A SHORT RADIUS HORIZONTAL WELL DRILLED FROM AN EXISTING BORE HOLE IN THE BASS ISLAND TREND: THE MARING #3-B

Final Report

Submitted by:
Steven E. George, Sr. Geologist
Jeffrey C. Simmons, Vice President Energy
Resource Energy, Inc.
2876 S. Arlington Rd.
Akron, OH 44312

Submitted to:
John P. Martin, Ph.D.
Project Manager Energy Resources
New York State Energy Research and Development Authority
Corporate Plaza West
286 Washington Avenue Extension
Albany, NY 12203-6399

Agreement No: 4571-ERTER-ER-98

March 18, 1999

NOTICE

ABSTRACT

The Bass Island trend in western New York is a series of fields that produce oil and gas from fractured carbonate reservoirs. Resource America, Inc. with financial assistance from the New York State Energy Research and Development Authority (NYSERDA), drilled the first horizontal well in the trend. The method used was the re-entry of an existing well bore and the drilling of a short radius horizontal (SRH) leg into the pay zone using slim hole equipment (smaller than 4-1/2" OD), 2-3/8" drill pipe, adjustable down hole motors and down hole steering tools. This method has been proven in other basins and works perfectly for the Bass Island. The well was drilled without problems. Eighty-five feet of fractured and faulted reservoir rock was penetrated. The well was completed and is currently producing 13 BOPD, 13 MCFGPD and 13 BWPD. Initial pressures indicated some depletion and the production is indicative of a completion near the oil/water contact. The well cost approximately $216,000 or about 1.8 times more than the cost of a standard vertical well. Cost saving measures can ultimately reduce the cost to $191000. From the production results and considering the increased costs, it is unclear if the horizontal completion was advantageous.

ACKNOWLEDGEMENTS

Resource Energy, Inc. (REI) acknowledges the help of many people in the successful completion of this project. Most important was the financial assistance from NYSERDA. Their help turned this project from a wish into an accomplishment. REI also thanks Wilson Downhole for their expert directional drilling services, Limestone Drilling for the drill rig and crew, and Weatherford-Enterra for rental equipment and services. Special acknowledgment goes to Tom Wood of Frontier Resources for his expert consulting and supervision in all stages of this project. The cooperation and excellent communication among these parties created the successful outcome.

TABLE OF CONTENTS

TABLES AND FIGURES

Section 1
INTRODUCTION

Short Radius Horizontal (SRH) drilling is successful new technology currently used in many petroleum reservoirs. Applications include fractured carbonate reservoirs in Texas, reef reservoirs in Michigan, shale reservoirs in the Michigan and Williston Basins, and coal bed methane reservoirs in many basins. The common thread in most of these applications is the presence of high angle fracturing in the reservoir. Horizontal well bores intersect a greater number of high angle fractures than do vertical well bores, resulting in greater production and recovery rates.

The Bass Island trend in western New York is a classic fractured carbonate reservoir. Low angle faults, cutting through the Onondaga Limestone, have created surrounding high angle fracture envelopes. Before the drilling of the Maring #3-B SRH well, the Bass Island was only drilled and completed through conventional vertical well bores. This project involves the re-entry of an existing vertical well bore in the trend, and the drilling of a slim hole, short radius horizontal leg cutting through a fault and its surrounding fracture envelope.

Section 2

GEOLOGY AND RESERVOIR CHARACTERISTICS OF THE BASS ISLAND TREND

The Bass Island Trend is located in western Pennsylvania and New York (see Figure 1). It is approximately 1-½ miles wide and trends NE – SW, parallel to the shore of Lake Erie about 20 miles inland as shown. Wells in the trend produce oil and gas from faulted and fractured rock ranging in age from Silurian (Salina Group) to Devonian (Hamilton Group) at depths of 2000 to 3000 feet.

Reverse faults and associated fractures define the limits and trend of the production. The reverse faults trend NE – SW, are parallel to sub-parallel, sole in the Salina "B" salt and flatten into the bedding planes of shale units in the Marcellus and Hamilton Group. The majority of the faults dip to the SE at low angles (15 to 25 degrees) with antithetic faults dipping to the NW at higher angles (35 to 70 degrees). Throw, on the faults, ranges from a few feet to 150 feet. Occasionally back thrusts develop on the NW side of the trend and dip to the NW. The faults are moderately sinuous and can be discontinuous along strike. Tear or strike slip faults may cause offset in the main faults in some areas.

The fault geometry and depth to the oil/water contact limit the oil and gas accumulation in any specific fault and its surrounding fracture envelope. The reservoir rapidly degrades along the fault above the point where the Marcellus Shale intersects the fault plane in the footwall. Similarly, the reservoir rapidly degrades along the fault below the point where the Salina Formation intersects the fault plane in the hanging wall.

Three rock units are generally recognized between the Marcellus and the Salina. These are the primary "Bass Island" reservoirs. Below the Marcellus is the Onondaga Limestone. In Chautauqua Co. the Onondaga is a tan to gray, fine to medium crystalline limestone, approximately 175 to 200 feet thick. It contains abundant chert both bedded and nodular. Under the Onondaga is the Bois Blanc/Oriskany unit. This rock is a bluish to greenish white chert with some sand grains present and is 20 to 50 feet thick. Below is the Akron Dolomite. This rock is brown, sucrosic dolomite and is 30 to 50 feet thick. The best wells in the trend occur primarily in fault repeated sections of Onondaga Limestone.

Porosity in the reservoir rock is primarily fracture porosity. There are generally two types of fractures, fault plane and antithetic. Fault plane fractures dip to the SE and make up the gouge zone of the reverse faults. Antithetic fractures make up the fracture envelope surrounding the SE dipping faults. These fractures dip into (NW) the main fault plane at higher angles. Antithetic reverse faults are actually large relatives of these fractures. The extent of the antithetic fracture envelope has been measured in open hole well logs and commonly extends 40 feet (vertically) on either side of where the fault intersects the vertical well bore. Depending on the specific location, the fracture porosity can be in various stages of degradation. Secondary calcite growths in the fractures commonly reduce porosity and permeability. Hydrocarbons appear to have migrated into the fracture network, during to after porosity degradation.

Bass Island wells are often difficult to produce. The oil is paraffin based. Some wells start out producing gas, then rapidly change to oil production. Some wells never make any oil while some other ones produce emulsions of oil and water. Some start out making substantial amounts of oil and/or gas then rapidly water out. It is well known that the bubble point of the crude is very close to reservoir temperature. High well production rates tends to deposit paraffin in the production tubulars, and very likely in the formation.

Section 3
MARING #3-B WELL HISTORY AND PROPOSED COMPLETION

The Maring #3-B (API permit # 31-013-22005) well is located in east central North Harmony Township, Chautauqua Co., New York. It was drilled in 1991 as a Bass Island test (see Figure 1).

Conventional air-rotary drilling techniques were used to drill the well. An 11-inch surface hole was drilled to 450 feet and 8 5/8-inch casing was cemented to surface. A 7 7/8-inch vertical hole was drilled to a total depth of 2927 feet. At 2722 feet the well bore intersected a reverse fault with in the Onondaga Limestone Formation. The fault had a throw of approximately 70 feet, juxtaposing older Onondaga Limestone on top of younger Onondaga Limestone. A show of oil and gas was noticed, however, the hole immediately filled with salt water. 2714 feet of 4 ½-inch production casing was run and cemented to 2100 feet.

It was believed that the well intersected the fault (at a depth of –1215 Sub Sea) at or very near the oil/water contact. The original plan for completion involved perforating the casing adjacent to fracturing up hole from the fault and acidizing and/or fracing to stimulate production. This was never attempted and the well remained temporarily abandoned.

In 1997 Resource America, Inc. proposed to NYSERDA to re-enter the well bore with slim hole drilling tools. The plan consisted of setting a bridge plug inside the 4 ½-inch production casing, milling a window in the casing, and drilling a short radius horizontal lateral. The lateral leg would be drilled such that the bore-hole would be horizontal approximately 100 feet from the vertical hole, at a depth of 2658 feet (-1150 Sub Sea). The lateral would extend horizontally approximately 200 additional feet, drilling through the fault and it's surrounding fracture envelope (see Figure 2).

Section 4
DRILLING AND COMPLETION PROCEDURE

Initial operations on the Maring #3-B SRHW (Short Radius Horizontal Well) were begun on August 14th, 1998. The drilling method used consisted of a drill string conveyed slim hole, fluid driven, down-hole motor assembly. A conventional drill rig was employed. When necessary, the drill string was rotated with a power swivel and the tools were oriented using wire-line steering tools (see Table 1 for a list of equipment). The procedures used were as follows (dates, times and detail of labor can be reviewed on Table 2):

PREPARATION

A cement top and collar log was run to verify the presence of cement behind the 4 ½-inch casing above the proposed window and to locate casing collars. The cement top was found at 2100 feet. A bridge plug was set 5 feet above a casing collar at 2558 feet (plug set at 2553.23 feet).

Drilling equipment was moved to the location, set up and tested. Preparations were completed on August 23rd, 1998.

GYRO SURVEY

The well was surveyed for deviation with a wire-line gyro survey tool. At 2535 feet the hole was found to be 85.63 feet at a bearing of N. 35.17 deg. W. from the surface location.

WIPER RUN

A wiper run was made to verify the condition of the hole. A down-hole mill assembly consisting of a window and a watermelon mill was run in the hole with the drill string. 10,000 lbs. of drill string weight was set on the bridge plug to make sure it would hold. The bridge plug held and the hole was in good condition.

SET WHIPSTOCK AND MILL STARTER HOLE

A whipstock and a starter mill were run in the hole. The whipstock was oriented with the beveled face facing the direction of drilling (N. 37 deg. W.) and set on top of the bridge plug (top of the whipstock at 2541.73 feet). The pins holding the whipstock to the starter mill were sheered. The BOP was tested and a starter hole was milled from 2540 feet to 2542 feet. At 2540 feet the bottom hole location was 85.8 feet at N. 36.92 deg. W. from the surface location. The TVD (true vertical depth) was 2538.3 feet with an angle of 2.17 deg. from vertical (see Figure 3).

MILL WINDOW AND REAM

A window mill was run in the hole and a window in the casing was cut from 2542 feet to 2551 feet. The window mill was tripped out and a window and watermelon mill was run to ream the window.

DRILL STRAIGHT HOLE TO KICK OFF POINT

A drilling assembly consisting of a tri-cone bit, adjustable down-hole motor (set at 1.5 deg.), slick flex joint, mule shoe sub, 4 flex monel collars, and a cross-over sub was tripped in and a straight hole was drilled to the kick off point (from 2551 feet to 2583 feet). The purpose of this part of the drilling was to get the new hole far enough away from the metal casing in the vertical hole so that streering tools utilizing magnetometers could be used (all directional surveys up to that point used gyro tools). The bottom hole location was 88.5 feet at N. 40.55 deg. W. from the surface location. The TVD was 2581.2 feet with an angle of 3.88 deg. from vertical (see figure 3).

DRILL FIRST LEG OF CURVE

A drilling assembly with a 4 deg. fixed, down-hole motor was run in the hole and the first leg of the curve was drilled from 2583 feet to 2642 feet. Bottom hole location was 115.3 feet at N. 43.5 deg. W. from the surface location. The TVD was 2626.9 feet with an angle of 57.2 deg. from vertical (see figure 3).

FINISH DRILLING CURVE

A new bit and an adjustable down-hole motor (set at 1.5 deg.) assembly was tripped in and the rest of the curve was drilled from 2642 feet to 2713 feet. Bottom hole location was 181.3 feet at N. 43.3 deg. W. from the surface location. The TVD was 2650.6 feet with an angle of 79.3 deg. from vertical (see figure 3).

DRILL FIRST HORIZONTAL LEG

A new bit and an adjustable down-hole motor (set at 1.5 deg.) assembly was tripped in and the first horizontal leg was drilled from 2713 feet to 2806 feet. Bottom hole location was 273.6 feet at N. 39 deg. W. from the surface location. The TVD was 2659.4 feet with an angle of 88.3 deg. from vertical (see Figure 3).

DRILL SECOND HORIZONTAL LEG

A new bit and an adjustable down-hole motor (set at 1.5 deg.) assembly was tripped in and the first horizontal leg was drilled from 2806 feet to 2917 feet. At this point the drilling ceased. Bottom hole location at 2917 feet was 388.6 feet at N. 36.1 deg. W. from the surface location. The TVD was 2659.9 feet with an angle of 88.97 deg. from vertical (see Figure 3) (see Figure 4 for drill time curve and other drilling statistics).

WELL STIMULATION

Following the completion of the drilling, the hole was loaded with salt water and the drill string tripped out. All drilling tools were rigged down and the bottom joint of drill pipe was slotted, bent, and run to TD. Salt water was pumped down-hole and circulation to the surface was established. 500 gal of 28% HCL with iron control was pumped down the drill string. To avoid acidizing the Marcellus, only about 50 gal. were spotted outside the drill string before the well was shut in. The acid was then pumped away. The formation started taking fluid at 600 psi. and 3 bbl. were pumped at 2.5 BPM and 950 psi. The remainder was pumped at 3.98 BPM and 1400 to 1600 psi. Total displaced fluid was 10 bbl. ISIP was 350 psi. After 5 minutes pressure was 0 psi. The kill lines were opened and the well went on vacuum.

Section 5
RESULTS

DRILLING AND COSTS

No mechanical problems were encountered while drilling the well; the technology used works well for this application. The only problems were trying to familiarize a rig crew with horizontal drilling. For example, the rigs power tongs worked poorly at drill pipe connections. The special drill pipe used was hardened and the tongs could not grip it efficiently. As a result, connection and trip times were greater until the problems were solved by the tool pusher and the rig crew became familiar with the new procedures.

One surprise, while drilling, was the low penetration rates and the extreme bit wear. The penetration rate averaged approximately 4.4 min./ft. and four bits were needed to drill the 366 feet of hole (each bit cost $5820). The abundance of chert in the Onondaga contributed to this however the major reason is the small hole size and the low weight on bit used while drilling. Typically with a 3-7/8" hole, the down hole motors work best with about 8000 – 10000 lbs. WOB where as, in a 7 7/8" vertical well 40000 to 45000 lbs. WOB is used.

Because the services of the rig, directional drillers, and other support personnel and equipment were billed on a day rate, improvement should involve saving time and decreasing the amount of equipment used. Because this was REI's first horizontal drilling venture, we relied heavily on the advice of service companies as to the equipment. The remote location, combined with our desire for the success of the project, prompted us to assemble all the recommended equipment as well as renting and buying redundant equipment for back up. A way to substantially reduce costs is to secure the services of a drill rig that can supply (as part of their daily fee rate) an ample BOP, mud filtration system, a power swivel, and drilling tubulars (all of which we rented in addition to paying the rig day rate). Better bits would reduce drilling time, trip time, give better penetration rates and last longer.

Table 3 shows the actual drilling costs of the Maring #3-B as compared with the costs of drilling a standard vertical well. While it cost approximately an 80% more to drill the Maring #3-B, Table 4 shows a more realistic scenario for the drilling of a SRH well from an existing well bore. These costs were obtained by adjusting the Maring costs to reflect more efficient rig operation and reduced rental equipment. With these numbers it appears that a SRH well, drilled from an existing well bore, costs nearer to 60% more than a vertical well. Table 4 also shows that the estimated costs of drilling a medium radius horizontal well from a new surface location are an additional 80% greater than a vertical well.

GEOLOGY

The first formation encountered by the bit outside the casing was the Marcellus Shale. Shale was drilled from approximately 2546 to 2560 feet. The Top of the Onondaga Limestone was drilled at 2560 feet (2558.3 feet TVD). The well bore stayed in the Onondaga through TD. Numerous sample shows and fracture zones were encountered (see Figures 3 and 4).

At 2820 feet, approximately 200 feet from the vertical well bore and at 2659.8 feet TVD, the primary reservoir zone was encountered. It consisted of fractured chert with less abundant limestone. Secondary calcite with euhedral crystal faces were present in the fractures and there was a strong odor of oil and bright greenish-yellow florescence with cut under UV light. No oil flowed to the pits however; drilling fluid was being lost to the formation at a rate of 1 bbl. per 10 minutes. The fractured reservoir was drilled from 2820 feet to 2875 feet.

According to the drilling prognosis, the fault was expected to be encountered approximately 220 feet, NW of the vertical well bore at 2660 feet in depth. At 2875 feet, approximately 255 feet from the vertical well bore and at 2659.7 feet TVD depth, the fault zone was encountered. The rock in this zone was highly fractured, however the lithology changed from chert dominated to limestone dominated. Many fragments were completely encased in secondary calcite indicating box work fracturing. The outer edge of many of the calcite rims contained euhedral crystals indicating an open fracture network. Good sample shows were present through out the fault zone. The fault zone was drilled from 2875 feet to 2895 feet. Additional fractured rock with sample shows was drilled from 2895 feet to 2905 feet. From 2905 feet to TD no shows were encountered and the rock looked normal.

This method of drilling is highly effective for this reservoir. The pay zone can be drilled at the proper depth and more pay can be exposed to the well bore. The total reservoir thickness exposed to the well bore was 85 feet. Had this same section been drilled with a vertical well at this new bottom hole location, only 23 feet of reservoir rock would have been exposed to the well bore. It is unknown if fracture zones up hole from the primary zone contribute anything to the production; they did contain live oil. A vertical well bore at the new bottom hole location would not have encountered these zones.

PRODUCTION

After the well was acidized on Saturday the 29th, it was shut in pending completion. On Monday the casing pressure was 420 psi. The well was opened to temporary storage tanks and it started flowing oil and gas. It was determined that the well would be tested into line.

Production facilities including a 210-bbl. storage tank, separator, 2-inch flow lines, and a salt-water storage tank was built. A pumping unit, to control production and enable treatment for paraffin was set. Tubing (1-½ inch), rods and a downhole pump were installed and the well was turned in line on September 24, 1998. Table 5 shows the daily production of the well.

The type and rates of production seem to indicate that this well is completed near the oil/water contact and the initial pressures indicate depletion is present. Table 6 shows production histories from offset wells along with an extrapolated 12 month production from the Maring #3-B well. At present, it seems too early to make any meaningful comparisons between the Maring #3-B and any of the existing production. The gas to oil ratio seems to be closest to resembling the Green #1-B. Further study and more time is need before conclusions about the ultimate potential of the well can be made.

It appears that this well may reach pay out in 4 to 5 years. The low production rates may be due to the following factors:

1. Initial reservoir pressure indicated depletion. One of the reasons the well site was picked for this project was that it was thought that there are no other wells producing from this fault. It is possible that this reservoir is in communication with production on another fault via a cross-strike fracture zone.
2. The well was completed near the oil/water contact and as a result is making more water than anticipated. The targeted sub sea depth was based on the fault geometry. This depth is about as high as possible along the fault without running into Marcellus Shale in the footwall (causing reservoir degradation). The depth to the oil/water contact varies with each fault, unfortunately it seems the contact on the Maring #3-B fault is relatively high compared to other faults.
3. There is some question as to the effectiveness of the acid treatment. The well was treated open hole and when the acid was pumped into the formation it was impossible to tell exactly where it went. Following the path of least resistance, the acid could have entered the formation in a very narrow but highly permeable zone leaving a substantial portion of the fracture zone untreated.

Section 6
CONCLUSIONS

The following is a list of conclusions regarding the drilling of the Maring #3-B SRH well:

1. The well was drilled essentially as planned with out major difficulty.
2. The technology used in drilling the well worked adequately.
3. More research is needed to identify 3-7/8” bits that will last longer and give better penetration rates.
4. Substantial time and money savings can be realized by familiarizing drill rig crews with horizontal drilling procedures.
5. Less rented equipment can save costs.
6. The cost of drilling a slim hole SRH well is 1.6 times that of a conventional vertical well.
7. Horizontal drilling through faults, and their surrounding fracture envelopes, results in greater thickness of pay exposed to the well bore.
8. Well production data seems to indicate the presence of reservoir pressure depletion and close proximity to the oil/water contact.
9. It is too early to tell whether the horizontal completion has increased production rates or future reserves.

INDEX MAP

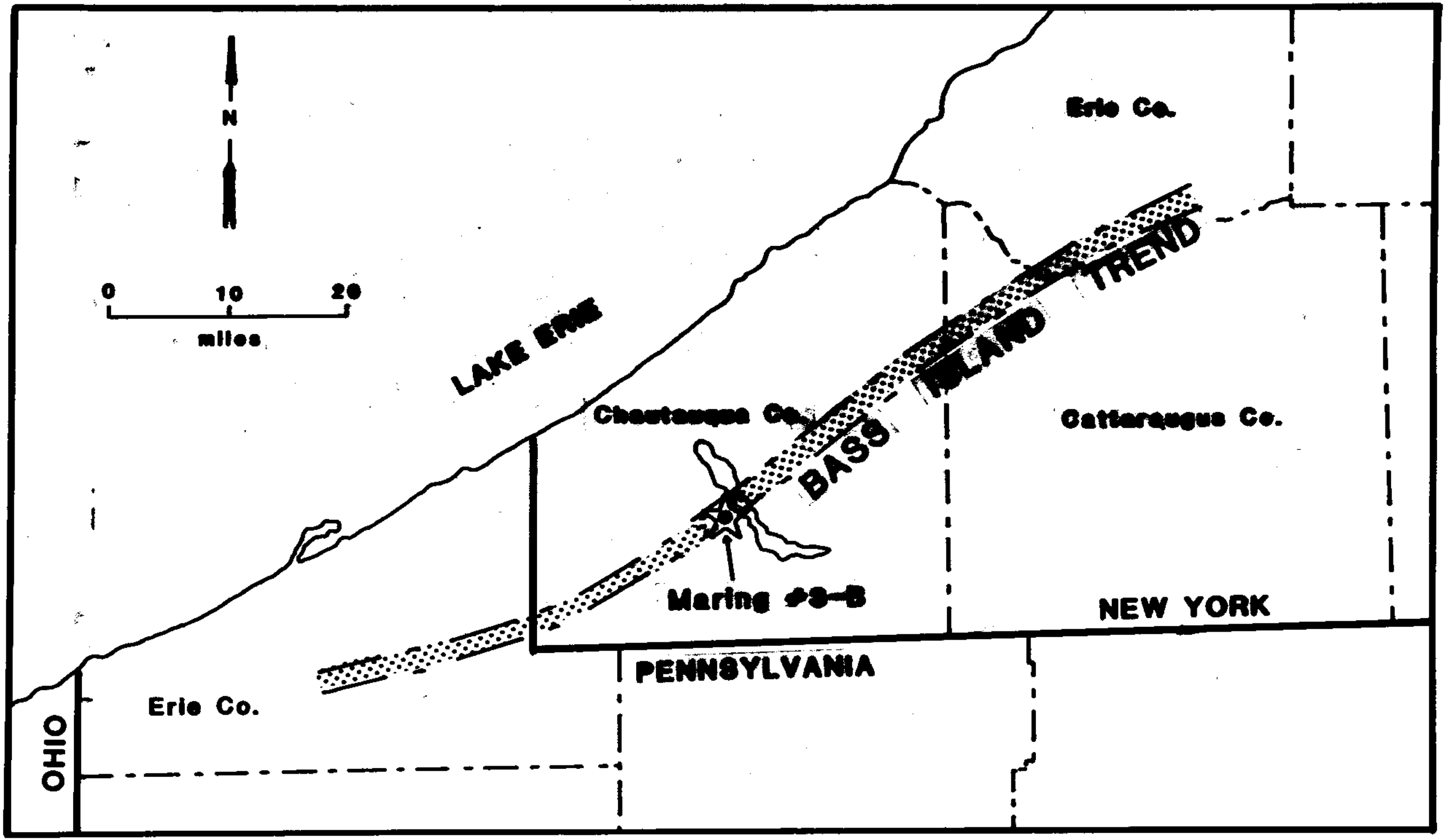


Figure 1

WELL PLAN FOR THE MARING #3-B SRH WELL

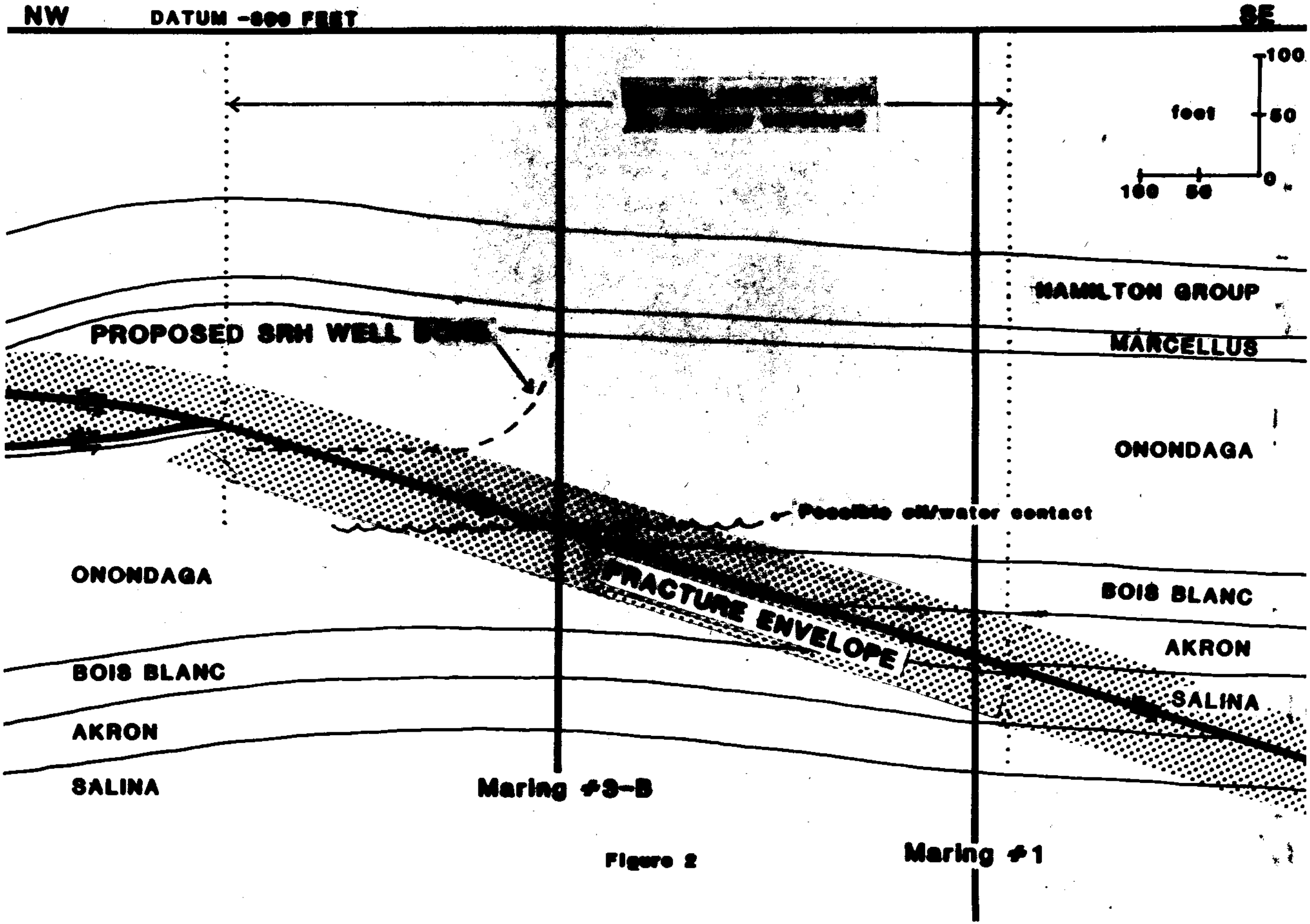


Figure 2

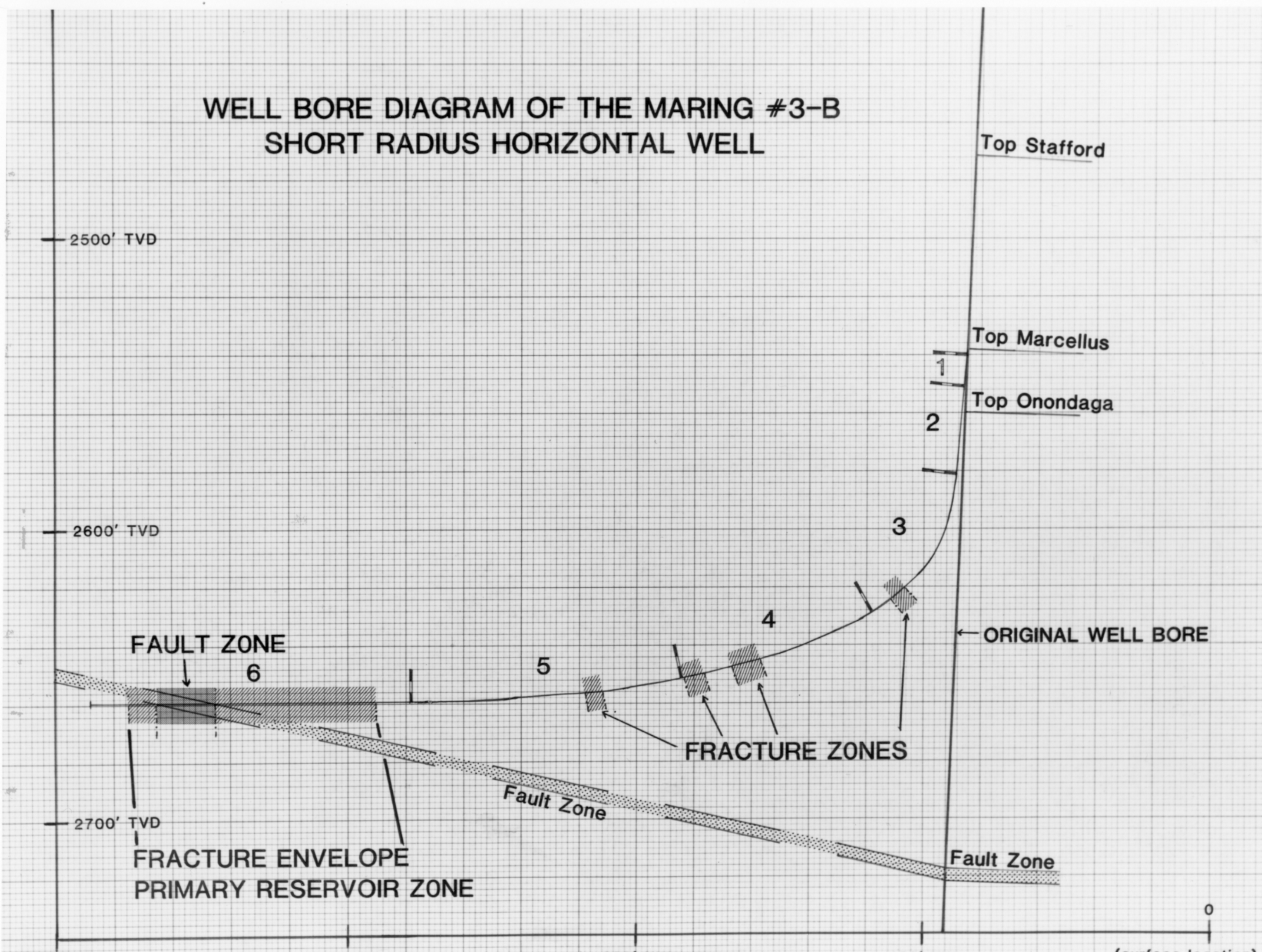

WELL BORE DIAGRAM OF THE MARING #3-B
SHORT RADIUS HORIZONTAL WELL
Top Stafford
2500′ TVD
Top Marcellus
1
Top Onondaga
2
2600′ TVD
3
4
ORIGINAL WELL BORE
FAULT ZONE
6
5
FRACTURE ZONES
Fault Zone
2700′ TVD
FRACTURE ENVELOPE
PRIMARY RESERVOIR ZONE
Fault Zone
0
400′ NW
300′ NW
200′ NW
100′ NW
(surface location)

Figure 3

DRILLING AND SAMPLE LOG

MARING #3-B PERMIT#31-013-22005-01

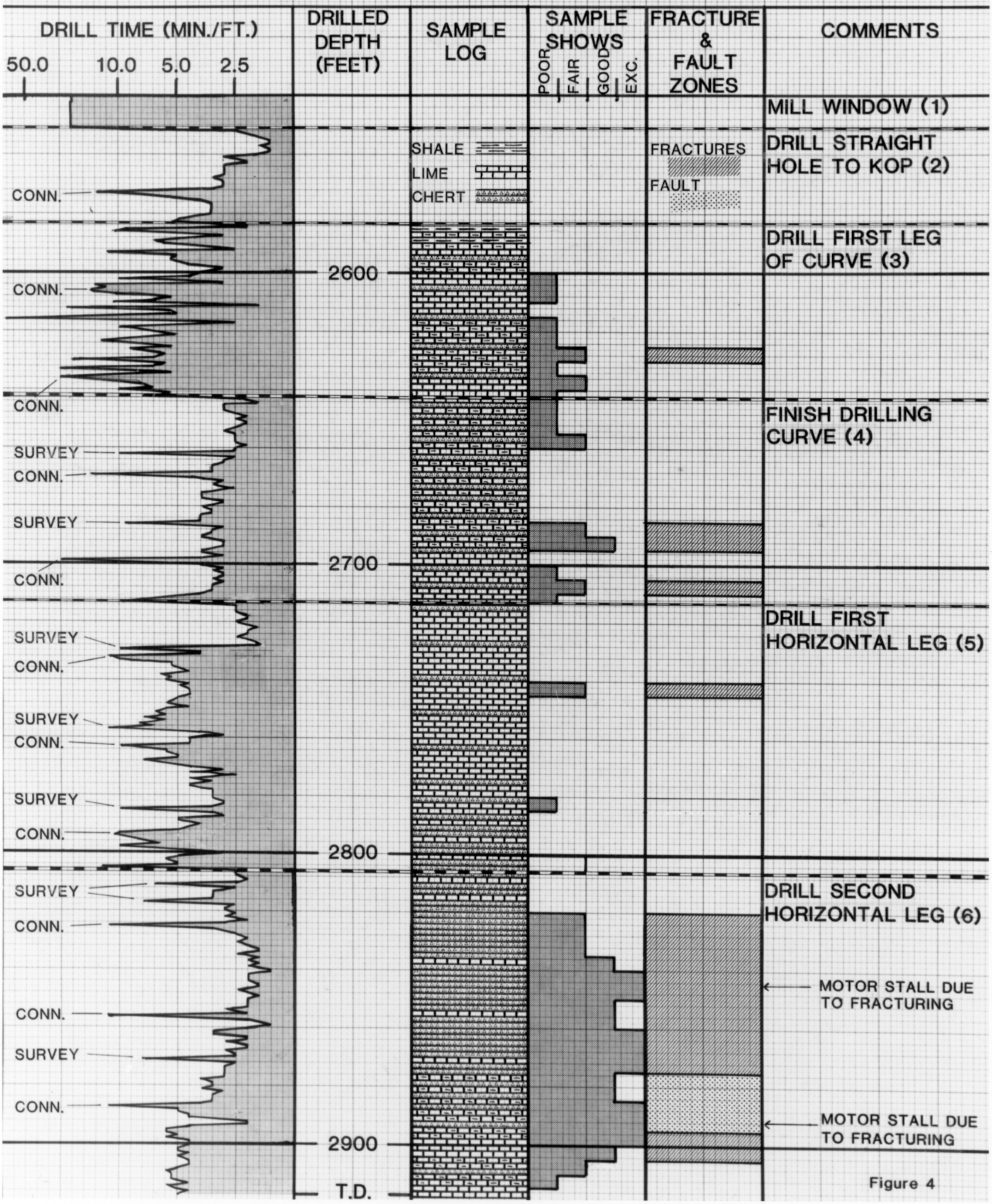


Figure 4

CHRONOLOGY OF THE MARING #3-B SRH WELL

PRE-DRILLING PREPARATIONS

Friday 7-25-98

9:30 AM – 12:00 PM	Pre-spud meeting. Representatives from RAI, Wilson Dowmhole Services, Weatherford Enterra and Limestone Drilling were present.

Friday 8-15-98

9:30 AM – 12:30 PM	Rigged up Superior Well Services. Ran cement top log. Cement top at 2100'. Set cast iron bridge plug at 2543'. Rigged down and released Superior Well Services.

Friday 8-15-98 – Sunday 8-23-98

Location prepared, Limestone Drilling, Oncourse, Wilson Downhole, and Weatherford Enterra moved on equipment and rigged up.

DRILLING OPERATIONS

Sunday 8-23-98

2:00 PM – 3:30 PM	Oncourse rigged up and ran gyro survey. Gyro out of hole. Bottom hole loc. - 2535 (TVD 2533.32), 85.63' @ 324.83 degrees.
3:30 PM – 9:30 PM	Contractors finish rigging up. Strap drill pipe. Rig up window and watermelon mill for wiper run.
9:30 PM – 12:00 AM	Tripped in hole with milling assembly.

Monday 8-24-98

12:00 AM – 3:00 AM	Tripped in hole with milling assembly.
3:00 AM – 4:00 AM	Tagged bridge @ 2553' (KB = 10'). Set down with 14,000 lbs. Circulated.
4:00 AM – 7:00 AM	Tripped out milling assembly.
7:00 AM – 10:00 AM	Rigged down mill assembly. Rigged up whipstock and starter mill.
10:00 AM – 2:30 PM	Tripped in hole with whipstock/milling assembly.
2:30 PM – 5:00 PM	Rigged up to orient whipstock. Rigged up power swivel and survey tools. Oriented whipstock and set.

5:00 PM – 7:00 PM	Rigged up choke lines. Repaired leaks. Tested BOP to 1,000 psi with NYSDEC on location.
7:00 PM – 8:30 PM	Cut two foot window in casing from 2540’ to 2542’ with 1000 lbs WOB, 60 RPM, 63 GPM @ 200 psi. Surveyed hole, bottom hole loc. at 2540 (TVD 2538.32’), 85.81’ @ 323.08 degrees.
8:30 PM – 9:00 PM	Circulated bottoms up.
9:00 PM – 9:30 PM	Rigged down power swivel and survey tools.
9:30 PM – 12:00AM	Tripped out milling assembly.

Tuesday 8-25-98

12:00 AM – 1:00 AM	Tripped out milling assembly.
1:00 AM – 2:00 AM	Rigged down mill assembly. Rigged up window mill.
2:00 AM – 6:00 AM	Tripped in hole with milling assembly.
6:00 AM – 6:45 AM	Rigged up power swivel and survey tools.
6:45 AM – 11:30 AM	Milled from 2542’ to 2551’ with 1000 lbs WOB, 60 RPM, 63 GPM @ 200 PSI.. Milled out of casing into Marcellus Shale. Surveyed hole, bottom hole loc. at 2550’ (TVD 2548.30’), 86.30’ @ 320.65 degrees.
11:30 AM –12:00 PM	Circulated bottoms up.
12:00 PM – 12:15 PM	Rigged down power swivel and survey tools.
12:15 PM – 2:00 PM	Tripped out milling assembly.
2:00 PM – 2:45 PM	Rigged down mill assembly. Rigged up new window mill and same watermelon mill used in 1st trip.
2:45 PM – 4:30 PM	Tripped in hole with milling assembly.
4:30 PM – 4:45 PM	Rigged up power swivel and steering tools.
4:45 PM – 5:45 PM	Re-milled and reamed window.
5:45 PM – 6:30 PM	Circulated hole clean.
6:30 PM – 6:45 PM	Rigged down power swivel and survey tools.
6:45 PM – 8:30 PM	Tripped out milling assembly.
8:30 PM – 9:15 PM	Rigged down mill assembly.

9:15 PM – 10:45 PM Rigged up drilling assembly #1 (Smith tri-cone bit #1 MF15GP, motor #1 adjusted to 1.5 degrees, slick flex joint, mule shoe sub, 4 flex monel collars, and cross over sub).

10:45 PM – 12:00AM Tripped in hole with drilling assembly #1.

WEDNESDAY 8-26-98

12:00 AM – 12:45 AM Tripped in hole with drilling assembly #1.

12:45 AM – 1:00 AM Rigged up power swivel and survey tools.

1:00 AM – 2:45 AM Drilled from 2551'to 2583' (total 32').
Rotated with 6000 lbs WOB, 20 RPM, 75 GPM @ 1000 psi.
Top of Onondaga at 2560'. Ran bottom hole surveys at 2560', 2570', 2580', and 2583'. Survey at 2560' (TVD 2558.28'), 86.94' @ 319.48 degrees. Survey at 2570' (TVD 2568.26'), 87.62' @ 320.62 degrees. Survey at 2580' (TVD 2578.24'), 88.29' @ 319.82 degrees. Survey at 2583' (TVD 2581.23'), 88.49' @ 319.45 degrees.

2:45 AM – 3:30 AM Rigged down power swivel and survey tools.

3:30 AM – 5:30 AM Tripped out drilling assembly #1.

5:30 AM – 6:00 AM Rigged down drilling assembly #1.

6:00 AM - 7:30 AM Rigged up gyro survey tools.
7:30 AM – 8:45 AM Rigged up same drilling assembly #2 (Smith tri-cone bit #1 MF15GP, 4 degree fixed motor #2, slick flex joint, mule shoe sub, 4 flex monel collars, and cross over sub).

8:45 AM – 12:30 PM Tripped in hole (had to push down until weight of drill string pulled it) with drilling assembly #2.

12:30 PM – 2:30 PM Rigged up power swivel and steering tools.

2:30 PM – 12:00 AM Drilled from 2583' to 2636'. Ran bottom hole surveys at 2598', 2613', and 2620'.
Survey at 2598' (TVD 2595.92'), 91.33' @ 323.00 degrees.
Survey at 2613' (TVD 2609.42'), 97.77' @ 318.10 degrees.
Survey at 2620' (TVD 2615.03'), 101.92' @ 315.60 degrees.

THURSDAY 8-27-98

12:00 AM – 1:15 AM Drilled from 2636' to 2642' (total 59').
Slide with 8000 – 10000 lbs WOB, 80 GPM @ 1000 psi. Ran bottom survey at 2638'.
Survey at 2638' (TVD 2626.88'), 115.29' @ 316.50 degrees.

1:15 AM – 1:30 AM Circulated.

1:30 AM – 2:45 AM Rigged down power swivel and survey tools.

2:45 AM – 4:00 AM	Tripped out with drilling assembly #2.
4:00 AM – 5:00 AM	Rigged down drilling assembly #2. Bit came out nubbed off and 1/8" under gage. Rigged up drilling assembly #3 (Smith tri-cone bit #2 MF15G, motor #3 adjusted to 1.5 degrees, slick flex joint, mule shoe sub, 4 flex monel collars, and cross over sub).
5:00 AM – 5:45 AM	Tripped in hole with drilling assembly #3.
5:45 AM	Dropped bit, motor, collars and 5 joints of drill pipe in hole.
5:45 AM - 7:30 AM	Rigged up fishing tools (3 5/8" overshot, 2 7/8" grapple and bumper jar).
7:30 AM – 9:30 AM	Tripped in hole with fishing tools.
9:30 AM – 9:45 AM	Fished bit, motor, collars and drill pipe.
9:45 AM – 11:30 AM	Tripped out with fish.
11:30 AM – 12:30 PM	Rigged down dropped drilling assembly #3 and checked for damage. Layed aside bit and motor.
12:30 PM – 1:30 PM	Rigged up drilling assembly #4 (Varel tri-cone bit #3 ETD536C, motor #4 adjusted to 1.5 degrees,slick flex joint, mule shoe sub, 4 flex monel collars, and cross over sub).
1:30 PM – 3:45 PM	Tripped in hole with drilling assembly #4.
3:45 PM – 4:30 PM	Rigged up power swivel and steering tools. Circulate.
4:30 PM – 6:45 PM	Work pipe and ream to 2642'.
6:45 PM – 12:00 AM	Drill from 2642' to 2711'. Ran bottom hole surveys at 2647', 2663', 2677', 2691' and 2709'. Survey at 2647' (TVD 2631.38'), 123.03' @ 317.91 degrees. Survey at 2663' (TVD 2638.09'), 137.48' @ 317.91 degrees. Survey at 2677' (TVD 2642.94'), 150.53' @ 316.30 degrees. Survey at 2691' (TVD 2646.81'), 163.89' @ 315.60 degrees. Survey at 2709' (TVD 2650.64'), 181.35' @ 316.70 degrees.

FRIDAY 8-28-98

12:00 AM – 12:15 AM	Drilled from 2711' to 2713' (total 71'). Slide from 2642' – 2699' with 10000 lbs WOB, 80 GPM @ 1000 psi. Rotated from 2699' – 2713' with 8000 lbs WOB, 15 RPM, 80 GPM @ 1000 psi.
12:15 AM – 1:00 AM	Circulated.
1:00 AM – 1:45 AM	Rigged down power swivel and steering tools.
1:45 AM – 3:30 AM	Tripped out drilling assembly #4.

3:30 AM – 4:00 AM	Rigged down drilling assembly #4. Bit came out nubbed off and ¼” under gage. Rigged up drilling assembly #5 (Smith tri-cone bit #4 MF15GP, motor #4 adjusted to 1.5 degrees, slick flex joint, mule shoe sub, 4 flex monel collars, and cross over sub).
4:00 AM – 5:45 AM	Tripped in hole with drilling assembly #5.
5:45 AM – 7:30 AM	Find bottom of gauge hole. Rigged up power swivel and steering tools.
7:30 AM – 9:30 AM	Reamed hole from 2630’ to 2713’, rotated with 5000 lbs WOB , 15 RPM, 59 SPM @ 1050 psi.
9:30 AM – 6:00 PM	Drilled from 2713’ to 2806’ (total 93’). Rotated from 2713’ – 2728’ with 8000 lbs WOB, 15 RPM, 80 GPM @ 1050 psi. Slide from 2728’ – 2755’ with 10000 – 15000 lbs WOB, 80 GPM @ 1050 psi. Rotated from 2755’ - 2793’ with 7000 lbs WOB, 15 RPM, 80 GPM @ 1050 psi. Slide from 2793’ – 2798’ with 15000 lbs WOB, 80 GPM @ 1050 psi. Rotated from 2798’ – 2806’ with 7000 lbs WOB, 15 RPM, 80 GPM @ 1050 psi. Ran surveys at 2733’, 2762’, 2771’, 2788’ and 2802’. Survey at 2733’ (TVD 2654.60’), 204.91’ @ 318.00 degrees. Survey at 2762’ (TVD 2657.41’), 233.72’ @ 321.20 degrees. Survey at 2771’ (TVD 2657.86’), 242.70’ @ 321.30 degrees. Survey at 2788’ (TVD 2658.81’), 259.67’ @ 321.60 degrees. Survey at 2802’ (TVD 2659.43’), 273.65’ @ 321.20 degrees.
6:00 PM – 6:15 PM	Circulated.
6:15 PM – 6:45 PM	Rigged down power swivel and steering tools.
6.45 PM – 8:30 PM	Tripped out drilling assembly #5.
8:30 PM – 9:15 PM	Rigged down drilling assembly #5. Bit came out nubbed off and 1/8” under gage. Rigged up drilling assembly #6 (Smith tri-cone bit #5 MF15GP, motor #4 adjusted to 1.5 degrees, slick flex joint, mule shoe sub, 4 flex monel collars, and cross over sub).
9:15 PM – 12:00 AM	Tripped in hole with drilling assembly #6.

Saturday 8-29-98

12:00 AM – 12:15 AM	Rigged up power swivel and steering tools.

12:15 AM – 7:30 AM	Drilled from 2806’ to 2917’ (total 111’). Rotated from 2806’ – 2810’ with 7000 lbs WOB, 15 RPM, 80 GPM @ 1150 psi. Slide from 2810’ – 2816’ with 15000 lbs WOB, 80 GPM @ 1150 psi. Rotated from 2816’ – 2917’ with 8000 lbs WOB, 15 RPM, 80 GPM @ 1150 psi. Ran surveys at 2833’, 2848’, 2864’ and 2895’. Survey at 2833’ (TVD 2659.89’), 304.64’ @ 322.44 degrees. Survey at 2848’ (TVD 2659.83’), 319.64’ @ 323.50 degrees. Survey at 2864’ (TVD 2659.69’), 335.64’ @ 323.20 degrees. Survey at 2895’ (TVD 2659.66’), 366.64’ @ 323.90 degrees.
7:30 AM	TD well at 2917’. Projected bottom hole location from last survey at 2895’ is 2917’ (TVD 2659.94’), 388.64’ @ 323.90 degrees.
7:30 AM – 8:30 AM	Circulated.
8:30 AM – 10:30 AM	Rigged down power swivel and steering tools. Oncourse released.
10:30 AM – 12:15 PM	Tripped out drilling assembly #6.
12:15 PM – 1:00 PM	Rigged down drilling assembly #6. Bit came out nubbed off and 1/8” under gage. Released Wilson Downhole Services and Weatherford Enterra.

WELL COMPLETION

Saturday 8-29-98

1:00 PM – 1:45 PM	Made up slotted, orange peeled and bent bottom joint in preparation to acidize well.
1:45 PM – 3:15 PM	Tripped in hole with drill string (bottom joint slotted).
3:15 PM – 3:45 PM	Rigged up Universal Well Services for acid job.
3:45 PM – 4:15 PM	Acidized well. Circulate hole with salt water. Pump 500 gal. (11.9 bbl) of 28 % HCl with iron control. Shut in pipe rams and annular BOP. Breakdown formation. Formation started taking fluid at 600 psi. Pumped 3 bbl at 2.5 BPM and 950 psi. ISIP 200 psi. Pumped remainder of acid at 3.98 BPM and 1400 to 1600 psi. Total displaced fluid was 10 bbls. ISIP 350 psi. After 5 min. 0 psi. Open kill lines, well on vacuum. Release BOP. Closed frac. valve beneath BOP. Released Universal Well Services.
4:15 PM – 6:00 PM	Tripped out drill string. Released Limestone Drilling.

SAMPLE DESCRIPTION FOR THE MARING #3-B SRH WELL

Drilled Depth	Sample Description	Sample Shows
2585' – 2590'	45% - **Shale**, black, blocky, some calcareous. 45% - **Limestone**, very fine to medium crystalline, white, light brown to dark brown, dark lime-stone is argillaceous, few fossils. 10% - **Chert**, light to medium brown, translucent, some black inclusions.	No show – scattered dull mineral fluorescence.
2590' – 2595'	60% - **Limestone**, very fine to medium crystalline, white, light brown to dark brown, dark lime-stone is argillaceous, few fossils. 30% - **Shale**, same as above. 10% - **Chert**, same as above.	No show – same as above.
2595' – 2600'	90% - **Limestone**, same as above. 10% - **Chert**, same as above.	No show – same as above.
2600' – 2605'	80% - **Limestone**, very fine to medium crystalline, white, light brown to dark brown. 20% - **Chert**, same as above.	**Poor Show –** scattered mineral fluorescence, faint milky cut with acid in white crystalline limestone and calcite.
2605' – 2610'	80% - **Limestone**, same as above (only few dark pieces). 20% - **Chert**, same as above.	**Poor Show –** same as above.
2610' – 2615'	80% - **Limestone**, same as above (only few dark pieces). 20% - **Chert**, same as above.	No show – scattered dull mineral fluorescence.
2615' – 2620'	80% - **Limestone**, very fine to medium crystalline, white, light brown to dark brown, dark lime-stone is argillaceous, few fossils. 20% - **Chert**, , light to medium brown, translucent, some black inclusions. Trace - Shale, black, blocky, some calcareous.	**Poor Show –** scattered mineral fluorescence, faint milky cut with acid in white crystalline limestone and calcite.

Drilled Depth	Sample Description	Sample Shows
2620' – 2625'	80% - **Limestone**, very fine to medium crystalline, white, light brown to dark gray-brown, dark limestone is argillaceous. 20% - **Chert**, light brown to gray brown, translucent, some black inclusions.	**Poor Show** – same as above.
2625' – 2630'	**Fracture Zone** 80% - **Limestone**, same as above. 20% - **Chert**, same as above.	**Fair Show** – scattered mineral fluorescence, faint milky cut with acid in white crystalline limestone and calcite. **One sample with micro-fracture**, oil fluorescence in fracture, poor milky cut with acid.
2630' – 2635'	**Fracture Zone** 80% - **Limestone**, same as above. 20% - **Chert**, same as above.	**Poor Show** – scattered mineral fluorescence, faint milky cut with acid in white crystalline limestone and calcite.
2635' – 2640'	**Fracture Zone** 70% - **Limestone**, very fine to coarse crystalline, white, light brown to dark gray-brown. 30% - **Chert**, same as above. Trace - Euhedral calcite and pyrite.	**Fair Show** – scattered mineral fluorescence, some very bright, poor milky cut in white crystalline limestone and calcite.
2640' – 2645'	**Fracture Zone** 90% - **Limestone**, very fine to medium crystalline, white, light brown to dark gray-brown (only few dark pieces). 10% - **Chert**, same as above. Trace - Pyrite.	**Poor Show** – scattered mineral fluorescence, poor milky cut in white crystalline limestone and calcite.
2645' – 2650'	60% - **Chert**, light brown to gray-brown, translucent, some black inclusions. 40% - **Limestone**, very fine to medium crystalline, white, light brown to dark gray-brown, dark limestone is argillaceous. Trace - Shale, black, blocky, some calcareous.	**Poor Show** – scattered mineral fluorescence, poor milky cut in white crystalline limestone and calcite.
2650' – 2655'	60% - **Chert**, same as above. 40% - **Limestone**, same as above.	**Poor Show** – same as above.

Drilled Depth	Sample Description	Sample Shows
2655' – 2660'	60% - **Chert**, same as above. 40% - **Limestone**, same as above.	**Fair Show** – scattered mineral fluorescence, some very bright, poor milky cut in white crystalline limestone and calcite.
2660' – 2665'	70% - **Limestone**, same as above. 30% - **Chert**, same as above.	No show – scattered dull mineral fluorescence.
2665' – 2670'	60% - **Limestone**, same as above, increase in dark colored limestone. 40% - **Chert**, same as above.	No show – same as above.
2670' – 2675'	70% - **Limestone**, same as above. 30% - **Chert**, same as above.	No show – same as above.
2675' – 2680'	70% - **Limestone**, same as above. 30% - **Chert**, same as above.	No show – same as above.
2680' – 2685'	60% - **Limestone**, same as above. 40% - **Chert**, same as above.	No show – same as above.
2685' – 2690'	**Fracture Zone** 80% - **Limestone**, very fine to medium crystalline, white, light brown to dark gray-brown, dark limestone is argillaceous, most of limestone is gray-brown, some fossils. 20% - **Chert**, , light brown to gray-brown, translucent, some black inclusions.	**Fair Show** – scattered dull mineral fluorescence, faint milky cut with acid in white crystalline limestone and calcite. **One sample with micro-fracture**, oil fluor-escence in fracture, milky cut with acid.
2690' – 2695'	**Fracture Zone** 80% - **Limestone**, very fine to medium crystalline, white, light brown to dark gray-brown, dark limestone is argillaceous, some fossils. 20% - **Chert**, , same as above.	**Good Show** – scattered mineral fluorescence, few bright pieces, milky cut. **Several samples with micro-fractures**, oil fluor-in fractures, milky cut, one sample with streaming cut.

Drilled Depth	Sample Description	Sample Shows
2695' – 2700'	60% - **Limestone**, very fine to medium crystalline, white, light brown to dark gray-brown. 40% - **Chert**, , same as above.	No show – scattered dull mineral fluorescence.
2700' – 2705'	60% - **Limestone**, very fine to medium crystalline, white, light brown to dark gray-brown. 40% - **Chert**, , same as above.	**Poor Show** – scattered mineral fluorescence, poor milky cut with acid in white crystalline limestone and calcite.
2705' – 2710'	**Fracture Zone** 60% - **Limestone**, very fine to medium crystalline, white, light brown. 40% - **Chert**, , same as above.	**Fair Show** – scattered mineral fluorescence, poor milky cut with acid in white crystalline limestone and calcite. **Several samples with micro-fractures**, oil fluorescence in fractures, milky cut with acid.
2710' – 2715'	50% - **Limestone**, same as above. 50% - **Chert**, same as above.	**Poor Show** – scattered mineral fluorescence, poor milky cut with acid in white crystalline limestone and calcite.
2715' – 2720'	80% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown. 20% - **Chert**, light brown to gray-brown, translucent, some black inclusions.	No show – scattered dull mineral fluorescence.
2720' – 2725'	90% - **Limestone**, same as above. 10% - **Chert**, same as above.	No show – same as above.
2725' – 2730'	90% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown, fractures filled with calcite. 10% - **Chert**, same as above.	No show – same as above.
2730' – 2735'	90% - **Limestone**, same as above. 10% - **Chert**, same as above.	No show – same as above.

Drilled Depth	Sample Description	Sample Shows
2735' – 2740'	80% - **Limestone**, same as above. 20% - **Chert**, same as above.	No show – same as above.
2740' – 2745'	**Fracture Zone** 70% - **Limestone**, same as above. 30% - **Chert**, same as above.	**Fair Show** – scattered dull mineral fluorescence. **Several samples with micro-fractures,** oil fluorescence in fractures, milky cut with acid.
2745' – 2750'	80% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown. 20% - **Chert**, same as above.	No show – scattered dull mineral fluorescence.
2750' – 2755'	90% - **Limestone**, same as above. 10% - **Chert**, same as above.	No show – same as above.
2755' – 2760'	80% - **Limestone**, same as above. 20% - **Chert**, same as above.	No show – same as above.
2760' – 2765'	80% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown. 20% - **Chert**, light brown to gray-brown, translucent, some black inclusions.	No show – scattered dull mineral fluorescence.
2765' – 2770'	**No Sample**	
2770' – 2775'	**No Sample**	
2775' – 2780'	70% - **Limestone**, same as above. 30% - **Chert**, same as above.	No show – same as above.
2780' – 2785'	70% - **Limestone**, same as above. 30% - **Chert**, same as above.	**Poor Show** – scattered mineral fluorescence, poor milky cut with acid in white crystalline limestone and calcite.

Drilled Depth	Sample Description	Sample Shows
2785' – 2790'	60% - **Limestone**, same as above. 40% - **Chert**, same as above.	No show – scattered dull mineral fluorescence.
2790' – 2795'	80% - **Chert**, same as above. 20% - **Limestone**, same as above.	No show – same as above.
2795' – 2800'	80% - **Chert**, same as above. 20% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown, some glauconite grains in white limestone and chert.	No show – same as above.
2800' – 2805'	70% - **Chert**, same as above. 30% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown, some glauconite grains in white limestone and chert.	**Fair Show** – scattered mineral fluorescence, poor milky cut in white crystalline limestone and calcite.
2805' – 2810'	70% - **Chert**, light brown to gray-brown, translucent, some black inclusions. 30% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown.	No show – scattered dull mineral fluorescence.
2810' – 2815'	70% - **Chert**, same as above. 30% - **Limestone**, same as above.	No show – same as above.
2815' – 2820'	70% - **Chert**, same as above. 30% - **Limestone**, same as above.	No show – same as above.
2820' – 2825'	**Fracture Zone** 90% - **Chert**, same as above. 10% - **Limestone**, same as above.	**Fair Show** – scattered mineral fluorescence, poor milky cut in white crystalline limestone and calcite, **faint oil odor in sample bag**.
2825' – 2830'	**Fracture Zone** 90% - **Chert**, same as above. 10% - **Limestone**, same as above.	**Fair Show** – same as above.

Drilled Depth	Sample Description	Sample Shows
2830' – 2835'	**Fracture Zone** 90% - **Chert**, same as above. 10% - **Limestone**, same as above.	**Fair Show** – same as above
2835' – 2840'	**Fracture Zone** 90% - **Chert**, same as above, euhedral calcite rinds. 10% - **Limestone**, same as above.	**Good Show -** moderate fluorescence, good milky cut with acid in white crystalline limestone and calcite, **good oil odor in sample bag.**
2840' – 2845'	**Fracture Zone** 90% - **Chert**, same as above, euhedral calcite rinds. 10% - **Limestone**, same as above.	**Excellent Show** - abundant fluorescence, good milky cut with acid in white crystalline limestone and calcite, **strong oil odor in sample bag.**
2845' – 2850'	**Fracture Zone** 90% - **Chert**, light brown to gray-brown, translucent, some black inclusions. 10% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown.	**Excellent Show** - abundant fluorescence, good milky cut with acid in white crystalline limestone and calcite, **strong oil odor in sample bag.**
2850' – 2855'	**Fracture Zone** 90% - **Chert**, same as above. 10% - **Limestone**, same as above.	**Good Show** - abundant fluorescence, good milky cut with acid in white crystalline limestone and calcite, **slight oil odor in sample bag.**
2855' – 2860'	**Fracture Zone** 90% - **Chert**, same as above. 10% - **Limestone**, same as above.	**Good Show** – abundant bright fluorescence, good milky cut with acid in white crystalline limestone and calcite.
2860' – 2865'	**Fracture Zone** 90% - **Chert**, same as above. 10% - **Limestone,** same as above.	**Excellent Show** - abundant bright fluorescence, immediate milky cut and excellent milky cut with acid in white crystalline limestone and calcite.

Drilled Depth	Sample Description	Sample Shows
2865' – 2870'	**Fracture Zone** 90% - **Chert**, same as above. 10% - **Limestone**, same as above.	**Excellent Show** – same as above.
2870' – 2875'	**Fracture Zone** 90% - **Chert**, same as above. 10% - **Limestone**, same as above.	**Excellent Show** – same as above.
2875' – 2880'	**Fault Zone** 70% - **Chert**, light brown to gray-brown, translucent, some black inclusions, some pyrite . 30% - **Limestone**, very fine to medium crystalline, white, light brown to dark gray-brown, black, black limestone argillaceous.	**Good Show** – abundant bright fluorescence, poor milky cut and good milky cut with acid in white crystalline limestone and calcite.
2880' – 2885'	**Fault Zone** 60% - **Chert**, light brown to gray-brown, translucent, some black inclusions. 40% - **Limestone**, same as above.	**Good Show** - abundant bright fluorescence, poor milky cut and good milky cut with acid in white crystalline limestone and calcite.
2885' – 2890'	**Fault Zone** 50% - **Chert**, same as above. 50% - **Limestone**, same as above, euhedral calcite rinds.	**Excellent Show** - abundant bright fluorescence, excellent milky cut with acid in white crystalline limestone and calcite.
2890' – 2895'	**Fault Zone** 70% - **Limestone**, same as above, many fractures filled with crystalline calcite, some pieces completely surrounded with calcite rinds. 30% - **Chert**, same as above.	**Excellent Show** – same as above.
2895' – 2900'	**Fracture Zone** 90% - **Limestone**, same as above, many fractures filled with crystalline calcite, some pieces completely surrounded with calcite rinds, pyrite inclusions in dark limestone. 10% - **Chert**, same as above. Trace - Shale, black.	**Excellent Sh**ow – same as above.

Drilled Depth	Sample Description	Sample Shows
2900' – 2905'	**Fracture Zone** 90% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown. 10% - **Chert**, same as above.	**Good Show** - abundant bright fluorescence, poor milky cut and good milky cut with acid in white crystalline limestone and calcite.
2905' – 2910'	90% - **Limestone**, very fine to medium crystalline, white, light brown to dark gray-brown, black, black limestone argillaceous. 10 % - **Chert**, light brown to gray-brown, translucent, some black inclusions.	**Fair Show** – scattered fluorescence, some bright, milky cut with acid in white crystalline limestone and calcite.
2910' – 2915'	90% - **Limestone**, same as above. 10% - **Chert**, same as above.	**Poor Show –** scattered dull fluorescence, poor milky cut with acid in white crystalline limestone and calcite.
2915' – 2917'	90% - **Limestone**, very fine to medium crystalline, white, light brown to gray-brown. 10% - **Chert**, light brown to gray-brown, translucent, some black inclusions. **Reached Total Depth @ 2917'**	No show – scattered dull mineral fluorescence.

REPORT OF DOWNHOLE SURVEY

SMITH DRILLING
& COMPLETIONS

Date: September 15, 1998

Company: Resource America, Inc.

Well: Maring 3-B

Location: Chautauqua County
New York

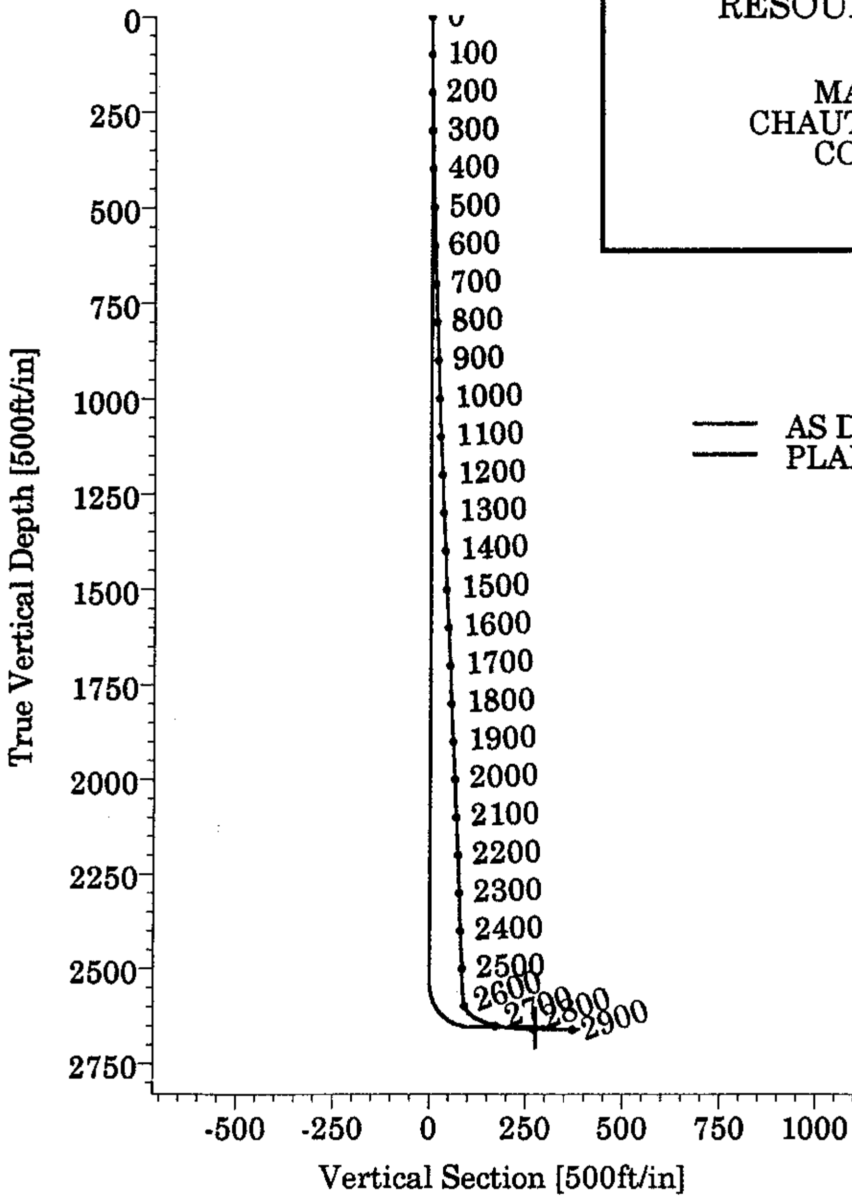
Magnetic Declination: 9.87° West, True

WILSON DOWNHOLE SERVICES
220 E. Sixteenth St. • P.O. Box 504 • Traverse City, MI 49684
Phone: (616) 947-2977 • Fax: (616) 947-2978

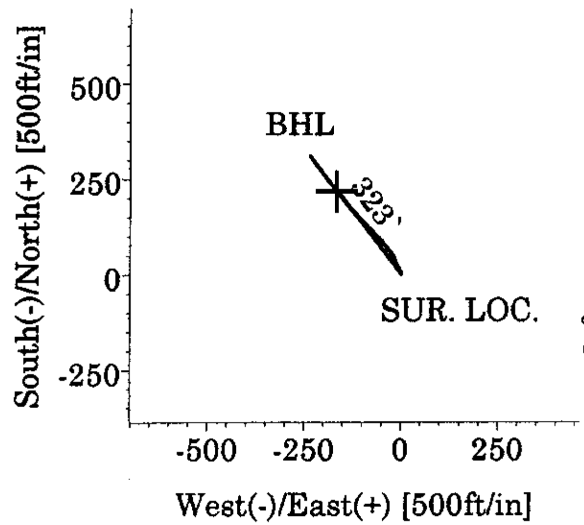
RESOURCES AMERICA INC.

MARING WELL #3-B
CHAUTAUQUA COUNTY, NY
COMPLETION PLOT

SMITH DRILLING & COMPLETIONS



LEGEND
AS DRILLED
PLANNED WELL



C-2

BHL AS DRILLED
308.5' NORTH - 236.4' WEST OF SURFACE
DISPL: 388.6' @ 322.54` (N 37.46` W)

G/T
M

All Angles Relative
To Local North

Grid North: 0.00
True North: 0.00
Magnetic North: -9.87

RESOURCES AMERICA
Field: CHAUTAUQUA COUNTY, NY
Site: MARING
Well: 3-B
Wellpath: AS DRILLED
Plan: PLANNED WELL

SMITH DRILLING & COMPLETIONS
A Business Unit of Smith International, Inc.
WILSON DOWNHOLE SERVICES

45	2771.0	87.00	2657.9	242.7	321.30	192.4	-147.9	242.7	322.45	2.48
46	2788.0	86.60	2658.8	259.7	321.60	205.7	-158.5	259.7	322.38	2.94
47	2802.0	88.30	2659.4	273.6	321.20	216.6	-167.2	273.6	322.33	12.47
48	2833.0	90.00	2659.9	304.6	322.40	241.0	-186.4	304.6	322.28	6.71

C-3

Wilson Downhole Services

Downhole Survey Report

Company:	RESOURCES AMERICA	Date: 9/15/98	Time: 09:44:08 Page: 1
Field:	CHAUTAUQUA COUNTY, NY	Co-ordinate(NE) Reference:	Site: MARING, Grid North
Site:	MARING	Vertical (TVD) Reference:	SITE 0.0 above Mean Sea Level
Well:	3-B	Section (VS) Reference:	Slot (0.0E,0.0N,322.8Azi)
Wellpath:	AS DRILLED	Survey Calculation Method:	Radius of Curvature

Survey: 857-26711
Maring Well # 3-B

Start Date: 8/28/98

Company: Resources America

Engineer: Vern Strassburg/R. Molski

Tool:

Survey

Stn.	MD ft	Incl deg	TVD ft	VS ft	Azim deg	N/S ft	E/W ft	ClsD ft	ClsA deg	DLS d/100ft
1	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.0	0.00	0.00
2	100.0	0.56	100.0	0.2	26.11	0.4	0.2	0.5	26.11	0.56
3	200.0	0.64	200.0	0.8	14.04	1.4	0.6	1.5	22.00	0.15
4	300.0	0.97	300.0	1.9	340.28	2.8	0.5	2.8	10.22	0.56
5	400.0	1.30	400.0	3.9	324.81	4.6	-0.4	4.6	354.92	0.45
6	500.0	1.49	499.9	6.3	322.74	6.5	-1.8	6.8	344.21	0.20
7	600.0	1.85	599.9	9.2	330.49	9.0	-3.4	9.6	338.94	0.42
8	700.0	1.89	699.8	12.4	331.89	11.8	-5.0	12.8	336.98	0.06
9	800.0	1.92	799.8	15.7	334.10	14.8	-6.5	16.2	336.16	0.08
10	900.0	1.97	899.7	19.1	332.46	17.8	-8.1	19.5	335.66	0.07
11	1000.0	1.98	999.7	22.4	333.93	20.9	-9.6	23.0	335.29	0.05
12	1100.0	2.01	1099.6	25.9	333.66	24.0	-11.1	26.5	335.09	0.03
13	1200.0	2.29	1199.5	29.5	340.25	27.5	-12.6	30.2	335.32	0.37
14	1300.0	2.47	1299.4	33.5	338.15	31.3	-14.1	34.4	335.79	0.20
15	1400.0	2.62	1399.3	37.8	335.40	35.4	-15.8	38.8	335.90	0.19
16	1500.0	2.65	1499.2	42.3	336.98	39.6	-17.7	43.4	335.93	0.08
17	1600.0	2.63	1599.1	46.8	333.68	43.8	-19.6	48.0	335.88	0.15
18	1700.0	2.58	1699.0	51.2	331.20	47.8	-21.7	52.5	335.58	0.12
19	1800.0	2.49	1798.9	55.6	327.64	51.6	-24.0	56.9	335.10	0.18
20	1900.0	2.51	1898.8	60.0	325.82	55.3	-26.4	61.3	334.51	0.08
21	2000.0	2.59	1998.7	64.4	325.52	59.0	-28.9	65.7	333.91	0.08
22	2100.0	2.42	2098.6	68.8	323.08	62.5	-31.4	70.0	333.31	0.20
23	2200.0	2.37	2198.6	73.0	322.19	65.8	-34.0	74.1	332.71	0.06
24	2300.0	2.23	2298.5	77.0	321.59	69.0	-36.4	78.0	332.16	0.14
25	2400.0	2.11	2398.4	80.8	319.68	71.9	-38.8	81.7	331.63	0.14
26	2500.0	2.06	2498.3	84.4	319.83	74.7	-41.2	85.3	331.13	0.05
27	2535.0	1.90	2533.3	85.6	324.84	75.7	-41.9	86.5	331.01	0.67
28	2540.0	2.17	2538.3	85.8	323.08	75.8	-42.0	86.7	330.99	5.54
29	2550.0	3.45	2548.3	86.3	320.65	76.2	-42.3	87.2	330.94	12.85
30	2560.0	3.88	2558.3	86.9	319.48	76.7	-42.7	87.8	330.86	4.36
31	2570.0	3.92	2568.3	87.6	320.62	77.2	-43.2	88.4	330.78	0.87
32	2580.0	3.78	2578.2	88.3	319.82	77.7	-43.6	89.1	330.70	1.50
33	2583.0	3.88	2581.2	88.5	319.45	77.9	-43.7	89.3	330.68	3.43
34	2598.0	18.00	2595.9	91.3	323.00	80.1	-45.5	92.1	330.39	94.20
35	2613.0	33.10	2609.4	97.8	318.10	85.1	-49.6	98.5	329.74	101.57
36	2620.0	40.10	2615.0	101.9	315.60	88.1	-52.5	102.5	329.22	102.22
37	2638.0	57.20	2626.9	115.3	316.50	97.8	-61.8	115.7	327.70	95.07
38	2647.0	62.70	2631.4	123.0	317.10	103.5	-67.1	123.3	327.02	61.38
39	2663.0	67.70	2638.1	137.5	317.10	114.1	-77.0	137.7	325.98	31.25
40	2677.0	71.80	2642.9	150.5	316.30	123.7	-86.0	150.6	325.17	29.77
41	2691.0	76.10	2646.8	163.9	315.60	133.3	-95.4	163.9	324.42	31.09
42	2709.0	79.30	2650.6	181.3	316.70	146.0	-107.6	181.4	323.62	18.75
43	2733.0	81.70	2654.6	204.9	318.00	163.4	-123.6	204.9	322.90	11.34
44	2762.0	87.20	2657.4	233.7	321.20	185.4	-142.3	233.7	322.49	21.91
45	2771.0	87.00	2657.9	242.7	321.30	192.4	-147.9	242.7	322.45	2.48
46	2788.0	86.60	2658.8	259.7	321.60	205.7	-158.5	259.7	322.38	2.94
47	2802.0	88.30	2659.4	273.6	321.20	216.6	-167.2	273.6	322.33	12.47
48	2833.0	90.00	2659.9	304.6	322.40	241.0	-186.4	304.6	322.28	6.71

Wilson Downhole Services
Downhole Survey Report

Company:	RESOURCES AMERICA	Date: 9/15/98 Time: 09:44:06	Page: 2
Field:	CHAUTAUQUA COUNTY, NY	Co-ordinate(NE) Reference:	Site: MARING, Grid North
Site:	MARING	Vertical (TVD) Reference:	SITE 0.0 above Mean Sea Level
Well:	3-B	Section (VS) Reference:	Slot (0.0E,0.0N,322.8Azi)
Wellpath:	AS DRILLED	Survey Calculation Method:	Radius of Curvature

Survey

Stn	MD ft	Incl deg	TVD ft	VS ft	Azim deg	N/S ft	E/W ft	ClsD ft	ClsA deg	DLS d/100ft
49	2848.0	90.50	2659.8	319.6	323.50	252.9	-195.4	319.6	322.31	8.06
50	2864.0	90.50	2659.7	335.6	323.20	265.8	-205.0	335.6	322.36	1.87
51	2895.0	89.60	2659.7	366.6	323.90	290.7	-223.4	366.6	322.46	3.68
52	2917.0	88.97	2659.9	388.6	323.90	308.5	-236.4	388.6	322.54	2.86