areas of early salt solution. If such a structural high is intersected,

Mississippian markers could be as much as 250 feet higher than suggested above.

(estimated maximum possible structural relief) Depending on the amount of structural

relief, this could give rise to entrapment in MC-1 beds.

Recommendation: Total/depth of hole should be minimum feet (-1700' msl). 1-f.

Mississippian markers come in more than (100) feet above progress, hole should be continued to a point (30) feet below top of Niskau, and the Niskau should be evaluated.

If the Bakken-Lyleton interval is thin (approx. 80'), the hole should be deepened to the base of the Devonian, because the structure will probably be self supported. If the

Bakken + Lyliton interval is thick by an amount approaching the amount of structural relief, the structure probably is due solely to early salt solution with no associated Winnipegosis reef development, and the hole would be terminated in the Nisku.

- Upper 50' of Mississippian to be cored, and D.S.T. if warranted.
- Gas sniffer to be used throughout.
- any horizon giving oil or gas shows (core, samples, sniffer, log interpretation) to be drill stem tested.
- If hole drilled to base Devonian, upper 50' of Winnipegosis to be cored.
- Induction E-log to be run T.D. to casing shoe.
- BHC Sonic Gamma log to be run T.D. to surface.
- sample cuttings to be taken from surface to T.D.

2 April /76

Preliminary Prognosis for MMR Sealion Prov. 9-3-12-26:

Estimated K.B. 1497

Cretaceous -	Favel	837	(+660)	928 958
	Ashville	910	(+557)	1119 1140
	Ash Sd.	1125	(+372) $\pm 60'$ thick	1240 -
	Swan River	-	-	1300 1305
Jurassic	Imrie	1290	(+207)	1755 1880
	Evap	1765	(-248)	1754 1800
	Red Beds	1837	(-340)	1813 1855
	Mississippian - Lodgepole	1847	(-350')	1847 1863
Mississippian -	Virden Crinoidal	1897	(-400') (highest possible approx. -330')	1830 (-352)
	Bakken sh.	2167	(-670')	
	" sst.	2177	(-680)	
	Devonian - Lyleton	2197	(-700)	
Devonian -	Nisku	2237	(-740)	
	Duperow	2350	(-853)	
	Souris River	2937	(-1440)	
	Dawson Bay	3227	(-1730)	
	Prairie Evap.	3407	(-1910)	
	Winnipegosis	3407/3437	(-1910 to -1940) etc.	
	Ashern	3552	(-2055)	
Silurian -	Interlake	3574	(-2077)	
Ordovician -	Stonewall	3897	(-2400)	
	Stony Mountain	3962	(-2465)	
	Red River	4087	(-2590)	
	Winnipeg	4557	(-3060)	
Precambrian		4707	(-3210)	

\* 9-3 location should be approx 20' higher than referenced (in-27) basis regional dip on Ash sh.

Structure in the area is rather complex with numerous sharply defined linear structural lines, all having a (maximum) relief of about 120', and all probably resulting from late salt solution (late ~~Mississippian~~ and post-Mississippian). Some early salt solution also occurs in the area, as in the 6-24-12-26 well. However not all structural data can be fitted into a pattern of simple solution. Minor structural irregularities are also evident in post-Mississippian strata, such as Fard. Potential error for Mesozoic tops is about  $\pm 30'$ . For Mississippian and Devonian markers, tops could be as much as 70 feet higher (see maximum estimated Crinoidal elevation), or possibly 50 feet lower, depending on the amount of salt collapse that has occurred. It is possible that the relict high that seems to occur in the target area is reef supported, but the data suggest that maximum Winnipegosis thickness probably is only about  $\frac{100}{50}'$  to 140 feet.

Pre-Devonian strata are interpreted to be normal with no anomalies expected. Sand development is expected in the Winnipeg Formation with 1-2 sands totalling about 25' thick in the upper Winnipeg, and 1 to 3 sands totalling about 30 feet thick in the lower Winnipeg. Although the facies is favorable, there is no evidence that trapping conditions are present.

- Prospective horizons include the Mississippian reservoir beds, which should be present in the target area. Limiting factor will be the extent of pre-Jurassic anhydritization and dolomitization which in large part determines the up-dip limit of Mississippian accumulation.
- Structural configuration appears to be such that limited closure is possible in upper Devonian strata.
- As noted here, Winnipegosis reef build up is possible, with some potential local entrapment.
- Sand pinchouts in the Winnipeg Formation also offer some slight chance for entrapment.
- it is not possible to relate the E1 Rex anomaly to any specific geologic prospect.

Requirements: Total depth 63250 feet, in Precambrian.

- gas sniffer required throughout.
- well cuttings from grass roots.
- adequate mud maintained to provide good quality well cuttings throughout.
- any oil or gas shows (core, sample, sniffer, or log) to be drill stem tested.  
Especially watch for horizons that are nitrogen reservoirs at Daly.
- 60 foot core of Mississippian to be taken, commencing approximately 400 feet below unconformity surface.
- Induction E-log (dual ind. L.L.) to be run from T.D. to casing shoe.
- BHCS Sonic Gamma Log to be run from T.D. to surface (incl. &).
- ? [- 60 foot core, upper part of Winnipeg Formation]

Preliminary Progression for North Waskada M.M. 6-8-2-25 10 PM.

Est. K.B. \_\_\_\_\_

	Elev.
Cretaceous - Fossil	+30
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MC-1	-1470
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Devonian - Niskau	-2260
Ashem	-3410

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Alternative T.D.	(-3450')

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relief, this could give rise to entrapment in MC-1 beds.

Recommendation: Total <sup>minimum</sup> depth of hole should be \_\_\_\_\_ feet (-1700' msl). 1-f.

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If the Bakken-Lyleton interval is thin (approx. 80'), the hole should be deepened to the base of the Devonian, because the structure will probably be reef supported. If the



Bakken + Lyleton interval is thick by an amount approaching the amount of structural relief, the structure probably is due solely to early salt solution with no associated Winnipegosis reef development, and the hole would be terminated in the Nisku.

- Upper 50' of Mississippian to be cored, and D.S.T. if warranted.
- Gas sniffer to be used throughout.
- any horizon giving oil or gas shows (core, samples, sniffer, log interpretation) to be drill stem tested.
- If hole drilled to base Devonian, upper 50' of Winnipegosis to be cored.
- Induction E-log to be run T.D. to casing shoe.
- BHC Sonic Gamma log to be run T.D. to surface.
- sample cuttings to be taken from surface to T.D.

# Preliminary Prognosis for MMR Scallion Prov. 9-3-12-26:

Estimated K.B. \_\_\_\_\_

Cretaceous -	Favel	(+660)	110 63
	Ashville	(+557)	(1644) (1699)
	Ash Sd.	(+372) ± 60' thick	833 832
	Swan River	-	929 953
Jurassic		(+207)	1119 1140
	Imie	-	1210 -
	Evap.	(-268)	1320 1305
	Red Beds	(-340)	1753 1920
Mississippian -	hodgepote	(-350')	257 261
	Virden Crinoidal	(-400') (highest possible approx. -330')	1756 1750
	Bakken sh.	(-670')	1833 1858
	" sst.	(-680)	1847 1853
Devonian -	Lyleton	(-700)	1370 (-352)
	Nisku	(-740)	
	Duperow	(-853)	
	Souris River	(-1440)	
	Dawson Bay	(-1730)	
	Prairie Evap.	(-1910)	
	Winnipegosis	(-1910 to -1940)	
Silurian -	Ashern	(-2056)	
	Interlake	(-212)	
Ordovician -	Stenevall	(-2077)	
	Stony Mountain	(-2400)	
	Red River	(-2465)	
	Winnipeg	(-2590)	
Precambrian		(-3060)	
		(-3310)	

\* 9-3 location should be approx 20' higher than reference well (14-27) basis regional dip on Ash sh.

Structure in the area is rather complex with numerous sharply defined linear structural lines, all having a (maximum) relief of about 120', and all probably resulting from late salt solution (late Mississippian and post-Mississippian). Some early salt solution also occurs in the area, as in the 6-24-12-26 well. However not all structural data can be fitted into a pattern of simple solution. Minor structural irregularities are also evident in post-Mississippian strata, such as Fard. Potential error for Mesozoic tops is about  $\pm 30'$ . For Mississippian and Devonian markers, tops could be as much as 70 feet higher (see maximum estimated Crinoidal elevation), or possibly 50 feet lower, depending on the amount of salt collapse that has occurred. It is possible that the relief high that seems to occur in the target area is reef supported, but the data suggest that maximum Winnipegosis thickness probably is only about  $\frac{100}{50}$  to 140 feet.

Pre-Devonian strata are interpreted to be normal with no anomalies expected. Sand development is expected in the Winnipeg Formation with 1-2 sands totalling about 25' thick in the Upper Winnipeg, and 1 to 3 sands totalling about 30 feet thick in the lower Winnipeg. Although the facies is favorable, there is no evidence that trapping conditions are present.

- Prospective horizons include the Mississippian reservoir beds, which should be present in the target area. Limiting factor will be the extent of pre-Jurassic anhydritization and dolomitization which in large part determines the up-dip limit of Mississippian accumulation.
- Structural configuration appears to be such that limited closure is possible in upper Devonian strata.
- As indicated here, Winnipegosis reef build up is possible, with some potential for oil entrapment.
- Sand pinchouts in the Winnipeg Formation also offer some slight chance for entrapment.
- It is not possible to relate the ELPV anomaly to any specific geologic prospect.

requirements: Total depth (3250) feet, in Precambrian.

- gas sniffer required throughout.
- well cuttings from grass roots.
- adequate mud maintained to provide good quality well cuttings throughout.
- any oil or gas shows (core, sample, sniffer or log) to be drill stem tested. (especially watch for horizons that are nitrogen reservoirs at Daly).
- 60 foot core of Mississippian to be taken, commencing approximately 40 feet below unconformity surface.
- Induction E-log. (dual ind. L.L.) to be run from T.D. to casing shoe.
- BHCS Sonic Gamma Log to be run from T.D. to surface (m.d.).
- ? [- 60 foot core, upper part of Winnipeg Formation]

Waskada Area Structure interp. - re Isopach and Structure maps.

Basis for contouring: no single structure has been defined in the Waskada area. Width of structure is indicated. (between 3-30, 1-30 and 11-29) to be on the order of 3 lsd. Trends appear to be essentially linear, and greater than 1-2 miles, with the only defined trends being N-S, in Waskada Field and East Waskada area. In North Dakota, trend appears to be east-west. Structures are largely or entirely the result of early salt solution (Bohner-Hyettan). For comparison purposes, the structural pattern may be related to the better defined pattern in the Vorden area. Here structures are linear, 2-6 lsd wide and commonly 2-6+ miles long with a common relief of about 100'-120'. Trends are commonly NW, roughly || to regional strike, but some structures trend N-S, and a few transverse structures trend NE. All are salt collapse lows - post-Mississippian. It is thought that the Waskada area structures may be the mirror image of the Vorden structures - being highs rather than lows because collapse occurred earlier. On the basis of the Vorden structural pattern, it is suggested that the Waskada structures probably are linear features 2-3+ lsd wide and 2+ miles long, with a relief of at least 170 feet. The contour and isopach maps have been drawn on this basis, assuming a regional SW dip with little or no true structure, minor topography, and complicated only by early & late multiple sequence salt solution.

# MC-36 Reservoir - Waskada Field (North-Omega)

Ave. Net. per Barrel. Oct/73 = \$ 3.37

Apr/74 = \$ 6.10

Ave. Prod rate ('73) approx 10-12 BOPD. - no water cut.

Well	Pay'	Poros. %	Perm. md.	Recov. %	Prime Recv. :	Bbls.	To Dec/73
3-30-1-25	11	11.5	2.2	30	151 bbl/acre-ft,	66,500	bbls. 39,045
4-30	15	17.9	45.2	25	195 "	117,000	" 38,332
5-30	15.9	14.3	41.2	25	156 "	99,200	" 83,593
6-30	12.0	9.1	5.4	30	119	57,000	" 61,812
11-30	6.0	9.8	4.85	30	128.5	30,900	" 32,161
12-30	10.5	11.9	41.8	30	156	65,500	" 41,432
Ave:	11.7'	12.4 %	23.4 md (?)	28.3 %		72,700 bbls.	49,396

no good correlation of reservoir parameters with actual production rates.

Dec/73 Ave 10 BOPD

In general, actual oil production rate is below predicted oil production rate, this is due to a greater than expected decline rate due probably to either a partially effective water drive or "well deterioration". Apparently no conditioning to date? On the highly favorable side is the complete lack of water encroachment to date. In part this may be due to the lower than expected rate of production, but for some wells, cumulative production has greatly exceed the point at which water encroachment had been predicted. This suggests a tight seal & possibly a greater than expected downing extent to the O/W interface. Ultimate production should exceed expectations, although costs will be higher because of lower rates of production. Need look at reservoir eng. data to determine if water flood would be useful (if BHP data).

At 20 BOPD initial production rate, effective Gross Royalty rate ~ 35% @ 20 BOPD.  
effective Gross Price ~ 3.97 /bbl. = \$2,376/mo  
(less operating costs).

@ ave 10 BOPD = 20.7 + 6.9 = 27.6% Total Royalty.

As of 1968, the estimate was net worth of \$76,430 per well, for initial cost of

\$35,000 per well for completion (in part recoverable from second equip?), with production only to 1973/78

(Note: above data for northern part of field only. Of the 4 wells to the south in section 19, one abandoned because of high water cut (12-14), others show some water cut, but no regular decline in O/W. ratio. Exact correlation of these producing zones are uncertain. Believed to be Waskada (MC-36) beds but possibly stratigraphically lower??

(Special production rates as twice that of Ebar Field & no water disposal costs so probable op. costs ~ 1.20

## Expected MC-36 Reservoir Parameters:

Porosity 12.4 %  
Perm. 23.4 md.  
Recoverable 80,000 bbls/40 acre sp

@ 20.7 Min Price  
77,360 @ 132,480 @ 35%  
168,000 Royalties in Omaha

Gross Value \$ 480,000  
Cost (depl. 100,000)

@ 4.50/yr/15yrs

Operating cost 80,000  
Payroll 150,000

Expected

Net profit 150,000

MC-3a Reservoir - Waskada East (12-23, 14-23-1-25)

12-23-1-25

Perf. Int = 8' Maximum = 12'  
Weighted Poros. = 12.2%  
Perm. Kinan = 10.7 md.

Cumulative Prod Dec/73 = 11,928 bbls - no water. @ ~12 BOPD  
intermittent.

14-23-1-25

Perf. Int. 5' (2963-68) Max 8'  
Weighted Porosity 2966'-686' = 14.1%  
" Perm. " = 11.7 md.

Aband P. 26 Nov/73 - cumulative Prod. 166 Bd/2511 water.  
DST. showed only oil. They suggest fracturing into underlying  
aquifer during completion. Had hoped to re-drill  
this location.

Estimated Ave Porosity ~ 13%  
Permeability ~ 11 md. - probably minimum expected values  
since only very thin slice of MC-3 left.

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MC-1 Reservoir: all former producers in vicinity Waskada dome.

② Imp. C.S. Hemfield 1-30-1-25. Approx Porosity = 6% ~~ref~~ Lt.  
KB 1551 Perf 3013-3017 (4 feet) (-1462-1466) 41 md.  
Avg Porosity for 14' of MC-1 beds (all analyzed) = 16%  
Avg Perm - radial for all 14' = 54 md.

Perm for 17' perf. int ~ 41 md.

Cum Prod to Abandonment July/57 = 2290 Oil / 2244 water.  
Top MC = 106' above L pole. i.e. middle LP.

9-13-1-26. Caliban Waskada. Perf. <sup>-1494</sup> 3028-3052 <sup>-1518</sup> (24')  
for 13.6' analyzed in Perf. Interval Porosity = 26.1% (i.e. 13.6/15.7)  
KB 1534' max weight Perm. = 9.7 md.

For all MC-1 core analyzed. Avg weighted porosity = 24.5%  
Avg K max = 15.6 md.

Aband. (16-7-57): cumulative 4,007 Oil / 30,163 water.

(Top MC-2 = 146' above L pole - complete sec w/ MC-2 cap).

13-18-1-25. Kyle Lee Waskada Per 13-18-1-25

KB 1545' no core data - Perf. <sup>-1503-1507</sup> 3048-52, <sup>-1516-1520</sup> 3061-65.

Cumulative at abandon (22/5-61) = 3730 Oil / 40244 water.

Top MC-2 (distaken L.P. not known - at top of MC-2 sec).

2-22-1-25 De Kalb at Waskada. Perf <sup>-1486-1441</sup> 2994-2999 = 5'  
Top MC-1 @ 2982'

KB 1558. Core started @ 3000' so no data re K of prod. interval.  
Core analyses show fluid Oil Sat. <sup>-1467</sup> 3025.2' (total = 43.2'  
for oil sat interval <sup>-1442</sup> 3000-<sup>-1467</sup> 3025.2' weighted Avg Porosity = 14.25%  
Perm = 43.16 md

Aband "P" 26 Nov/73: cumulative 1480 Oil / 755 W.

~~744/1000~~

%W. 766/342 : 570/329 : 116/0 : 28/84, X.

Top MC-2 = 115' above L pole (i.e. middle MC-2).

Expected Reservoir Parameters  $\geq$  15% Porosity  
15-50 md. (avg).

Pay thickness indeterminate - depends on structural-topographic closure. (>10')

If structural/topog closure is encountered, probable in middle MC-2, could expect performance comparable to Waskada Field producers - although possibility of ~~bottom~~ bottom water encroachment possibly a problem.

①

[illegible]

## Washada Prospects

Devonian - require structural high - at present location of high is (are) uncertain. - probably multiple highs. Should have option of deepening any test hole to have Devonian if the hole turns out to be structurally high (and min a 100'?). Should note that upper reef build up will reduce amount of possible collapse. so could have reef supported high. This could be determined by drilling to Nisku. - If well is structurally high but does not show Bakken/Lgl. thickening, then will be reef supported. Cif told structure & early BTH salt collapse. only Mias will be high due to MSC - Nisku & balance Dev will be low. <sup>(in region)</sup> - but to date seems that Ni. at least is also high on MSC. Struct - (possible upper Dep. SE). In general - some poss. Ni. high because of Dep. thick but MSC highs will not be high on pre-salt horizons. Most favorable struct will be highs with no. BTH thickening - should be high throughout Dev. & reef supported. - would require ~700' greater depth of T. H. - no firm location but some option open.

MC-1 : still potential on up dip. limit of window on struct. high, but can't be specific - attempted up dip from Kern field. but too far - & cannot pick up much elevation on unconform. between 1-30 & 11-29. Possibly could try N. or E. of 130 but can't estimate struct. trap configuration - could try up-dip from any. MC-1 oil show but can't explain why 10-27 was dry. - no firm location but check as possible to arise

40' Upper. Dep. thick in 10-13-26

~83' Bakken Lgl - "

~40' Lg. thick in - 11-29.

general.

MC-3a :

Alask. N. - has rel. large areal extent of potential traps depending on struct. interp etc. Actual porosity in 15-14, however is low, particularly in basal portion. This may be local & could possibly run directly up-dip & find better porosity - might be better to move on strike to SE. away from tight area. & hence for better chance of improved porosity. accum does occur at "normal" ensinal edge as per 12-23 & 14-23. - although no good well for production.

Also can have MC-3a accum in flanks of trunc. struct highs, as evidenced by extensive staining in 16-8 well. This is also favorable for regional traps well. - since rel good porosity. However. - why was no oil recovered in DST despite extensive staining over considerable interval. & apparent low sat. Seems similar to MC-1 oil shows. Would seem to be fairly good potential to move up-dip - from 16-8, along struct high. - but struct. config not known & location diff to determine. Even if struct drops off, would seem to have MC-3b potential.

- note that 13-1 have basal MC-3 - recheck core - 1/2 temp indicates some sat - only 20' dd. (I don't report stain) below sand so are tendency to have section by facies change &

N.B

Any well struct high - even only 20' should be drilled to Nisku to check for early salt sch. (i.e. poss. reef devel) - with optical cell cores to have dev.

i.e. give 3 possible target depths.

top. Lipole (str. low).

Nisku (str. high + B&G sch).

Albion struct high - no B&G sch.

could you expect extensive oil staining in all high from patches.

On balance, I think I would prefer test of MC-3a in gen. nr

13-8-2-26, although not totally committed. Secondary loc. nr 16-8-1-25

A test for either MC-3a or MC-3b is also reasonable although I cannot pick specific location; & struct + facies more complex.

I would place work test (with) above Persen, because of potential.

Persen possibly better chance for oil, but unlikely to prove up any appreciable area - purely local perm trap.

13-1-1-25 well has oil thin remaining MC-3a below Dando Cap - oil stained. but "dry". This is possibly in "updip" position from 16-8 ??

Also check. 12-14-1-25. - log core & 10-14.

ECFex or electroflex follow up ?????

Conditions to check re. Waskada MC-3b. trap no. 7-1-25.

- A) Presence of (Dando) Evaporite seal.
- B) MC-3b beds present - not infilled or replaced by evaporite as in 11-24.
- C) trap to SE. & possibly even NW. lateral closure very poorly defined. (works out OK on our structural interpretation but poor control).

by comparison with MC-3a.

- A) seal seal to MC-2 - no question of its presence.
- B) no reason to suspect loss of MC-3a by primary change to trap, but may have problem with secondary authigenic infill below unconformity. (potential indicated by production from 12-14-23). - caution - some thinning of MC-2 from top.
- C) Regional drop to NW provides regional closure <sup>in that dir.</sup> & Waskada high. probably offers closure to SE, although may be gap in closure. & east Waskada would seem to support this. - also retaining in 14-14-2-26.

On balance, I would think that an MC-3a test offers

(a) better chance for finding oil (production: potential prob. not as high).

(b) larger potential area of accumulation: - potentially 4x (n=4x).

(caution: rel. poor reservoir quality in 14-14 & could decrease to NE - however good porosity in some other area & production from E. Waskada).

Re: Pierson. step out: Pierson may possibly have better chance for finding oil, but would do little more than prove up drill site, since accumulation apparently poorly perm. trap & probably small & patchy.

See revision? in light of extensive MC-3a staining in 16-8 - no necessary change - any hole should have 3 possible target depths. @ L pole if struct low.

① Waskada if structural high ② Ashoon if structural high & no BTL thickening.

# 1976 Drill Targets

- ① 9-3-12-26 Jordan Anomaly - basement test - ~4800'
- ② opp. 12-24-2-26 ?? MC-3a. - hogpole 3250  
possibly should move farther from 14-14 + tight hole?
- ③ opp 7-1-25 MC-3b. " 3350.
- ④ 11-16-3-29 MC-3 " ~3600.
- ⑤ { 21-24 Basement - gran. amon: lower Pelsa. 4,000'  
26-27 " " lower Pelsa. 3,500'
- ⑥ SW-13-22. Basement - Winnipeg only test. 4100.

new data for 16-18 suggests MC-3a possibilities up dip from this location... but how does this relate to 13-1 dry hole?

Waskada Area Structure interp. - w. Isopach and Structure maps.

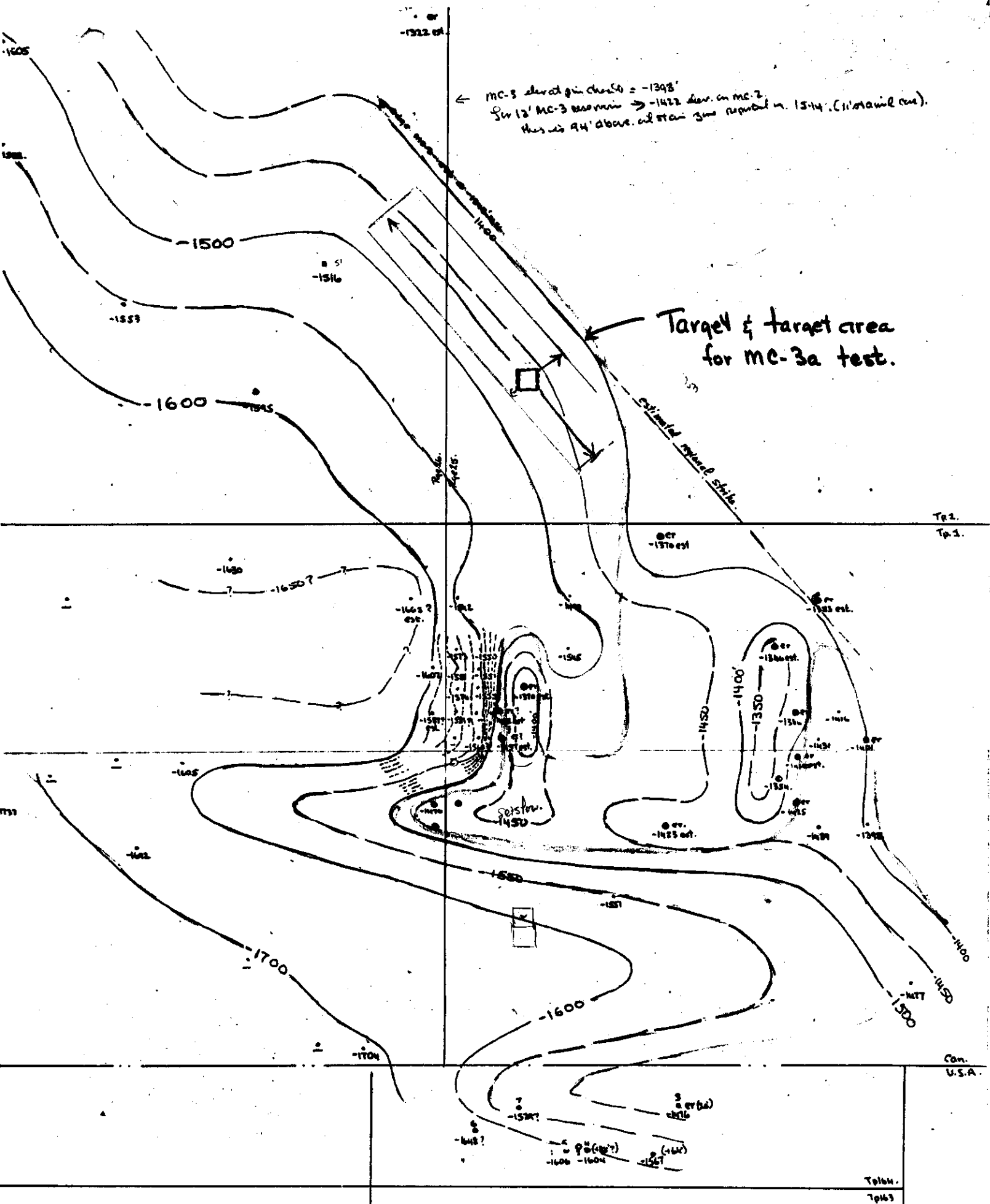
Basis for contouring: no single structure has been defined in the Waskada area. Width of structure is indicated. (between 3-30, 1-30 and 11-29) to be on the order of 3 lsd. Trends appear to be essentially linear, and greater than 1-2 miles, with the only defined trends being N-S, in Waskada Field and East Waskada area. In North Dakota, trend appears to be east-west. Structures are largely or entirely the result of early salt solution (Bakken-Lyletan). For comparison purposes, the structural pattern may be related to the better defined pattern in the Urdan area. Here structures are linear, 2-6 lsd wide and commonly 2-6<sup>+</sup> miles long, with a common relief of about 100'-120'. Trends are commonly NW, roughly || to regional strike, but some structures trend N-S, and a few transverse structures trend NE. All are salt collapse lines - post-Mississippian. It is thought that the Waskada area structures may be the mirror image of the Urdan structures - being highs rather than lows because collapse occurred earlier. On the basis of the Urdan structural pattern, it is suggested that the Waskada structures probably are linear features 2-3<sup>+</sup> lsd wide and 2<sup>+</sup> miles long, with a relief of at least 120 feet. The contour and isopach maps have been drawn on this basis, assuming a regional SW dip with little or no true structure, minor topography, and complicated only by early & late multiple sequence salt solution.

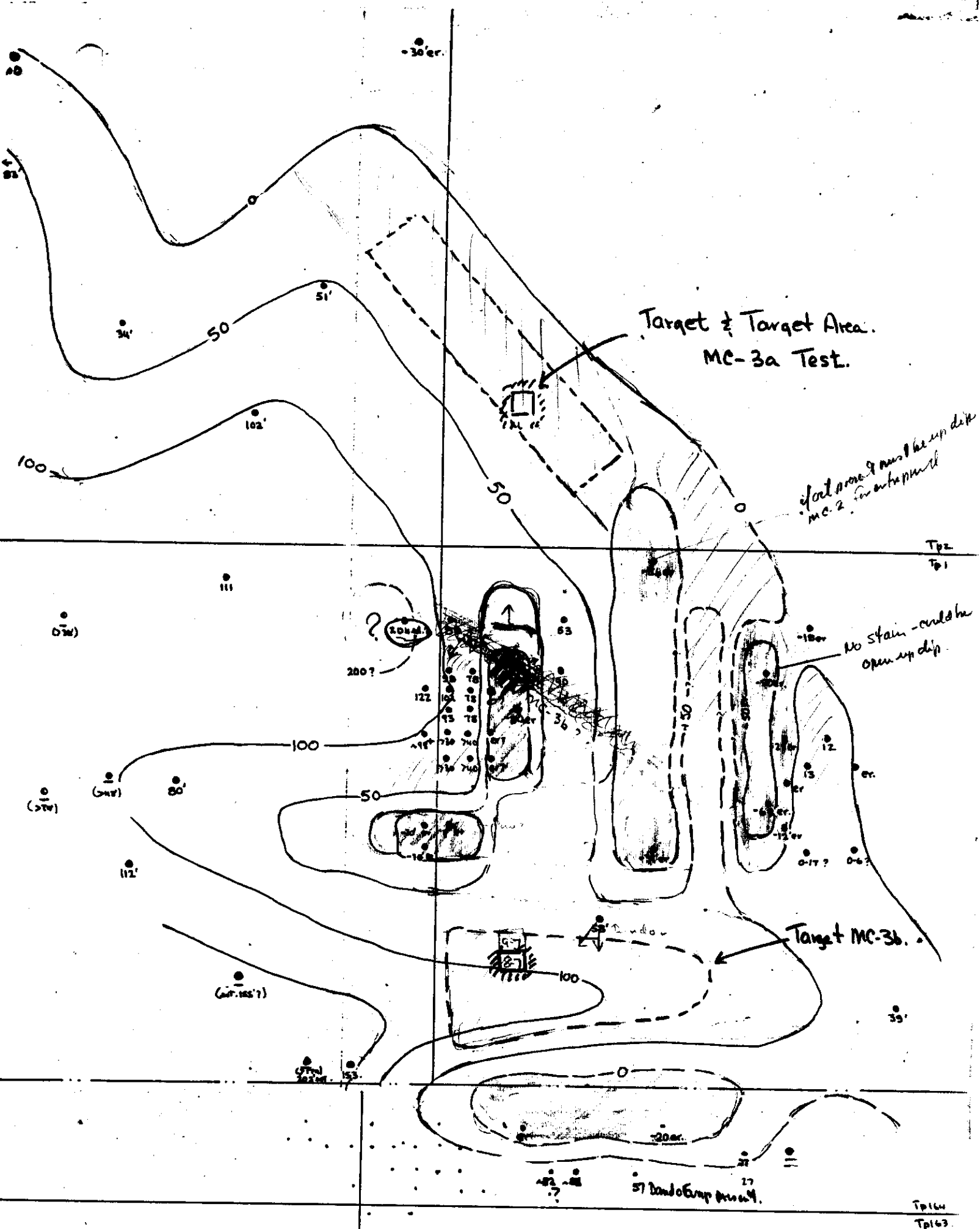
for maps see original transparencies

4/20/75. HM

Revised maps. - Waskada Area - suggested  
follow-up target areas.







Isopach reflects: ① paleotopography on Mississippian erosion surface.  
 ② regional erosional truncation to the northeast.  
 ③ differential local truncation on structural highs or lows.

(where well control is sufficiently close to establish local structural trends, as in Waskada and east Waskada, pattern seems verti-linear to-S and possibly east-west. This may indicate linear salt solution features, possibly fault or fracture controlled).

NB. No attempt made to conform to seismic.

Re Vindau S.E. structures - width ~2-6 km and length ~10-15 km (est.)  
 cf. only defined until ~1 km from 3 (S) + length (linear trend?) ~10 km  
 trends with undulating NW, also N.E. only from N.E.

MISSISSIPPIAN - MC-3 + CHARLES ISOPACH (post MC-2).



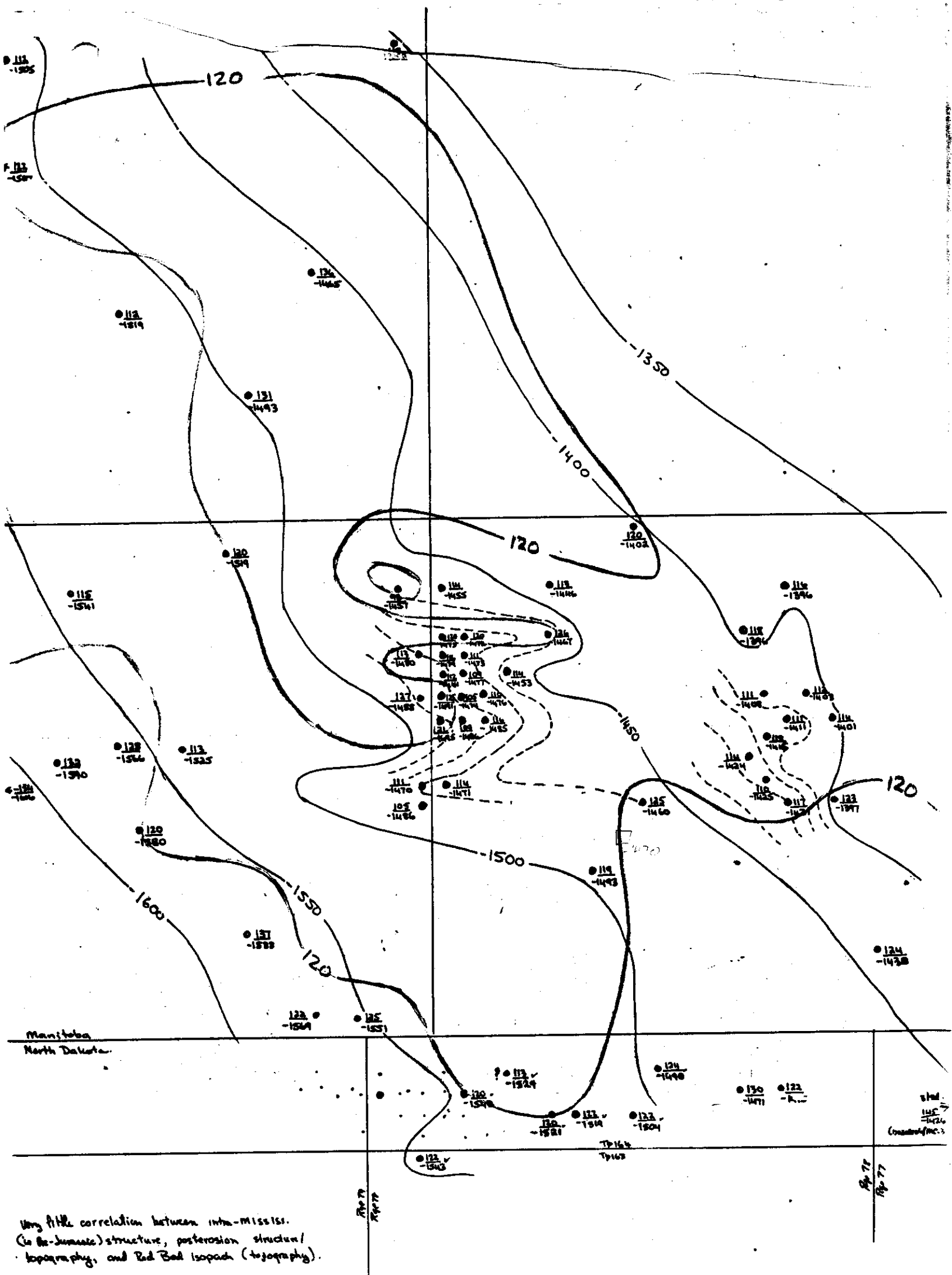
Waskada Area Structure interp. - re Isopach and Structure maps.

Basis for contouring: no single structure has been defined in the Waskada area. Width of structure is indicated (between 3-30, 1-30 and 11-29) to be on the order of 3 lsd. Trends appear to be essentially linear, and greater than 1-2 miles, with the only defined trends being N-S, in Waskada field and East Waskada area. In North Dakota, trend appears to be east-west. Structures are largely or entirely the result of early salt solution (Bakken-Lyleton). For comparison purposes, the structural pattern may be related to the better defined pattern in the Urdin area. Here structures are linear, 2-6 lsd wide and commonly 2-6<sup>+</sup> miles long, with a common relief of about 100'-120'. Trends are commonly NW, roughly || to regional strike, but some structures trend N-S, and a few transverse structures trend NE. All are salt collapse lens - post-Mississippian. It is thought that the Waskada area structures may be the minor imaged the Urdin structures - being highs rather than lens because collapse occurred earlier. On the basis of the Urdin structural pattern, it is suggested that the Waskada structures probably are linear features 2-3<sup>+</sup> lsd wide and 2<sup>+</sup> miles long, with a relief of at least 120 feet. The contour and isopach maps have been drawn on this basis, assuming a regional SW dip with little or no true structure, minor topography, and complicated only by early & late multiple sequence salt solution.

4/20/75. NM







Waskada Area Structure interp. - re Isopach and Structure maps.

Basis for contouring: no ... .. Waskada area. Width of structure is indicated. (between 3-30, 1-30 and 11-29) to be

on the order of 3 lsd. Trends appear to be essentially linear, and generally

1-2 miles, with the only defined trends being N-S, in Waskada Field and

East Waskada area. In North Dakota, trend appears to be east-west. Structures

are largely or entirely the result of early salt solution (Baker-Hyett). For

comparison purposes, the structural pattern may be related to the better defined

pattern in the Vorden area. Here structures are linear, 2-6 lsd wide

and commonly 2-6<sup>+</sup> miles long, with a common relief of about 100'-120'. Trends are

commonly NW, roughly 11 to regional strike, but some structures trend N-S, and

a few transverse structures trend NE. All are salt collapse lines - post-Mississippian -

It is thought that the Waskada area structures may be the minor imaged the Vorden

structures - being highs rather than lows because collapse occurred earlier. On the basis of

the Vorden structural pattern, it is suggested that the Waskada structures probably are linear

features 2-3 lsd wide and 2<sup>+</sup> miles long, with a relief of at least 170 feet.

The contour and isopach maps have been drawn on this basis, assuming

a regional SW dip with little or no true structure, minor topography, and complicated

only by early & late multiple sequence salt solution.

4 NW / 7 S. NW.









Re: ~~Test~~ of MC-36 - Wasikade Beds. Southwest of  
a line through 11-29-1-25, should have developed  
Wasikade beds with Oando snap. seat seal, as in  
Wasikade field. the identical situation seen to obtain  
in North Dakota - 1 mile south of 5-1-25, where  
have production from Wasikade beds on S. flank of a truncated  
(salt collapse) high. (will have produced from what  
appears to be flank trap. traps. the area  
between Wasikade field and N.D. field should potentially  
show same facies and potentially be productive in the  
flanks of the structural highs - Sections 5, 6, 7, and 8  
+ possibly 4 and 9 seem to offer good potential.  
Could also have MC-36 entrapment if structural  
configuration favorable.

Target should be located on either side in  
Sec 7, possibly 8-7-1-25. To same interest.  
Additional ~~interests~~ should be acquired in overall  
target area (secs 3-10 incl).

Need detailed study of N.D. well data for more accurate  
evaluation.

16: Follow up to MC-3a. prospect (14-33-1-25).

will have to locate NW of 14-33 location. Could drop off to the east and pick up. MC-3a but too close to regional pinch-out of MC-3 to chance. <sup>(E1 12.7) 3-2-25.</sup> Could drop off structurally to the south and pick up MC-3 but regional trend possibly N-S. & central part of area may be generally high. Least known area & of potentially largest trap would be to NW although still a. B/Maxis. General area. vic Sec 8. Top 2 Pgs 25 - all presently land. - also NES. , SW 17, SE 18. - essentially "on strike regionally. from original 3-4-2-26 location. - we have no idea of true extent of struct high indicated by 14-33 test, so exact replacement location is purely conjecture. The overall potential area extends roughly for 1/2 section (miles) from line roughly between Sec 3 & Sec 35 - 2-26.

As alternatin. could attempt to do an Whittaker. Block A. Check location against Elflex - limited target size. (vic Sec. 27, 28, 34).

Should extend Elflex survey. To cover SW-2-25. <sup>8, 9, 17, 18, 19, 20</sup> and also fill in in vicinity of already noted anomalies (esp. 3-27-1-25).

Should attempt to combine interest in Block A + Whittaker lands vic NW block. both of which would be MC-3a test areas.

Note that high Elflex readings flank 14-33 location, suggesting.

Note: could attempt to extend red geod prod of 12-23 to SW N. - stepping 5-23-1-25 in

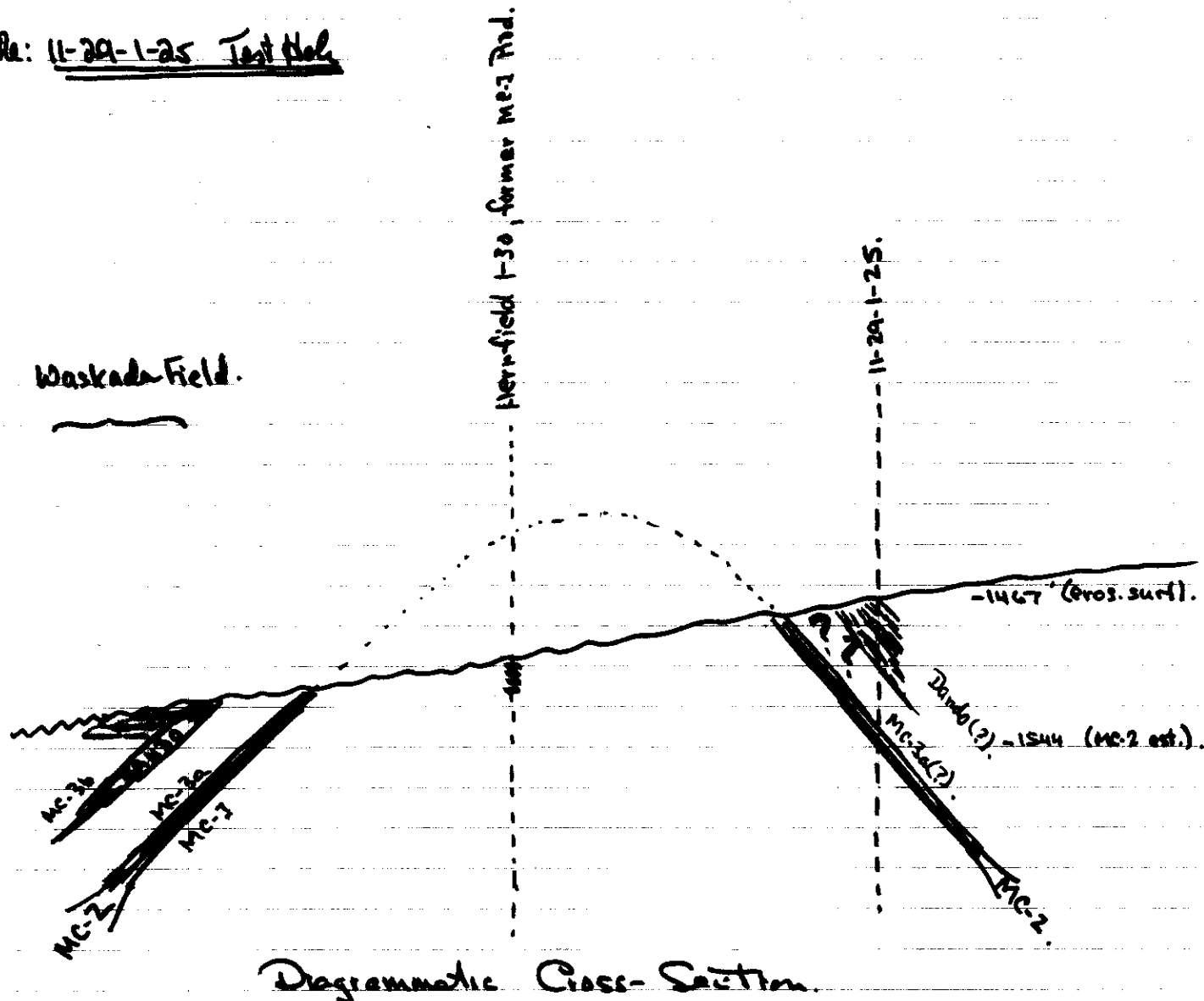
## Re: Waskada Structure.

The Waskada 9-13 well is approx 150-200' structurally high, with 150-200' of differential truncation of MC. over the high. Bakken-Lyleton thickening can account for only about  $\pm 80'$  of this relief. However, the total section from Lodgepole to top Prairie Evaporite shows a total thickening of 176' between the 11-29 hole and 9-13. Slight specific thickening occurs in the Second Red, & Duperow as well, and there appears to be a slight, general thickening throughout much of the section. May be result of slight normal regional thickening to southwest, or facies/stratigraphic expansion?

Nisku is at least 73' (and probably 100') high in 1-30 relative to 11-29 and 3-32, and Waskada 9-13 etc. probably are similarly high. It thus appears that Mississ. structural highs are also Nisku highs, although the structural relief on the Nisku is  $\pm 100'$  less than on the Mississippian. If all structures in the Waskada area show a salt solution pattern similar to the above (a very big "if") the Nisku seismic structure maps should show Mississippian structures - qualitatively but not quantitatively. This severely reduces the value of Nisku structure maps in determining areas of possible Mississippian entrapment, especially for truncation traps on the flanks of the structural highs - such as the Waskada Field.

Note: criteria for deep test drg. Hole should be on reef supported high. Lower potential on purely S.C. high because line structure with depth. However some Ni struct remains because of Dep. thickening. If well is structurally high - drill to top Nisku. If B+L is thick by amount of est. struct high - struct is strictly S.C. However, if B+L is thin or shows insufficient thickening to account for structure, then structure high either Dep. thickening or Wapiti reef. thick + should be tested to base Devonian.

Re: 11-29-1-25 Test Hole



Correlations for 11-29 presently uncertain. My present guessimate from geograph log only, is that the core consists of 225' of Dando Evap. and 5' of MC-3a limestone - with patchy stain. This must be evaluated later.

- Ⓐ up dip extension of MC-3a (esp. towards Hornfield high) has potential. Surprisingly MC-2 elev. of -1544 is 45' below elev. of Dando well which showed only slight oil stain for MC-3a & was abandoned dry.
- Ⓑ the MC-3b carbonate reservoir that produces in Waskada Field appears to have been lost by eastward facies change into an almost totally evaporitic facies (Charles?).
- Ⓒ entire hole somewhat low. - 225' in Tens, 17' on Miss. erosion surface.

Should be late salt sed'm - normal strat. succession with no local anomalies.  
no salt section, possibly thin Winnipegosis.

A- Opt'cons. holes. - Run w/ Elfex to evaluate potential in light of new data.  
- if we do have good anomalies - targets per Jordan - but to try to drill new target 30% later.

B- T.D. on 2nd hole. - 3400/3700 -

C- What have we learned & when do we go.

- (i) Structure more complex than hoped for - of smaller scale. - indicates very small targets & diff. or impossible to predict from good data - possibly Elfex??
- (ii) Both with oil shows. - MC-2 & MC-3. w 50' closure possible in MC-3a.
- (iii) MC-3b. of limited extent due to local change to map to NNE. - MC-3a peak OK.
- (iv) why did 11-29 have some oil in MC-3a at MC-2 elev. 1500 while Bando had no trace from 1499, 45' higher - structural separation.

Whistler should be perfectly willing to extend agreement option if we run Elfex to evaluate.

14-33-1-25: Encountered structural high - about 100' above estimated regional. This caused loss of MC-3 target reservoir because of truncation over the high. The MC-1 beds at the unconformity showed fair patchy porosity and oil stain, once more indicating the widespread occurrence of - to date - non-economic oil shows in MC-1 beds on structural highs.

The size, extent, trend, relief etc of this structural high are not known. No suggestion of structural high on seismic map - should have been Poor.

The presence of this structure has shifted the position of the MC-3 pinchout. MC-3 beds might reappear off structure to the northeast, but this would depend on the extent and relief of the structure. The most logical step out direction would seem to be to the north, although there is no way of determining if other structural highs are present in this area.

In general, the 14-33 test shows that the structural highs in the Waskada area are more widespread and complicated than thought previously. This is the most northerly structurally anomalous (high) well in the Waskada area. The potential for MC-1 accumulation on such truncated structural highs is still not known - and will not be known until the configuration of one of the highs has been determined, either by drilling or seismic means - Elfex should also be used to specifically try to extend anomaly MC-1 shows or production - especially Hornfield 1-30+, Waskada 16-18

is results favorable but completely indefinite or even specific.



11-29-1-25:

~~Preliminary prognosis~~ Original prognosis completely incorrect. Attempted a 1st step out from structural high, but found structure had dropped off completely to regional low prognosis. It appears that structures of 200-250' relief may occur across only 1 or 2 1st. Previously, no data were available to determine the extent of the structures. Although the present data indicate an anomaly width of only about 2 1st., this is in only one direction, and the full extent of the structural high still is not known - for example the 1-30 high could extend N-S or E, SE etc. into the large undrilled area in the center (Sec 20-21-28) that was considered as ~~one~~ possibly one large high on the basis of peripheral well data. This now seems unlikely. Central area may be complex of highs and lows.

The ~~possibility~~ possibility of such a rapid drop off had been considered, and the "minimum" prognosis depths proved to be ~~very~~ close. The MC-3 interval intersected thus is the mirror image of the Waskada producing zone, on the opposite flank of the 1-30 high. It had been hoped that, if the 11-29 test proved to be structurally low, oil accumulation comparable to the Waskada Field would be encountered. Unfortunately, the MC-3b reservoir beds apparently have been lost, by facies change to evaporites. This possibility had also been anticipated, because of the regional encroachment of basin-margin evaporites from the northeast. This further complicates the specific evaluation of oil and gas prospects in the area, but does not necessarily downgrade the potential overall.

The occurrence of petrographical stain in the MC-3a is of specific interest in the 11-29 well. These reservoir beds occur at a depth of 55' below the erosion surface, and must rise to the erosion surface between the 11-29 location and the 1-30 location. The presence of staining at depth strongly suggests the possibility of economic production from this zone between the 11-29 and 1-30 locations, although the extent & trend of the possible trap are highly uncertain & locally limited.

Re: gas prospects in the Field, test data indicate presence of some gas but unlikely to be economic. Further evaluation should be carried out with respect to interpretation of DST data, E log data, and possibly core analysis. For the first time, acoustical logs and DST of the complete zone are available and will provide all the available data for regional review of prospects for shallow Cretaceous gas. The gas detector gave minor indication of gas from the lower portion of the Specks (7and), and FSIP showed good build up despite lack of DST blow.

Theraps shows - offshore reported for Buhlen rd. should be followed up.

Memo: Mr. H.C. Master.

Sept 9, 1975.

From: H.R. McCh.

Re: Preliminary report on results of Waskada drilling project.

- (a) MMR Waskada 14-33-1-25: comments and data furnished previously.  
(b) MMR Waskada Prov. 1429-1-25:

Formation Tops: (K13 15555')

Cretaceous -	Bogus Fm.	1234'
	Favel "	1578'
	Ashville "	1662'
	Swan River "	2002'
Jurassic -		3127
	Linu	2628
	Evaporite	2724.
	Red Beds.	2884'
	Mississippian - Mission Canyon (Mc-3 Evap)	3010'
	Mc-3 Shinarump	3067'
	Mc-2 Evap.	3110'
	Mc-1 Ls	3131'
	Lodgepole Fm.	3278'
	Bakken Fm (shale)	3832
Devonian -		(3181) 3841
	Lyleton Fm.	3861
	Nisku "	3914
	Duperow "	4014.
	Souris River "	4464
	<del>First Red</del>	4500
	First Red	4700
	Dawson Bay Fm.	4724
	Second Red	4881

pe. to Glen Minter  
re to Bill Johnson  
on loan.  
4 maps attach.

	Prairie Evaporite Fm.	4907.
	Winnipegosis Fm.	4942.
	Ashern "	5058
Silurian -	Interlake Group	5078
Ordovician -	Stonewall Fm.	5404
	<del>Stony Mountain Fm</del> Stonewall Fm	5464
	( " " shale)	5529
	Red River Fm.	5591
	Winnipeg Fm	6144.
	( <sup>basal</sup> sand)	6276.
Cambrian -	Deadwood Fm.	6324
Precambrian -	(granite)	6372

T.D.

6390

## CORED INTERVALS.

#1	1550 - 1610	Rec 57.4'	(Morden/Favel)
#2	1610 - 1665	Rec 50.2'	(Favel)
#3	3014 - 3074	Rec. 60'	(Mission Canyon).
#4	3940 - 4000	Rec ~ 60'	(Nisku).
#5	4988 - 5031	Rec. 42.4'	(Winnipegosis).
#6	6264 - 6324	Rec. 60'	(Winnipeg/Deadwood).

## DST:

#1 1560-1665 (Favel): Rec. 40' Mud. Very weak blow, died in 30 min.  
 HP 720-720; SI 500/500; IF 50, FF 80  
~~YO~~ 5/60, ~~SI~~ 60/40.

Summary: The two-hole test program in the Waskada area gave oil shows at both locations, but both holes showed unexpected structural anomalies. The first hole was 100 feet high in structure - the second 200 feet low. These new data suggest that the structural ~~peaks~~ highs in the Waskada area may be very abrupt, sharply-defined features of relatively small size. The results of the test holes do not permit delineation of any other <sup>specific</sup> exploration targets, but suggest that, while prospects are still good for additional commercial production in the Waskada area, pinpointing of specific targets solely on the basis of geological data will be difficult or impossible without additional supporting geophysical data - seismic, resistivity, gravity etc. The potential for oil accumulation in the Waskada area is still high (relative to all other areas of Manitoba in my opinion) and I would recommend:

- Ⓐ resistivity survey in the Waskada area to define anomalous areas.
- Ⓑ an evaluation of the usefulness of seismic survey to unravel the complex structure - either review of present data or running of additional seismic line. The possibility of University of Manitoba involvement in such a seismic survey should be considered, especially when the results of their recent survey in the Dawson Bay area have been compiled.

General Comments, 11-29-1-25 test hole:

the 11-29 test hole was expected to intersect a structural high. The location

chosen was only two 1/2 (0.7 mi.) from the structurally high 1-30-1-25 well. The possibility of a rapid structural drop-off east of the 1-30 well had been anticipated, but the lateral extent of the structures had not been defined anywhere in the Waskada area, and it was expected that the proximity of the 11-29 test to the 1-30 location would ensure that the test would still be situated on the structural high. Such was not the case, and Mississippian marker beds were found to be 170 feet lower at the test location than at the 1-30 location.

The results of the 11-29 test hole thus show that at least some of the structures in the Waskada area are extremely sharp and of high relief - at least 170 feet in 0.7 miles or less. The only sedimentary structure of comparable relief in <sup>southwestern</sup> Manitoba (other than crater-associated structures) is the structural low on the east flank of the Daly Field, with an indicated relief of 190 feet over a distance of 1.8 miles. The 170 foot drop off between the 1-30 and 11-29 wells also includes some slight post Mississippian subsidence, as the Second Specks and other Cretaceous markers are almost 30 feet below prognosis depth. The lower Paleozoic formations appear to be perfectly normal with no evidence of either structural or stratigraphic anomalies. The only slightly unexpected feature was the presence of 58 feet section of Cambrian Deadwood Formation below the Winnipeg. The only other occurrence of Deadwood strata in Manitoba is in the 16-16-1-27 well, and it was expected that Deadwood strata would have pinched out between the 16-16 location and the Waskada area.

Gas Evaluation - 11-29-1-25:

the gas detector recorded gas kicks over the following intervals.

- ① Cretaceous shale near bedrock surface. Gas shows repeated over a considerable section. No reservoir beds are known for this section, and the gas probably reflects local entrapment in fractures beneath drift cover. A number of shallow water wells in the general Waskada area have produced sufficient gas to operate one or two lights, stove etc.
- ② Gas show recorded over lower part of Ford Formation. Core shows no visible porosity although may have some fine intergranular porosity in highly calcareous zones. Although the DST results were negligible, the relatively rapid build up of the SIP would seem to warrant further checking by Johnson Testers (?) to ascertain if the buildup could possibly reflect gas flow. Core analyses could possibly be run detail porosity and permeability, if any.
- ③ No gas shows were recorded over the MC-3a interval despite the presence of oil shows in the basal 6 feet of the cored section, and very gassy smell.
- ④ Gas show recorded over Bahken silt interval. Log shows poor thin oil development, water saturated, and cuttings show only traces of oil.

No other shows were encountered, to my knowledge, ~~but~~ but a detailed examination of the entire gas log should probably be made. Throughout most of the drilling, a brief gas kick was noted after circulation had been stopped for a time. This appears to have been due to the near surface gas (zone a) breaking up the fluid, as the kick occurs immediately after circulation is resumed.

### MC-3 Evaluation:

The 90 foot section of MC-3 beds is comparable in thickness to the MC-3 section in the Waskada Field, and beds equivalent to the Waskada reservoir beds (MC-3b) should be present. However, the entire top 55 feet of the MC-3 is anhydritic, indicating that porous reservoir beds have been lost by facies change to evaporites. Detailed examination of the core must still be made to attempt to detail the correlation and facies changes. Further exploration for MC-3b oil accumulation will have to be limited to the area around dip from the point of limestone/anhydrite facies change. (a very difficult area to define)

Patchy oil staining and fair to good porosity in the basal MC-3 limestones (MC-3a) indicate a good potential for oil accumulation from these beds in a structurally higher position. Such higher areas must occur both to the southwest, towards the 1-30 well, and regionally up dip to the north east, but entrapment will require structural or stratigraphic closure, and presently available data are not sufficient to define such areas of closure.

Other horizons: Because the 11-29-1-25 test was ~~also~~ structurally low on the Mississippian members, the potential for entrapment in the underlying strata was considered negligible, and in fact no shows were encountered other than the trace of gas from the Bakken. Cores and samples provided detailed data regarding the good to excellent porosity of the strata tested. E-log analyses showed all prospective reservoir beds to be water saturated.

As expected, when the Mississippian members proved to be structurally low, the Winnipegosis Formation was thin (116'), with a thin anhydrite cap (35'). No salt was present in the Prairie Evaporite, but a minimum of 170' of Prairie Evaporite salt must have been removed during post-Mississippian-pre-Jurassic time. There is no evidence of any earlier salt solution.

Of interest is the top 2 feet of Winnipegosis core. This section showed finely laminated dolomite with bedding inclined at 15 to 20 degrees to the core. This suggests proximity to either a Winnipegosis reef or the Winnipegosis fringing bank. It was hoped that a part of the structural highs in the Waskoda area might be due to dropping over a buried Winnipegosis reef, and the "intermediate" thickness of the Winnipegosis, along with the inclined (fossil?) bedding suggests that reef build up is possible. However, additional data are necessary to differentiate between reef and fringing bank, and to determine in which direction buildup may occur.



Change in hole locations: the locations of both test holes were changed by one 1st. At the time, it was indicated that the change in location ~~would~~ <sup>should</sup> have little effect on the tests. In retrospect, the changes may have been considerable, but there was no way of anticipating this at the time. The original 6-29-1-25 location was closer to the structurally high 1-30 well, and farther from the structurally low 3-32-1-25 well. The 6-29 location might thus have been higher in structure than 11-29, possibly sufficiently high to have had accumulation in the MC-3 beds. (Fig\_-)

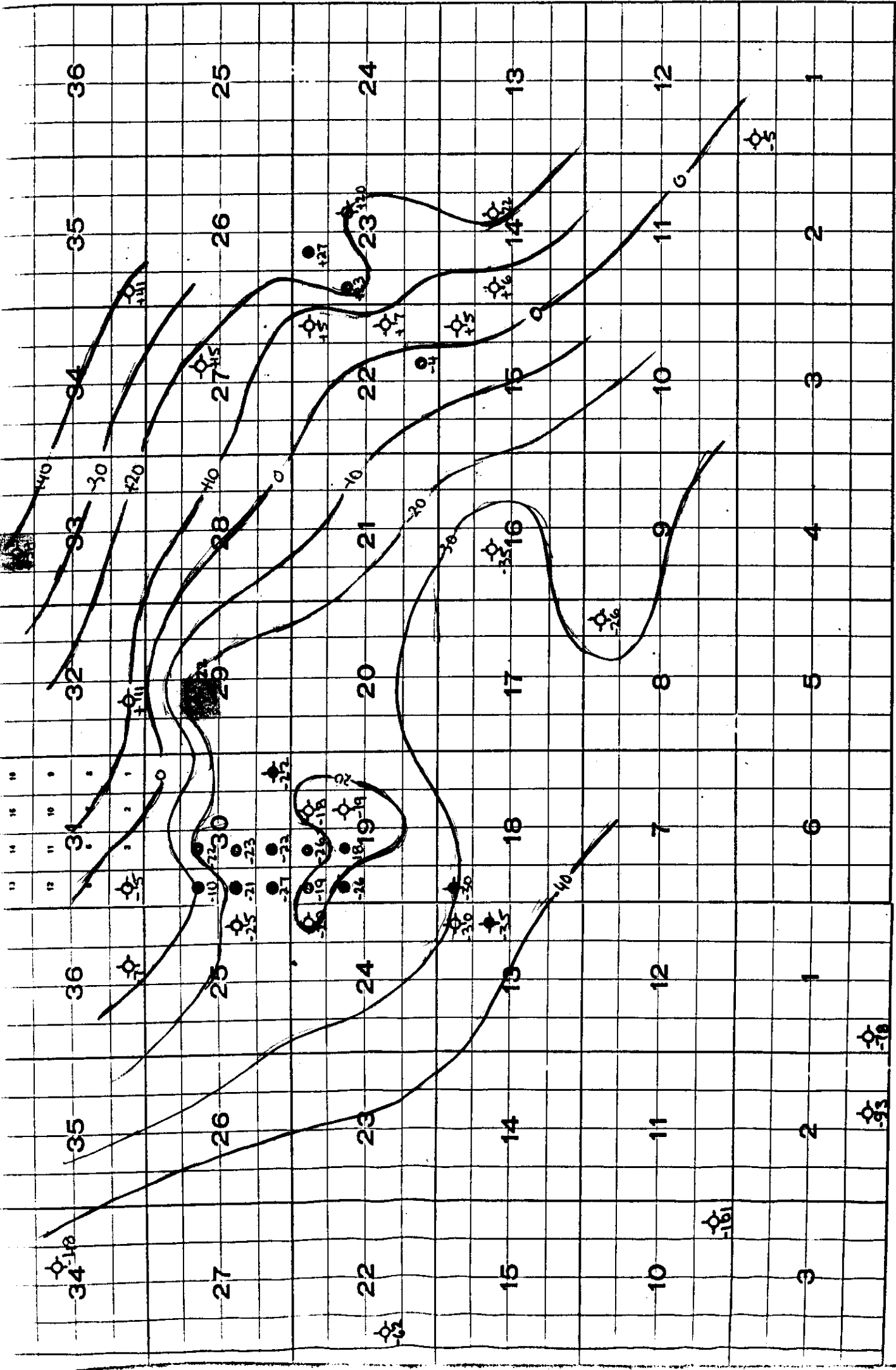
After the original 3-4-2-26 location, this was farther north and could possibly have avoided the structural high that caused loss of the MC-3 reservoir beds. However, this is highly problematical, and the position of the MC-3 outcrop edge is likely to be extremely irregular and difficult to determine if, as suggested by the 14-33-1-25 hole, the area of structural anomalies extends farther north from the Waskada area (i.e. along the Birdtail Waskada Axis)

FAIRFAX FORMATION

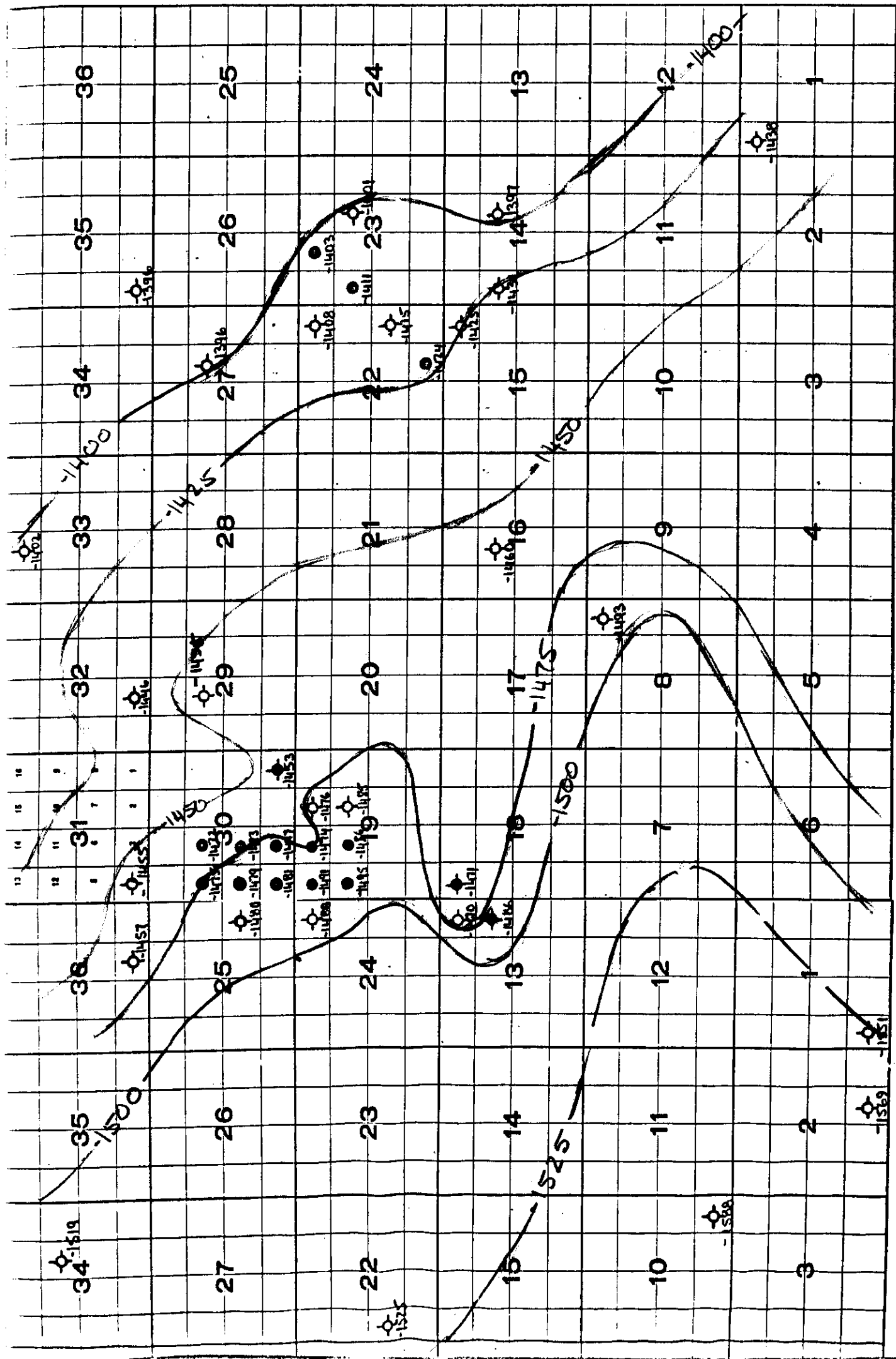
WASKADA AREA

Rge. 25 W

26 W



Top

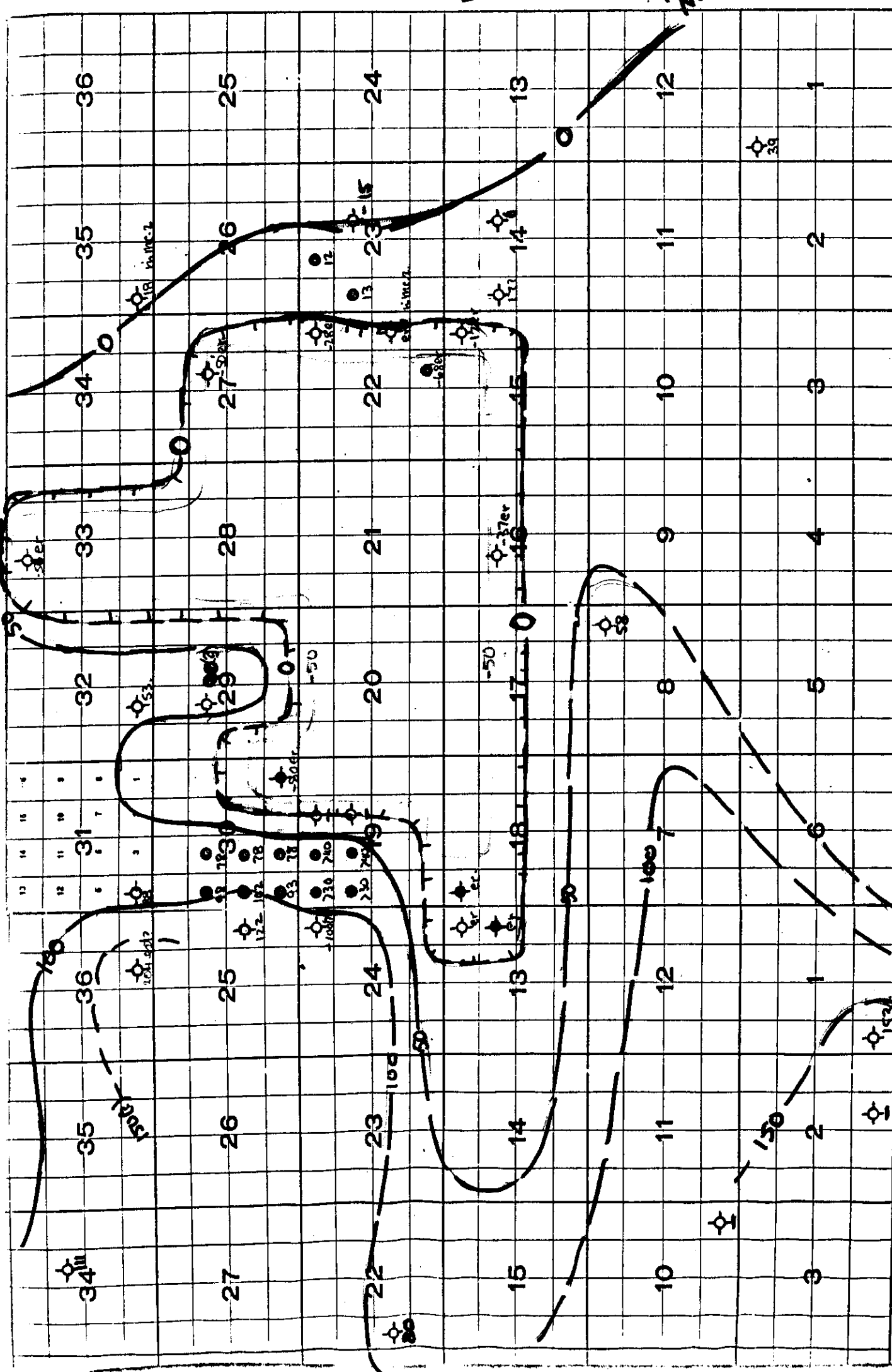


Rge. 25 W

26 W

# WASKADA AREA

Map of the Waskada Area



"Normal" Subcrop Edge

MC-3 ISOPACH

Rge. 25 W

WASKADA AREA

26 W



Province of Manitoba

## inter-departmental memo

H. C. Moster  
Director  
Petroleum Branch

Date August 15, 1975

From H. McCabe  
Stratigrapher

Subject: MMR Waskada 14-33-1-25 (K.B. 1,568)

Following are the results from the above test hole:

	<u>Actual</u>	<u>(Prediction)</u>
a) Formation Tops: Cretaceous - Favel Fm.	1530 (+38)	+ 48
Ashville	1621 (-53)	- 36
Ashville Sand	—	—
Swan River	1948 (-380)	- 378
Jurassic -	2150 (-582)	- 600
Lime	2590 (-1002)	- 1020
Evaporite	2720 (-1152)	- 1160
Red Beds	2850 (-1282)	- 1282
Mississippian - MC-3	-er-	- 1410
MC-2	-er-	- 1460
MC-1	2968 (-1400)	- 1492
Lodgepole	3113 (-1545)	- 1642

- b) Cored Interval 2,970' - 3,030' Recoverd approximately 60'  
 - core sent to Core Lab, Calgary, for analysis; not yet received  
 - detailed log prepared by Clare Cawston  
 - in general fair to good patchy staining to very top of core, decreasing with depth. No visible stain in bottom 15 feet. Fair to good but very patchy porosity in predominantly fine calcarenitic (pseudo-oolitic) limestone.
- c) Schlumberger calculations as to percent water saturation (as shown on E-log) indicate 100% water saturation below 2,986'
- d) DST interval 2,972 - 2,994 The top packer was set in Mississippian, as close as possible to the top to avoid misrun due to possible poor seat in Red Beds. Bottom packer set just above porous water ~~sat~~ zone 2,988-3,006 on Sonic Log so as to avoid expected high water flow from this zone.

Recovered 300' GOCM (Flecked at top, becoming heavily oil cut and gassified towards bottom)

180' MW

IHP	1620	IFP	90	ISIP	1350
FHP	1620	FFP	240	FSIP	1350
VO	5/90				
SI	60/120				

On the basis of the above data, Mr. Cawston proposed abandonment of the hole. A small amount of oil might possibly have been obtained, but the high water saturation and lack of any seat seal to keep out bottom water indicated that

water encroachment would have been rapid. I concurred with Clare's evaluation and proposed to abandon.

RESUMEE:

The section down to the top of the Mississippian was normal and the tops ran close to prognosis. The top of the Mississippian was normal to possibly 10 feet high (within estimated margin for error), but within the Mississippian, the structural markers are 103 feet higher than predicted. This pre-erosion structural high has been truncated so that the MC-3 target beds have been eroded at this location.

The extent of this new structural high is completely unknown. It may represent a separate structural high, or it could possible connect with one of the other structurally high wells previously encountered. It is the most northerly well in the Waskada area and suggests that other structural highs may occur to the north, along the Birdtail-Waskada Axis. This possibility was anticipated in the prognosis. The presence of this high makes it more difficult to predict the location of the "normal MC-3 pinchout" on the north flank of the Waskada structures, but does not rule out the possibility of potentially extensive MC-3 oil accumulation.

The potential of the MC-1 beds remains uncertain. All structurally high MC-1 tests in the MC-1 subcrop belt have given oil shows on DST or have been placed on production for limited periods - except for Peregrine 10-27-1-25. These oil shows occur over a range of elevations from 1,404' (this well) to 1,537' (16-13-1-26). The occurrence of oil shows over such a large elevation range indicates reservoir discontinuity - possibly a complex series of isolated highs.

The next test hole (11-29-1-25) should provide a good test of the potential for MC-1 accumulation on these small(?) isolated structural highs, and will provide one of the first up-dip tests of MC-1 production, and also will provide information as to the size extent and possibly trend of the structures. As noted previously, it is possible that the structural drop-off up-dip from the Hornfield 1-30 well may be so rapid that the MC-1 trap could be lost. In this case accumulation in the MC-3(a or b) should be possible, but the potential for pre-Mississippian entrapment would be severely reduced. The 11-29-1-25 well will nevertheless be carried to basement regardless of structure encountered - this is my understanding.

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H. McCabe

HMcC/et

J.M.R. WASKADA PROV. # 11-29-1-25 W.I.M.

CORE #1 (1550-1610) RECOVERED: 57.4' / 60

14'0" Shale, medium dark grey, slightly calcareous, few scattered *Inoceramus* fragments, poorly fissile, other small scattered fossil fragments, uniform throughout

13.3' Shale, slightly darker grey, almost black, slightly more calcareous (moderately calcareous), numerous fine horizontal calcite stringers ( $\pm 1$  mm.) throughout (prismatic crystalline *Inoceramus* fragments), also few small calcareous specks. Several pyrite nodules.

Favel Formation - 15' 7.3'

6.2' Limestone, medium grey, finely crystalline, moderately granular appearing, consisting at least in part of comminuted *Inoceramus* prisms, few thin shaly partings and a 1" bentonite bed 8" above base. Possible slight intergranular porosity, to fair in some thin shelly bands

21.9 ~~0.3~~' Shale, medium dark grey, strongly calcareous, finely to coarsely speckled throughout, moderately fissile. Fairly banded with some more calcareous, speckled beds to 1/2" Several thin bentonite beds near top. 2" @ 0.3', 3/4" at 1.6', 1/4" @ 2.9', 1/4" @ 4.6'

1.4' Limestone, massive, granular appearing, seems to be "concentrated specks", also fine glassy sand-size calcite grains, fossil fragments etc. no visible porosity. Grades into underlying

0.6' Shale, medium dark grey, calcareous, speckled, banded with whitest  
muc calcareous bands, transitional to underlying

Rec. 57.4'

Core #2, 1610 - 1665, Recovered. 50.2'/55

8.9' Shale, medium dark grey, moderately fine to, quite strongly calcareous,  
very finely speckled + fine thin bands highly speckled, several fine  
white calcareous partings, several pebbles concretionary  
sharp contact with.

3.8' Limestone, variably argillaceous grading in part to calcareous <sup>shale</sup> in 1 foot band  
in middle, seems to be a concentration of specks with fine glossy sand  
size calcareous grains as well. Numerous Inoceramus fragments, no visible  
porosity but possibly some fine intergranular. Base marked by  $\frac{1}{4}$ " bentonite  
bed.

12.4' Shale dark grey strongly calcareous, ranges from finely speckled to coarsely  
speckled and banded with abundant Inoceramus fragments.

6" limestone band at 6.2' and 1" bentonite bed at 7'

Grades to relatively clean looking shale in bottom 18" with sparse fine specks but  
still very calcareous. Grades sharply to:

5.7' Limestone, ranges from relatively pure to strongly argillaceous as above - seems to be  
due to increase in specks and Inoceramus fragments. Masses to fairly well bedded.  
 $\frac{1}{2}$ " bentonite bed at 1.5'

8.2' Shale, highly calcareous, abundant coarse white specks and platy banded  
Inoceramus fragments, fairly well bedded + banded, moderately fine  
1" bentonite band at 2'. 4" bentonite bed at 5.2' (good clean bentonite)

11.2'

Shale, dark grey, calcareous, strongly speckled throughout; sparse scattered white Inoceramus bands and fragments throughout; massive & poorly fissile.  $\frac{1}{4}$ " bentonite bed  $1\frac{1}{2}$  feet above base.

50.25

Appears to be very thin soft greasy shale at very base of core.

Dropped 25' of core in hole, could not recover. This probably marks the base of the Tavel + soft core of ~~Font~~ Ashville probably washed out + could not be caught by core spring.

Base Tavel is 1660.2' estimated.

Px 5

60 JS [in turn]

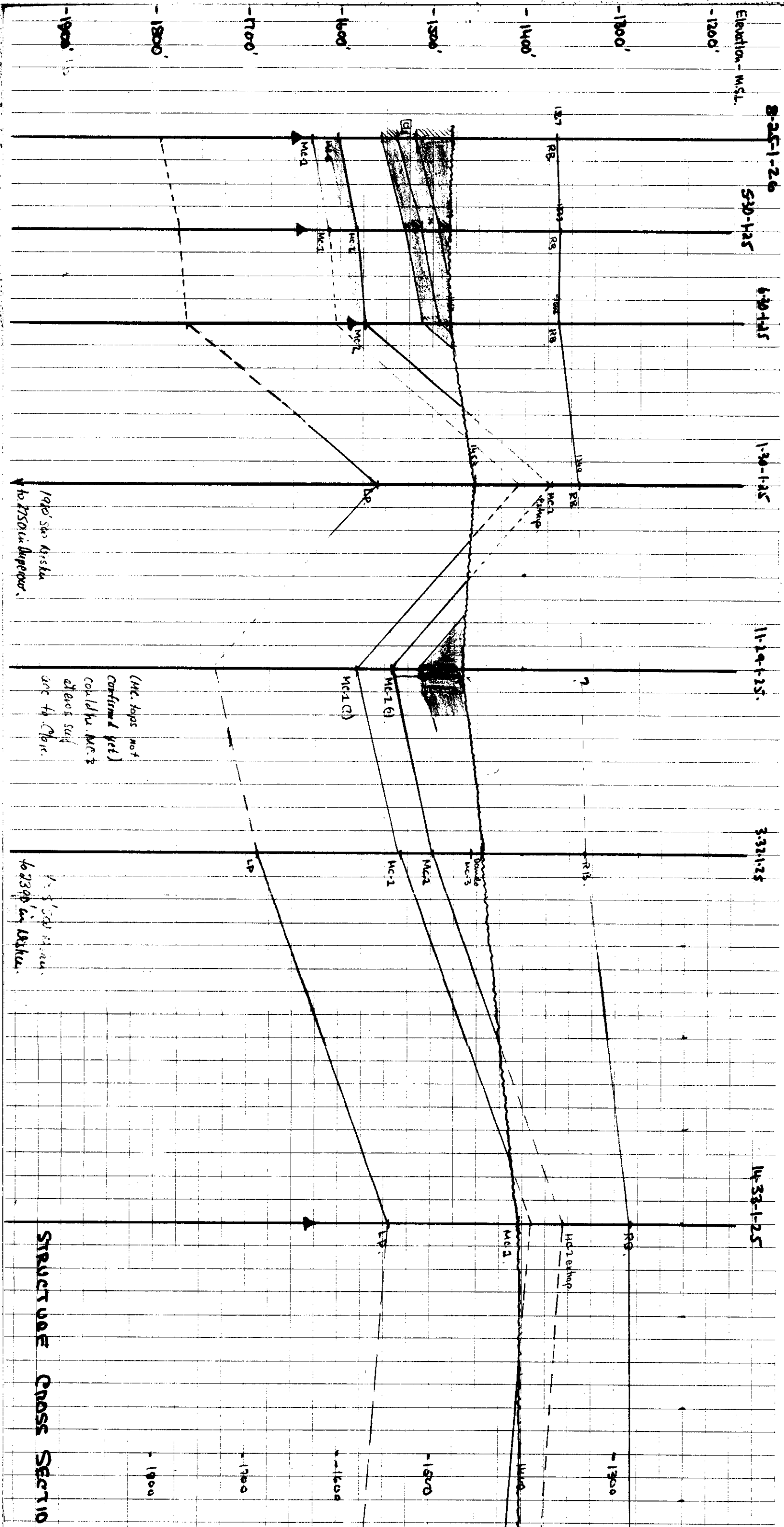
60 Pher'

90 Fwd 18]

1610 + 50. 2 =

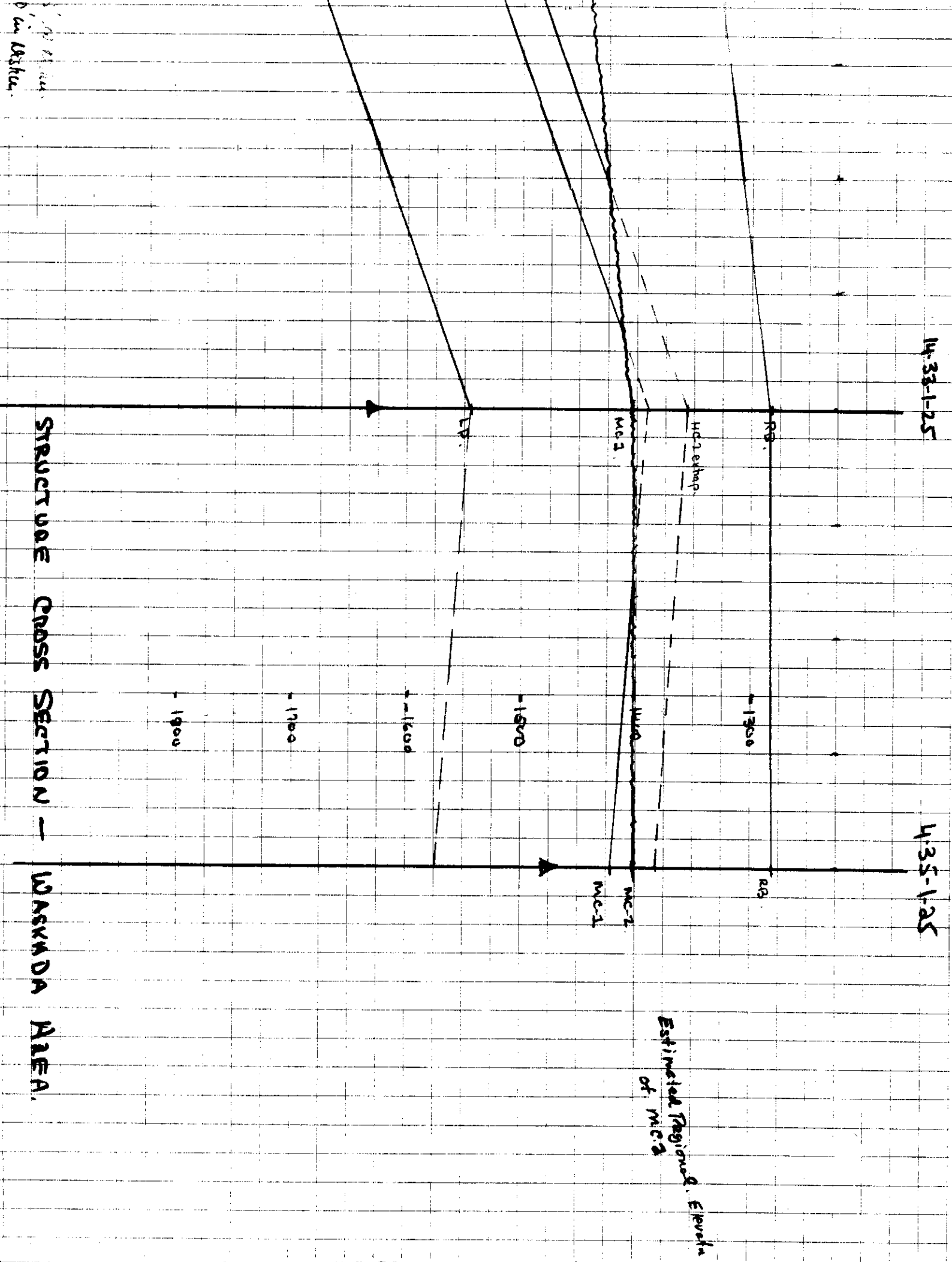
1660.

Pher Sun Nit



14-33-1-25  
14-35-1-25

STRUCTURE CROSS SECTION - WASKADA AREA.



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Petroleum Reservoir Engineering  
CALGARY, ALBERTAManitoba Minerals  
Corporation Ltd.

Company Formation MISSISSIPPIAN Page 1 of

Well MMR WASKADA 14-33-1-25 Date Report File 2004-5396

Field, Province Wildcat, Waskada, Manitoba D. Fluid White Gas M.V.O. Analysts C.C.A.R.D.B.

Location L.S.D. 14-33-1-25 W.M. Analysis Full Diameter Remarks RESIDUAL SATURATIONS DETERMINED FROM SAME END PIECES.

## CORE ANALYSIS RESULTS

(Figures in parentheses refer to footnote remarks)

Sample Number	Depth Feet	Ft. Rep.	Permeability Millidarcys			Perm. Ft.	Porosity Percent	Porosity Feet	Density		Residual Saturation		Visual Examination
			K Max	K 90°	KV				Bulk	Grain	Oil %	Total water % Pore	
						CORE #1		2970-3030 (REC. 60) (13 BOXES)					
1	2970.0 - 70.7	0.7	0.48	0.37	<0.01	0.33	3.8	2.66	2.67	2.78	24.3	37.8	1 P.V.A
2	70.7 - 72.0	1.3	<0.01	<0.01	<0.01	-	1.2	1.56	2.71	2.75	TRACE	61.2	1 A
-	72.0 - 76.6	4.6											DENSE A
3	76.6 - 77.0	0.4	4.35	4.35	0.43	1.74	8.4	3.36	2.58	2.82	26.6	15.5	1 P.V.A
4	77.0 - 77.5	0.5	78.90	2.28	15.00	39.45	10.8	5.40	2.51	2.81	19.6	24.4	1 P.V.A V.F
-	77.5 - 80.7	3.2											DENSE NO STAIN
5	80.7 - 81.4	0.7	0.89	0.17	0.26	0.62	12.7	8.89	2.38	2.73	0.0	62.3	1 P.V. V.F
-	81.4 - 84.4	3.0											DENSE NO STAIN
6	84.4 - 85.6	1.2	0.73	0.72	0.50	0.88	12.4	14.88	2.42	2.76	0.0	66.8	1 P.V. A V.F
7	85.6 - 86.5	0.9	2.01	1.80	0.47	1.81	15.2	13.68	2.35	2.78	0.0	67.5	1 P.V.
8	86.5 - 87.1	0.6	0.89	0.81	0.30	0.53	9.2	5.52	2.47	2.72	TRACE	50.1	1 P.V.A
9	87.1 - 88.2	1.1	2.90	2.74	2.55	3.19	12.0	13.20	2.46	2.73	14.5	27.8	1 P.V.A DOLITIC
10	88.2 - 88.8	0.6	8.00	6.45	6.54	4.80	13.3	7.98	2.37	2.74	9.9	30.5	1 P.V.A V.F
11	88.8 - 89.5	0.7	*	5.24	*	3.67	13.0	9.10	2.37	2.73	10.1	33.6	1 P.V. O.V.F
12	89.5 - 90.4	0.9	16.50	16.00	15.60	14.85	14.4	12.96	2.35	2.74	12.8	31.4	1 P.V.
13	90.4 - 91.2	0.8	31.30	20.60	27.70	25.04	17.3	13.84	2.26	2.74	11.2	40.3	1 P.V. F
14	91.2 - 92.1	0.9	25.20	24.30	19.90	22.68	18.3	16.47	2.22	2.71	11.7	36.1	1 P.V.
15	2992.1 - 92.8	0.7	34.90	32.90	18.30	24.43	18.2	12.74	2.22	2.71	12.1	38.1	1 P.V.

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Petroleum Reservoir Engineering

CALGARY, ALBERTA

Company \_\_\_\_\_ Formation \_\_\_\_\_ Page 2 of \_\_\_\_\_Well MMR WASKADA 14-33-1-25 Date Report \_\_\_\_\_ File 70.4-5396

Field, Province \_\_\_\_\_ D. Fluid \_\_\_\_\_ Analysts \_\_\_\_\_

Location \_\_\_\_\_ Analysis \_\_\_\_\_ Remarks \_\_\_\_\_

## CORE ANALYSIS RESULTS

(Figures in parentheses refer to footnote remarks)

Sample Number	Depth Feet	Ft. Rep.	Permeability Millidarcys			Perm. Ft.	Porosity Percent	Porosity Feet	Density		Residual Saturation		Visual Examination
			K Max	K 90°	KV				Bulk	Grain	Oil % Pore	Total water % Pore	
16	299.28 - 93.7	0.9	21.30	19.20	3.72	19.17	18.2	16.38	2.22	2.72	8.6	38.7	1 PPV
-	93.7 - 95.6	1.9											DENSE No STAIN
17	95.6 - 96.4	0.8	636.00	25.10	88.30	508.80	31.6	25.28	1.89	2.77	TRACE	12.4	MARKY VF
18	96.4 - 97.8	1.4	39.60	38.90	9.50	55.44	31.7	44.38	1.88	2.75	0.0	86.4	MARKY
19	97.8 - 99.2	1.4	39.80	38.90	6.44	55.72	30.1	42.14	1.93	2.77	6.1	62.1	MARKY
20	299.2 - 00.2	1.0	61.00	60.40	20.00	61.00	31.4	31.40	1.90	2.77	6.3	17.8	MARKY
-	300.2 - 03.3	3.1											DENSE No STAIN
21	03.3 - 04.0	0.7	<0.01	<0.01	<0.01	-	0.1	0.07	2.58	2.59	7.3	64.0	DENSE
22	04.0 - 05.0	1.0	3.99	3.66	1.45	3.99	16.2	16.20	2.25	2.69	0.0	74.8	1 STR PPV
23	05.0 - 05.9	0.9	7.78	7.63	1.06	7.00	16.6	14.94	2.24	2.68	0.0	73.1	1 PPV
24	05.9 - 07.0	1.1	36.60	9.71	37.00	40.26	19.0	20.91	2.17	2.67	7.1	43.7	1 PPV VF
25	07.0 - 08.0	1.0	6.24	6.14	4.13	6.24	16.5	16.50	2.24	2.69	0.0	64.0	1 PPV
26	08.0 - 09.0	1.0	25.60	7.00	14.30	25.60	19.1	19.10	2.17	2.68	0.0	74.0	1 PPV VF
27	09.0 - 09.7	0.7	2.66	2.43	2.35	1.86	15.5	14.85	2.28	2.70	0.0	72.4	1 PPV
28	09.7 - 10.7	1.0	18.10	17.30	9.52	18.10	17.3	17.30	2.23	2.69	0.0	70.7	1 PPV
-	10.7 - 11.4	0.7											DENSE No STAIN
29	11.4 - 12.6	1.2	2.33	2.14	0.85	2.80	15.2	18.24	2.30	2.71	0.0	55.7	1 PPV
30	12.6 - 13.5	0.9	12.80	6.23	12.50	11.52	10.8	9.72	2.42	2.72	12.3	33.9	1 STR PPV VF
31	13.5 - 14.4	0.9	*	98.00	*	88.20	18.6	16.74	2.17	2.67	0.0	59.1	1 PPV VF
-	3014.4 - 30.0	15.6											DENSE No STAIN

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Petroleum Reservoir Engineering

COMPANY MANITOBA MINERALS CORPORATION LTD. FIELD WILDCAT, WASKADA FILE 7004-5396  
WELL MMR WASKADA 14-33-1-25 DATE \_\_\_\_\_  
LOCATION LSD 14-33-1-25 WIM PROV MANITOBA ELEV. \_\_\_\_\_

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T.C. 11 SECS.

VERTICAL SCALE: 5" = 100'

SENS. 5000 CPM.

