A. L. Hickerson

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PROFESSIONAL ENGINEER
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RESIDENCE:
3216 BAINBRIDGE DRIVE
ODESSA, TEXAS 79762
PHONE: (915) 362-4814

April 12, 1991

Mike Williams
Stewart Rogers Schlock
210 620 1592

Ms. Valerie Pierce
B & E, Inc.
P.O. Box 756
Carlsbad, New Mexico 88220

Dear Ms. Pierce:

At your telephone request I have reviewed our Carlsbad Eugenie Brine well files.

Fresh water is injected down the tubing (set at 583') of the No. 2 well, circulated through the rock salt section to the No. 1 well, where it is forced up the tubing, set at 587 feet. (Please see attached sketch.)

As the fresh water circulates, it tends to move upward as it moves through the salt. This is because fresh water is lighter than brine, 1.0 SP.GR, as compared to 1.2 SP.GR for brine. However, as the water moves through the brine and along the face of the rock salt, it becomes more saturated until it reaches complete saturation. It has been found by research that the cavern formed by the dissolution of the salt well is roughly triangular in shape, being somewhat larger in the fresh water end of the triangle.

However, assuming that the cavern is triangular, its dimensions can be calculated. Assuming that 4,250,000 barrels (1,366,000 sold from July 1979 through April of 1983) of brine have been sold - divide by 7 (each seven barrels of brine dissolves out approximately one barrel of cavern) gives a cavern of about 607,142 barrels capacity. Multiply by 5.61 (cu.ft per bbl) gives 3,406,071 cu. ft. in cavern. Divide by 350 feet (distance between wells - 327 feet and some washout) gives 9,731 square feet for cross sectional area of triangle. Divide by 127/2 (depth of cavern and divide by 2 to get area of triangle) gives a top dimension of caverns to be 153 feet.

In my opinion this is not excessive, based on amount and kind of hard rock overburden at this site. You usually have some warning of danger of caving or sloughing of the roof of the cavern, in the form of minor cavings which would break or bend the 2 7/8" in the No. 2 well.

However, there is always the possibility of major subsidence. In your location, and the degree of liability exposure, I would recommend that you put about 300 barrels of crude oil down the No. 2 well. This crude will float on top of the brine in the cavern and effectively prevent further dissolution of the cavern roof. I would also recommend that serious consideration be given to the drilling of a third well to greatly minimize any danger of subsidence. See attached plat for location.

Attached are copies of pertinent articles. You may be able to locate your cavern by use of a seismograph truck. I have never tried such a method.

Articles - "Yes, We Can Locate Solution Cavity Boundaries"
- "The Problem of Subsidence In Salt Producing Areas"
- "Brine Field Subsidence At Windsor, Ontario"

Hoping this information will be of help to you, I am,

Sincerely,

A.L. Hickerson

ALH/scd

Attachments

B & E EUGENIE BRINE WELLS

[redacted] (PRODUCTION)

No 2 well (INJECTION)

BRINE WATER OUT

FRESH WATER IN

SAND & GRAVEL

40' GRAVEL

98' RED BEDS

10' HARD LIMESTONE

42' RED BEDS

12' ANHYDRITE

70' STRIPS OF ANHYDRITE & RED BEDS

GYPSUM & ANHYDRITE

LIMESTONE & SANDSTONE

TOP OF SALT 456'

CAVERN

ROCK SALT

LIME & SHALE STRINGER

BOTTOM OF SALT 692'

FRACTURE INITIATED BETWEEN WELLS

ANHYDRITE TO 648'

5½ CEMENTED TO 285'

9 5/8 CEMENTED TO 349.4'

2⅞ to 583' CEMENTED TO 523'

5½" CEMENTED TO 456'

SCALE 1" = 100'

CROSS SECTION

OIL CONSERVATION DIVISION
ARTESIA, NEW MEX. 88210

TO: Stewart Rogers - Scurlock Permian 210 620 1592

FROM: Jim Morrow

DATE: 5-25-94

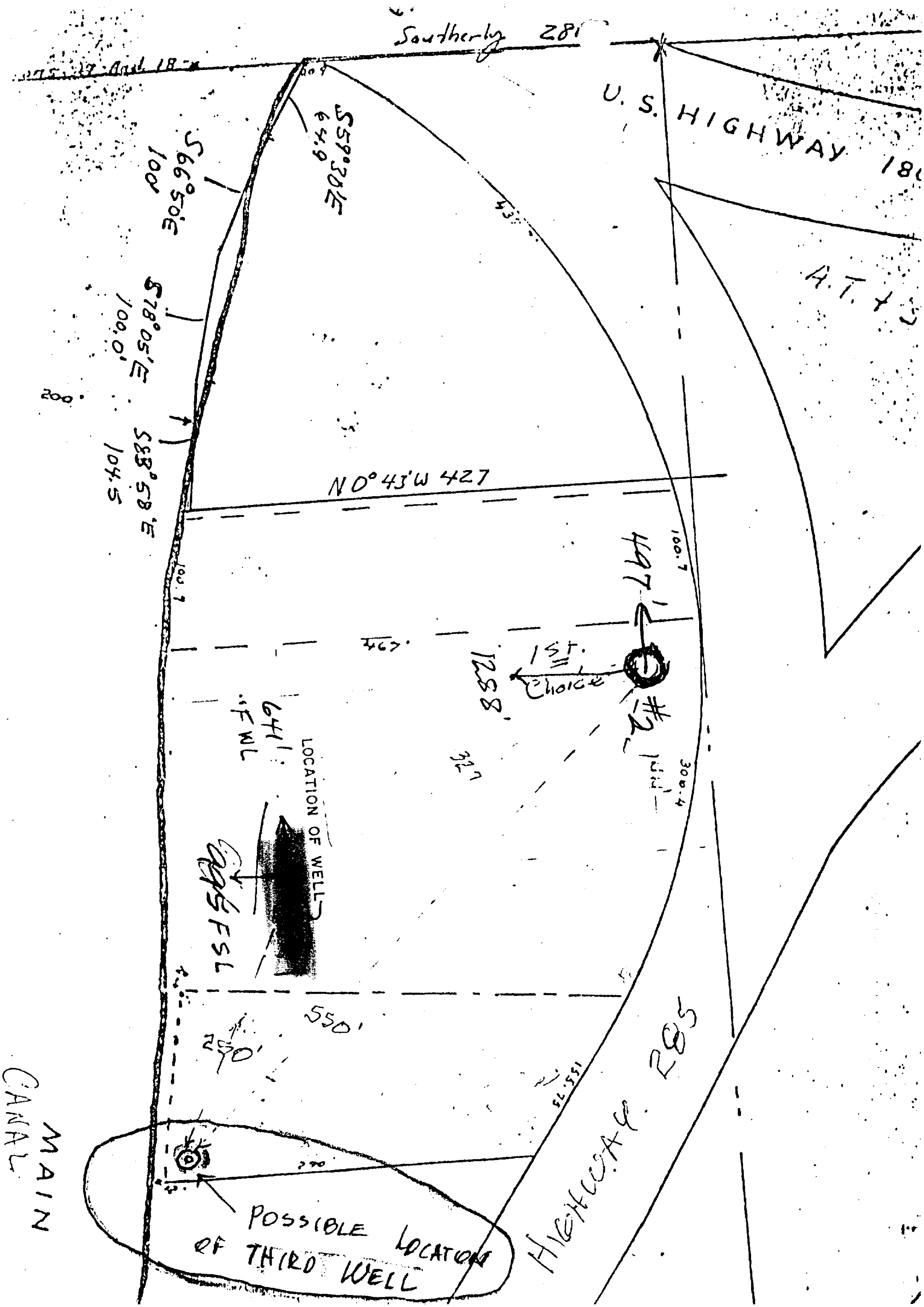
NUMBER OF SHEETS (INCLUDING TRANSMITTAL SHEET) 5

IF YOU HAVE ANY PROBLEMS WITH THIS TRANSMISSION, PLEASE CALL 505-748-1283.

FAX NUMBER (505) 748-9720

Here is Hickerson's letter.

JHM


Southerly 281
U.S. HIGHWAY 18
A.T.
S59°30'E 64.9
S66°50'E 100
S78°05'E 100.0'
S88°58'E 104.5
200
N 0° 43' W 427
100.7
1st Choice
1288'
#2
300.4
641' FWL
LOCATION OF WELL
995 FSL
550'
250'
HIGHWAY 285
MAIN CANAL
POSSIBLE LOCATION OF THIRD WELL