SUMMARY OF STATE OF NEVADA-FUNDED STUDIES OF THE SATURATED ZONE AT YUCCA MOUNTAIN, NEVADA PERFORMED BY L. LEHMAN

By

Linda L. Lehman and Tim P. Brown
L. Lehman & Associates, Inc.

PRESENTATION OUTLINE

Saturated Zone

Water Table Frequency Analysis
Response of Water Table to Earthquakes
Saturated Zone Conceptual Flow Model

Future Research Directions

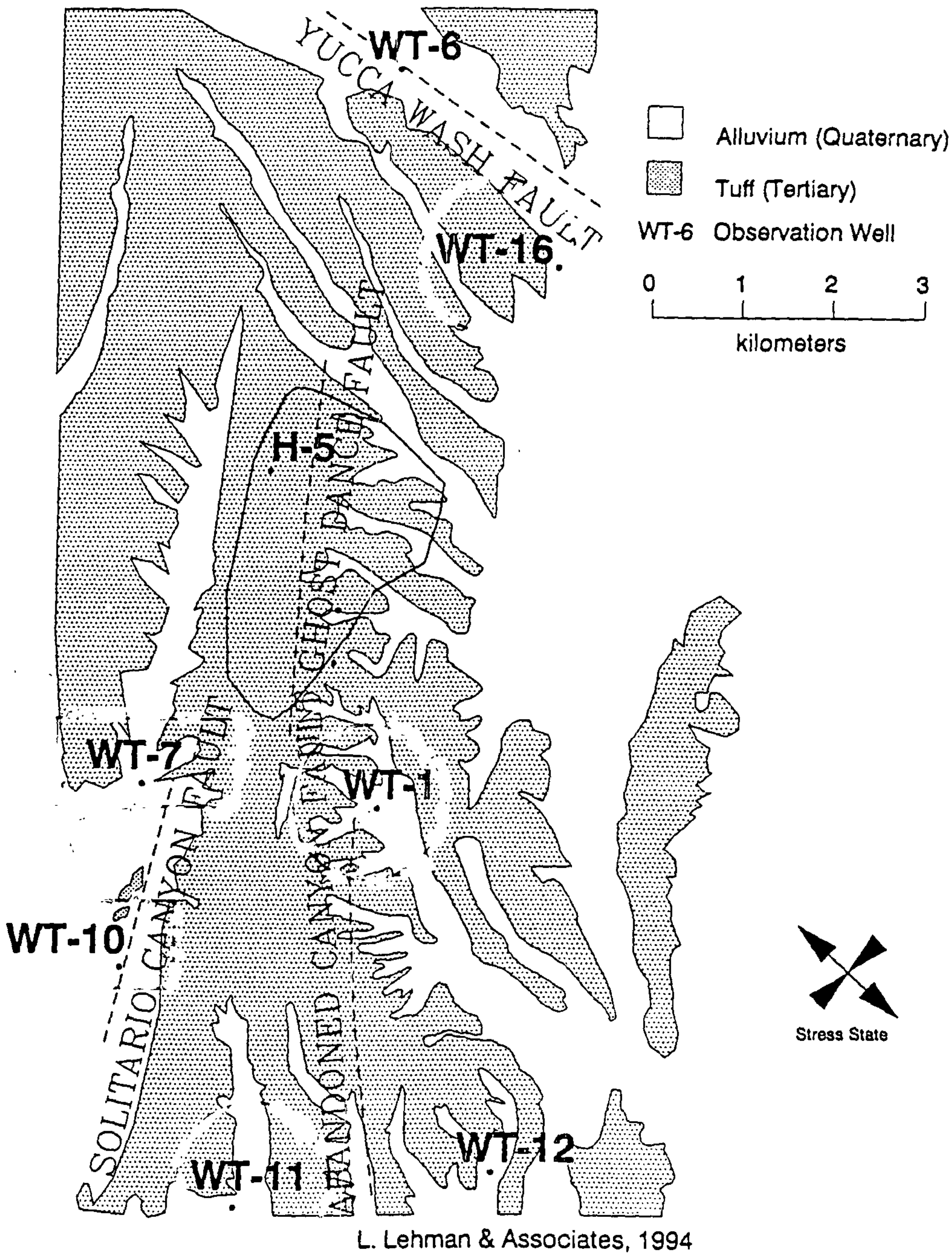


Figure 1. Location of wells that exhibited different fitted periodicity at Yucca Mountain with circles indicating periods of 870 days and squares indicating periods near 1000 days.

Figure 3. FIT.M. Results for WT-1

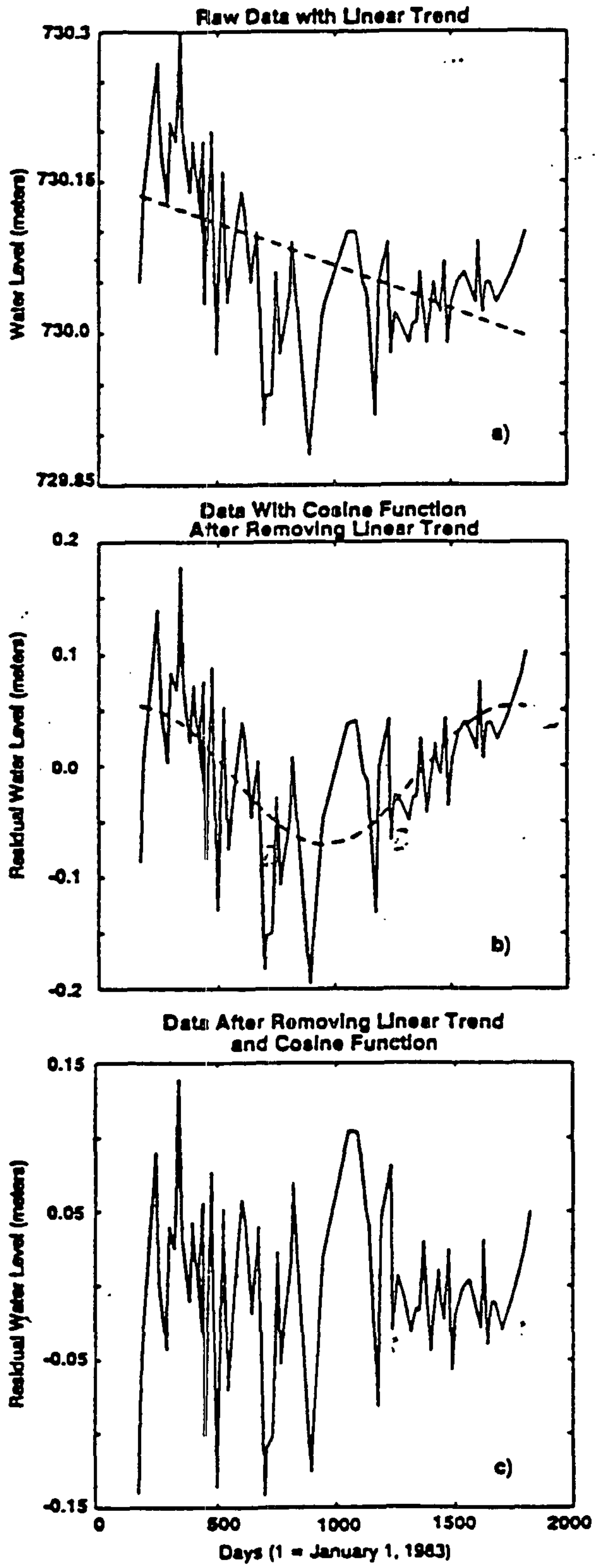


TABLE [illegible]

WATER-LEVEL DATA SET RESULTS

Well #	Period	Phase Shift	Amplitude	r^2	Slope	Cycles
WT-7	1012.2	177.7	0.09	0.47	0.000107	1½ cycle
WT-10	925.4	182.4	0.7	0.22	0.000074	~ 2 cycles
WT-12	1240.0	169.8	0.7	0.35	0.000101	~ 1½ cycles
WT-1	889.2	249.5	0.1	0.44	.000191	almost 2 cycles
WT-11	887.7	253.4	0.115	0.58	0.000100	~ 1½ cycles
WT-16	860.6	266.9	0.11	0.68	0.000240	~ 1½ cycles
WT-6	2975.2	738.1	1.3	0.75	.00323	~ ½ cycle
H-5	1936.8	416.6	0.54	0.45	-0.000044	< ½ cycle
H-5	1888.4	417.9	0.31	0.28	-0.00033	~ ½ cycle

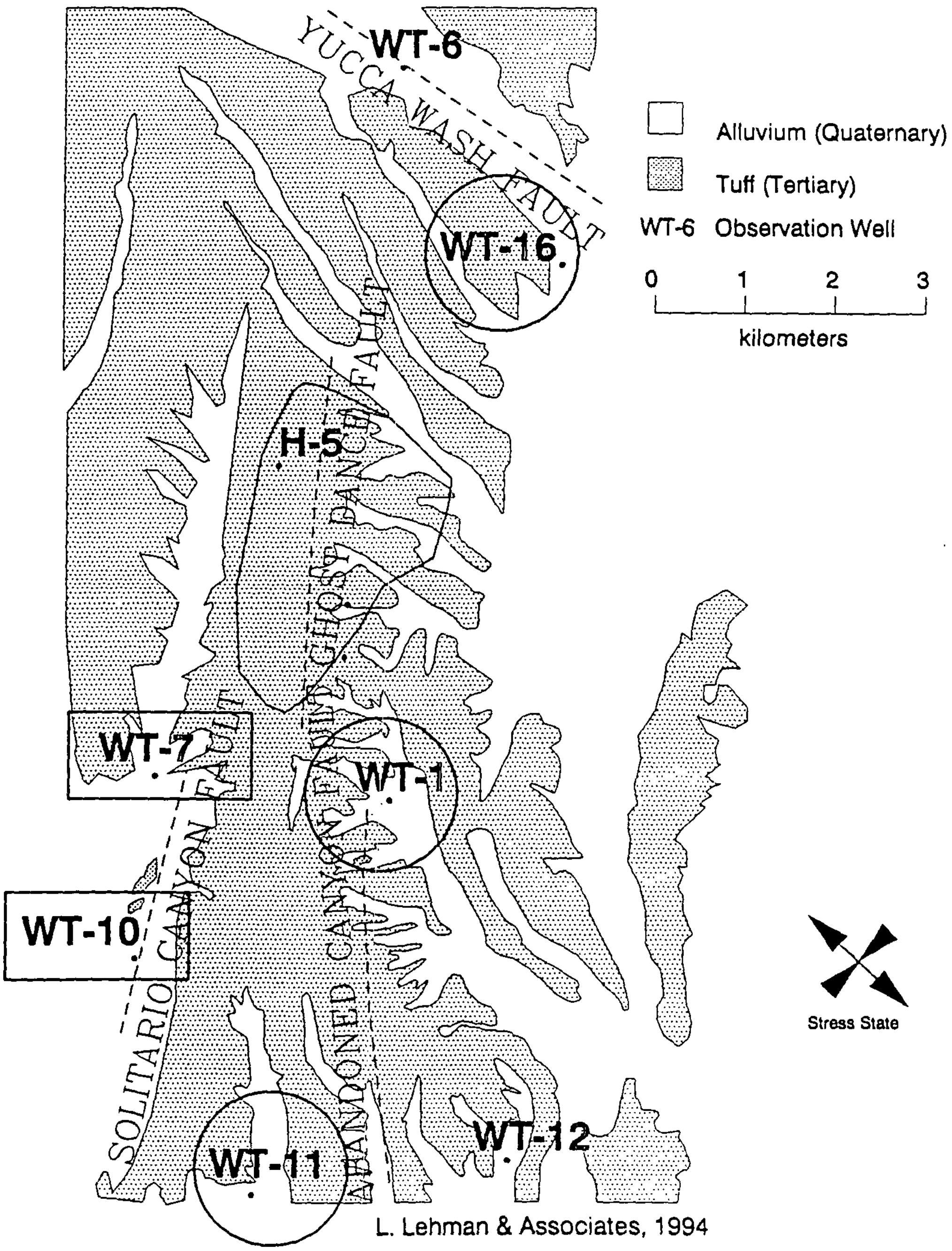


Figure 1. Location of wells that exhibited different fitted periodicity at Yucca Mountain with circles indicating periods of 870 days and squares indicating periods near 1000 days.

Water Level Frequency Analysis

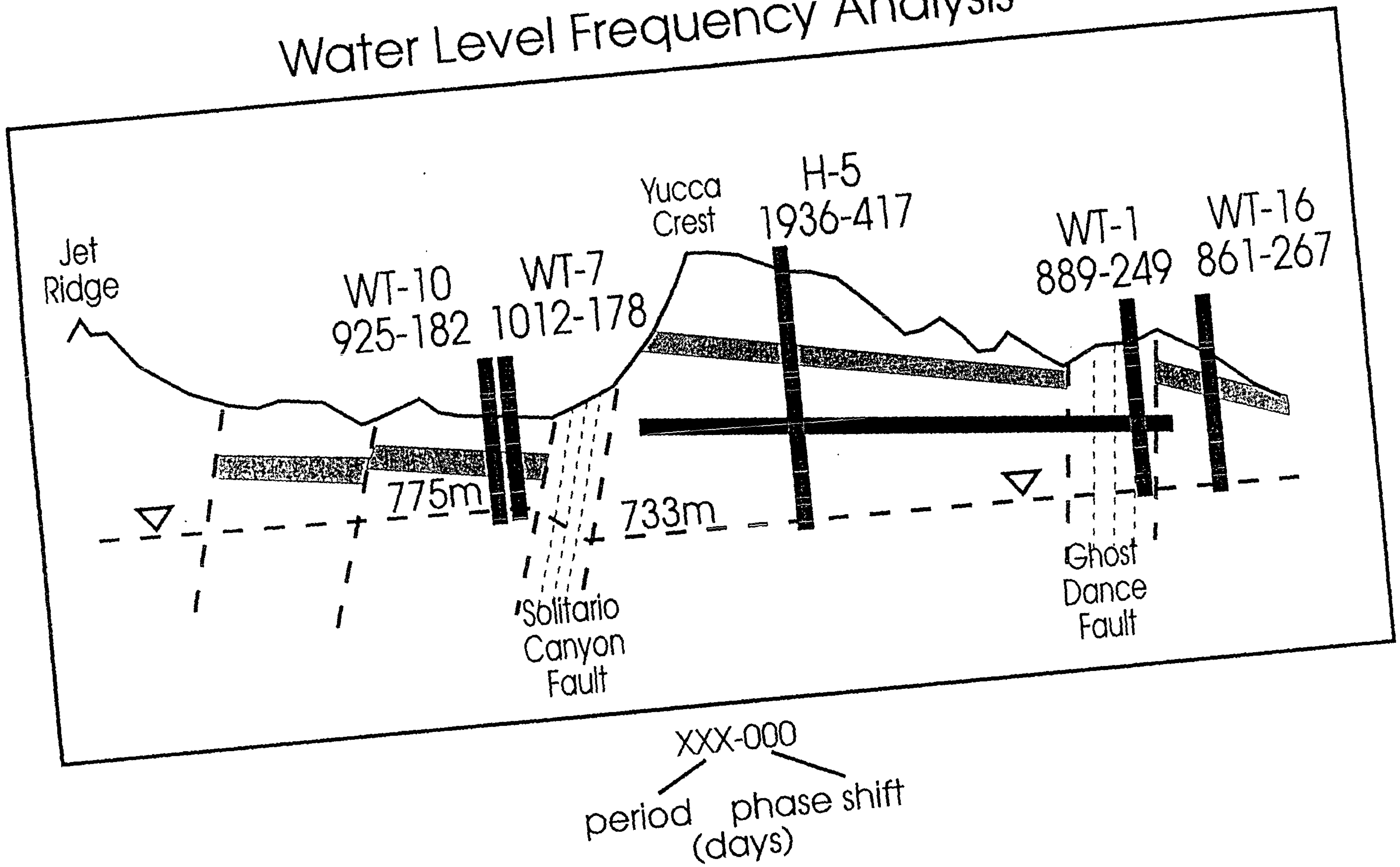
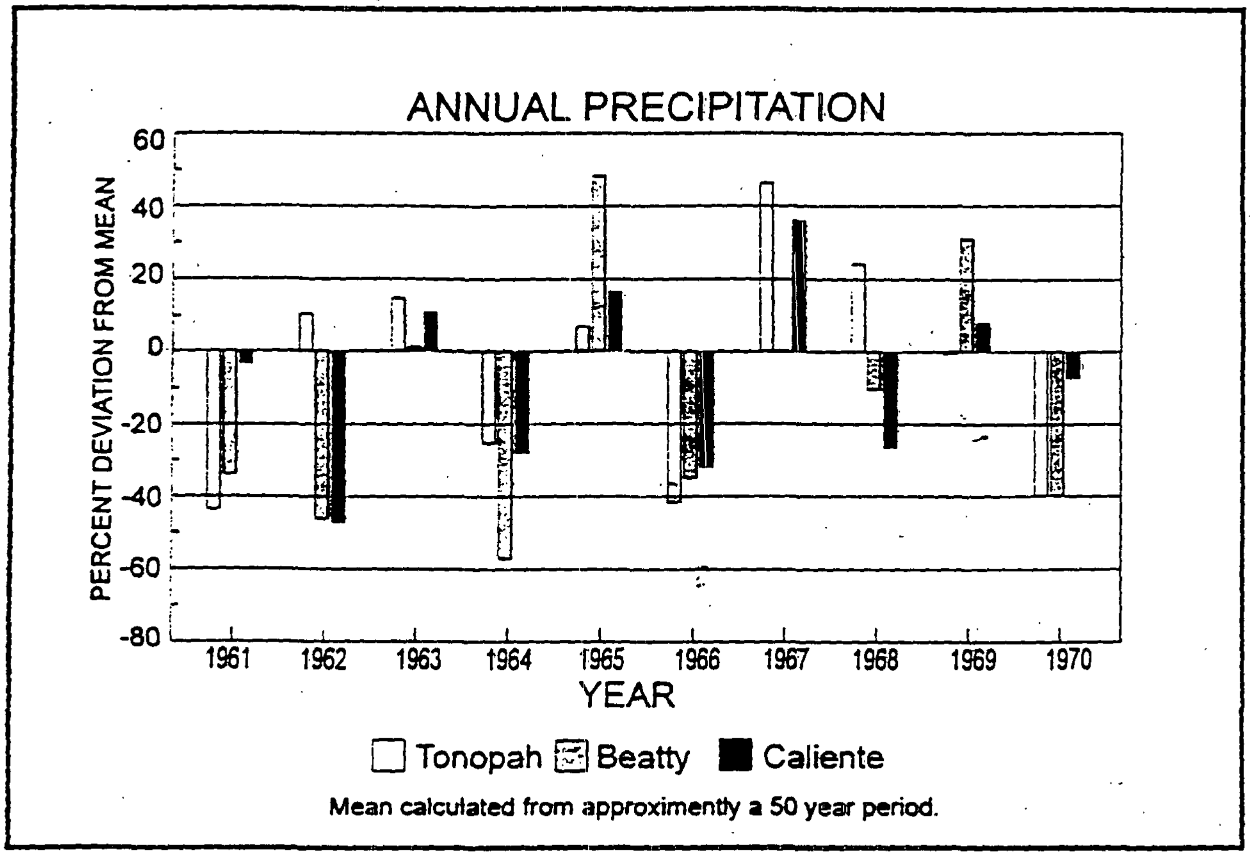


Figure 4. Average Annual Precipitation for Selected Stations in Southeastern Nevada



Frequency Analysis

- Linearity - structure controlled
- Frequency and phase shift different on each side of the block
- 2.5 year Deviation from mean average annual rainfall

Figure 9. Location of Features for Correlation Study

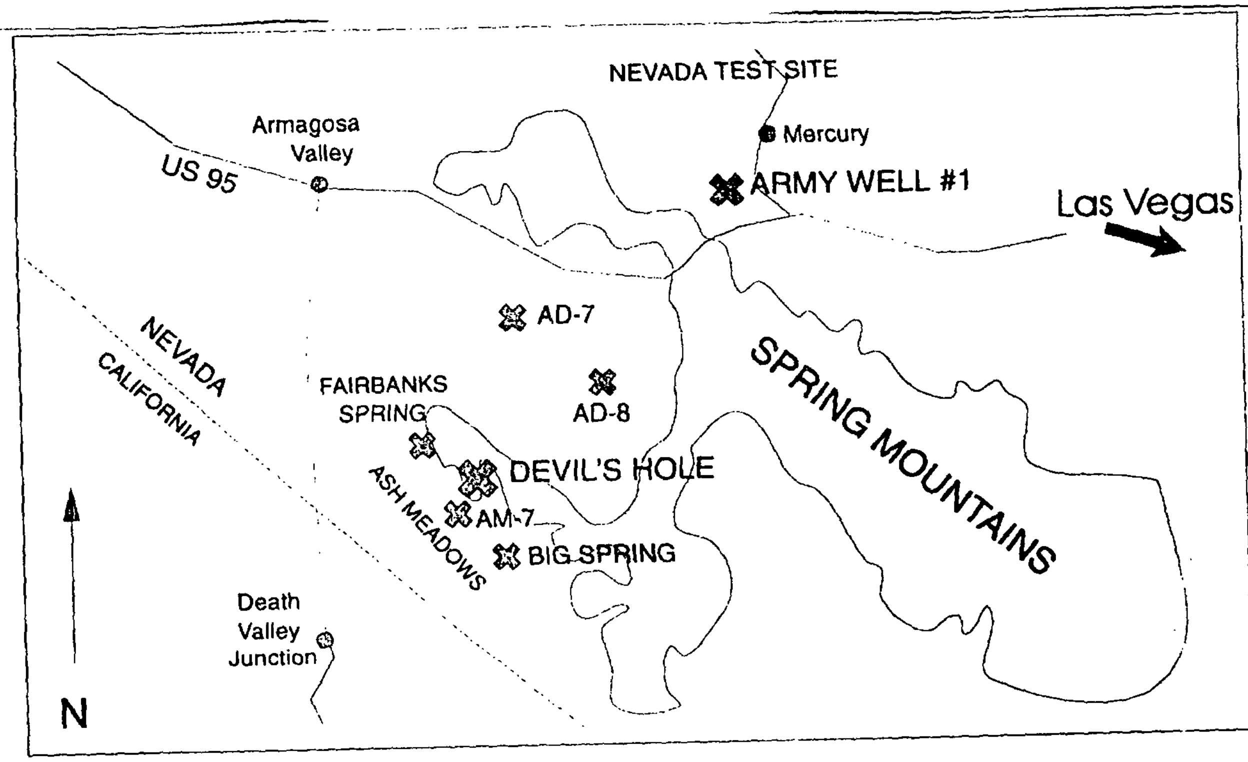
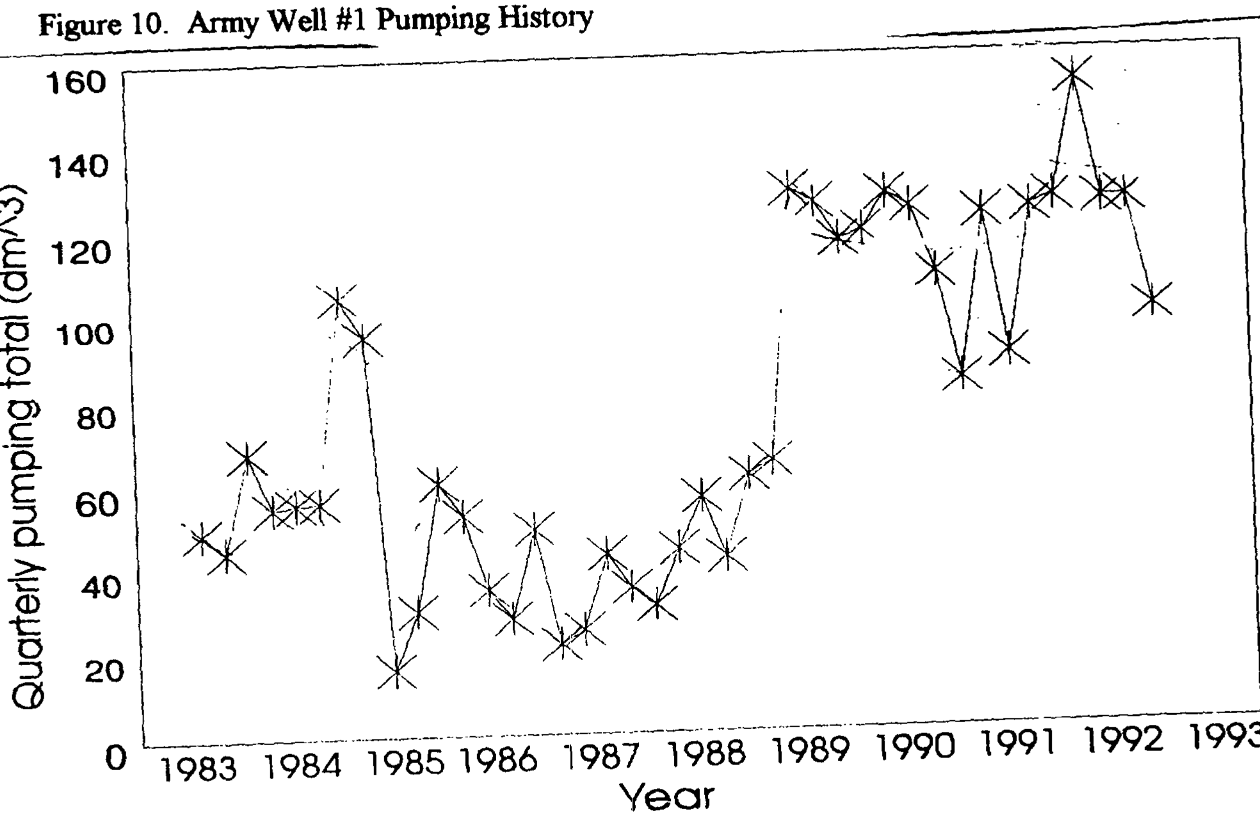


Figure 10. Army Well #1 Pumping History



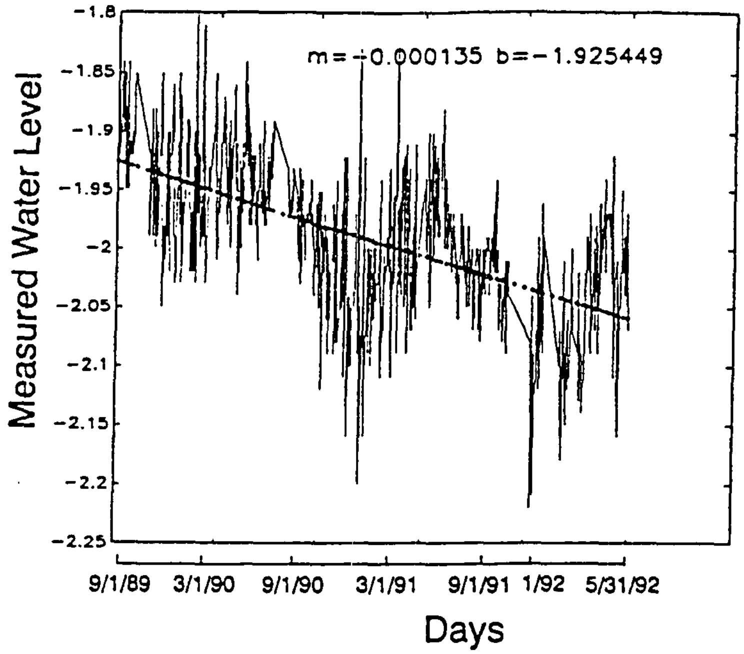


Figure 1b. Devil's Hole Water Level Trend as of 5/31/92.

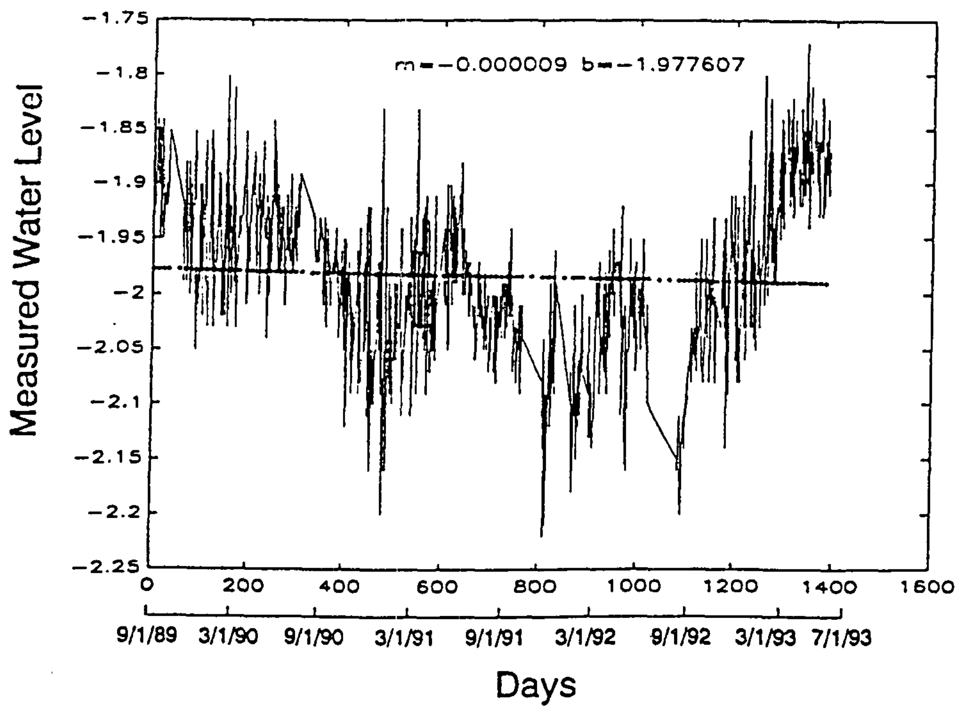


Figure 1c. Devil's Hole Water Level Trend as of 7/93
without Earthquake affected data of July, 1992.

DEVIL'S HOLE WATER LEVELS

The new data show some interesting features which were not seen in previous data sets. The first is a striking drop in water level during July, 1992 (see Figure 1a). This drop coincides with the period following the June 29th Little Skull Mountain earthquake centered within the Nevada Test Site. Abrupt changes in water table elevations of this scale, about 1/2 foot, are commonly associated with earthquake activity. The second feature is a steady rise in the water level beginning in August 1992 and continuing until approximately the end of the data. This rise is longer lasting and of higher magnitude than the previously seasonal variation. This seemingly short term trend is roughly coincident with high precipitation experienced in southwestern Nevada in the winter and spring of '92-'93.

The additional data have significant effects on the analysis of the long-term linear trend in water levels. Figure 1a shows the linear regression fit of the mean daily water level data for the period 8/30/89-6/30/93 including the low earthquake related measurements. The slope of the line fitted to the long-term trend was found to be -0.000017, a nearly 8-fold decrease in magnitude compared to the fitted line for the previously analyzed data period 8/30/89-5/31/92 shown in Figure 1b.

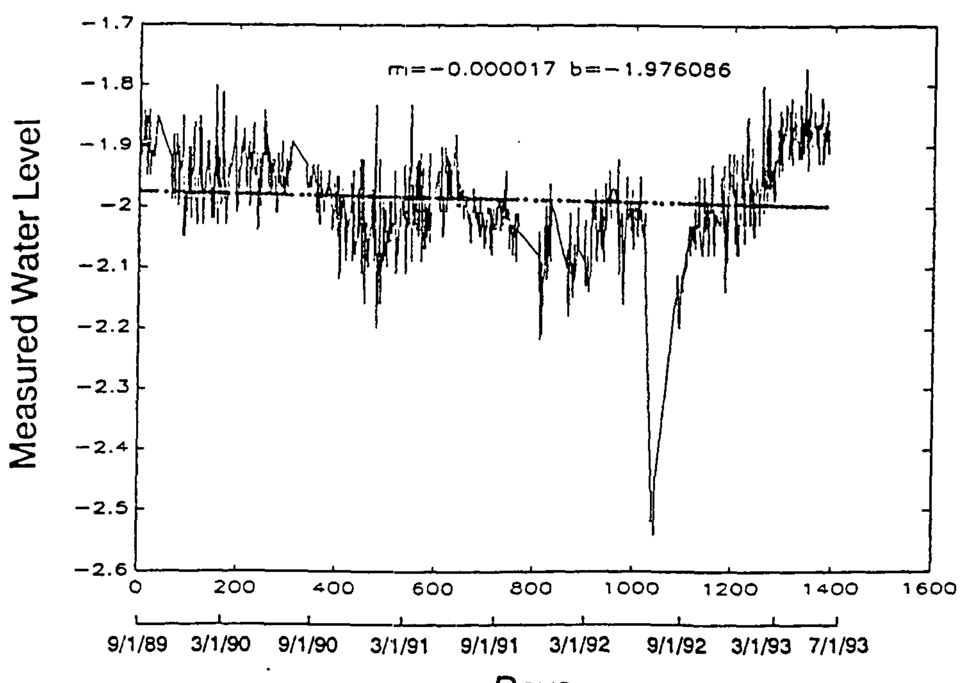


Figure 1a. Devil's Hole Water Level Trend as of 7/93 including Earthquake affected data of July, 1992.

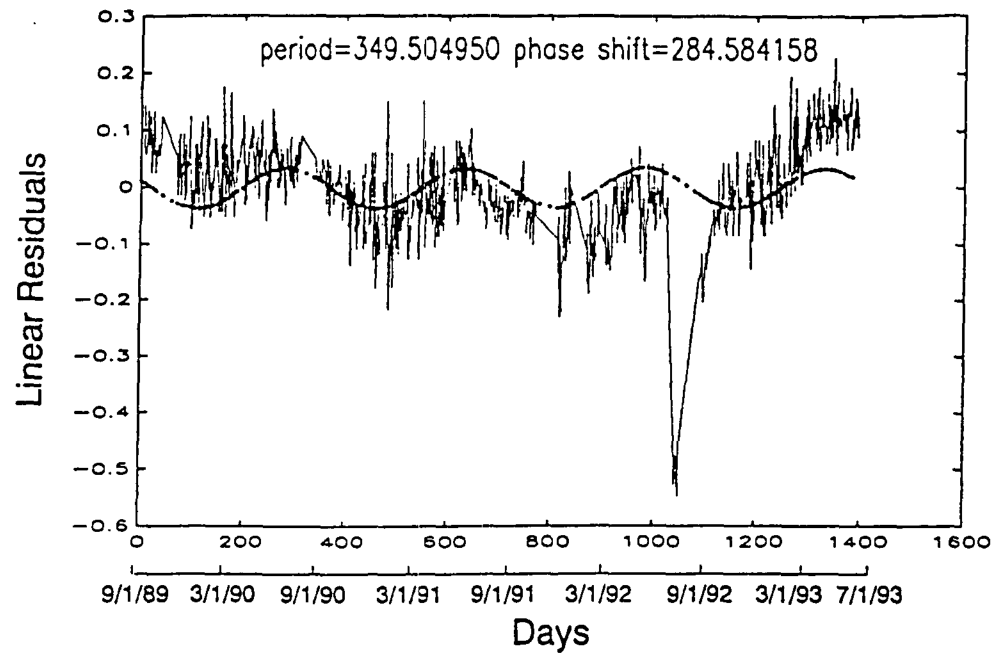


Figure 2. Linear Residuals with Fitted Cosine Function for data including Earthquake affected water levels.

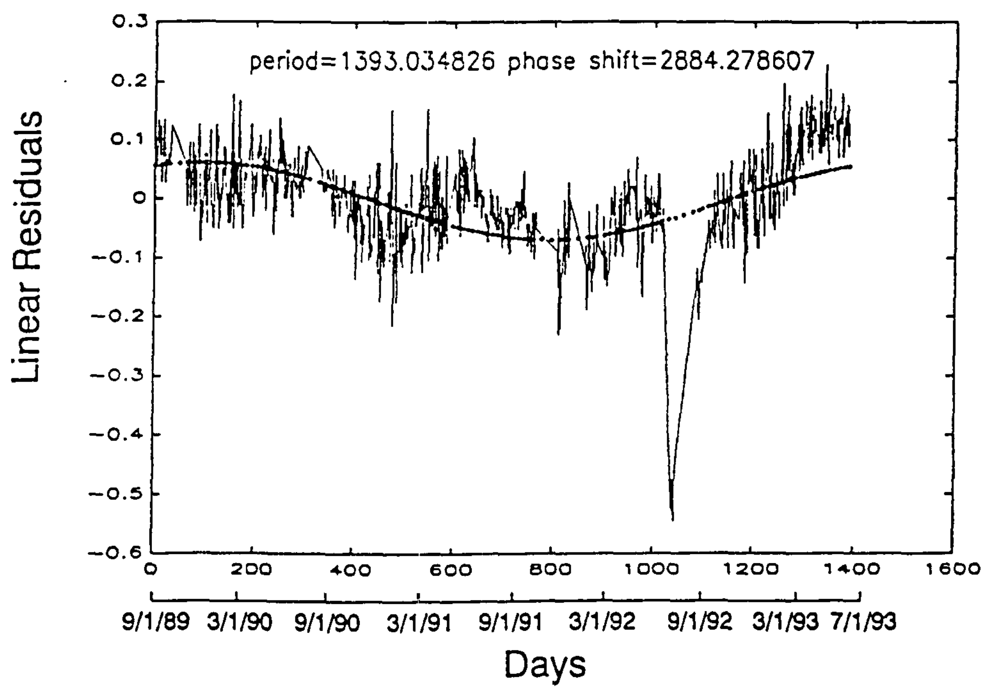


Figure 3. Linear Residuals with Fitted Cosine Function with 3.8 year (1393 day) period.

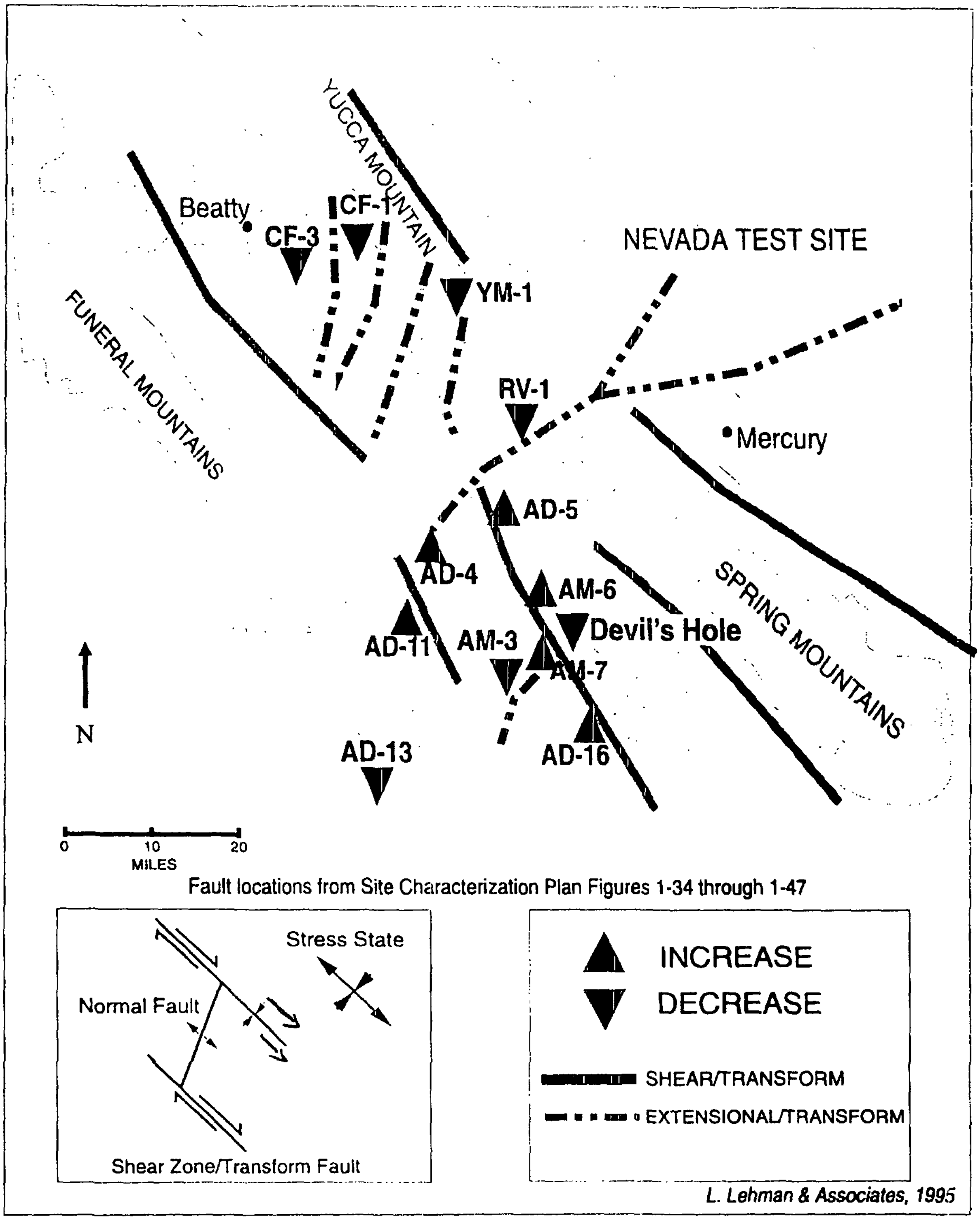


Figure 15. Well locations which showed greater than 15 cm sustained elevation change after earthquakes, compared with fault locations.

Earthquake Response

<u>Observations</u>

- Extensional Zones Water Table Decreased
- Shear Zones Water Table Increased

STATUS OF UNDERSTANDING OF THE SATURATED-ZONE GROUND-WATER FLOW SYSTEM AT YUCCA MOUNTAIN, NEVADA, AS OF 1995

U.S. GEOLOGICAL SURVEY

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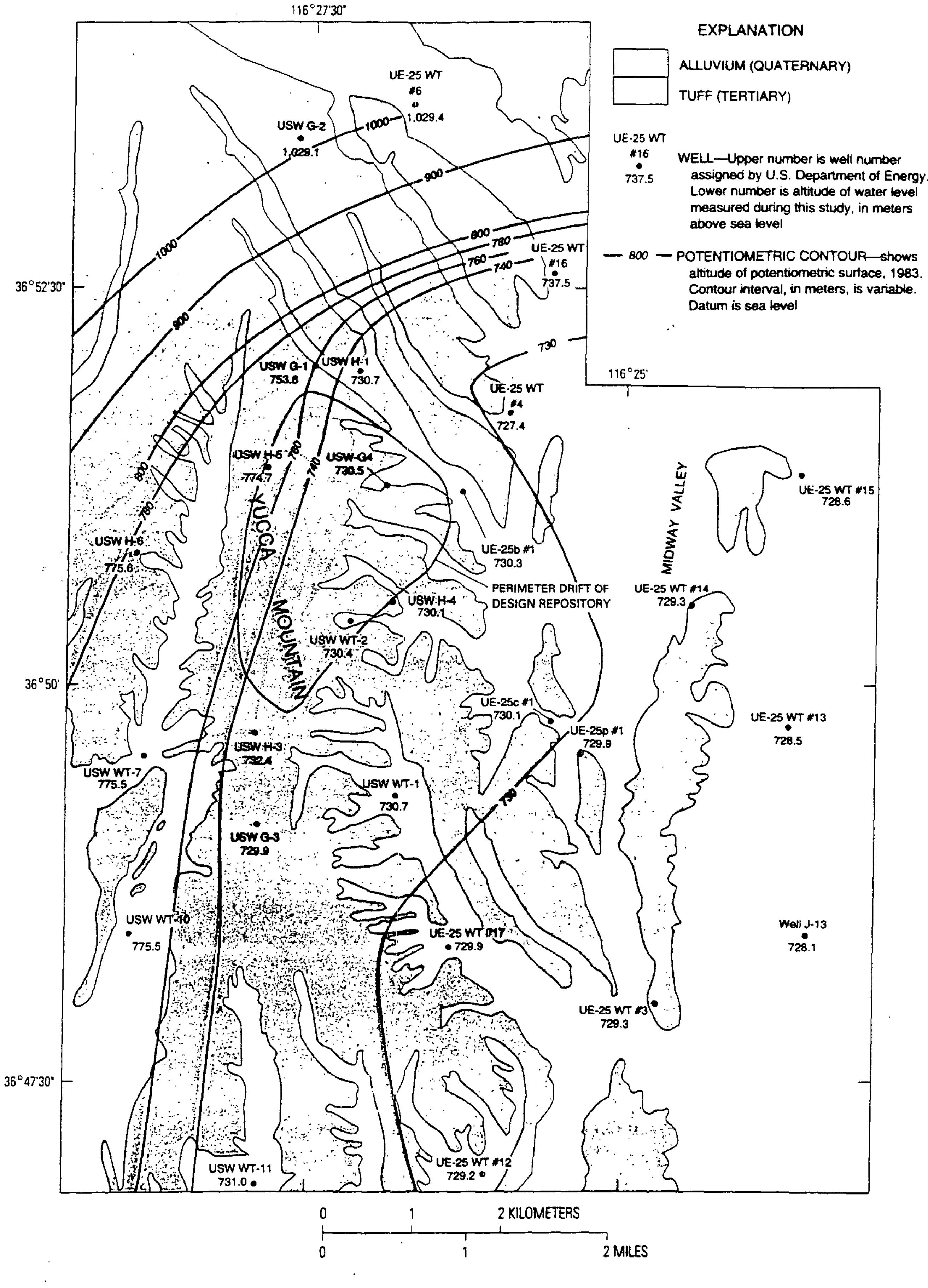


Figure 8. Preliminary potentiometric surface, Yucca Mountain (from Robison, 1984, fig. 2).

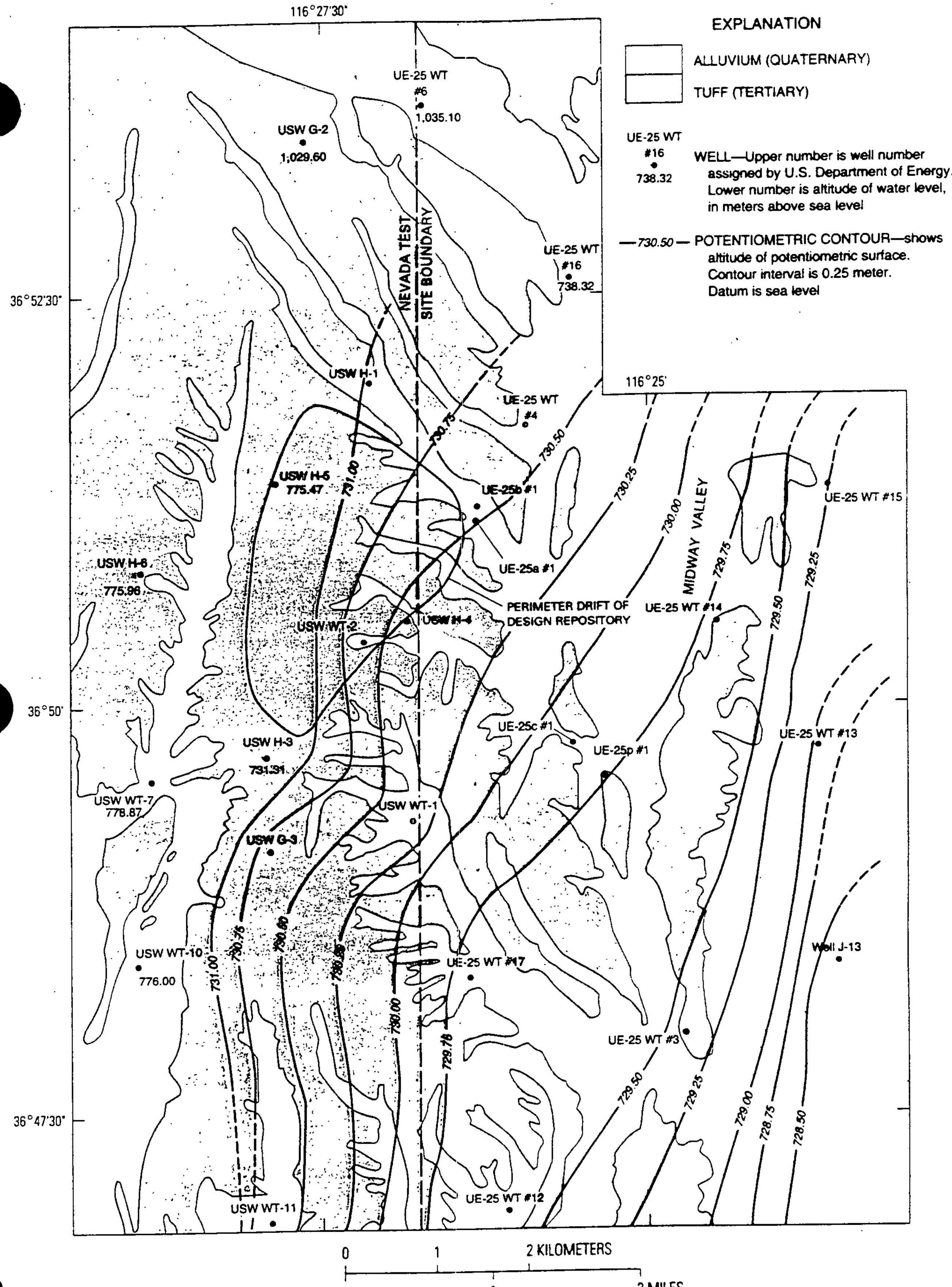


Figure 9. Revised potentiometric surface of an area of small hydraulic gradient, Yucca Mountain (from Ervin and others, 1993, fig. 1).

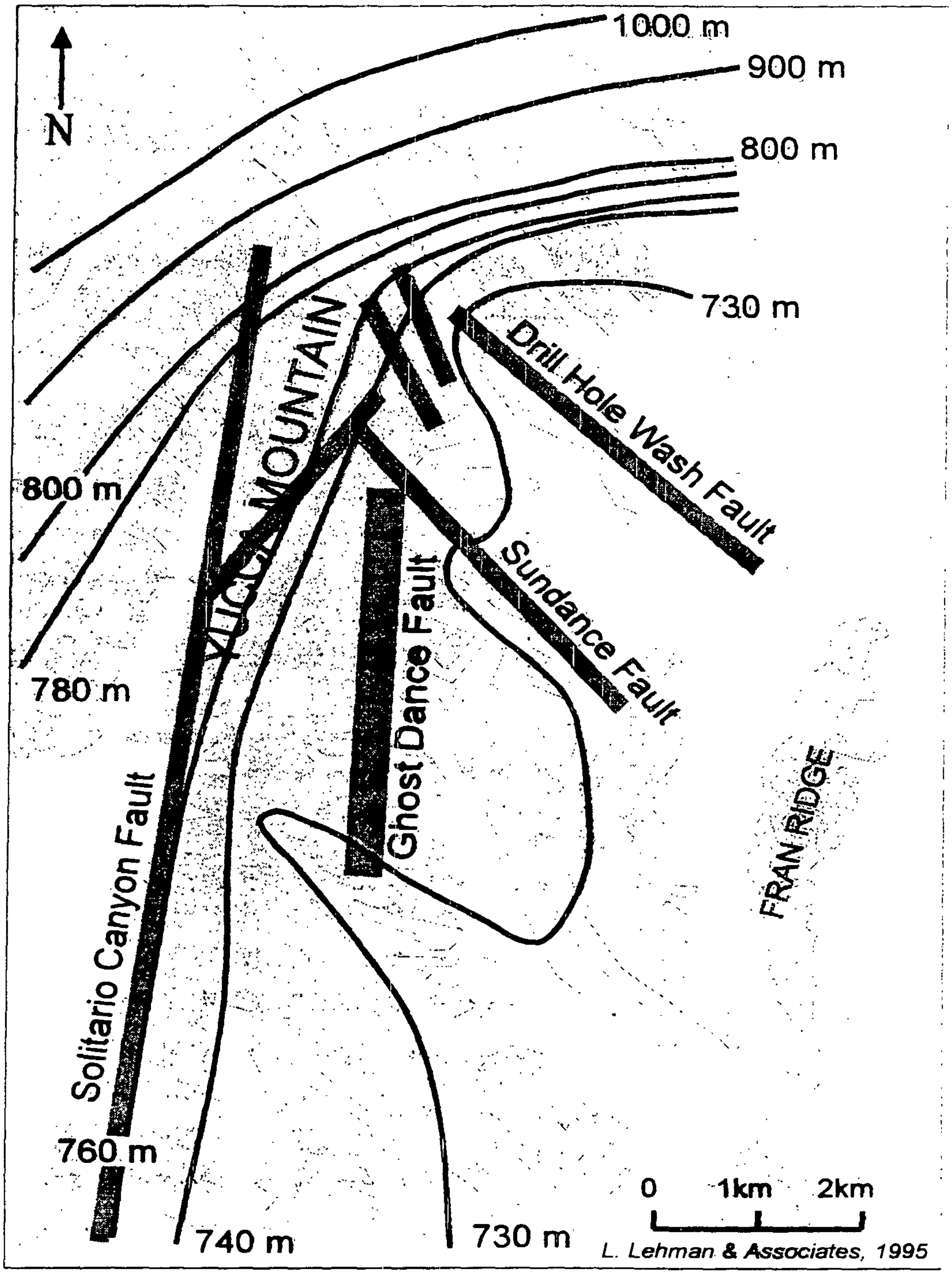
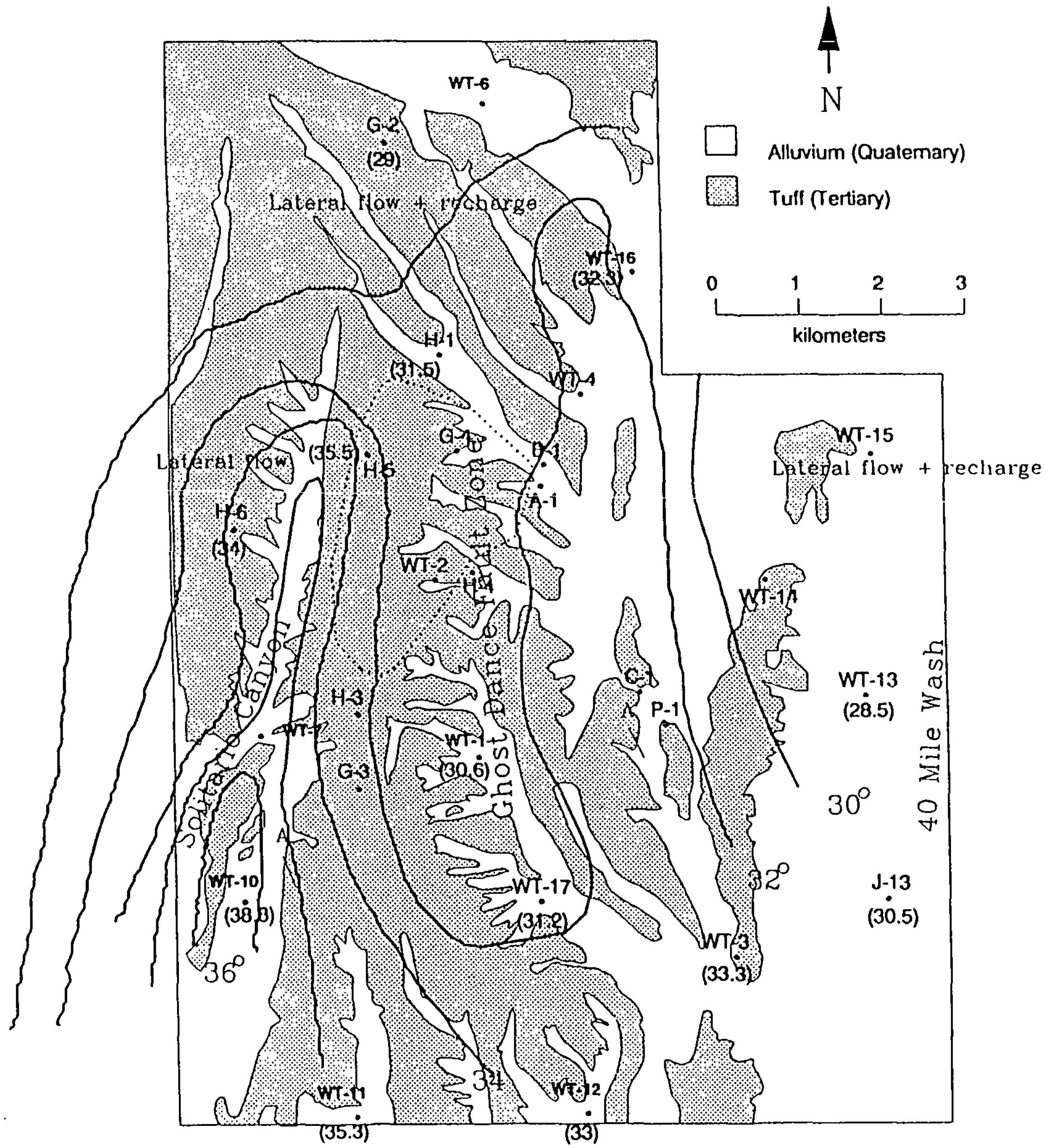
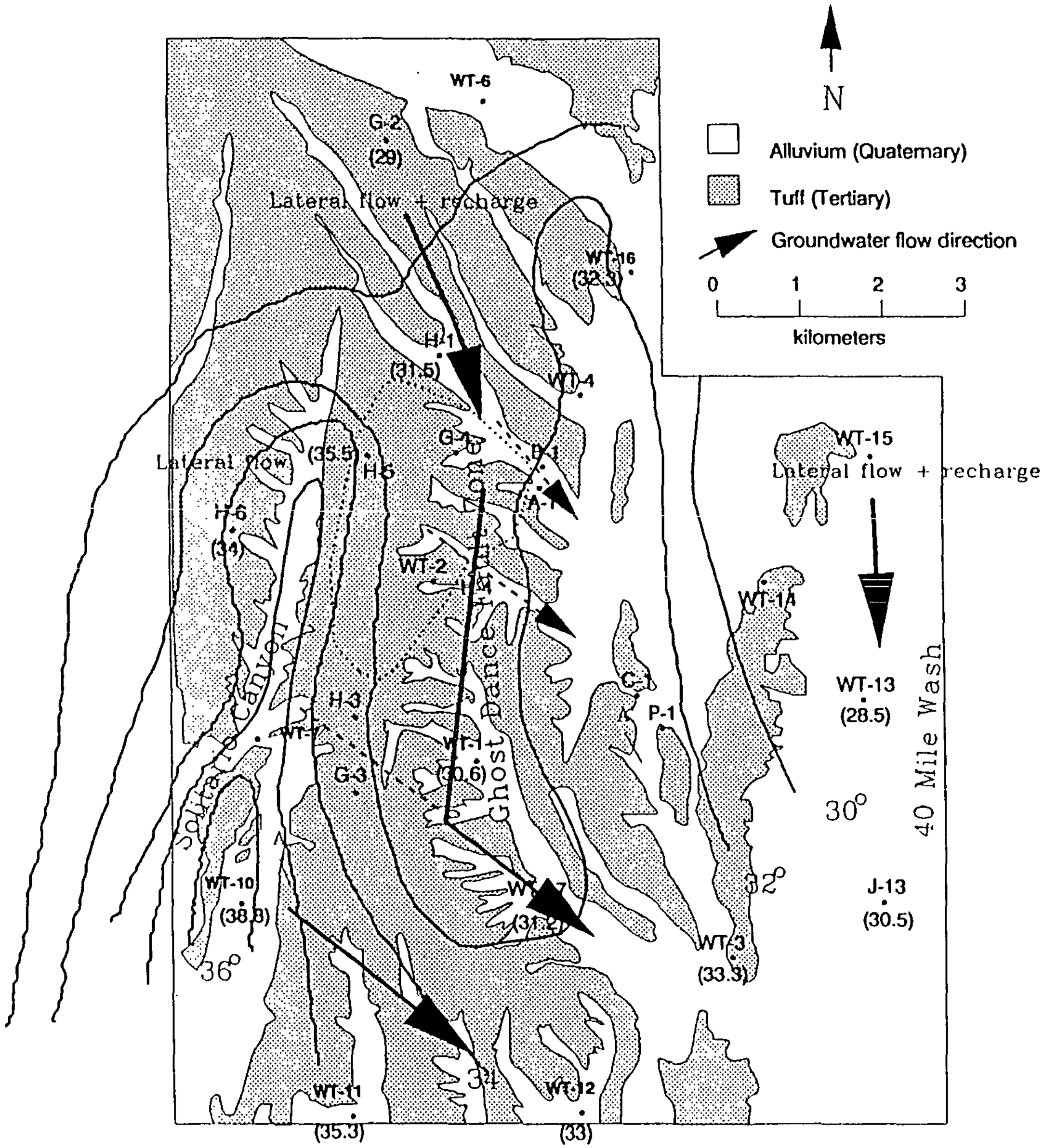


Figure 2. Saturated zone potentiometric surface and fault locations based on data from Ervin et al, 1994.

Saturated Zone Isotherms



Saturated Zone Conceptual Flow Model



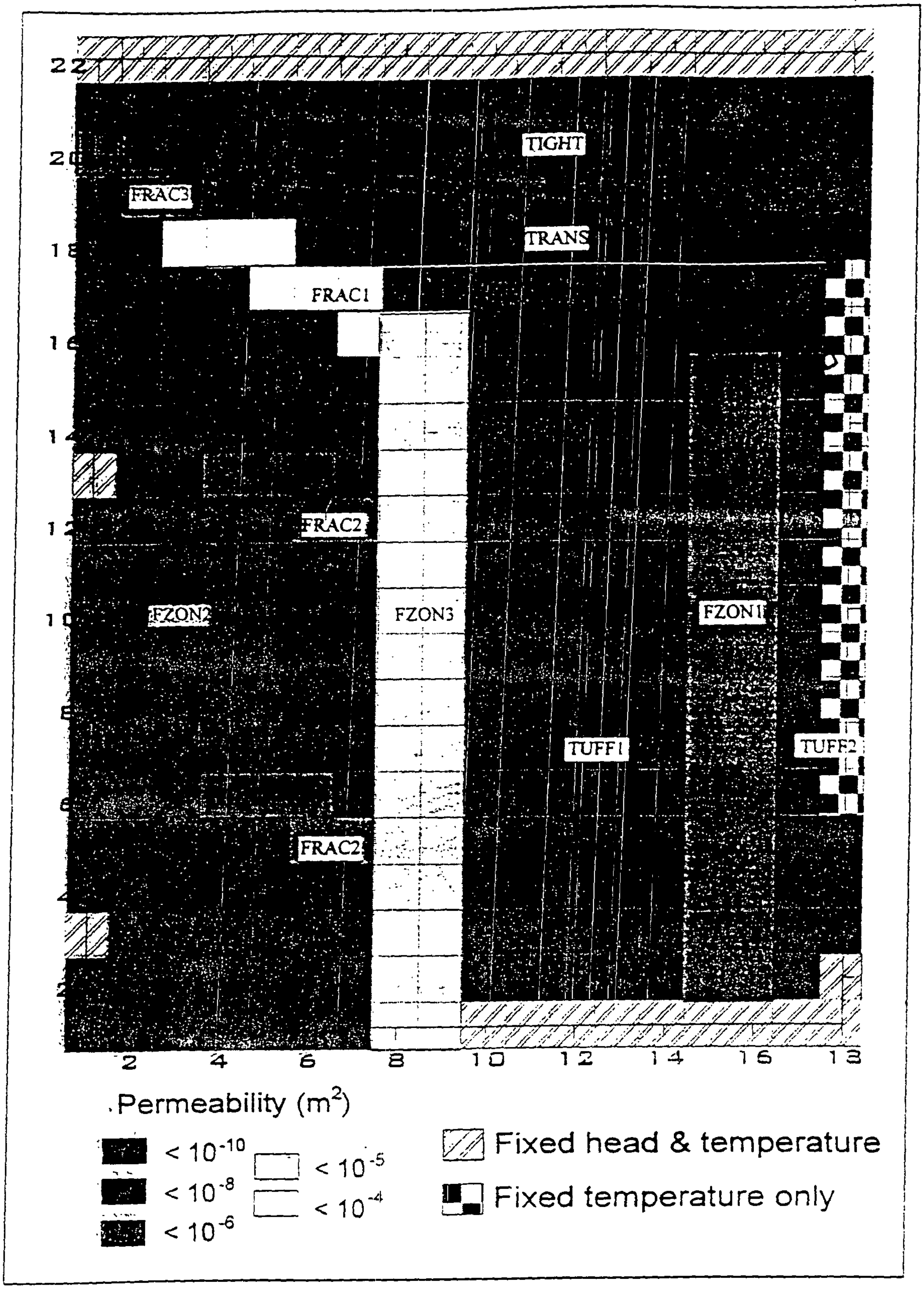


Figure 4. Schematic of saturated zone model permeability distribution and layout.

Table 1. Parameters used for the VTOUGH saturated zone model.

DOMAIN NAME	POROSITY	PERMEABILITY (M^2)	ELEMENT VOLUME (M^3)
TIGHT	0.20	1×10^{-12}	1.25×10^{8}
TRANS	0.20	8×10^{-10}	1.25×10^{8}
TUFF1	0.30	9×10^{-10}	1.25×10^{8}
TUFF2	0.30	1×10^{-9}	1.25×10^{8}
FRAC1	0.30	9×10^{-5}	1.25×10^{6}
FRAC2	0.30	7×10^{-8}	1.25×10^{6}
FRAC3	0.30	1×10^{-8}	1.25×10^{6}
FZON1	0.30	1×10^{-7}	1.25×10^{8}
FZON2	0.30	1.5×10^{-11}	1.25×10^{8}
FZON3	0.30	7×10^{-6}	1.25×10^{8}

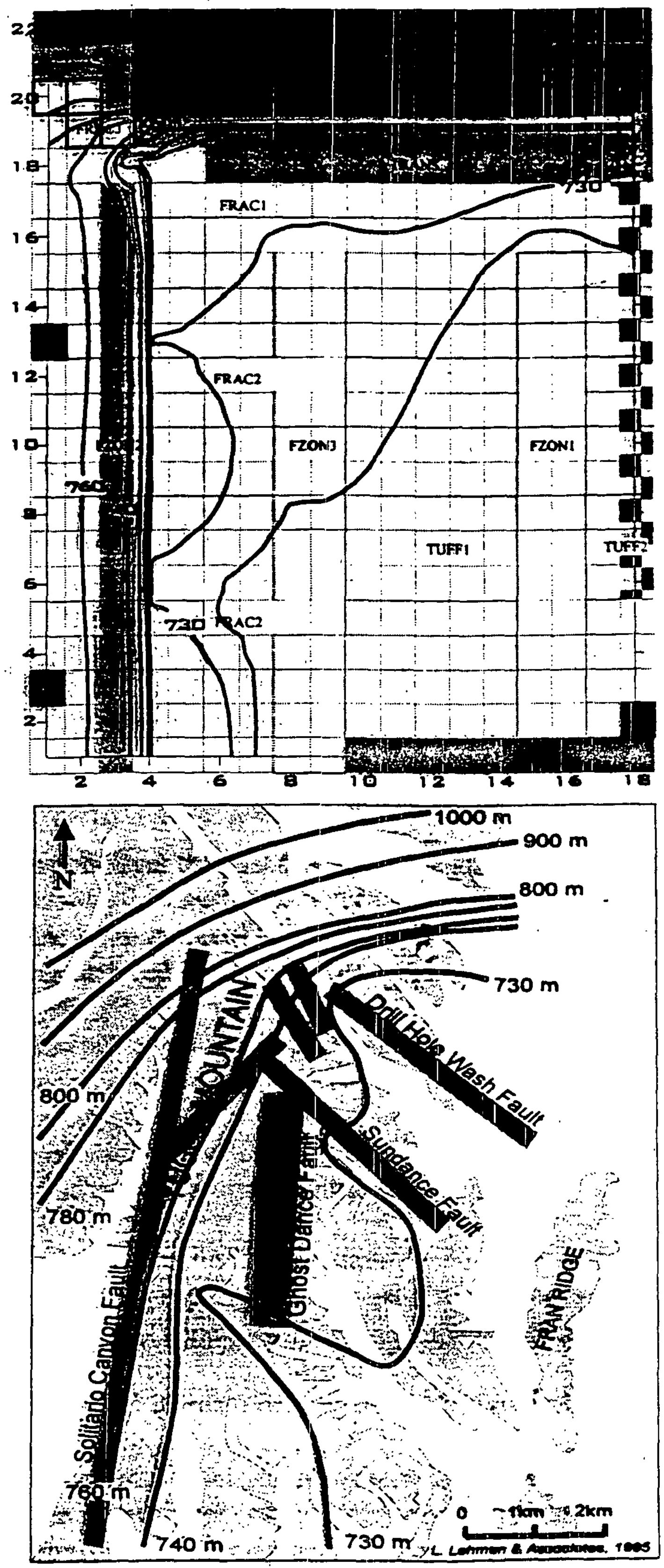


Figure 5. Comparison of measured and modeled potentiometric surface.

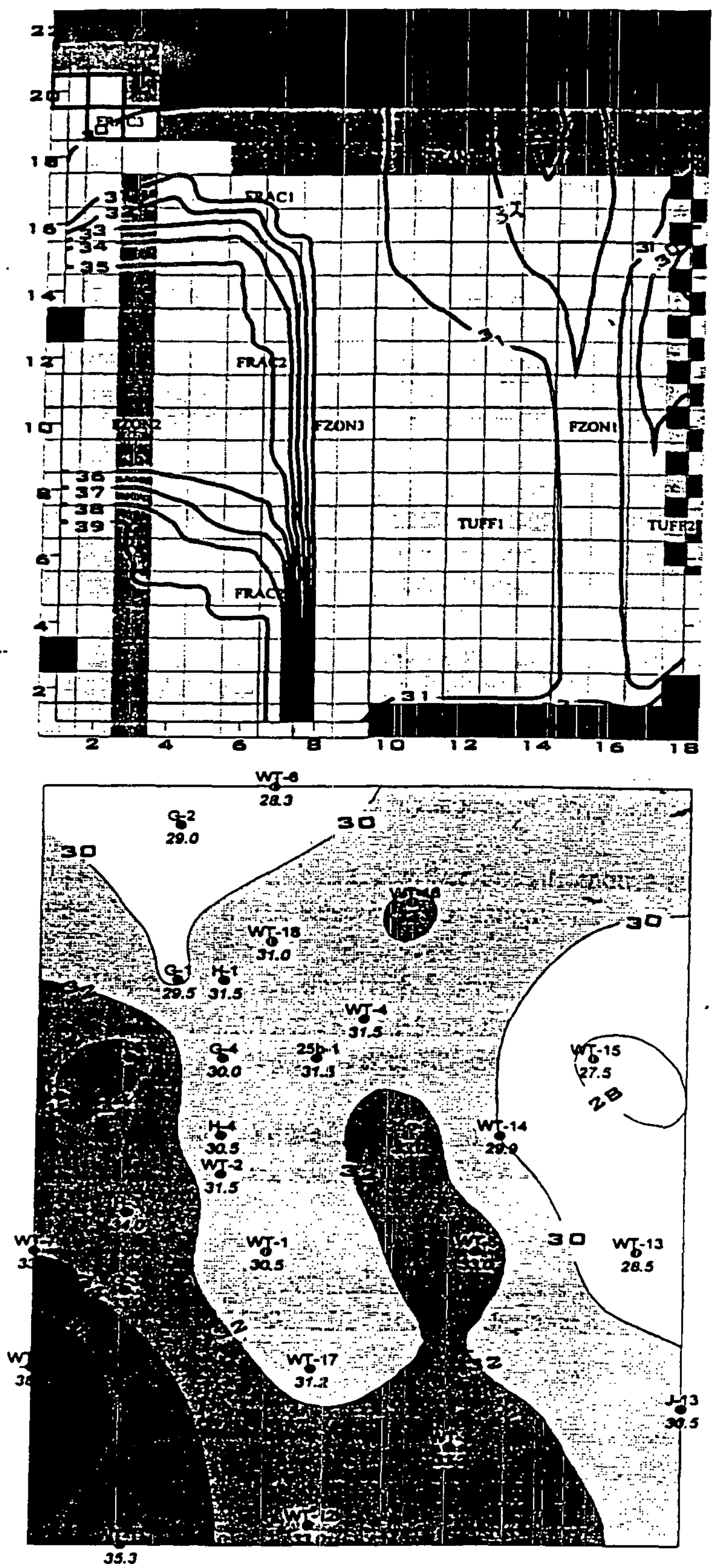
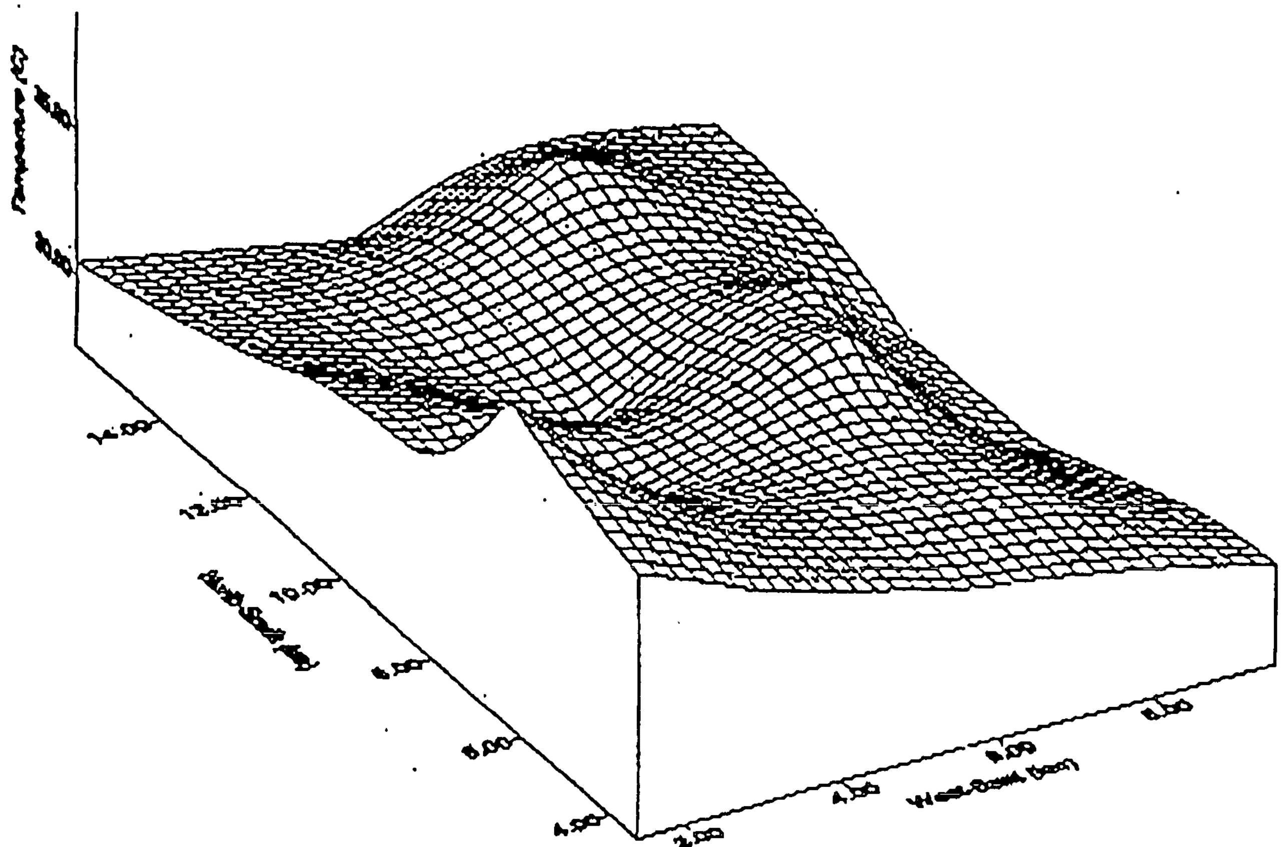


Figure 6. Comparison of measured and modeled temperatures.



4. Isometric projection of the water table temperature view looking ~~to~~ from the south

(data from Fridrich et al [1994]) Bredehoeft 12-2-97