NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

DIGITAL ANALYSIS OF BOREHOLE-MEASURED AQUIFER RESISTIVITY TO DETERMINE WATER QUALITY

by

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Technology in partial fulfillment of the requirements for the degree
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ABSTRACT

Methods of log interpretation were developed whereby quantitative values of parameters relating to water quality can be determined in order to obtain maximum use from modern macroresistivity and microresistivity logs.

Two methods of interpretation, each based on different formation resistivity factor concepts and each programmed for digital computers, are discussed and evaluated for unconsolidated alluvial deposits. The "F-Method", based on interval formation resistivity factors, gave results which compare favorably with chemical analysis of water samples; the "FF-Method", based on a generalized "field formation resistivity factor", gave results which do not compare favorably with chemical analysis. The F-Method is the preferred method for the geographic areas studied. The interpretation is aided by auxiliary computer programs.

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PURPOSE AND SCOPE

The purpose of this thesis is to discuss an investigation of interpretation methods whereby modern electrical resistivity logs are analized to determine quantitative values of parameters relating to water quality. The work which preceded the writing of the thesis was carried out on the New Mexico Tech campus from January 1967 through February 1969.

Alluvial aquifers for three geographic areas were studied. The geographic areas, shown on Figure 1, and corresponding water wells studied are: ((1)) Bosque del Apache Grant, Socorro County, New Mexico, (1) USGS Test Well #B-5, (2) USGS Test Well #B-6A (Relocated); ((2)) Eastern Valencia County, New Mexico, (1) City of Belen Water Well #4, (2) Village of Los Lunas Water Well #3; ((3)) Hueco Bolson near El Paso, Texas, (1) City of El Paso Water Well #3 Offset, (2) El Paso Natural Gas Company Test Well #3.

The principal electric logs used in the study are the induction-resistivity log and the microlog. A proximity log was recorded in one well, the City of El Paso Water Well #3 Offset. Computer techniques were used to analize log data.

A discussion on logging water wells in consolidated aquifers is presented in Appendix F.

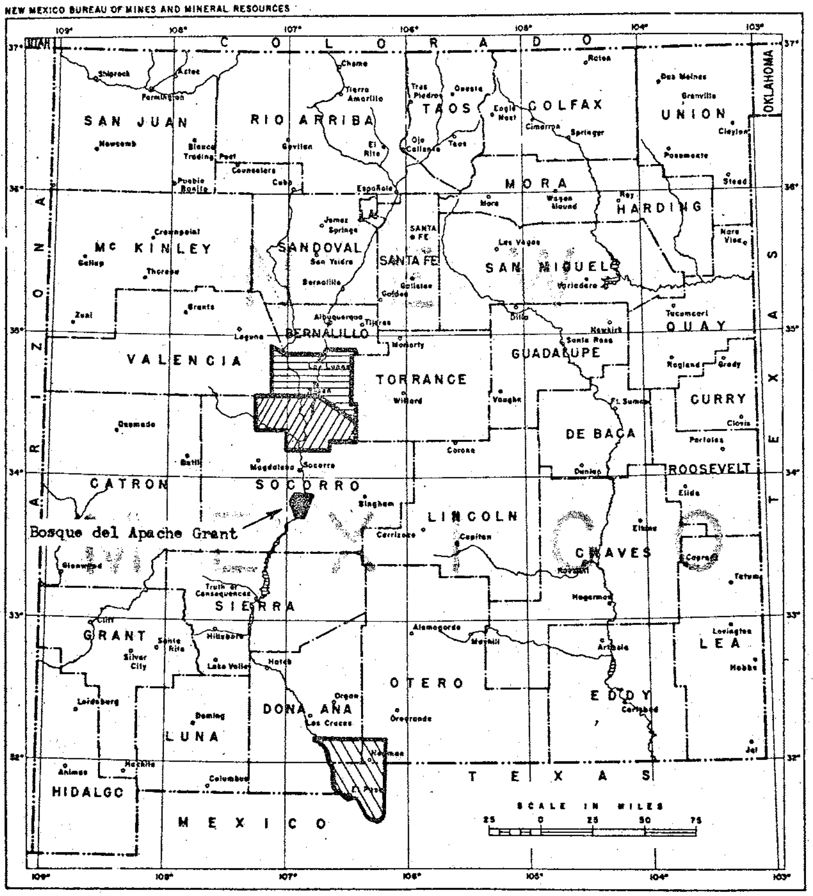


Fig. 1. Areas in New Mexico and west Texas from which resistivity log and water quality data are used in this thesis.

PREVIOUS WORK

Basic to the purposes of this thesis is the concept of the formation resistivity factor introduced by Archie [1942]. Alger [1966] presented the format for charts that are useful for establishing relationships between ionic composition and the electrical properties of water. Turcan [1966] introduced the concept and application of the field formation resistivity factor to aquifer studies in Louisiana.

PRINCIPLES OF WELL LOGGING

Why Resistivity Logs should be Recorded in Water Wells

Scaled and calibrated resistivity logs should be recorded in water wells in order to obtain geophysical information about aquifers and to determine quantitative values of certain parameters that help in predicting the use-value of ground water.

Drill stem tests made for aquifer units that could possibly produce water of a desired quality may, in many cases, be used to obtain water samples that can be chemically analyzed to determine the relative water quality. The dangers of sticking the drill stem and possibility of losing the well, particularly in wells drilled in unconsolidated rocks, make this method of examining the aquifer unnecessarily risky. Furthermore, drill stem tests are expensive in terms of time and labor. Aquifer testing of this type is not to be preferred as a diagnostic tool over a properly selected logging method.

Basic Assumptions

The basic assumptions for water well resistivity log interpretation are as follows:

1. The aquifer units are homogeneous, isotropic, and of constant thickness;

2. Aquifer units are not steeply dipping;

3. Porosity, Φ, and formation resistivity, F, factor do not vary radially from the borehole/aquifer interface within any descrete aquifer unit;

4. The liquid saturation in the flushed zone, S_{xo}, the invaded zone, S_z, and the uncontaminated zone, S_w, is 100 percent;

5. There is a radially symmetrical distribution of mud-filtrate/native-water mixture and native water about the borehole within each aquifer unit;

6. Deep depth of investigation induction logging devices read the uncontaminated zone resistivity, R_o, directly;

7. Isothermal conditions exist in layers normal to the well bore at any given depth--temperature gradients in the direction of the well bore are recognized;

8. The formation resistivity factor is assumed to be a normalized formation resistivity factor to the effect that dirty aquifers can be treated as clean aquifers;

9. The values of calculated parameters relating to water quality, TDS, Cl, SO_4, HARD, etc., corresponding to the volume of aquifer sampled by the resistivity devices, are representative of the portion of the entire aquifer that produces water through the corresponding well;

10. The mud filtrate composition is constant at all depths in the well;

11. The quantitative values of concentrations for those parameters selected as relating to water quality, as may be determined from the last series of chemical analysis data for a given aquifer and geographic area, are considered characteristic of the aquifer from the time of sampling and analysis to the time of logging and log interpretation.

Figure 2 illustrates an idealized aquifer and borehole geometry that was constructed from the list of basic assumptions. However, due to aquifer inhomogeneities, borehole drilling fluids do not invade a permeable aquifer in the sharp, regular and concentric patterns that Figure 2 implies. The surfaces separating the flushed zone from the invaded zone, and the invaded zone from the uncontaminated zone are irregular. Furthermore, for a permeable aquifer in which the pressure differential is into the aquifer, a gradation exists from 100 percent drilling mud filtrate in the flushed zone, through some generally undeterminable mixture of mud filtrate and native aquifer fluids, to 100 percent natural aquifer fluids. However, for resistivity log interpretation it is necessary to make simplifying assumptions as to the distribution of mud filtrate and natural formation waters.

Basic assumption (11) is necessary because I have found that the ionic composition of production samples, as determined from chemical analysis, changes with time. See, for example, Knowles and Kennedy [1958, pp. 82-96].

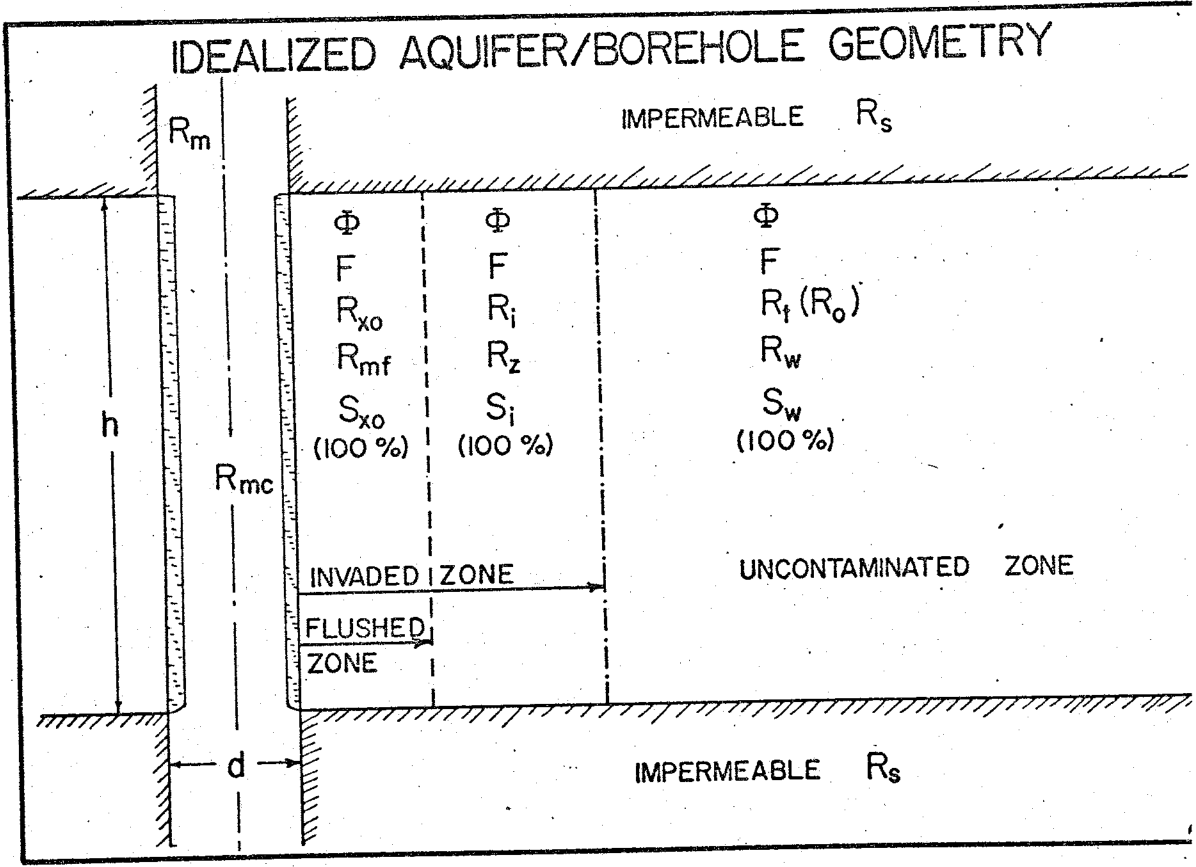


Fig. 2. Idealized aquifer and borehole geometry and some symbols used in electric log interpretation. Symbols are defined in Appendix A.

Electrical Properties of Aquifers

Water containing a quantity of ions is electrically conductive in proportion to the ionic concentration, the ionic mobility, the temperature of the solution [*Gondouin et al.*, 1957], the valence of the ions [*Vonhof*, 1966], and the geometry of the pore spaces [*Wyllie and Rose*, 1950; *Winsauer et al.*, 1952; *Yamashita*, 1964; and *Walther*, 1968].

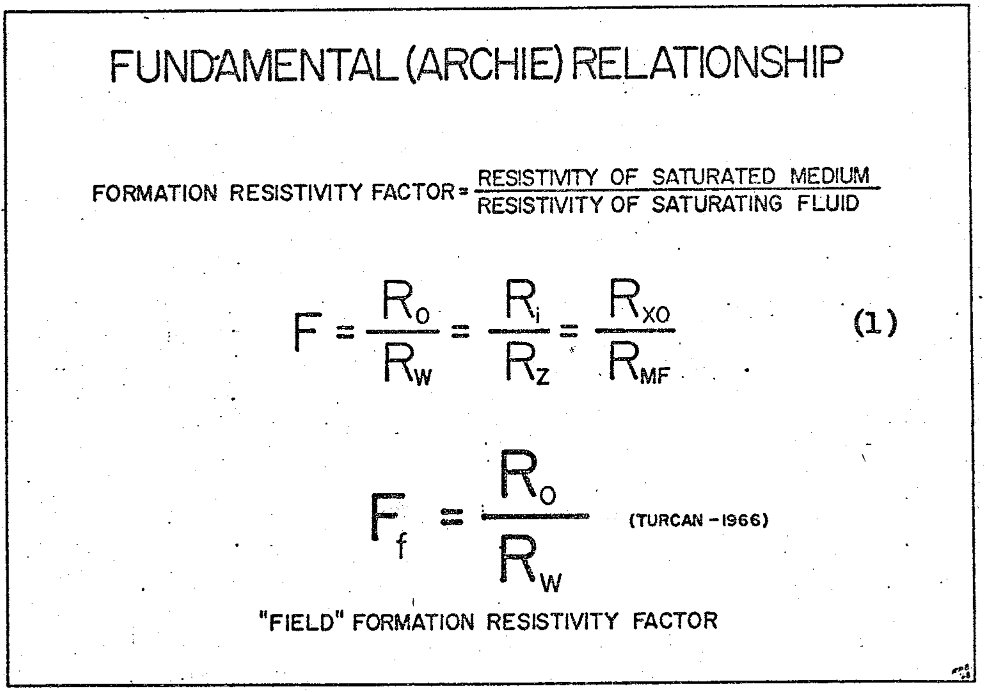
Rock matrix materials are presumed to be non-conductors of electric current unless they contain substantial quantities of metallic ores or are associated with shales that are in contact with electrolytes [*Lynch*, 1962; *Grim*, 1942].

Therefore, it follows that a body of rock will be conductive of electric current only if it contains an electrolyte; also, the ability of a rock body to conduct electrically is confined to the interstitial electrolyte--provided the rock does not contain shales or clay materials.

The Formation Resistivity Factor

Fundamental (Archie) Relationship

Archie [1942] presented an expression, empirically derived from the study of consolidated salt-water saturated Gulf Coast oil well cores, that relates the resistivity of a saturated rock to the resistivity of the saturating fluid. This expression, the formation resistivity factor--F, is defined in Figure 3. F is the formation resistivity factor for each aquifer unit, R_o is the uncontaminated zone resistivity in ohm-meters, R_w is the native water resistivity in ohm-meters, R_i is the invaded zone resistivity in ohm-meters, R_z is the resistivity of the invading fluid mixiture in ohm-meters, R_{xo} is the flushed zone resistivity in ohm-meters, and R_{mf} is the invading mud filtrate resistivity in ohm-meters.



FUNDAMENTAL (ARCHIE) RELATIONSHIP

$$\text{FORMATION RESISTIVITY FACTOR} = \frac{\text{RESISTIVITY OF SATURATED MEDIUM}}{\text{RESISTIVITY OF SATURATING FLUID}}$$

$$F = \frac{R_o}{R_w} = \frac{R_i}{R_z} = \frac{R_{xo}}{R_{MF}} \qquad (1)$$

$$F_f = \frac{R_o}{R_w} \qquad \text{(TURCAN - 1966)}$$

"FIELD" FORMATION RESISTIVITY FACTOR

Fig. 3. The fundamental Archie relationship, formation resistivity factor, defined. The concept of "field formation resistivity factor", F_f, is discussed in the text.

From Figure 3, one can observe that there are possible three independent definitions of formation resistivity factor. If the value of F can be determined independently from both R_o and R_w, for example, by $F = R_{xo}/R_{mf}$, then it is possible to determine the corresponding value of R_w from $R_w = R_o/F$. R_o is determined from the electrical response of a current-focused, deep depth of investigation induction device [Doll, 1949]. R_{xo} is determinable from shallow depth of investigation resistivity devices--current-focused [Doll, 1953; Doll et al., 1960] or current un-focused [Doll, 1950]--, and R_{mf} can be measured from the filtrate recovered from a representative drilling fluid sample that has been placed in a standard filtration cell and pressurized [Gatlin, 1960]. The borehole drilling fluid is usually controlled by the driller and samples are easily obtained.

Archie [1942] also related formation resistivity factor to the porosity of the rock by an empirical equation which has the general form

$$F = a/\Phi^m. \qquad (2)$$

Φ is the fractional porosity and "a" and "m" are formation constants that are evaluated experimentally. "m" is usually referred to as the "cementation exponent"--cementation implying some dependence on compaction, grain orientation, and actual secondary coalescence of formation aggragates. Equation (2) was empirically derived by Archie from a plot of calculated values of F versus core-analysis derived porosity.

It has been demonstrated by Patnode and Wyllie [1950], Perkins et al, [1954], Poupon et al, [1954], de Witte [1955], Hill and Milburn [1956], and de Witte [1957] that the formation resistivity factor relationship, as presented by Archie, is not applicable to formations that contain conductive solids--clays or shales--if the formation is not 100 percent water saturated.

Patnode and Wyllie [1950] concluded that an apparent formation resistivity factor is valid for a formation containing conductive solids--as contrasted to the true formation resistivity factor concept in which the effects of conductive solids are eliminated--provided the formation is 100 percent water saturated; i.e.,

$$F \equiv F_a = R_o/R_{wa} = R_{xo}/R_{mf}. \tag{3}$$

F_a is the apparent formation resistivity factor.

The apparent formation resistivity factor concept is used as the basis for the water-well resistivity log interpretation methods presented in this thesis.

Nature of the Formation Resistivity Factor

Because the rock matrix is assumed to be a nonconductor of electric current (conductive solids being excluded from the matrix), the apparent formation resistivity factor is some function of the parameters mentioned in the discussion on Electrical Properties of Aquifers, page 9.

The nature of the formation resistivity factor may be expressed as

$$F \propto f(C_i, l_i, t, z_i, T, m) \tag{4}$$

where C_i relates to ionic concentrations

l_i relates to ionic mobility,

t relates to temperature of the electrolyte,

z_i relates to the valences of the ions,

T relates to the tortuosity of the aquifer, and

m relates to the cementation factor of the aquifer.

Equation (4) may be written as

$$F = Qf(C_i, l_i, t, z_i, T, m) \tag{5}$$

where Q is a proportionality constant which relates all the unknown parameters to F.

Wyllie and Rose [1950] present arguments in support of the idea that hydraulic and electrical tortuosity, in porous media, correspond sufficiently close so that the two can be considered identical--at least to a first approximation.

On this assumption, they define the formation resistivity factor as

$$F = [\beta/P_d][1/Kt_s\Phi]^{\frac{1}{2}} \qquad (6)$$

where β represents the interfacial tension between solid and liquid, [dynes/cm],

P_d represents displacement pressure [psi],

K represents specific permeability [md],

t_s represents a shape factor (approximately 2.25) [nil-dimensional], and

Φ represents the fractional porosity of the formation.

This proposal is interesting, at least theoretically, in that the formation resistivity factor may be determined from fundamental hydraulic concepts. My position is that a field determination of the apparent formation resistivity factor from direct resistivity measurements of the aquifer is much more efficient than a determination from a hydraulic method that must be performed in a laboratory.

"Discrete" Apparent Formation Resistivity Factor Defined

"Discrete" apparent formation resistivity factor is defined as corresponding to the ratio of flushed zone resistivity to mud filtrate resistivity for a specified interval; i. e.,

$$F \equiv F_a = R_{xo}/R_{mf}. \qquad (7)$$

If a resistivity device is so designed that it responds principally to the resistivity of the flushed zone, and a reliable value of this measured resistivity is obtained, then it is possible to determine the value of the apparent formation resistivity factor that is characteristic, and therefore "discrete", for a given elemental volume of the aquifer. This discrete value of the apparent formation resistivity factor for the elemental aquifer volume is assumed representative of the entire aquifer unit of which the sampling is made. The value of the mud filtrate resistivity, R_{mf}, can easily be determined from samples of drilling fluid (mud) that are usually available at the drilling site at the time the well is logged.

"Field" Formation Resistivity Factor Defined

If the value of the apparent formation resistivity factor for all aquifers and aquifer sub-units, identifiable from electrical resistivity logs, is assumed to be one constant value, throughout the areal extent of the hydrologic units, then that value is called the "field" formation resistivity factor [Turcan, 1966]. This concept is useful in cases where a flushed zone resistivity log is not available and allows the log analyst to make approximations as to the selected parameters relating to water quality. The field formation resistivity factor is used exactly the same way as the discrete formation resistivity factor; i.e., as the proportionality constant relating aquifer resistivity to water resistivity. The symbol representing a field formation resistivity factor is F_f. Therefore,

$$FF \equiv F_f = R_o/R_w. \tag{8}$$

Methods of Determination

There are three methods whereby a value of the field formation resistivity factor for a particular geographic area can be determined. These methods are:

1. Chemical analysis of water samples obtained from drill-stem tests. The procedure is outlined graphically in Figure 4.

To apply the method, the following must be known; (a) The total dissolved solids content of the water from a chemical analysis of the drill stem test sample or its resistivity, and (b) a resistivity log over the corresponding interval tested; this gives a knowledge of R_o. Therefore,

$$FF = R_o(\text{from log})/R_w(\text{from chem. analysis or measured}). \quad (9)$$

This method defeats the principal purpose for recording resistivity logs in water wells--to eliminate the need for drill stem tests.

2. The value of FF, for a given geographic area that has given satisfactory results in the past, may be known from experience.
3. In the absence of items (1) and (2) above, the log analyst may be compelled to <u>guess</u> at the value of the field formation resistivity factor.

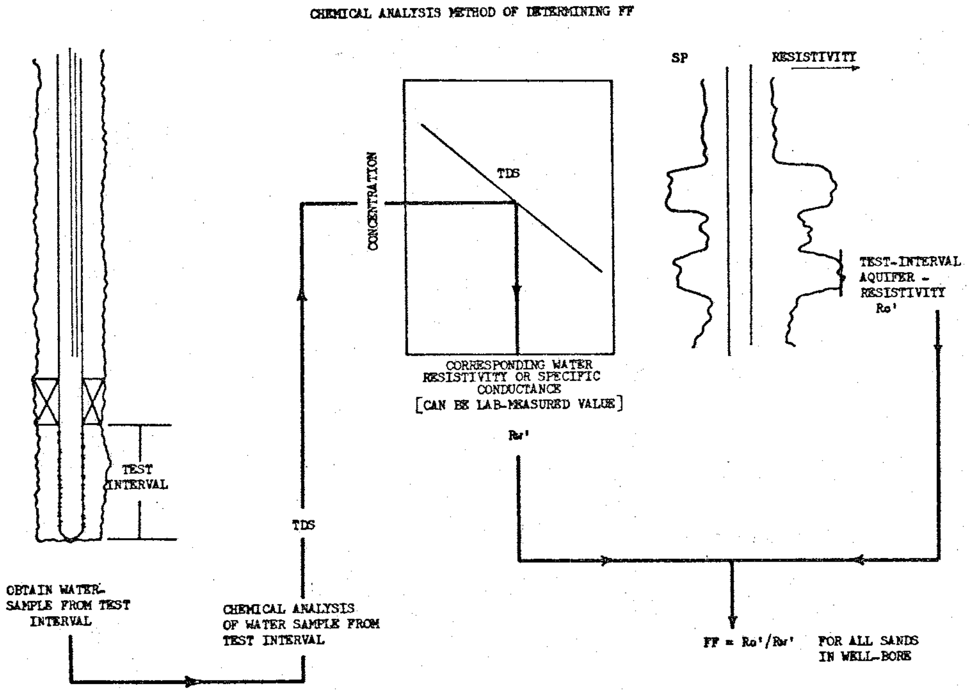


Fig. 4. Chemical analysis method for determining a field formation resistivity factor.

Application of Borehole Resistivity Measurements

Deep induction logs recorded in boreholes filled with fresh mud do not require, in many cases, corrections for borehole effects, such as fluid conductivity, invasion, and adjacent-bed effects [Doll et al., 1960].

After a correct value of R_o is determined, either water quality may be evaluated or effective grain size of aquifer aggregates and a coefficient of permeability may be determined. See Figure 5. Proposed methods for determining effective grain size and coefficient of permeability are discussed in the paper by Alger [1966].

If aquifer parameters other than water quality are to be determined from knowledge of R_o, then the formation resistivity factor for each aquifer unit must be determined from an independent source; either from a resistivity device that measures the aquifer resistivity in the flushed zone only or from chemical analyses of waters obtained from drill stem tests of each aquifer unit. The drill stem test method would be both unnecessarily expensive and dangerous.

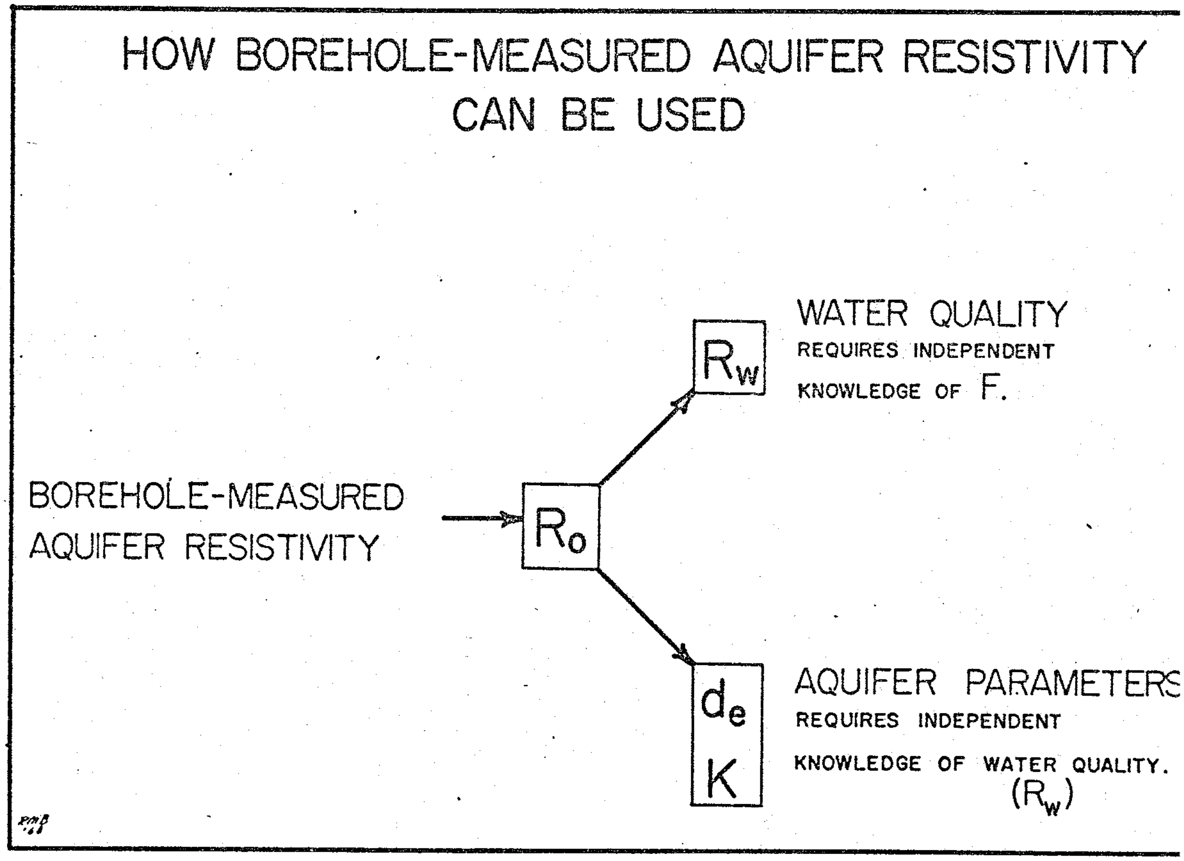


Fig. 5. How borehole measured aquifer resistivity can be used.

Water Well Resistivity Logging

Methods

For hydrological studies, two types of resistivity logs must be considered. (1) Macroresistivity logs; These logs represent the resistivity of relatively large volumes of aquifers as compared with the second classification--microresistivity logs. Among the common macroresistivity logs are the focused and deep depth of investigation induction logs [Doll, 1949; Doll et al., 1959; Moran and Kunz, 1962], unfocused long lateral and long normal logs [Schlumberger, 1950], and focused laterolog records [Doll, 1951]. These logs represent, with varying degrees of accuracy, the resistivity of the uncontaminated zone. I recommend the focused and deep depth of investigation induction logs as the fundamental resistivity logs in water well logging methods. (2) Microresistivity logs: These logs represent the resistivity of relatively small volumes of aquifers as compared with the volumes measured by macroresistivity logs. Among the common microresistivity logs are the focused proximity log [Doll et al., 1959], the focused microlaterolog [Doll, 1953], and the unfocused microlog [Doll, 1950]. These logs represent the flushed zone resistivity with varying degrees of accuracy depending on the mud cake and small borehole irregularities that may influence the log. I recommend the proximity as the first supplemental log to the induction log in water well logging methods. The microlog and microlaterolog have utility in water well logging programs; but, mud cake corrections must be applied to log values of resistivity in order to obtain improved values of R_{xo}. See Schlumberger [1968].

Interpretation

This thesis investigates the application of two interpretation methods that are based on two water well logging methods. These methods are: (1) the One-log Approach and (2) the Two-log Approach.

(1) One-log Approach (FF-Method): This logging method has as the fundamental source of borehole geophysical data the deep depth of investigation induction log. Plate I is an example of such a logging method. Included with this log are supplemental records of secondary importance; as far as this thesis is concerned. These logs are the medium depth of investigation induction log, the laterolog-eight [Tixier et al., 1963], and the spontaneous potential log [Doll, 1948; Gondouin et al., 1957]. The quantitative determination of the parameters relating to water quality is based on the field formation resistivity factor concept.

(2) Two-log Approach (F-Method): This logging method includes, in addition to the deep depth of investigation induction log, a microresistivity log. Plates IIa and IIb together are an example of the two-log method. The quantitative determination of the parameters relating to water quality from the two-log approach is based on the discrete formation resistivity factor concept. This allows the analyst to determine F independently from R_o and R_w. One advantage of the two-

log approach is that the log analyst can determine approximate values of aquifer porosity indices from knowledge of F and $F = a/\Phi^m$.

Water Quality Standards

Because the waters extracted from wells drilled in the areas covered by this thesis are intended for domestic consumption, I adopted the water quality standards for drinking water recommended by the U. S. Public Health Service [Hem, 1959]. These standards are as follows:

1. NACCEPT: Not Acceptable;

   TDS concentration greater than 1000 ppm. or
   SO_4 " " " 250 " "
   Cl " " " 250 " .

2. PACCEPT: Possibly Acceptable;

   500 ppm. $< TDS < 1000$ ppm.
   0 " $< SO_4 < 250$ "
   0 " $< Cl < 250$ " .

3. GOOD-SCREEN: Water acceptable for production;

   $TDS < 500$ ppm. and
   $SO_4 < 250$ " "
   $Cl < 250$ " .

The NACCEPT, PACCEPT, and GOOD-SCREEN representations have been integrated into the Fortran programs for decision-making purposes.

Using Empirical Relationships

Most electrical log interpretation fundamentals are based on empirically derived relationships. The concept of a formation resistivity factor is such a relationship. For this reason, all available hydrogeologic and geohydrologic information for each geographic area studied was assembled and examined before any of the logs were analized.

METHODS OF INVESTIGATION

Interpretation Control Data

I used three types of data for interpretation control.

Type 1. *Ionic concentrations as a function of the corresponding water resistivity or specific conductance.* One source for information of this type is contained in hydrogeological papers and reports that have been published by governmental agencies. For the hydrogeologic domains of this thesis, the following publications and reports were consulted for this information: *Spiegel* [1955], *Knowles and Kennedy* [1958], *Titus* [1963], and *Cooper* [1968].

The most important information for the quantitative determination of parameters relating to water quality from logs is the chemical analysis of water samples, corresponding specific conductance, and the geologic source. Table 1 is an example of Type 1 interpretation control data.

TABLE 1

EXAMPLE OF TYPE 1 INTERPRETATION CONTROL DATA[(a)]

Location number: number designates well or spring from which sample was obtained and location (see well-numbering system, p. 7); (S) preceding number denotes spring in this appendix only

Geologic source: Qal--alluvium, Quaternary age; QTs--Santa Fe Group, Tertiary and Quaternary (?) age; Km--Mancos Shale, Late Cretaceous age; Kd--Dakota Sandstone, Early and Late Cretaceous age; Jm--Morrison Formation, Late Jurassic age; Trc--Chinle Formation, Late Triassic age; Ps--San Andres Formation, Permian age; Py--Yeso Formation, Permian age; Pa--Abo Formation, Permian age; Pb--Bursum Formation, Permian age; Pm--Madera Formation, Pennsylvanian age

(Analyzed by U.S. Geological Survey. Chemical constituents in parts per million)

Location number	Owner or name	Date collected	Geologic source	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium plus Potassium (as Na)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$		Per cent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH
																		Calcium, magnesium	Non-carbonate				
3.3.10.324	Santa Fe Railway Co.	10- 3-06	QTs	--	--	-	132	38	85	--	--	455	33	-	--	--	834	--	--	28	1.8	--	-
10.324a	Santa Fe Railway Co.	8-12-03	QTs	--	--	-	88	42	68	68	--	449	37	-	--	--	945	392	336	27	1.5	--	-
3.5.28.444	C. Pohl	8-29-49	Pa	--	16	-	32	25	66	272	0	55	27	1.0	7.6	--	364	183	--	44	2.1	611	-
32.210	M. A. Pohl	8-29-49	Pb	--	13	-	4	2.2	264	336	42	70	120	1.8	0.1	--	682	19	0	97	26	1,140	-
4.1.9.324	B. C. Ringer	4-24-56	QTs	73	--	-	--	--	192	98	0	869	292	-	0.5	--	--	980	900	30	2.7	2,480	7.2
4.2.7.141	---	10-31-51	Qal	--	--	-	286	84	579	578	0	965	595	-	1.9	--	3,000	1060	586	54	7.7	4,080	-
7.412	---	10-31-51	Qal	--	--	-	164	25	147	502	0	317	62	-	1.8	--	1,010	512	100	38	2.8	1,480	-
7.423	---	10-31-51	Qal	--	--	-	112	19	69	420	0	86	50	-	3.7	--	540	358	14	29	1.0	948	-
8.243	Mr. Pattison	4-11-56	Qal	56	--	-	--	--	43	203	0	115,	24	-	1.4	--	--	228	62	29	1.2	631	7.4
1/ 22.121	Mr. Cannon	3-27-50	QTs	--	49	-	40	9.7	21	143	--	40	17	0.4	2.4	--	250	140	23	25	0.8	357	-
30.232	---	10-30-51	Qal	--	--	-	94	62	210	848	0	1.2	176	-	1.1	--	966	490	0	48	4.1	1,820	-
35.214	Mr. Cannon	2-24-50	QTs	--	32	-	24	6.3	34	115	0	49	9	0.8	1.6	--	214	86	0	47	1.1	310	-
35.214	Mr. Cannon	4-11-56	QTs	71	32	-	23	5.9	34	108	0	51	8	0.8	1.1	--	210	82	0	47	1.6	317	7.4
4.3.26.144	West & Pyle Cattle Co.	3-29-50	QTs	--	17	-	20	6.0	28	98	--	40	7	0.6	1.6	--	168	74	0	45	1.4	263	-
4.2W.2.433	F. D. Huning	5-24-56	QTs	74	53	-	41	18	823	644	0	640	538	3.1	5.3	--	2,360	176	0	91	27	3,820	7.8
(S)4.3W.6.444	Ward and Dysart (?)	4-30-57	Pm	68	25	-	681	314	7,450	2440	0	3490	9,610	2.0	-	--	22,700	2990	990	84	59	31,000	7.0
5.1.13.332	Town of Belen	11-28-56	QTs	69	31	-	37	15	99	178	0	176	24	1.0	4.7	--	476	154	8	58	3.5	720	7.9
24.344	Justo Gabaldon(?)	4-13-56	QTs(?)	66	--	-	--	--	125	202	0	213	44	-	1.0	--	--	178	12	60	4.1	890	7.5
28.114	B. C. Ringer	4-24-56	QTs	72.2	24	-	322	119	221	166	0	1230	252	0.2	1.3	--	2,420	1290	1160	27	2.7	2,960	7.2
5.2.32.143a	James Matsu	6-26-58	Qal	59	--	-	--	--	--	273	0	198	45	-	-	0.09	--	364	140	--	--	900	7.5
5.3.8.222	B. C. Ringer	6-17-58	QTs	70	54	-	33	6.2	17	132	0	23	9	-	1.1	--	208	108	0	26	0.7	277	7.8
11.331	B. C. Ringer	6-17-58	QTs	62	--	-	--	--	--	139	0	64	11	-	-	--	--	123	9	--	--	391	7.2
5.1W.14.231	F. D. Huning	5-24-56	QTs	63	--	-	--	--	--	416	0	1780	228	-	-	--	--	1580	1240	--	--	3,970	7.2
5.3W.19.111	C. E. Darnell	5- 1-57	Pa	64	20	-	405	233	336	177	0	2300	100	0.7	19.0	--	3,790	1970	1820	27	3.3	3,960	7.7

1/ Sample obtained from stock tank.

(a) Source: Titus [1963]

Type 2. Geohydrologic data: This information is related to the occurrence, distribution, and movement of ground waters within the geographic areas and aquifers of interest and can be obtained from published reports, discussions and interviews, and personal experience and knowledge of the log analyst.

Type 3. Hydrogeologic data: Basically, this information is the known geology that influences the occurrence, distribution, and movement of ground water within the hydrogeologic domain. Included in this category of known information are the local and regional geology--lithology, structure, and history--, the geology of the recharge area(s), and the geologic relationships between the two.

Working Hypothesis

Jones and Burford [1951] demonstrated that, for a given aquifer, the ionic composition can be expressed as a definite function of the corresponding total dissolved solids content. Their ideas were used to establish the example in Figure 6.

Rossum [1949], Richards [1954], and Hem [1959] demonstrated a linear relationship to exist between the total dissolved solids and electrical conductivity of water. Thus, if the ionic composition, I, is proportional to the TDS content; i.e.,

$$I \propto TDS \text{ and if}$$

$$TDS \propto 1/R_w \equiv C_w;$$

$$\text{then } I \propto C_w.$$

TDS is the total dissolved solids content in parts per million and C_w is the water conductivity in micromhos/cm.

From this concept follows the assumption, basic to this work, that ground waters, within a given geographic area and corresponding hydrogeologic domain, have characteristic concentrations of ions for a given electrical resistivity.

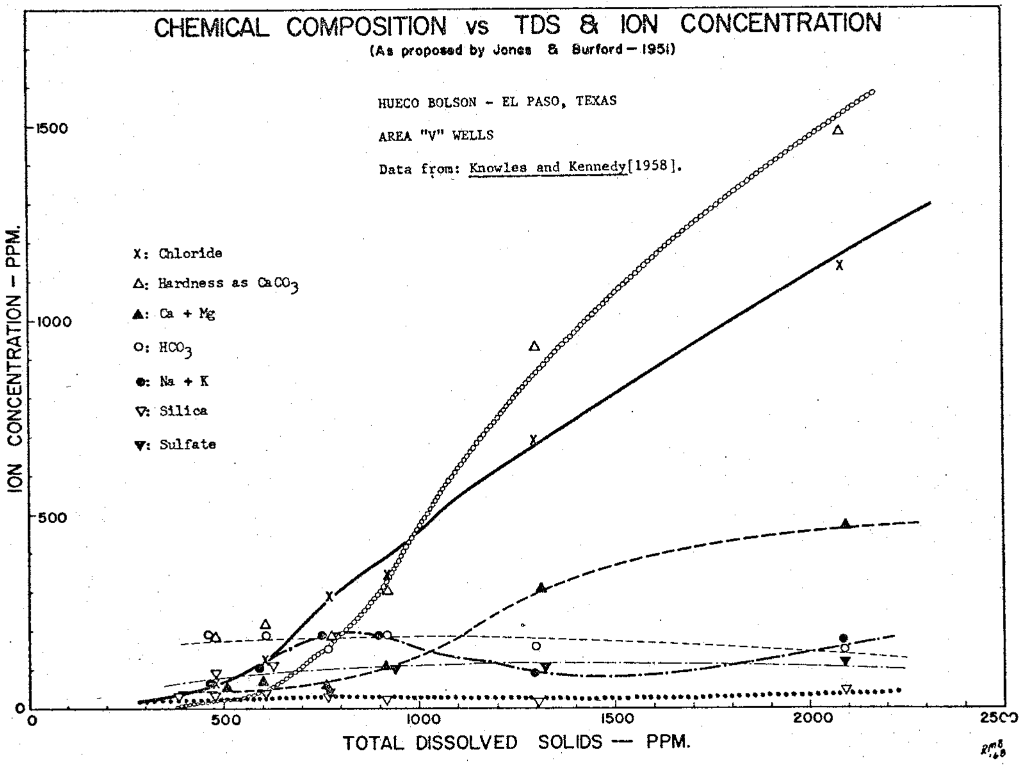


Fig. 6. Water chemical composition as a function of total dissolved solids (TDS) for area "V" of the Hueco Bolson near El Paso, Texas. Data from Kennedy and Knowles [1958].

Ions Diagnostic of Water Quality

From the variety of reported chemical analysis data that may be available for establishing ion concentration and electrical conductivity relationships, it is usually neither convenient nor efficient to use all the ions to describe water quality from resistivity log analysis. In general, I selected those ions that were present in concentrations at least greater than 25 parts per million and that would be meaningful in evaluating the water quality of the aquifers studied. For example, fluoride ion concentrations were not used to evaluate water quality because the reported concentrations of this ion, throughout the areas studied, did not exceed 5.8 ppm. [Titus, 1963].

After examining the data from some areas, I found that the concentrations of particular ions did not significantly vary with the electrical conductivity of the samples. For example, notice some of the charts in Appendix B; particularly the charts on pages 115 and 121. It would be meaningless to describe water quality in terms of ions that are present in constant concentrations for any specific conductance.

For the purpose of this thesis, I chose sulfate, chloride, and TDS concentrations to be primarily diagnostic of water quality in the regions of New Mexico and West Texas from which data were selected. A secondary parameter relating to water quality, hardness as calcium carbonate, was used in one case and bicarbonate ion concentrations were used in another. The selection of this ion group is based on U. S. Public Health Service standards for drinking water [Todd, 1959].

Interpretation Control Charts

The interpretation control charts used in this work are exhibited in Appendix B.

Interpretation control charts were constructed in four steps:

Step 1. All available geologic and ground-water literature for the particular regions of interest was gathered and studied.

Step 2. Ions that were considered to be most conveniently descriptive of water quality for the corresponding regions were selected. TDS, chloride (Cl), and sulfate (SO_4) ion concentrations were included in the basic group.

Step 3. Lines of best fit were constructed through the plotted data, either graphically or by least squares. A computer program, which applies the least squares curve fitting technique to such plotted data, is included in the companion volume Additional Programs--Digital Analysis of Borehole-Measured Aquifer Resistivity to determine Water Quality [Brimhall, 1969]. Curve fitting was used to determine approximate equations relating water quality to the electrical conductivity of water.

The best average of data was from areas where the water quality and electrical conductivity relationships exhibit the least scatter. Examples are shown in Figure 7. Notice that the chloride ion concentration of chart (c) exhibits a much better fit than that of chart (a). Also, notice the "shot-gun" scatter of chloride ion concentration data on chart (b). For logs recorded in the respective areas, cloride ion concentration determinations for the wells located within the corresponding hydrogelogic domain for which chart (c) was constructed would be more reliable than the chloride determinations for wells drilled within the hydrogeologic domain for which chart (a) was constructed.

Step 4. From the scatter of data on the plotted charts, it was decided whether electrical resistivity logs would indeed give quantitative interpretation results of sufficient accuracy to warrant the investigation of existing induction resistivity logs.

Plotting the selected parameters relating to water quality as a function of electrical resistivity has great utility in ground-water quality determinations from resistivity logs; particularly in chart determination methods. The specific conductance scale parallel to the resistivity scale facilitated plotting data from actual chemical analyses for specific geographic areas.

Charts prepared for this thesis conform to the U. S. Geological Survey temperature standard for reporting specific conductance. This standard "Chart Temperature" is 25°C (77°F). This means that water resistivity values from logs recorded at aquifer temperature must be corrected to 25°C before entering the charts to determine ionic concentrations. Therefore, It is paramount that an accurate aquifer temperature be obtained. In fact, I recommend that a temperature survey be made an integral part of any water well logging method.

The interpretation control charts are only applicable to the specific areas for which they were prepared.

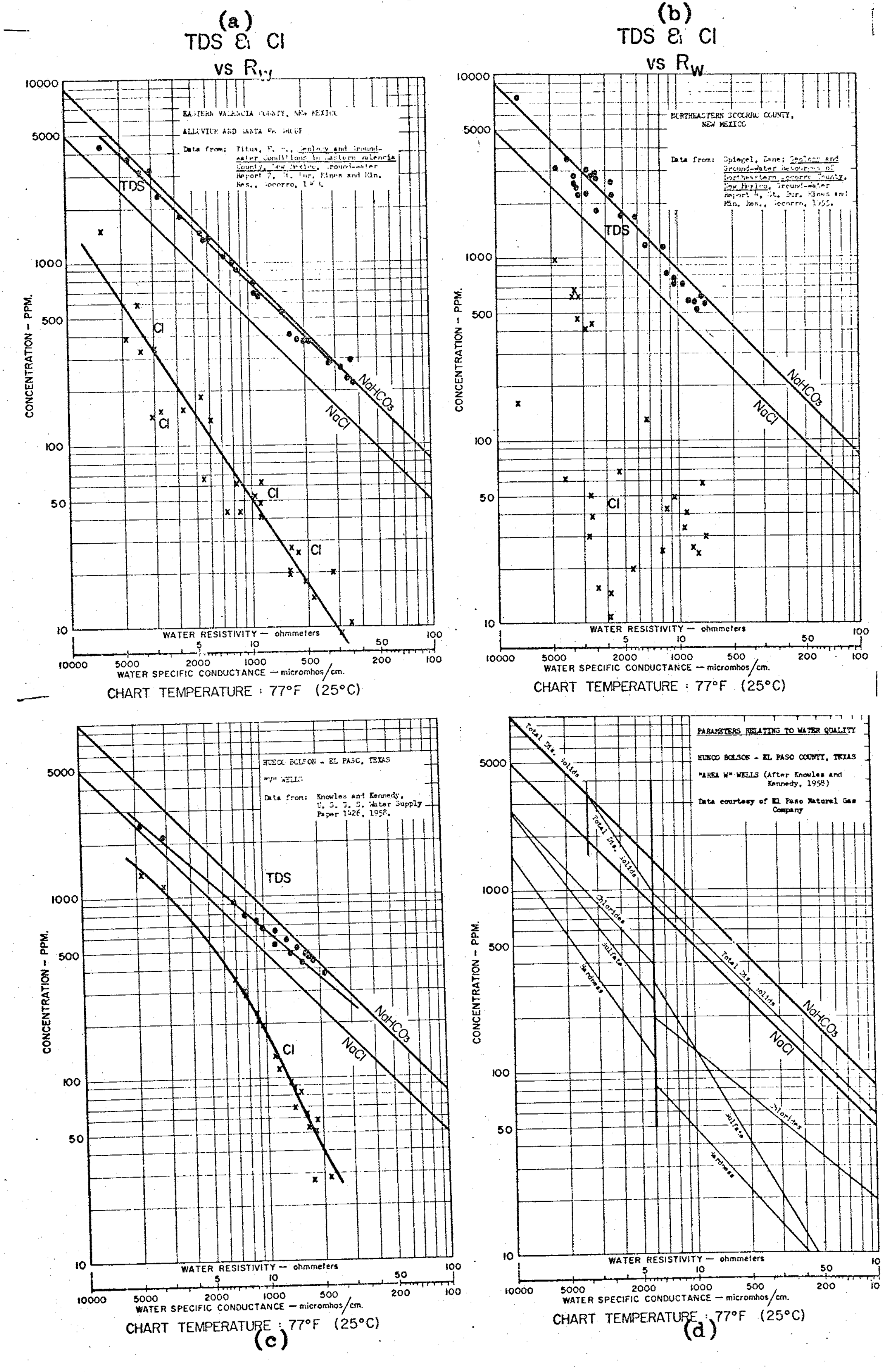


Fig. 7. Examples of interpretation control data.

Approximate Equations Relating Water Quality to Water Resistivity

To facilitate computer applications to water quality determinations from resistivity logs, approximate equations relating water quality to either water resistivity or to water specific conductance were developed from the interpretation control charts. These equations can have either of the two general forms:

$$\frac{\text{Ion concentration}}{\text{ppm.}} = cR_w^{-d'} \qquad (10)$$

or

$$\frac{\text{Ion concentration}}{\text{ppm.}} = \sum_{i=1}^{n} e_i C_w^{\,i-1}. \qquad (11)$$

Equation (10) represents a linear relationship on log-log grid charts. "c" and "d'" are empirical constants. Equation (11) represents a polynomial relationship determined from a least squares curve-fitting technique. The e_i (i = 1, 2, 3, ..., n) represent empirical constants.

The equations actually used in the machine determinations are summarized in Appendix D. Each equation is valid only for a specified range of water resistivity, or specific conductance, values.

Parametric Interpretation Data

Parametric interpretation data, by definition, remain essentially constant for each interpretation problem but may vary from well to well and logging program to logging program. Included in parametric data are: (1) mud filtrate and mud cake resistivity, (2) mud cake thickness, (3) annual mean surface temperature for the geographic area and hydrogeologic domain under consideration, (4) bottom hole temperature of the well, (5) the total depth of the well, (6) a clay parameter that allows the log analyst to include in computer programs a means of distinguishing impermeable aquifer units from productive sands and gravels, and (7) constants "a" and "m" for porosity index determinations from the relation

$$F = a/(\text{porosity index})^m. \qquad (12)$$

Mud filtrate resistivity is necessary in order that the apparent formation resistivity factor for each data point can be determined. Mud cake resistivity and thickness are important in order that correction can be made to the log values of flushed zone resistivity as determined from a microlog or a microlaterolog. In general, mud cake corrections are not necessary in determining values of R_{xo} if a proximity log is recorded [Schlumberger, 1968]. Values of R_{mf} and R_{mc} can be measured at the well site from drilling fluid samples considered to be representative of the entire drilling fluid column and are usually reported on log headings. If a borehole-caliper survey is recorded in a well bore that was drilled with an eight and three-quarter inch bit, for example, but the caliper survey indicates a borehole diameter of eight and one-quarter inches, the mud cake thickness is one-quarter of an inch. However, if the well bore is washed out it may be necessary to make an intelligent estimate as to the value of mud cake thickness. For the purposes of this thesis, I assumed a uniform and constant mud cake thickness of 1/8 inch.

For log values of resistivity to be corrected to 77° F, it is necessary to know the formation temperature at each data point. An accurate temperature survey is the best means to determine aquifer temperatures. Because a temperature survey was not available for any of the wells studied, I used a linear temperature gradient relationship--a linear relationship is as good as any other relationship because this is another estimate anyway--to determine a temperature for each data point from (1) the mean annual surface temperature, (2) the bottom hole temperature, and (3) the total depth of the well. The mean surface temperature was determined from data collected by local weather stations. The bottom hole temperature is usually recorded at the time the well is logged.

The clay parameter is some log characteristic that allows the log analyst to distinguish clay and clay-bearing aquifer units from aquifer units that are mostly sands and gravels. The clay parameters used were either a characteristic resistivity below which a given resistivity value is indicative of a clay-bearing aquifer unit, or a relationship between the micro-inverse and micro-normal resistivity curves as recorded by the microlog [Doll, 1950]. Clay parameters, as used in the preparation of this thesis and companion volume [Brimhall, 1969], are listed by well as follows:

1. El Paso Natural Gas Company Test Well #3 (Plate I): The resistivity clay parameter for this well was selected as 4.1 ohm-meters as read from the induction log. Any aquifer unit with a log resistivity of 4.1 ohm-meters or less is classified as predominantly a clay-bearing bed and not suitable for water production; i.e., "NACCEPT-CLAY".
2. USGS Test Well #B-5 (Plates IIa and IIb): Micro-inverse resistivity greater than micro-normal resistivity classifies the corresponding aquifer unit as a predominantly clay bearing bed and not capable of water production. Therefore, on the computer line-printer output, the aquifer unit was given the symbolic notation "NACCEPT-CLAY".

If the micro-inverse resistivity was between the micro-normal resistivity and some limiting assumed value of R_{xo}, arbitrarily selected to allow some margin of discretion, then the aquifer unit was classified as a sandy clay and could possibly produce water to a well--provided the water quality is acceptable. The symbolic notation "PACCEPT/SANDY-CLAY" is used for such beds. If the micro-normal resistivity is greater than the corresponding micro-inverse resistivity by the assumed value of R_{xo}, the aquifer unit is classified as productive; i.e., "GOOD-SCREEN".

3. <u>City of Belen Water Well #4</u>:

   The same system that was used in (2) above was used for this well. The resistivity clay parameter was selected as 18.0 ohm-meters.

4. <u>City of El Paso Water Well #3 Offset</u>:

   The same system that was used in (1) above was used for this well. The resistivity clay parameter was selected as 5.1 ohm-meters.

5. <u>USGS Test Well #B-6A (Relocated)</u>:

   The scheme for delimiting clay and con-clay beds was used as in the USGS Test Well #B-5.

6. *Village of Los Lunas Water Well #3*:
   The same system and the same resistivity clay parameter that was used in (3), above, was used for this well.

The adjunctive interpretation programs and corresponding tabular and computer plots of results for the wells listed under (3), (4), (5), and (6) are presented in the companion volume [*Brimhall*, 1969].

From the relationship $F = a/\Phi^m$, I was able to determine approximate values of an aquifer porosity index for the aquifer units evaluated. The main problem in applying the formula is deciding which values of "a" and "m" to use. Neither constant can be determined from field resistivity measurements. For clastic rocks, "m" can have a value between 1.0 for completely unconsolidated rocks and 4.0 for consolidated rock [*Walther*, 1968]. I arbitrarily selected "m" equal to 1.5 in the porosity index determinations made in this thesis. Values of "a" were varied by trial and error until reasonable values of clean aquifer porosity indices were obtained. Table 2 summarizes the values of "a" and "m" selected as being applicable in the study. Porosity index values for the clay beds were calculated but, as in the case of non-clay bearing beds, should be considered only as relative values.

TABLE 2

SUMMARY OF CONSTANTS "a" AND "m" AS USED TO DETERMINE AQUIFER POROSITY INDICES

Geographic Area Well Name	"a"	"m"
Bosque del Apache Grant		
USGS Test Well #B-5	0.63	1.5
USGS Test Well #B-6A Relocated	0.79	1.5
Eastern Valencia County		
City of Belen Water Well #3	0.45	1.5
Village of Los Lunas Water Well #3	0.45	1.5
Hueco Bolson Area "V"		
City of El Paso Water Well #3 Offset	0.45	1.5
Hueco Bolson Area "W"		
El Paso Natural Gas Company Test Well #3	One-log approach logging program. Porosity index determinations not possible.	

Interpretation Procedure

I used the following basic procedure in both manual and machine interpretations of resistivity logs recorded in water wells:

Step 1. Relationships between water quality and specific electrical conductance--or resistivity--were determined for the ions selected as relating to water quality.

Step 2. The parametric data necessary to perform the interpretations were assembled.

Step 3. The basic data from the resistivity logs were read and tabulated. These data include, the data point number, the data point depth, R_o and R_{xo} (or related values of resistivity when corrected for borehole effects will give R_o and R_{xo}), and the corresponding aquifer unit temperatures. Because the digital computer was to be used in the interpretations, corresponding values of the spontaneous potential were included. The spontaneous potential is useful for correlation and graphical presentation of results. The logs were read and the data digitized every two feet if computer plots of interpretation results were to be plotted on a one inch per one hundred feet scale; every one foot if for a five inch per one hundred feet scale.

Step 4. All resistivity data were corrected to 77°F.

Step 5. Depending on the selected logging method, either the F-Method or the FF-Method of interpretation was applied as follows:

a. F-Method;
   - (1) F for each data point was calculated.
   - (2) Porosity indices were calculated.
   - (3) Step (7) was executed next.

b. FF-Method;
   - (1) FF was determined from either
     - (a) Chemical analysis of drill stem test samples, or
     - (b) Average values of F weighted against aquifer unit thickness for sands and gravels.
   - (2) Step (7) was executed next.

Step 6. R_w was calculated for each data point from $R_w = R_o/F$ or $R_w = R_o/FF$.

Step 7. From the interpretation control charts or appropriate equations, the values of parameters relating to water quality were determined; i.e., TDS, Cl, SO_4, HCO_3, HARD, etc.

Step 8. Aquifer units were classified as

(1) GOOD-SCREEN, or

(2) PACCEPT, or

(3) NACCEPT, or

(4) PACCEPT/SANDY-CLAY, or

(5) NACCEPT/CLAY.

Step 9. The interpretation was concluded with remarks regarding estimates as to the relative quantity of parameters relating to water quality for the well's production under pumping conditions. I did this for each screened interval by calculating average concentrations, for all diagnostic ions, which were weighted to their proportionate amounts of the total screened interval. This averaging method assumes that all aquifer units screened have the same permeability.

Computer Programs Applied to Resistivity Log Interpretation

The computer programs used in the preparation of this thesis are of three types:

1. Preliminary programs for determining interpretation control equations and for establishing a mud cake correction relationship for use in R_{xo} determinations from the microlog.

2. Adjunctive interpretation programs for determining those parameters relating to water quality, for calculating porosity indices, for classifying aquifer units as described in the previous section, for tabulating the initial log data and final interpretation results, and for graphically presenting the results as computer plots.

3. Secondary programs for comparing the results of F- and FF-Methods of interpretation when both methods are applied to the same interpretation problem. Secondary programs are discussed in the section on presentation and discussion of results.

For a well 1000 feet deep, the machine-time required for the interpretation, without presenting the results in the form of computer plots, is approximately 5 minutes. Plotting the results with a coordinate plotter requires an additional 4 minutes. Computer plots were made at the same scale as the depth scale of the original open hole logs. This facilitates the correlation of results with the original data.

Because of space limitations, the only machine programs presented in this thesis are for (1) the El Paso Natural Gas Company Test Well #3, and the (2) USGS Test Well #B-5. All other programs, preliminary, adjunctive, and secondary, are presented in the companion volume [Brimhall, 1969].

The flow chart, shown in Figure 8, illustrates the main steps performed by the adjunctive interpretation programs. Copies of all programs discussed in this thesis are preserved on data cards on file in the office of the Ground Water Hydrology department at New Mexico Institute of Mining and Technology.

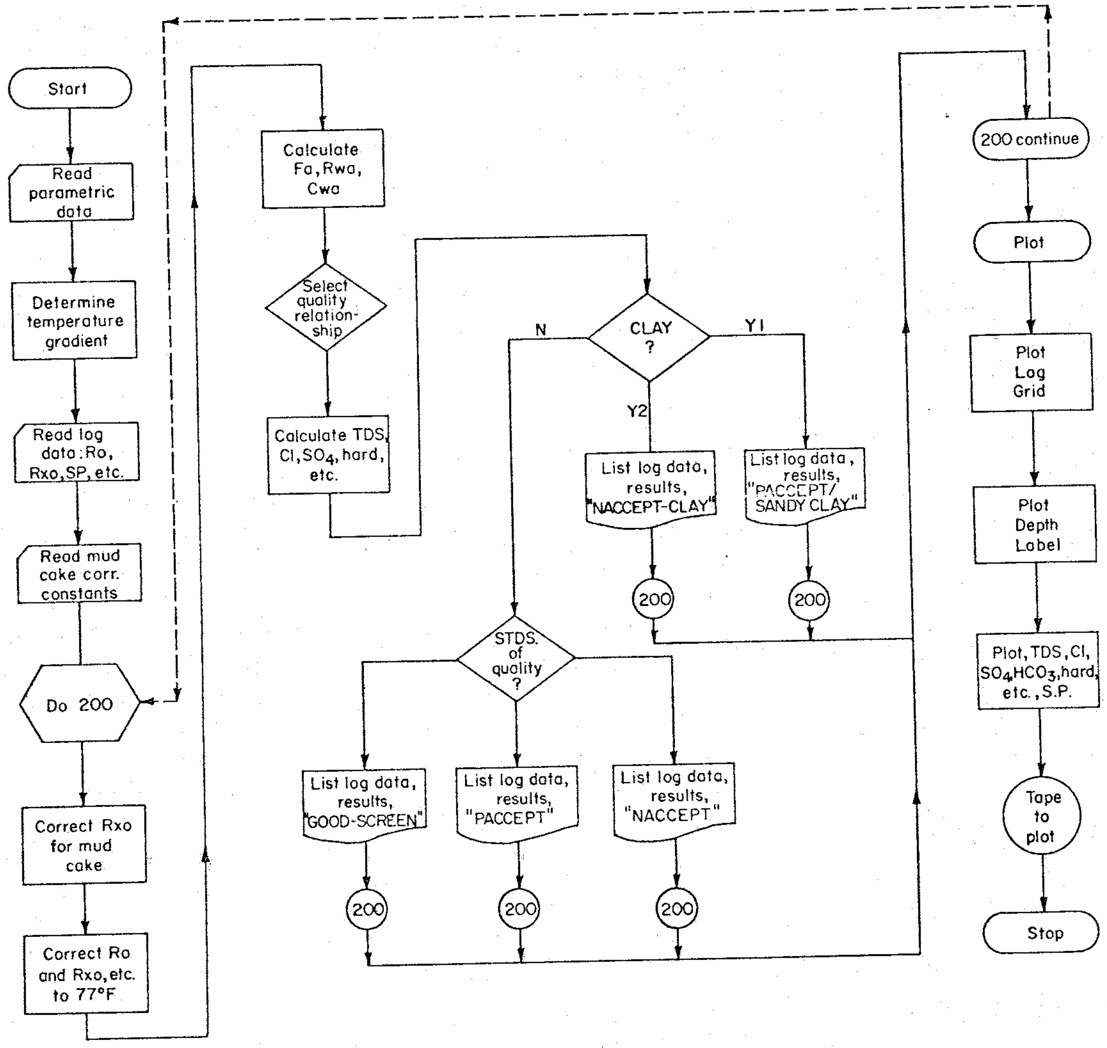


Fig. 8. Skeletal flow chart of adjunctive interpretation programs.

Preliminary Programs

Interpretation Control Data--DATFIT

The preliminary program for reducing interpretation control data charts to equation form for use in machine computations was accomplished by using the program named DATFIT [Brimhall, 1969]. DATFIT determines the coefficients for a polynomial of the general form

$$\frac{\text{Ion concentration}}{\text{ppm.}} = \sum_{i=1}^{n} e_i C_w^{\,i-1}$$

by the method of least squares and Gaussian elimination [Rule, 1968]. The e_i are constants ($i = 1, 2, 3, \ldots, n$), C_w is the specific conductance of water in micromhos/cm. Comments within DATFIT explain the execution of the program.

The values of the coefficients and the order of the resultant polynomial for each ion relating to water quality was selected on the basis of the corresponding minimum standard deviation. DATFIT determines the values of e_i for a polynomial with maximum order of 9. This represents a ten term polynomial. For the example in the companion volume, the selected equation for TDS is

$$\begin{aligned} \text{TDS} = {} & 8.3 + 6.8\text{x}10^{-1}Cw + 1.7\text{x}10^{-7}Cw^2 + 2.5\text{x}10^{-10}Cw^3 + \\ & 1.7\text{x}10^{-13}Cw^4 + 8.0\text{x}10^{-17}Cw^5 + 4.1\text{x}10^{-20}Cw^6 + \\ & 3.7\text{x}10^{-23}Cw^7 + 2.8\text{x}10^{-26}Cw^8 + 1.2\text{x}10^{-29}Cw^9. \end{aligned} \tag{13}$$

The equation could be simplified to

$$\mathrm{TDS} = 0.68C_w$$

without causing appreciable error. The actual equation used in BODEAP, the adjunctive interpretation program for which equation (13) could be used, was $\mathrm{TDS} = 0.705C_w$. This is the subjective equation derived from the charts (Appendix B).

The standard deviation, determined for each coefficient and polynomial order set, gives a quantitative measure of accuracy in the determination because it relates the calculated value of the water quality parameter to a corresponding maximum and minimum error. This measure of accuracy is useful--but not invaluable.

Microlog Mud Cake Correction--MUDCAK

The preliminary program for reducing mud cake correction charts, as they appear in interpretation-chart manuals, to equation form for use in machine computations was accomplished by using the program MUDCAK, [Brimhall, 1969]. MUDCAK calculates the coefficients for a 6th order and seven term polynomial for a given mudcake thickness. Mud cake thickness and the ratios of microinverse resistivity to mud cake resistivity and micronormal resistivity to mud cake resistivity are the parameters for calculating the ratio flushed zone resistivity to mud cake resistivity [Schlumberger, 1968]. The "apparent" true flushed zone resistivity can be calculated because mud cake resistivity is known. The example presented in the companion volume [Brimhall, 1969] is for a mud cake thickness of 1/8 inches; the mud cake thickness used exclusively for the machine interpretations. Knowledge of the physical character of drilling fluid, and the type lithology and qualitative permeability characteristics of aquifers are necessary before MUDCAK is applied. Comments within MUDCAK explain the execution of the program.

For the purposes of allowing me the maximum in discretionary authority in applying computer techniques to water well log interpretations, DATFIT and MUDCAK are not written into the adjunctive interpretation programs as subroutines.

Adjunctive Interpretation Programs

Adjunctive interpretation programs were written for each geographic area studied: BODEAP for the Bosque del Apache Grant, Socorro County, New Mexico; EVALCO for eastern Valencia County, New Mexico; and HUEB01 and HUEB02 for the Hueco Bolson near El Paso, Texas. HUEB01 applies the F-Method of interpretation; HUEB02 applies the FF-Method. Each program presents the results in tabular and graphic (computer plot) form; each contains sufficient comments to explain its function and execution. Only one example of BODEAP and only one example of HUEB02 are presented here. Examples of the other adjunctive interpretation programs are presented in the companion volume [Brimhall, 1969]

These programs are easily modified for application to geographic areas other than those discussed.

Hueco Bolson near El Paso, Texas--HUEBO2

Example-- El Paso Natural Gas Company Test Well #3

```
FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69106       NEW MEXICO TECH     PAGE  0001
               C          014P,10,858,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
               C      RONALD M. BRIMHALL - ELECTRIC LOG INTERPRETATION PROGRAM FOR WATER
               C                      WELLS
               C      AQUIFER PARAMETERS DETERMINED---TDS, CL, SO4, HARDNESS
               C
               C      ####################################################################
               C      EL PASO NATURAL GAS COMPANY ---- TEST WELL #3   PLOT RESULTS
               C      HUECO BOLSON 'W' WELL
               C      ####################################################################
               C
               C      RESISTIVITY LOG INTERPRETATION PROGRAM HUEB02---
               C      ********************************************************************
               C      PURPOSE---
               C              HEUB02 DETERMINES QUANTITATIVE VALUES OF PARAMETERS RELAT-
               C      ING TO WATER QUALITY--TOTAL DISSOLVED SOLIDS, CHLORIDE, SULFATE
               C      AND HARDNESS CONCENTRATIONS IN UNITS OF PARTS PER MILLION.  THIS
               C      PROGRAM IS APPLICABLE TO AREA ''W'' OF THE HEUCO BOLSON NEAR EL
               C      PASO, TEXAS (BRIMHALL, 1969,,KNOWLES & KENNEDY, 1956).  RESISTI-
               C      VITY DATA FROM A BOREHOLE MACRORESISTIVITY DEVICE AND A KNOWN
               C      VALUE OF A FIELD FORMATION RESISTIVITY FACTOR ARE NECESSARY FOR
               C      HEUB02.  THE FIELD FORMATION RESISTIVITY FACTOR METHOD FOR CALCU-
               C      LATING QUANTITATIVE VALUES OF TDS, ETC. IS USED IN HEUB02.  WATER
               C      AT EACH DATA POINT IS CLASSIFIED AS TO ITS ACCEPTABILITY BASED ON
               C      US PUBLIC HEALTH SERVICE STANDARDS (TODD, 1959).  EACH AQUIFER
               C      UNIT IS EXAMINED FOR CLAY.  CALCULATION RESULTS ARE PRESENTED IN
               C      TABLE AND LOG FORM.
               C      ********************************************************************
               C
               C
               C      ********************************************************************
               C      REFERENCES---
               C      BRIMHALL, R. M., DIGITAL ANALYSIS  OF BOREHOLE-MEASURED AQUIFER
               C      RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER OF
               C      SCIENCE THESIS, N. MEX. INST. MINING AND TECH., SOCORRO, JUNE 1969.
               C
               C      KNOWLES, D. B., AND R. A. KENNEDY, GROUND-WATER RESOURCES OF THE
               C      HUECO BOLSON NORTHEAST OF EL PASO, TEXAS, USGS WATER SUPPLY PAPER
               C      1426, 1956.
               C
               C      TODD, D. K., GROUND WATER HYDROLOGY, WILEY, NEW YORK, 1959.
               C      ********************************************************************
               C
               C
               C
               C      ********************************************************************
               C      NOMENCLATURE--
               C
               C            SCALAR QUANTITIES--
               C      T1 = INITIAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
               C      N = NUMBER OF DATA POINTS AND DO 200 ITERATIONS.
               C      FF = FIELD FORMATION RESISTIVITY FACTOR.
               C      AVTEMP = AVERAGE SURFACE TEMPERATURE FOR CALCULATING GRAD.
               C      TD = TOTAL DEPTH OF WELL FOR CALCULATING GRAD.
               C      BHT = BOTTOM HOLE TEMPERATURE FOR CALCULATING GRAD.
               C      ROCL = AQUIFER RESISTIVITY BELOW WHICH AQUIFER CLASSIFIED CLAY--
               C            OHM-METERS.
               C      K = SUBSCRIPT FOR SUBSCRIPTED VARIABLES.
               C      GRAD = TEMPERATURE GRADIENT OF AQUIFER.
               C      Y = ORDINATE POSITION OF FPN--INCHES.
               C      HEIGHT = HEIGHT OF NUMERICS WRITTEN BY CALL NUMBER--INCHES.


FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69106       NEW MEXICO TECH     PAGE  0002
               C      THETA = ANGLE WITH RESPECT TO CAL COMP COORDINATES FOR WRITING
               C            FPN--DEGREES.
               C      NN = NUMBER OF DECIMAL DIGITS TO RIGHT OF DECIMAL IN FPN (-1 SUP-
               C            PRESSES DECIMAL POINT.)
               C      I = SUBSCRIPT FOR ABSCISSA OF FPN.
               C      T2 = FINAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
               C      TIME = PROGRAM EXECUTION TIME--SECONDS.
               C
               C
               C      SUBSCRIPTED VARIABLES---
               C
               C      DATA = DATA POINT NUMBER.  CALCULATED FROM DEPTH IN HUEB02.
               C      DEPTH = DEPTH OF DATA POINT--FEET.
               C      RO = DEEP INDUCTION RESISTIVITY--OHM-METERS.
               C      TDS = TOTAL DISSOLVED SOLIDS CONCENTRATION--PPM.
               C      CL = CHLORIDE CONCENTRATION--PPM.
               C      SO4 = SULFATE CONCENTRATION--PPM.
               C      HARD = HARDNESS AS CALCIUM CARBONATE--PPM.
               C      RW = WATER RESISTIVITY--OHM-METERS.
               C      SPCOND = SPECIFIC CONDUCTANCE OF WATER--MICROMHOS/CM.
               C      ROC = TEMPERATURE CORRECTED DEEP INDUCTION RESISTIVITY--OHM-METERS
               C      SP = DEFLECTION OF SP CURVE FROM LEFT EDGE OF TRACK I--INCHES.
               C      ABC = DATA POINT DEPTH RESCALED TO 5 INCHES/100 FEET.
               C      TDSP = TDS RESCALED FOR PLOT--INCHES.
               C      SO4P = SO4 RESCALED FOR PLOT--INCHES.
               C      CLP = CHLORIDE RESCALED FOR PLOT--INCHES.
               C      X = ABSCISSA POSITION OF FPN--INCHES.
               C      FPN = DEPTH LABEL--A FLOATING POINT NUMBER.
               C      ********************************************************************
               C
               C
               C      ********************************************************************
               C      SUBPROGRAMS CALLED--
               C
               C            CLOCK
               C            IBCOM#
               C            SETMSG
               C            PLOT
               C            NUMBER
               C            FRXPR#
               C      ********************************************************************
               C
               C
               C
  0001                CALL CLOCK(T1)
  0002                DIMENSION DATA(234),DEPTH(234),RO(234),TDS(234),CL(234),SO4(234),
                     *HARD(234),RW(234),SPCOND(234),ROC(234),SP(234)
                     *,ABC(234),TDSP(234),SO4P(234),CLP(234),X(3),FPN(3)
               C
               C      PARAMETRIC DATA
  0003                N = 234
  0004                FF = 0.935
  0005                AVTEMP = 72.
  0006                TD = 550.
  0007                BHT = 85.
  0008                ROCL = 4.1
               C
               C      RO AND SP VALUES READ IN FROM DATA CARDS.
  0009                READ(5,1)(DEPTH(K),RO(K),SP(K), K = 1,N)
  0010              1 FORMAT(F5.0,F4.1,F4.2)
               C
```

```
FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69106        NEW MEXICO TECH     PAGE  0003

              C      WRITE PROBLEM IDENTIFICATION DATA.
 0011                WRITE(6,2)
 0012              2 FORMAT('9',//39X,'EL PASO NATURAL GAS COMPANY TEST WELL #3',//50X,
                    *'HUECO BOLSON W WELL',//49X,'EL PASO COUNTY, TEXAS')
 0013                WRITE(6,998)
 0014            998 FORMAT(////30X,'INTERPRETATION BY FIELD FORMATION RESISTIVITY FACT
                    *OR METHOD')
 0015                WRITE(6,999)
 0016            999 FORMAT(//15X,'FIELD FORMATION RESISTIVITY FACTOR USED = 0.935')
 0017                WRITE(6,1001)
 0018           1001 FORMAT(//15X,'REPORTED MAXIMUM AQUIFER TEMP = 85 F',////)
 0019                WRITE(6,1000)
 0020           1000 FORMAT(5X,'DATA',5X,'DEPTH',6X,'RO',5X,'SPCOND',6X,'RW',6X,'TDS',6
                    *X,'CL',7X,'S04',5X,'HARD.',4X,'REMARKS')
              C
              C      CALCULATE TEMPERATURE GRADIENT.
 0021             99 GRAD = (BHT-AVTEMP)/TD
              C
              C      PRIMARY DO LOOP.
 0022                DO 200 K = 1,N
              C
              C      RESCALE DEPTH TO LOG SCALE.
 0023                ABC(K) = (DEPTH(K) - 300.)*0.05
              C
              C      APPLY TEMPERATURE CORRECTION TO RO.
              C           TEMPERATURE CORRECTIONS ARE TO 77 F.
 0024             98 ROC(K) = RO(K)*(AVTEMP + GRAD*DEPTH(K))/77.
              C
              C      SHIFT SP 3/4 INCH.
 0025             88 SP(K) = 0.75 + SP(K)
              C
              C      DETERMINE WATER RESISTIVITY.
 0026             97 RW(K) = ROC(K)/FF
              C
              C      DETERMINE SPECIFIC CONDUCTANCE OF WATER.
 0027             96 SPCOND(K) = 10000.0/RW(K)
              C
              C      DETERMINE THE DATA POINT NUMBER--NOT READ IN.
 0028             92 DATA(K) = DEPTH(K) - 309.
              C
              C      SELECT PROPER GROUP OF INTERPRETATION CONTROL EQUATIONS AND
              C           RESCALE TDS, CL, AND S04 FOR PLOT.
              C
              C      SP TRACK I, 10 MILLIVOLTS PER LOG DIVISION.
              C
              C      S04, TRACK II, 1000 - 0 PPM.
              C
              C      TDS AND CL, TRACKS II AND III, 4000 - 0 PPM.
 0029             91 IF(RW(K).GE.6.17)GO TO 3
 0030             90 IF(RW(K).LT.6.17.AND.RW(K).GE.2.5)GO TO 4
 0031             89 IF(RW(K).LT.2.5)GO TO 5
 0032              3 TDS(K) = 5814.3/RW(K)**0.99
 0033                CL(K) = 912.9/RW(K)**0.84
 0034                HARD(K) = 826./RW(K)**1.223
 0035                S04(K) = 7690./RW(K)**1.756
 0036                S04P(K) = (5.75 - (2.5E-03)*S04(K))
 0037                TDSP(K) = (8.25 - (1.25E-03)*TDS(K))
 0038                CLP(K) = (8.25 - (1.25E-03)*CL(K))
 0039                GO TO 888
 0040              4 TDS(K) = 14276./RW(K)**1.515


FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69106        NEW MEXICO TECH     PAGE  0004

 0041                CL(K) = 2704./RW(K)**1.085
 0042                HARD(K) = 1617./RW(K)**1.47
 0043                S04(K) = 2700./RW(K)**1.25
 0044                S04P(K) = (5.75 - (2.5E-03)*S04(K))
 0045                TDSP(K) = (8.25 - (1.25E-03)*TDS(K))
 0046                CLP(K) = (8.25 - (1.25E-03)*CL(K))
 0047                GO TO 888
 0048              5 TDS(K) = 8900./RW(K)**0.989
 0049                CL(K) = 2704./RW(K)**1.085
 0050                HARD(K) = 1617./RW(K)**1.47
 0051                S04(K) = 2700./RW(K)**1.25
 0052                S04P(K) = (5.75 - (2.5E-03)*S04(K))
 0053                TDSP(K) = (8.25 - (1.25E-03)*TDS(K))
 0054                CLP(K) = (8.25 - (1.25E-03)*CL(K))
 0055                GO TO 888
              C
              C      TEST FOR CLAY.
 0056            888 IF(RO(K).LE.ROCL)GO TO 810
              C
              C      IF NO CLAY, TEST & CLASSIFY WATER QUALITY.
 0057             10 IF(TDS(K).GE.1000.)GO TO 11
 0058                IF(CL(K).GE.250.)GO TO 11
 0059                IF(TDS(K).LT.1000..AND.TDS(K).GE.500..AND.CL(K).LT.250.)GO TO 12
 0060                IF(TDS(K).LT.500.)GO TO 13
 0061             11 WRITE(6,21) DATA(K),DEPTH(K),RO(K),SPCOND(K),RW(K),TDS(K),CL(K),
                    *S04(K),HARD(K)
 0062             21 FORMAT(5X,F5.0,4X,F5.0,4X,F5.1,4X,F6.0,4X,F5.1,4(4X,F5.0),4X,'NACC
                    *EPT')
 0063                GO TO 200
 0064             12 WRITE(6,22) DATA(K),DEPTH(K),RO(K),SPCOND(K),RW(K),TDS(K),CL(K),
                    *S04(K),HARD(K)
 0065             22 FORMAT(5X,F5.0,4X,F5.0,4X,F5.1,4X,F6.0,4X,F5.1,4(4X,F5.0),4X,'PACC
                    *EPT')
 0066                GO TO 200
 0067             13 WRITE(6,23) DATA(K),DEPTH(K),RO(K),SPCOND(K),RW(K),TDS(K),CL(K),
                    *S04(K),HARD(K)
 0068             23 FORMAT(5X,F5.0,4X,F5.0,4X,F5.1,4X,F6.0,4X,F5.1,4(4X,F5.0),6X,'GOOD
                    *--SCREEN')
 0069                GO TO 200
 0070            810 IF(TDS(K).GE.1000.)GO TO 811
 0071                IF(CL(K).GE.250.)GO TO 811
 0072                IF(TDS(K).LE.1000..AND.TDS(K).GE.500..AND.CL(K).LT.250.)GO TO 12
 0073                IF(TDS(K).LT.500.)GO TO 13
 0074            811 WRITE(6,821)DATA(K),DEPTH(K),RO(K),SPCOND(K),RW(K),TDS(K),CL(K),
                    *S04(K),HARD(K)
 0075            821 FORMAT(5X,F5.0,4X,F5.0,4X,F5.1,4X,F6.0,4X,F5.1,4(4X,F5.0),4X,'NACC
                    *EPT-CLAY')
 0076                GO TO 200
 0077            200 CONTINUE
              C
              C      WRITE COLUMN IDENTIFICATION.
 0078                WRITE(6,1000)
              C
              C      DETERMINE PROGRAM EXECUTION TIME.
 0079                CALL CLOCK(T2)
 0080                TIME = T1 - T2
 0081                WRITE(6,2000)TIME
 0082           2000 FORMAT(/////40X,'PROGRAM TIME IN SECONDS = ',E14.7)
              C
              C      IDENTIFY PROGRAMMER.
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FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATF  69106       NEW MEXICO TECH     PAGE  0005

 0083            WRITE(6,9999)
 0084       9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'B
                *OX 31 CAMPUS STA.',/30X,'SOCORRO, N. M.   87801')
           C
           C
           C
           C
           C
           C     PLOT RESULTS IN LOG (GRAPHIC) FORM.
 0085            CALL SETMSG(13,'BRIMHALL PLOT')
 0086            CALL PLOT(0.,-15.,-3)
 0087            CALL PLOT(15.,1.4,-3)
           C
           C
           C
           C     ESTABLISH LOG GKID.
           C
           C     LOG GRID SCALE IS 5 INCHES PER 100 FEET OF WELL DEPTH.
 0088            CALL PLOT(0.,2.5,2)
 0089            CALL PLOT(0.,3.25,3)
 0090            CALL PLOT(0.,8.25,2)
 0091            CALL PLOT(12.5,8.25,2)
 0092            CALL PLOT(12.5,3.25,2)
 0093            CALL PLOT(12.5,2.5,3)
 0094            CALL PLOT(12.5,0.,2)
 0095            CALL PLOT(0.,0.,2)
 0096            CALL PLOT(0.,2.5,3)
 0097            CALL PLOT(12.5,2.5,2)
 0098            CALL PLOT(12.5,3.25,3)
 0099            CALL PLOT(0.,3.25,2)
 0100            CALL PLOT(0.,5.1,3)
 0101            CALL PLOT(12.5,5.1,2)
 0102            CALL PLOT(12.5,5.75,3)
 0103            CALL PLOT(0.,5.75,2)
 0104            CALL PLOT(0.,7.9375,3)
 0105             CALL PLOT(12.5,7.9375,2)
 0106            CALL PLOT(2.5,8.25,3)
 0107            CALL PLOT(2.5,3.25,2)
 0108            CALL PLOT(2.5,2.5,3)
 0109            CALL PLOT(2.5,0.,2)
 0110            CALL PLOT(5.,0.,3)
 0111            CALL PLOT(5.,2.5,2)
 0112            CALL PLOT(5.,3.25,3)
 0113            CALL PLOT(5.,8.25,2)
 0114            CALL PLOT(7.5,8.25,3)
 0115            CALL PLOT(7.5,3.25,2)
 0116            CALL PLOT(7.5,2.5,3)
 0117            CALL PLOT(7.5,0.,2)
 0118            CALL PLOT(10.,0.,3)
 0119            CALL PLOT(10.,2.5,2)
 0120            CALL PLOT(10.,3.25,3)
 0121            CALL PLOT(10.,8.25,2)
 0122            CALL PLOT(12.5,8.25,3)
 0123            CALL PLOT(12.5,3.25,2)
 0124            CALL PLOT(12.5,2.5,3)
 0125            CALL PLOT(12.5,0.,2)
           C
           C
           C     ***********DEPTH LABEL**********
 0126            Y = 2.85


FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69106       NEW MEXICO TECH     PAGE  0006

 0127            HEIGHT = 0.10
 0128            THETA = 0.
 0129            NN = -1
 0130            N = 3
 0131            READ(5,800)(X(I),FPN(I),I = 1,N)
 0132        800 FORMAT(F5.2,F4.0)
 0133            DO 801 I = 1,N
 0134            CALL NUMBER(X(I),Y,HEIGHT,FPN(I),THETA,NN)
 0135        801 CONTINUE
           C
           C
           C     **********CURVE GENERATION**********
           C
 0136            N = 233
           C
           C
           C     #####SP GENERATION#####
 0137            CALL PLOT(ABC(1),SP(1),3)
 0138                       DO 2001  K = 2,N
 0139                       CALL PLOT(ABC(K),SP(K),2)
 0140       2001 CONTINUE
           C
           C
           C     #####SO4 GENFRATION#####
 0141            CALL PLOT(ABC(1),SO4P(1),3)
 0142                       DO 2002  K = 2,N
 0143                       CALL PLOT(ABC(K),SO4P(K),2)
 0144       2002 CONTINUE
           C
           C
           C     #####TDS GENFRATION#####
 0145            CALL PLOT(ABC(1),TDSP(1),3)
 0146                       DO 2003  K = 2,N
 0147                       CALL PLOT(ABC(K),TDSP(K),2)
 0148       2003 CONTINUF
           C
           C
           C     #####CL GENFRATION#####
 0149            CALL PLOT(ABC(1),CLP(1),3)
 0150                       DO 2004  K = 2,N
 0151                       CALL PLOT(ABC(K),CLP(K),2)
 0152       2004 CONTINUF
           C
           C     FILE MARK.
 0153            CALL PLOT(20.,0.,999)
 0154            STOP
 0155            END

                                                SCALAR MAP
  SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION
  T1         000188       N          00018C       FF         000190       AVTEMP     000194       TD         000198
  BHT        00019C       ROCL       0001A0       K          0001A4       GRAD       0001A8       T2         0001AC
  TIME       0001B0       Y          0001B4       HEIGHT     0001B8       THETA      0001BC       NN         0001C0
  I          0001C4

                                                ARRAY MAP
  SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION
  DATA       0001C8       DEPTH      000570       RO         000918       TDS        000CC0       CL         001068
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 FORTRAN IV    MODEL 44  PS          VERSION 3   LEVEL 1   DATE  69106      NEW MEXICO TECH     PAGE  0007

SO4         001410        HARD        001788        RW          001860       SPCOND      001F08        ROC         002280
SP          002658        ABC         002A00        TDSP        002DA8       SO4P        003150        CLP         0034F8
X           0038A0        FPN         0038AC

                                          SUBPROGRAMS CALLED
SYMBOL      LOCATION      SYMBOL      LOCATION      SYMBOL      LOCATION     SYMBOL      LOCATION      SYMBOL      LOCATION
CLOCK       003888        IBCOM#      00388C        SETMSG      0038C0       PLOT        0038C4        NUMBER      0038C8
FRXPR#      0038CC

                                          LABEL MAP
LABEL       LOCATION      LABEL       LOCATION      LABEL       LOCATION     LABEL       LOCATION      LABEL       LOCATION
    1       003C68            2       003C90          998       003D14         999       003D78         1001       003DCC
 1000       003E18           99       003F72           98       003EAA          88       003EC6           97       003ED2
   96       003EE2           92       003FEE           91       003EFA          90       003F08           89       003F3A
    3       003F48            4       004018            5       0040E8         888       004188           10       0041CE
   11       00424C           21       0042C4           12       004300          22       004374           13       004380
   23       004424          810       004464          811       0044EA         821       004560          200       0045A0
 2000       004608         9999       00464C          800       0048CC         801       004908         2001       004976
 2002       0049D8         2003       004A3A         2004       004AA4

   TOTAL MEMORY REQUIREMENTS 004BEC BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
// EXEC LNKEDT(MAP)
LIST        PHASE   HUEB02,*                                                          CREATED
LIST        INCLUDE HUEB02,L                                                          CREATED
LIST   AUTOLINK     CLOCK
LIST   AUTOLINK     IBCOM#
LIST   AUTOLINK     PLOT
LIST     REP  000560 0010000,0000    PLOTAPE   22 DEC 68     W/D SENSW
LIST   AUTOLINK     NUMBER
LIST   AUTOLINK     FRXPR#
LIST   AUTOLINK     RCBORG#
LIST   AUTOLINK     USEROPT
LIST   AUTOLINK     UNITAB#
LIST   AUTOLINK     SYMBOL
LIST   AUTOLINK     FRXPI#
LIST   AUTOLINK     ALOG10
LIST   AUTOLINK     EXP
LIST   AUTOLINK     SIN
LIST        ENTRY                                                                     CREATED
```

```
                           EL PASO NATURAL GAS COMPANY TEST WELL #3

                                      HUECO BOLSON W WELL

                                    EL PASO COUNTY, TEXAS


                 INTERPRETATION BY FIELD FORMATION RESISTIVITY FACTOR METHOD

     FIELD FORMATION RESISTIVITY FACTOR USED = 0.935

     REPORTED MAXIMUM AQUIFER TEMP = 85 F


DATA   DEPTH    RO    SPCOND    RW     TDS     CL     SO4    HARD.   REMARKS
  1.   310.    3.5    2593.    3.9   1847.   625.   500.   222.   NACCEPT-CLAY
  2.   311.    3.0    3024.    3.3   2332.   739.   606.   279.   NACCEPT-CLAY
  3.   312.    2.8    3239.    3.1   2588.   796.   660.   308.   NACCEPT-CLAY
  4.   313.    2.6    3488.    2.9   2894.   862.   724.   344.   NACCEPT-CLAY
  5.   314.    2.5    3626.    2.8   3070.   899.   760.   364.   NACCEPT-CLAY
  6.   315.    2.4    3776.    2.6   3264.   940.   799.   386.   NACCEPT-CLAY
  7.   316.    2.3    3939.    2.5   3480.   984.   843.   411.   NACCEPT-CLAY
  8.   317.    2.3    3938.    2.5   3479.   984.   842.   411.   NACCEPT-CLAY
  9.   318.    2.4    3773.    2.7   3260.   939.   798.   386.   NACCEPT-CLAY
 10.   319.    3.1    2920.    3.4   2211.   711.   580.   265.   NACCEPT-CLAY
 11.   320.    4.0    2262.    4.4   1502.   539.   421.   182.   NACCEPT-CLAY
 12.   321.    6.0    1508.    6.6    893.   186.   277.    82.   PACCEPT
 13.   322.    8.0    1130.    8.8    672.   146.   167.    57.   PACCEPT
 14.   323.   10.0     904.   11.1    538.   121.   113.    44.   PACCEPT
 15.   324.   14.0     646.   15.5    386.    91.    63.    29.     GOOD--SCREEN
 16.   325.   13.5     669.   14.9    400.    94.    67.    30.     GOOD--SCREEN
 17.   326.   10.6     852.   11.7    508.   115.   102.    41.   PACCEPT
 18.   327.    8.0    1129.    8.9    671.   146.   167.    57.   PACCEPT
 19.   328.    6.5    1389.    7.2    824.   174.   240.    74.   PACCEPT
 20.   329.    5.6    1612.    6.2    954.   197.   312.    89.   PACCEPT
 21.   330.    5.1    1769.    5.7   1035.   413.   310.   127.   NACCEPT
 22.   331.    5.2    1734.    5.8   1004.   404.   302.   123.   NACCEPT
 23.   332.    6.9    1307.    7.7    775.   165.   216.    69.   PACCEPT
 24.   333.    8.8    1024.    9.8    609.   135.   141.    51.   PACCEPT
 25.   334.   10.0     901.   11.1    537.   121.   112.    44.   PACCEPT
 26.   335.   15.0     601.   16.7    359.    86.    55.    26.     GOOD--SCREEN
 27.   336.   20.0     450.   22.2    270.    68.    33.    19.     GOOD--SCREEN
 28.   337.   20.0     450.   22.2    270.    67.    33.    19.     GOOD--SCREEN
 29.   338.   10.0     900.   11.1    536.   121.   112.    43.   PACCEPT
 30.   339.   10.0     900.   11.1    536.   121.   112.    43.   PACCEPT
 31.   340.    8.0    1124.    8.9    668.   146.   166.    57.   PACCEPT
 32.   341.    5.0    1799.    5.6   1061.   420.   316.   130.   NACCEPT
 33.   342.    4.1    2193.    4.6   1433.   521.   405.   174.   NACCEPT-CLAY
 34.   343.    3.6    2496.    4.0   1744.   600.   476.   210.   NACCEPT-CLAY
 35.   344.    3.1    2898.    3.5   2187.   705.   574.   262.   NACCEPT-CLAY
 36.   345.    3.1    2897.    3.5   2186.   705.   574.   262.   NACCEPT-CLAY
 37.   346.    3.2    2806.    3.6   2082.   681.   551.   250.   NACCEPT-CLAY
 38.   347.    3.3    2720.    3.7   1986.   658.   530.   239.   NACCEPT-CLAY
 39.   348.    3.4    2639.    3.8   1898.   637.   511.   228.   NACCEPT-CLAY
 40.   349.    3.4    2639.    3.8   1897.   637.   511.   228.   NACCEPT-CLAY
 41.   350.    3.5    2563.    3.9   1814.   617.   492.   218.   NACCEPT-CLAY
 42.   351.    3.6    2491.    4.0   1738.   598.   475.   210.   NACCEPT-CLAY
 43.   352.    3.7    2423.    4.1   1666.   581.   459.   201.   NACCEPT-CLAY
 44.   353.    3.9    2298.    4.4   1538.   548.   430.   186.   NACCEPT-CLAY
 45.   354.    4.0    2240.    4.5   1479.   533.   416.   179.   NACCEPT-CLAY
 46.   355.    4.1    2184.    4.6   1425.   519.   403.   173.   NACCEPT-CLAY
 47.   356.    4.1    2184.    4.6   1424.   519.   403.   173.   NACCEPT-CLAY
 48.   357.    4.0    2238.    4.5   1477.   533.   416.   179.   NACCEPT-CLAY
 49.   358.    3.9    2294.    4.4   1535.   547.   429.   186.   NACCEPT-CLAY
 50.   359.    3.8    2354.    4.2   1595.   563.   443.   193.   NACCEPT-CLAY
 51.   360.    3.5    2555.    3.9   1806.   615.   490.   218.   NACCEPT-CLAY
 52.   361.    3.4    2629.    3.8   1887.   635.   508.   227.   NACCEPT-CLAY
 53.   362.    3.3    2708.    3.7   1973.   655.   528.   237.   NACCEPT-CLAY
 54.   363.    3.2    2792.    3.6   2066.   677.   548.   248.   NACCEPT-CLAY
 55.   364.    2.9    3080.    3.2   2398.   754.   620.   286.   NACCEPT-CLAY
 56.   365.    2.8    3189.    3.1   2527.   782.   647.   301.   NACCEPT-CLAY
 57.   366.    2.9    3078.    3.2   2395.   753.   619.   286.   NACCEPT-CLAY
 58.   367.    3.1    2879.    3.5   2164.   700.   569.   259.   NACCEPT-CLAY
 59.   368.    3.3    2703.    3.7   1968.   654.   526.   236.   NACCEPT-CLAY
 60.   369.    3.4    2623.    3.8   1880.   633.   507.   226.   NACCEPT-CLAY
 61.   370.    3.6    2477.    4.0   1723.   595.   472.   208.   NACCEPT-CLAY
 62.   371.    3.7    2409.    4.2   1652.   577.   456.   200.   NACCEPT-CLAY
 63.   372.    3.5    2546.    3.9   1797.   613.   488.   216.   NACCEPT-CLAY
 64.   373.    3.5    2545.    3.9   1796.   613.   488.   216.   NACCEPT-CLAY
 65.   374.    3.6    2474.    4.0   1720.   594.   471.   207.   NACCEPT-CLAY
 66.   375.    3.7    2406.    4.2   1649.   576.   455.   199.   NACCEPT-CLAY
 67.   376.    4.1    2171.    4.6   1411.   516.   400.   171.   NACCEPT-CLAY
 68.   377.    5.6    1589.    6.3    941.   195.   304.    87.   PACCEPT
 69.   378.    7.2    1235.    8.1    734.   158.   196.    64.   PACCEPT
 70.   379.    7.0    1270.    7.9    754.   161.   205.    66.   PACCEPT
 71.   380.    5.7    1560.    6.4    924.   192.   294.    85.   PACCEPT
 72.   381.    5.0    1778.    5.6   1043.   415.   312.   128.   NACCEPT
 73.   382.    4.4    2019.    5.0   1265.   477.   365.   154.   NACCEPT
 74.   383.    3.6    2467.    4.1   1713.   592.   470.   207.   NACCEPT-CLAY
 75.   384.    3.5    2537.    3.9   1787.   611.   486.   215.   NACCEPT-CLAY
 76.   385.    3.5    2536.    3.9   1786.   610.   486.   215.   NACCEPT-CLAY
 77.   386.    3.6    2465.    4.1   1711.   592.   469.   206.   NACCEPT-CLAY
 78.   387.    4.5    1972.    5.1   1220.   464.   355.   149.   NACCEPT
 79.   388.    5.0    1774.    5.6   1039.   414.   311.   127.   NACCEPT
 80.   389.    4.9    1810.    5.5   1071.   423.   319.   131.   NACCEPT
 81.   390.    3.5    2533.    3.9   1783.   609.   485.   215.   NACCEPT-CLAY
 82.   391.    3.1    2859.    3.5   2141.   695.   564.   257.   NACCEPT-CLAY
 83.   392.    2.8    3164.    3.2   2497.   776.   641.   298.   NACCEPT-CLAY
 84.   393.    2.5    3543.    2.8   2964.   877.   738.   352.   NACCEPT-CLAY
 85.   394.    2.6    3405.    2.9   2792.   840.   702.   332.   NACCEPT-CLAY
 86.   395.    2.7    3278.    3.1   2635.   806.   670.   314.   NACCEPT-CLAY
 87.   396.    2.9    3051.    3.3   2364.   746.   612.   282.   NACCEPT-CLAY
 88.   397.    3.1    2854.    3.5   2136.   694.   563.   256.   NACCEPT-CLAY
 89.   398.    3.8    2327.    4.3   1568.   556.   436.   190.   NACCEPT-CLAY
 90.   399.    4.3    2056.    4.9   1300.   486.   374.   158.   NACCEPT
 91.   400.    4.5    1964.    5.1   1213.   462.   353.   148.   NACCEPT
 92.   401.    5.0    1767.    5.7   1033.   412.   309.   127.   NACCEPT
 93.   402.    6.0    1472.    6.8    873.   183.   266.    79.   PACCEPT
 94.   403.    7.0    1262.    7.9    749.   160.   203.    66.   PACCEPT
 95.   404.    7.6    1162.    8.6    690.   150.   175.    59.   PACCEPT
 96.   405.    8.0    1103.    9.1    656.   143.   160.    56.   PACCEPT
 97.   406.    7.6    1161.    8.6    690.   150.   175.    59.   PACCEPT
 98.   407.    6.5    1357.    7.4    805.   171.   231.    72.   PACCEPT
 99.   408.    5.8    1520.    6.6    901.   188.   281.    83.   PACCEPT
100.   409.    5.2    1695.    5.9    970.   394.   294.   119.   NACCEPT
101.   410.    4.9    1799.    5.6   1061.   420.   316.   130.   NACCEPT
102.   411.    4.2    2098.    4.8   1340.   497.   383.   163.   NACCEPT
103.   412.    4.1    2148.    4.7   1389.   510.   395.   169.   NACCEPT-CLAY
104.   413.    3.5    2516.    4.0   1765.   605.   481.   213.   NACCEPT-CLAY
105.   414.    3.3    2668.    3.7   1928.   645.   518.   232.   NACCEPT-CLAY
106.   415.    3.2    2750.    3.6   2019.   666.   538.   242.   NACCEPT-CLAY
107.   416.    3.2    2749.    3.6   2019.   666.   538.   242.   NACCEPT-CLAY
108.   417.    3.3    2665.    3.8   1926.   644.   517.   231.   NACCEPT-CLAY
109.   418.    3.3    2664.    3.8   1925.   644.   517.   231.   NACCEPT-CLAY
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 110.   419.   3.2   2747.   3.6   2016.   666.   537.   242.   NACCEPT-CLAY
 111.   420.   3.2   2746.   3.6   2015.   665.   537.   242.   NACCEPT-CLAY
 112.   421.   3.1   2834.   3.5   2113.   688.   558.   253.   NACCEPT-CLAY
 113.   422.   3.1   2833.   3.5   2112.   688.   558.   253.   NACCEPT-CLAY
 114.   423.   3.2   2744.   3.6   2012.   665.   536.   242.   NACCEPT-CLAY
 115.   424.   3.3   2660.   3.8   1920.   643.   516.   231.   NACCEPT-CLAY
 116.   425.   3.4   2581.   3.9   1834.   622.   497.   221.   NACCEPT-CLAY
 117.   426.   3.5   2506.   4.0   1755.   603.   479.   212.   NACCEPT-CLAY
 118.   427.   4.1   2139.   4.7   1380.   507.   393.   168.   NACCEPT-CLAY
 119.   428.   5.1   1719.   5.8    991.   400.   299.   122.   NACCEPT
 120.   429.   6.1   1437.   7.0    852.   179.   255.    77.   PACCEPT
 121.   430.   7.0   1252.   8.0    743.   159.   200.    65.   PACCEPT
 122.   431.   9.8    894.  11.2    532.   120.   111.    43.   PACCEPT
 123.   432.  10.1    867.  11.5    517.   117.   105.    42.   PACCEPT
 124.   433.  10.1    867.  11.5    516.   117.   105.    42.   PACCEPT
 125.   434.  18.0    486.  20.6    291.    72.    38.    20.      GOOD--SCREEN
 126.   435.  21.0    417.  24.0    250.    63.    29.    17.      GOOD--SCREEN
 127.   436.  18.0    486.  20.6    291.    72.    38.    20.      GOOD--SCREEN
 128.   437.  12.0    729.  13.7    435.   101.    77.    34.      GOOD--SCREEN
 129.   438.  11.5    760.  13.2    454.   105.    83.    35.      GOOD--SCREEN
 130.   439.  14.0    624.  16.0    373.    89.    59.    28.      GOOD--SCREEN
 131.   440.  15.0    582.  17.2    348.    84.    52.    26.      GOOD--SCREEN
 132.   441.  14.0    624.  16.0    373.    89.    59.    28.      GOOD--SCREEN
 133.   442.  18.5    472.  21.2    283.    70.    36.    20.      GOOD--SCREEN
 134.   443.  27.5    317.  31.5    191.    50.    18.    12.      GOOD--SCREEN
 135.   444.  20.0    436.  22.9    262.    66.    31.    18.      GOOD--SCREEN
 136.   445.  14.0    623.  16.0    373.    89.    59.    28.      GOOD--SCREEN
 137.   446.  15.9    549.  18.2    328.    80.    47.    24.      GOOD--SCREEN
 138.   447.  16.0    545.  18.3    326.    79.    46.    24.      GOOD--SCREEN
 139.   448.  10.1    863.  11.6    514.   117.   104.    41.   PACCEPT
 140.   449.   8.0   1089.   9.2    648.   142.   157.    55.   PACCEPT
 141.   450.   6.1   1428.   7.0    847.   178.   252.    76.   PACCEPT
 142.   451.   5.6   1555.   6.4    921.   191.   293.    85.   PACCEPT
 143.   452.   5.1   1707.   5.9    981.   397.   296.   120.   NACCEPT
 144.   453.   5.0   1741.   5.7   1010.   406.   304.   124.   NACCEPT
 145.   454.   5.3   1642.   6.1    924.   381.   282.   114.   NACCEPT
 146.   455.   6.1   1426.   7.0    846.   178.   252.    76.   PACCEPT
 147.   456.   7.3   1191.   8.4    708.   153.   183.    61.   PACCEPT
 148.   457.   9.0    966.  10.4    575.   128.   127.    47.   PACCEPT
 149.   458.  10.5    828.  12.1    493.   113.    97.    39.      GOOD--SCREEN
 150.   459.  13.0    668.  15.0    399.    94.    66.    30.      GOOD--SCREEN
 151.   460.  14.0    621.  16.1    371.    88.    58.    28.      GOOD--SCREEN
 152.   461.  11.0    790.  12.7    471.   108.    89.    37.      GOOD--SCREEN
 153.   462.   9.1    954.  10.5    568.   127.   124.    47.   PACCEPT
 154.   463.   9.5    914.  10.9    544.   122.   115.    44.   PACCEPT
 155.   464.   9.4    923.  10.8    550.   123.   117.    45.   PACCEPT
 156.   465.   9.0    964.  10.4    574.   128.   126.    47.   PACCEPT
 157.   466.   7.4   1172.   8.5    696.   151.   178.    60.   PACCEPT
 158.   467.   6.0   1445.   6.9    857.   180.   257.    78.   PACCEPT
 159.   468.   6.9   1256.   8.0    746.   160.   201.    65.   PACCEPT
 160.   469.   6.9   1256.   8.0    745.   160.   201.    65.   PACCEPT
 161.   470.   5.4   1604.   6.2    950.   196.   309.    88.   PACCEPT
 162.   471.   4.3   2014.   5.0   1260.   475.   364.   153.   NACCEPT
 163.   472.   3.5   2474.   4.0   1720.   594.   471.   207.   NACCEPT-CLAY
 164.   473.   3.0   2885.   3.5   2171.   702.   571.   260.   NACCEPT-CLAY
 165.   474.   2.6   3328.   3.0   2696.   820.   682.   321.   NACCEPT-CLAY
 166.   475.   2.4   3604.   2.8   3042.   894.   754.   361.   NACCEPT-CLAY
 167.   476.   2.3   3760.   2.7   3243.   936.   795.   384.   NACCEPT-CLAY
 168.   477.   2.2   3930.   2.5   3468.   982.   840.   410.   NACCEPT-CLAY
 169.   478.   2.1   4116.   2.4   3699.  1032.   890.   438.   NACCEPT-CLAY
 170.   479.   2.1   4115.   2.4   3698.  1032.   890.   438.   NACCEPT-CLAY
 171.   480.   2.2   3926.   2.5   3463.   981.   839.   409.   NACCEPT-CLAY
 172.   481.   2.3   3755.   2.7   3237.   934.   794.   383.   NACCEPT-CLAY
 173.   482.   2.3   3754.   2.7   3235.   934.   793.   383.   NACCEPT-CLAY
 174.   483.   2.4   3596.   2.8   3032.   891.   752.   360.   NACCEPT-CLAY
 175.   484.   2.6   3319.   3.0   2684.   817.   680.   320.   NACCEPT-CLAY
 176.   485.   3.0   2875.   3.5   2160.   699.   568.   259.   NACCEPT-CLAY
 177.   486.   3.3   2613.   3.8   1869.   630.   504.   225.   NACCEPT-CLAY
 178.   487.   3.4   2536.   3.9   1786.   610.   486.   215.   NACCEPT-CLAY
 179.   488.   3.5   2462.   4.1   1708.   591.   468.   206.   NACCEPT-CLAY
 180.   489.   3.4   2534.   3.9   1784.   610.   485.   215.   NACCEPT-CLAY
 181.   490.   3.1   2779.   3.6   2051.   674.   545.   246.   NACCEPT-CLAY
 182.   491.   2.9   2969.   3.4   2268.   724.   592.   271.   NACCEPT-CLAY
 183.   492.   3.0   2870.   3.5   2154.   698.   567.   258.   NACCEPT-CLAY
 184.   493.   2.9   2968.   3.4   2266.   724.   591.   271.   NACCEPT-CLAY
 185.   494.   2.6   3309.   3.0   2673.   815.   678.   318.   NACCEPT-CLAY
 186.   495.   2.5   3441.   2.9   2835.   850.   711.   337.   NACCEPT-CLAY
 187.   496.   2.4   3583.   2.8   3015.   888.   748.   358.   NACCEPT-CLAY
 188.   497.   2.3   3738.   2.7   3214.   930.   789.   381.   NACCEPT-CLAY
 189.   498.   2.5   3438.   2.9   2832.   849.   711.   337.   NACCEPT-CLAY
 190.   499.   3.0   2864.   3.5   2147.   696.   566.   257.   NACCEPT-CLAY
 191.   500.   3.1   2771.   3.6   2042.   672.   543.   245.   NACCEPT-CLAY
 192.   501.   3.0   2862.   3.5   2146.   696.   565.   257.   NACCEPT-CLAY
 193.   502.   2.6   3302.   3.0   2664.   813.   676.   317.   NACCEPT-CLAY
 194.   503.   2.3   3731.   2.7   3206.   928.   787.   380.   NACCEPT-CLAY
 195.   504.   2.2   3900.   2.6   3428.   973.   832.   405.   NACCEPT-CLAY
 196.   505.   2.4   3574.   2.8   3003.   885.   746.   356.   NACCEPT-CLAY
 197.   506.   2.6   3298.   3.0   2659.   812.   675.   317.   NACCEPT-CLAY
 198.   507.   2.7   3175.   3.1   2510.   779.   643.   299.   NACCEPT-CLAY
 199.   508.   2.8   3061.   3.3   2375.   748.   615.   284.   NACCEPT-CLAY
 200.   509.   2.5   3427.   2.9   2818.   846.   708.   335.   NACCEPT-CLAY
 201.   510.   2.2   3893.   2.6   3419.   972.   830.   404.   NACCEPT-CLAY
 202.   511.   2.0   4281.   2.3   3846.  1077.   935.   465.   NACCEPT-CLAY
 203.   512.   2.1   4076.   2.5   3664.  1021.   879.   432.   NACCEPT-CLAY
 204.   513.   2.3   3721.   2.7   3193.   925.   785.   378.   NACCEPT-CLAY
 205.   514.   2.4   3565.   2.8   2992.   883.   744.   355.   NACCEPT-CLAY
 206.   515.   2.9   2949.   3.4   2245.   719.   587.   269.   NACCEPT-CLAY
 207.   516.   3.1   2758.   3.6   2029.   669.   540.   243.   NACCEPT-CLAY
 208.   517.   3.2   2671.   3.7   1932.   646.   519.   232.   NACCEPT-CLAY
 209.   518.   3.4   2514.   4.0   1762.   604.   481.   212.   NACCEPT-CLAY
 210.   519.   3.4   2513.   4.0   1761.   604.   480.   212.   NACCEPT-CLAY
 211.   520.   3.6   2373.   4.2   1615.   568.   447.   195.   NACCEPT-CLAY
 212.   521.   3.9   2189.   4.6   1430.   520.   404.   173.   NACCEPT-CLAY
 213.   522.   4.1   2082.   4.8   1325.   493.   380.   161.   NACCEPT-CLAY
 214.   523.   4.5   1896.   5.3   1150.   445.   338.   140.   NACCEPT
 215.   524.   5.4   1580.   6.3    936.   194.   301.    86.   PACCEPT
 216.   525.   6.1   1398.   7.2    829.   175.   243.    74.   PACCEPT
 217.   526.   7.2   1184.   8.4    703.   152.   182.    61.   PACCEPT
 218.   527.   7.6   1122.   8.9    667.   145.   165.    57.   PACCEPT
 219.   528.   7.6   1121.   8.9    666.   145.   165.    57.   PACCEPT
 220.   529.   8.9    957.  10.4    570.   127.   125.    47.   PACCEPT
 221.   530.   8.6    990.  10.1    589.   131.   133.    49.   PACCEPT
 222.   531.   8.0   1064.   9.4    633.   139.   150.    53.   PACCEPT
 223.   532.   7.3   1166.   8.6    693.   150.   177.    60.   PACCEPT
 224.   533.   6.0   1418.   7.1    841.   177.   249.    76.   PACCEPT
 225.   534.   4.8   1772.   5.6   1038.   414.   311.   127.   NACCEPT
 226.   535.   3.3   2577.   3.9   1830.   621.   496.   220.   NACCEPT-CLAY
 227.   536.   2.8   3037.   3.3   2347.   742.   609.   280.   NACCEPT-CLAY
 228.   537.   2.5   3400.   2.9   2785.   839.   701.   331.   NACCEPT-CLAY
 229.   538.   2.4   3541.   2.8   2962.   877.   738.   351.   NACCEPT-CLAY
 230.   539.   2.3   3694.   2.7   3158.   918.   778.   374.   NACCEPT-CLAY
 231.   540.   2.4   3539.   2.8   2959.   876.   737.   351.   NACCEPT-CLAY
 232.   541.   2.5   3397.   2.9   2780.   838.   700.   331.   NACCEPT-CLAY
 233.   542.   2.6   3265.   3.1   2619.   803.   666.   312.   NACCEPT-CLAY
 234.   543.   2.7   3143.   3.2   2472.   770.   635.   295.   NACCEPT-CLAY
 DATA   DEPTH   RO   SPCOND   RW    TDS     CL     SO4   HARD.   REMARKS


                    PROGRAM TIME IN SECONDS =  0.1032834E 03
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Bosque del Apache Grant,
New Mexico---BODEAP

Example---USGS Test Well #B-5

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FORTRAN IV     MODEL 44  PS          VERSION 3   LEVEL 1   DATE  69106        NEW MEXICO TECH     PAGE  0001
          C            014P,10,858,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
          C      RONALD M. BRIMHALL - ELECTRIC LOG INTERPRETATION PROGRAM
          C      WATER QUALITY & POROSITY ESTIMATIONS FROM INDUCTION & MICROLOG
          C
          C      ------------------------------------------------------------------
          C      THIS PROGRAM PRINTS OUT SPECIFIC CONDUCTANCE IN THE RESULTS
          C      ------------------------------------------------------------------
          C
          C
          C
          C      $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
          C      SOCORRO COUNTY NEW MEXICO WATER WELL (USGS TEST WELL #B-5)
          C      $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
          C
          C
          C
          C
          C
          C      *******************************************************************
          C      PURPOSE OF BODEAP---
          C           BODEAP DETERMINES QUANTITATIVE VALUES OF PARAMETERS RELATING
          C      TO WATER QUALITY--TOTAL DISSOLVED SOLIDS, SULFATE, AND CHLORIDE
          C      CONCENTRATIONS IN UNITS OF PARTS PER MILLION.  BODEAP IS APPLI-
          C      CABLE TO THE BOSQUE DEL APACHE GRANT, SOCORRO COUNTY, NEW MEXICO
          C      (BRIMHALL, 1969,, COOPER, 1968).  RESISTIVITY DATA FROM A MACRO-
          C      RESISTIVITY LOG AND A MICROLOG ARE NECESSARY FOR BODEAP.  THE
          C      APPARENT FORMATION RESISTIVITY FACTOR METHOD FOR CALCULATING
          C      QUANTITATIVE VALUES OF TDS, ETC. IS USED IN BODEAP.  WATER AT EACH
          C      DATA POINT IS CLASSIFIED AS TO ITS ACCEPTABILITY BASED ON US
          C      PUBLIC HEALTH SERVICE STANDARDS (TODD, 1959).  EACH AQUIFER UNIT
          C      IS EXAMINED FOR CLAY AND A POROSITY INDEX IS DETERMINED.  CALCU-
          C      CATION RESULTS ARE PRESENTED IN TABLE AND LOG FORM.
          C
          C
          C      *******************************************************************
          C      REFERENCES---
          C
          C      BRIMHALL, R. M., DIGITAL ANALYSIS  OF BOREHOLE-MEASURED AQUIFER
          C      RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER OF
          C      SCIENCE THESIS, N. MEX. INST. MINING AND TECH., SOCORRO, JUNE 1969.
          C
          C      COOPER, J. B., GROUND-WATER EXPLORATION IN THE BOSQUE DEL APACHE
          C      GRANT, SOCORRO COUNTY, NEW MEXICO, USGS OPEN FILE REPORT,
          C      ALBUQUERQUE, 1968.
          C
          C      TODD, D. K., GROUND WATER HYDROLOGY, WILEY, NEW YORK, 1959.
          C      *******************************************************************
          C
          C
          C
          C      *******************************************************************
          C      NOMENCLATURE--
          C
          C          SCALAR QUANTITIES--
          C      T1 = INITIAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
          C      N = NUMBER OF DATA POINTS AND DO 200 ITERATIONS.
          C      K = SUBSCRIPT FOR SUBSCRIPTED VARIABLES.
          C      AVTEMP = AVERAGE SURFACE TEMPERATURE FOR CALCULATING GRAD.
          C      TD = TOTAL DEPTH OF WELL FOR CALCULATING GRAD.
          C      BHT = BOTTOM HOLE TEMPERATUEE FOR CALCULATING GRAD.
          C      RMF = MUD FILTRATE RESISTIVITY--OHM-METERS.

FORTRAN IV     MODEL 44  PS          VERSION 3   LEVEL 1   DATE  69106        NEW MEXICO TECH     PAGE  0002
          C      AM = CEMENTATION EXPONENT IN F = A/POR**AM.
          C      RMC = MUD CAKE RESISTIVITY--OHM-METERS.
          C      A = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
          C      B = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
          C      C = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
          C      D = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
          C      E = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
          C      O = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
          C      G = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
          C      GRAD = TEMPERATURE GRADIENT OF AQUIFER.
          C      Y = ORDINATE POSITION OF FPN--INCHES.
          C      HEIGHT = HEIGHT OF NUMERICS WRITTEN BY CALL NUMBER--INCHES.
          C      THETA = ANGLE WITH RESPECT TO CAL COMP COORDINATES FOR WRITING
          C            FPN--DEGREES.
          C      NN = NUMBER OF DECIMAL DIGITS TO RIGHT OF DECIMAL IN FPN (-1 SUP-
          C            PRESSES DECIMAL POINT.)
          C      I = SUBSCRIPT FOR ABSCISSA OF FPN.
          C      T2 = FINAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
          C      TIME = PROGRAM EXECUTION TIME--SECONDS.
          C
          C
          C      SUBSCRIPTED VARIABLES---
          C
          C      IDATA = DATA POINT NUMBER.
          C      JDEPTH = DATA POINT DEPTH----FEET.
          C      RMN = MICRONORMAL RESISTIVITY READ FROM MICROLOG--OHM-METERS.
          C      RO = DEEP INDUCTION RESISTIVITY--OHM-METERS.
          C      F = APPARENT FORMATION RESISTIVITY FACTOR.
          C      TDS = TOTAL DISSOLVED SOLIDS CONCENTRATION--PPM.
          C      RW = WATER RESISTIVITY--OHM-METERS.
          C      POR = POROSITY INDEX CALCULATED FROM F = A/POR**AM.
          C      SPCOND = SPECIFIC CONDUCTANCE OF WATER--MICROMHOS/CM.
          C      CL = CHLORIDE CONCENTRATION--PPM.
          C      SO4 = SULFATE CONCENTRATION--PPM.
          C      RXOC = MICRONORMAL RESISTIVITY CORRECTED FOR TEMPERATURE AND
          C              MUDCAKE--OHM/METERS.
          C      ROC = TEMPERATURE CORRECTED DEEP INDUCTION RESISTIVITY--OHM-METERS
          C      TDSP = TDS RESCALED FOR PLOT--INCHES.
          C      SO4P = SO4 RESCALED FOR PLOT--INCHES.
          C      PORP = POROSITY INDEX RESCALLED FOR PLOT--INCHES.
          C      ABC = DATA POINT DEPTH RESCALED TO 2 INCHES/100 FEET.
          C      X = ABSCISSA POSITION OF FPN--INCHES.
          C      FPN = DEPTH LABEL--A FLOATING POINT NUMBER.
          C      RMI1 = MICROINVERSE RESISTIVITY AS READ FORM MICROLOG--OHM-METERS.
          C      RXOR = 1.15*RMN--AN EMPIRICAL RESISTIVITY USED TO DEFINE AQUIFER
          C      UNITS THAT MAY BE CLASSIFIED AS SANDY-CLAY.
          C      SP = DEFLECTION OF SP CURVE FROM LEFT EDGE OF TRACK I--INCHES.
          C      W = RATIO RMN/RMC--A PARAMETER IN MUD CAKE CORRECTIONS.
          C      RXO1 = MICRONORMAL RESISTIVITY CORRECTED FOR MUD CAKE--OHM-METERS.
          C      *******************************************************************
          C
          C
          C      *******************************************************************
          C      SUBPROGRAMS CALLED--
          C
          C           CLOCK
          C           IBCOM#
          C           SETMSG
          C           PLOT
          C           NUMBER
```

```
C          FRXPR#
C     *****************************************************************
C
C
C
      CALL CLOCK(T1)
      DIMENSION IDATA(211),JDEPTH(211),RMN(211),RO(211),F(211),TDS(211),
     *RW(211),POR(211),SPCOND(211),CL(211),RXOC(211),ROC(211),TDSP(211),
     *SO4P(211),PORP(211),ABC(211),X(6),FPN(6)
     *,SO4(211)
     *,RMI1(211),RXOR(211)
     *,SP(211)
     *,W(211),RXO1(211)
C
C     PARAMETRIC DATA.
      N = 211
      AVTEMP = 72.
      TD = 510.
      BHT = 84.
      RMF = 5.9
      AM = 1.5
      RMC = 6.0
C
C     READ FROM DATA CARDS--DATA POINT NUMBER, DEPTH, MICORNORMAL,
C     INDUCTION, AND MICROINVERSE RESISTIVITIES, AND SP.
      READ(5,1)(IDATA(K),JDEPTH(K),RMN(K),RO(K),RMI1(K),SP(K),K=1,N)
    1 FORMAT(2I4,3F5.1,F4.2)
C
C     WRITE PROBLEM IDENTIFICATION .
      WRITE(6,2)
    2 FORMAT('9',///40X,'SOCORRO COUNTY, NEW MEXICO WATER WELL',//49X,'U
     *SGS TEST WELL #B-5')
C
C     WRITE SOME PARAMETRIC DATA.
      WRITE(6,600)
  600 FORMAT(///29X,'RMF = 5.4 OHM-M @ 84F',/31X,'M = 1.5',////)
C
C     LABEL LINE PRINTER OUTPUT.
      WRITE(6,610)
  610 FORMAT(    4X,'DATA',5X,'DEPTH',5X,'RMN',7X,'RO',3X,'*',3X,'F',6X,
     *'POR',4X,'SPCOND',7X,'TDS',8X,'CL',7X,'SO4',6X,'REMARKS')
C
C     CONSTANTS FOR MUD CAKE THICKNESS OF 1/8 INCHES
      A = -0.3299839E-04
      B = +0.1307268E-01
      C = -0.2115985E+00
      D = 0.1284551E+01
      E = -0.3342364E+01
      O = +0.5336034E+01
      G = -0.1959661E+01
C
C     DETERMINE TEMPERATURE GRADIENT.
      GRAD = (BHT-AVTEMP)/TD
C
C     PRIMARY DO LOOP.
      DO 40 K = 1,N
C
C     MUDCAKE CORRECTION FOR TMC = 1/8 INCH ASSUMED
      W(K) = RMN(K)/RMC
      RXO1(K) = (A*W(K)**6+B*W(K)**5+C*W(K)**4+D*W(K)**3+E*W(K)**2+O*W(K
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     *)+G)*RMC
C
C     ADAPTED FROM SCHLUMBERGER, 'LOG INTERPRETATION CHARTS', P. 34,
C     1968.
      IF(RXO1(K).LE.0.0)GO TO 611
C
C     TEMPERATURE CORRECTIONS TO RO, RXO1.
C          TEMPERATURE CORRECTIONS ARE TO 77 F.
  700  ROC(K) = RO(K)*(AVTEMP + GRAD*JDEPTH(K))/77.
      RXOR(K) = 1.15*RMN(K)
      RXOC(K) = RXO1(K)*(AVTEMP+GRAD*JDEPTH(K))/77.
      GO TO 701
  611 RXO1(K) = RMN(K)
      GO TO 700
C
C     DETERMINE APPARENT FORMATION RESISTIVITY FACTOR.
  701 F(K) = RXOC(K)/RMF
C
C     DETERMINE WATER RESISTIVITY.
      RW(K) = ROC(K)/F(K)
C
C     DETERMINE WATER SPECIFIC CONDUCTANCE.
      SPCOND(K) = 10000.00/RW(K)
C
C     SELECT PROPER INTERPRETATION CONTROL EQUATIONS.
      IF(SPCOND(K).LT.2700.)GO TO 6000
      IF(SPCOND(K).GE.2700..AND.SPCOND(K).LE.3440.)GO TO 6010
      IF(SPCOND(K).GT.3440.)GO TO 6020
 6000 TDS(K) = 0.705*SPCOND(K)
 6001 SO4(K) = 0.222*SPCOND(K)
 6002 CL(K) = 0.079*SPCOND(K)
      GO TO 705
 6010 TDS(K) = 0.705*SPCOND(K)
 6011 SO4(K) = 0.1395*SPCOND(K) + 225.
 6012 CL(K) = 0.079*SPCOND(K)
      GO TO 705
 6020 TDS(K) = 0.705*SPCOND(K)
 6021 SO4(K) = 0.1395*SPCOND(K) + 225.
 6022 CL(K) = 0.408*SPCOND(K) - 1170.
      GO TO 705
C
C     DETERMINE POROSITY INDEX.
  705 POR(K) = 50.0/(F(K)**(1.0/AM))
C
C     CLAY IDENTIFICATION POROSITY INDEX = 65%.
      IF(POR(K).GT.65.)POR(K) = 65.
C
C     RESCALE ABC, POR, TDS, SO4 FOR PLOT.
C
C     POROSITY, TRACK II, 100 - 0%.
C     TDS, SO4, TRACKS II & III, 5000 - 0 PPM.
C     SP, TRACK I, 10 MILLIVOLTS PER LOG DIVISION.
      ABC(K) = JDEPTH(K)*0.02
      PORP(K) = (5.75 - (2.5E-02)*POR(K))
      TDSP(K) = (8.25 - (1.0E-03)*TDS(K))
      SO4P(K) = (8.25 - (1.0E-03)*SO4(K))
C
C     TEST FOR CLAY.
      IF(RMI1(K).GT.RXOR(K))GO TO 800
      IF(RMI1(K).LE.RXOR(K).AND.RMI1(K).GE.RMN(K).AND.TDS(K).LT.775..AND
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                    *.TDS(K).GF.500..AND.SO4(K).LT.250.)GO TO 810
 0062                 IF(RMII(K).LT.RMN(K))GO TO 3
               C
               C      IF NO CLAY, TEST AND CLASSIFY WATER QUALITY.
 0063               3 IF(TDS(K).GF.1000.)GO TO 4
 0064                 IF(SO4(K).GF.250.)GO TO 4
 0065                 IF(TDS(K).LT.775..AND.TDS(K).GF.500.)GO TO 6
 0066                 IF(TDS(K).LT.500.)GO TO 5
 0067               4 WRITE(6,10)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),T
                     *DS(K),CL(K),SO4(K)
 0068              10 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                     *7.0,2(5X,F5.0),5X,'NACCEPT')
 0069                 GO TO 40
 0070               5 WRITE(6,20)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),T
                     *DS(K),CL(K),SO4(K)
 0071              20 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                     *7.0,2(5X,F5.0),4X,'GOOD-SCREEN')
 0072                 GO TO 40
 0073               6 WRITE(6,30)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),T
                     *OS(K),CL(K),SO4(K)
 0074              30 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                     *7.0,2(5X,F5.0),5X,'PACCEPT')
 0075                 GO TO 40
 0076             800 WRITE(6,910)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),
                     *TDS(K),CL(K),SO4(K)
 0077             910 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                     *7.0,2(5X,F5.0),6X,'NACCEPT-CLAY')
 0078                 GO TO 40
 0079             810 WRITE(6,811)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),
                     *TDS(K),CL(K),SO4(K)
 0080             811 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                     *7.0,2(5X,F5.0),5X,'PACC/SANDY-CLAY')
 0081                 GO TO 40
 0082              40 CONTINUE
               C
               C      WRITE COLUMN IDENTIFICATION.
 0083                 WRITE(6,610)
               C
               C      DETERMINE PROGRAM EXECUTION TIME.
 0084                 CALL CLOCK(T2)
 0085                 TIME = T1-T2
 0086                 WRITE(6,90)TIME
 0087              90 FORMAT(/////40X,'PROGRAM TIME IN SECONDS = ',E14.7)
               C
               C      IDENTIFY PROGRAMMER.
 0088                 WRITE(6,9999)
 0089            9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'B
                     *OX 31 CAMPUS STA.',/30X,'SOCORRO, N. M.   87801')
               C
               C
               C
               C
               C      PLOT RESULTS IN LOG (GRAPHIC) FORM.
               C      LOG GRID SCALE--2 INCHES PER 100 FEET.
 0090                 CALL PLOT(0.,-15.,-3)
 0091                 CALL PLOT(15.,1.4,-3)
               C
               C
               C      ESTABLISH LOG GRID
               C


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 0092                 CALL PLOT(0.,2.5,2)
 0093                 CALL PLOT(0.,3.25,3)
 0094                 CALL PLOT(0.,8.25,2)
 0095                 CALL PLOT(10.,8.25,2)
 0096                 CALL PLOT(10.,3.25,2)
 0097                 CALL PLOT(0.,3.25,2)
 0098                 CALL PLOT(0.,2.5,3)
 0099                 CALL PLOT(10.,2.5,2)
 0100                 CALL PLOT(10.,0.,2)
 0101                 CALL PLOT(0.,0.,2)
 0102                 CALL PLOT(0.,5.75,3)
 0103                 CALL PLOT(10.,5.75,2)
 0104                 CALL PLOT(10.,8.,3)
 0105                 CALL PLOT(0.,8.,2)
 0106                 CALL PLOT(1.,8.25,3)
 0107                 CALL PLOT(1.,3.25,2)
 0108                 CALL PLOT(1.,2.5,3)
 0109                 CALL PLOT(1.,0.,2)
 0110                 CALL PLOT(2.,0.,3)
 0111                 CALL PLOT(2.,2.5,2)
 0112                 CALL PLOT(2.,3.25,3)
 0113                 CALL PLOT(2.,8.25,2)
 0114                 CALL PLOT(3.,8.25,3)
 0115                 CALL PLOT(3.,3.25,2)
 0116                 CALL PLOT(3.,2.5,3)
 0117                 CALL PLOT(3.,0.,2)
 0118                 CALL PLOT(4.,0.,3)
 0119                 CALL PLOT(4.,2.5,2)
 0120                 CALL PLOT(4.,3.25,3)
 0121                 CALL PLOT(4.,8.25,2)
 0122                 CALL PLOT(5.,8.25,3)
 0123                 CALL PLOT(5.,3.25,2)
 0124                 CALL PLOT(5.0,2.5,3)
 0125                 CALL PLOT(5.,0.,2)
 0126                 CALL PLOT(6.,0.,3)
 0127                 CALL PLOT(6.,2.5,2)
 0128                 CALL PLOT(6.,3.25,3)
 0129                 CALL PLOT(6.,8.25,2)
 0130                 CALL PLOT(7.,8.25,3)
 0131                 CALL PLOT(7.,3.25,2)
 0132                 CALL PLOT(7.,2.50,3)
 0133                 CALL PLOT(7.,0.,2)
 0134                 CALL PLOT(8.,0.,3)
 0135                 CALL PLOT(8.,2.5,2)
 0136                 CALL PLOT(8.,3.25,3)
 0137                 CALL PLOT(8.,8.25,2)
 0138                 CALL PLOT(9.,8.25,3)
 0139                 CALL PLOT(9.,3.25,2)
 0140                 CALL PLOT(9.,2.5,3)
 0141                 CALL PLOT(9.,0.,2)
 0142                 CALL PLOT(10.,0.,3)
 0143                 CALL PLOT(10.,2.5,2)
 0144                 CALL PLOT(10.,3.25,3)
 0145                 CALL PLOT(10.,8.25,2)
               C
               C
               C      *****DEPTH LABEL*****
               C
 0146                 Y = 2.835
 0147                 HEIGHT = 0.10
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FORTRAN IV    MODEL 44  PS       VERSION 3  LEVEL 1  DATE  69106      NEW MEXICO TECH    PAGE  0007

 0148            THETA = 0.
 0149            NN = -1
 0150            N = 6
 0151            READ(5,9998)(X(I),FPN(I), I = 1,N)
 0152       9998 FORMAT(F4.2,F4.0)
 0153                 DO 1000  I = 1,N
 0154                 CALL NUMBER(X(I),Y,HEIGHT,FPN(I),THETA,NN)
 0155       1000 CONTINUE
           C
           C
           C      *****LINE GENERATION*****
           C
           C
           C      SP LINE GENERATION
           C
 0156            N = 210
 0157            CALL PLOT(ABC(1),SP(1),3)
 0158                 DO 1002  K = 2,N
 0159                 CALL PLOT(ABC(K),SP(K),2)
 0160       1002 CONTINUE
           C
           C      POROSITY INDEX LINE PLOT
           C
 0161            CALL PLOT(ABC(1),PORP(1),3)
 0162                 DO 1001  K = 2,N
 0163                 CALL PLOT(ABC(K),PORP(K),2)
 0164       1001 CONTINUE
           C
           C      TDS LINE GENERATION
           C
 0165            CALL PLOT(ABC(1),TDSP(1),3)
 0166                 DO 1003  K = 2,N
 0167                 CALL PLOT(ABC(K),TDSP(K),2)
 0168       1003 CONTINUE
           C
           C      SO4 LINE GENERATION
           C
 0169            CALL PLOT(ABC(1),SO4P(1),3)
 0170                 DO 1004  K = 2,N
 0171                 CALL PLOT(ABC(K),SO4P(K),2)
 0172       1004 CONTINUE
           C
           C      FILE MARK.
 0173            CALL PLOT(20.,0.,999)
 0174            STOP
 0175            END


                                           SCALAR MAP
SYMBOL     LOCATION     SYMBOL   LOCATION   SYMBOL   LOCATION    SYMBOL   LOCATION    SYMBOL   LOCATION
T1         000198       N        00019C     AVTEMP   0001A0      TD       0001A4      BHT      0001A8
RMF        0001AC       AM       0001B0     RMC      0001B4      K        0001B8      A        0001BC
B          0001C0       C        0001C4     D        0001C8      E        0001CC      Q        0001D0
G          0001D4       GRAD     0001D8     T2       0001DC      TIME     0001E0      Y        0001E4
HEIGHT     0001E8       THETA    0001EC     NN       0001F0      I        0001F4
                                           ARRAY MAP
SYMBOL     LOCATION     SYMBOL   LOCATION   SYMBOL   LOCATION    SYMBOL   LOCATION    SYMBOL   LOCATION
IDATA      0001F8       JDEPTH   000544     RMN      000890      RO       0008DC      F        000F28


 FORTRAN IV    MODEL 44  PS       VERSION 3  LEVEL 1  DATE  69106     NEW MEXICO TECH    PAGE  0008

TDS        001274       RW       0015C0     POR      00190C      SPCOND   001C58      CL       001FA4
RXOC       0022F0       ROC      00263C     TDSP     002988      SO4P     002CD4      PORP     003020
ABC        00336C       X        003688     FPN      0036D0      SO4      0036E8      RMI1     003A34
RXOR       003D80       SP       0040CC     W        004418      RX01     004764
                                        SUBPROGRAMS CALLED
SYMBOL     LOCATION     SYMBOL   LOCATION   SYMBOL   LOCATION    SYMBOL   LOCATION    SYMBOL   LOCATION
CLOCK      004AB0       IBCOM#   004AB4     PLOT     004AB8      NUMBER   004ABC      FRXPR#   004AC0
                                           LABEL MAP
LABEL      LOCATION     LABEL    LOCATION   LABEL    LOCATION    LABEL    LOCATION    LABEL    LOCATION
    1      004EC8           2    004EF4       600    004F5C        610    004FA8        700    0050EA
  611      005180         701    00519A      6000    005224       6001    005244       6002    005254
 6010      005266        6011    005286      6012    00529A       6020    0052AC       6021    0052CC
 6022      0052E0         705    0052F6         3    00545A          4    0054CE         10    005554
    5      0055A0          20    005620         6    005670         30    0056F0        800    00573C
  910      0057BC         810    00580C       811    00588C         40    0058E0         90    005948
 9999      00598C        9998    005CA8      1000    005CE8       1002    005D5A       1001    005DCC
 1003      005E4A        1004    005FC8

   TOTAL MEMORY REQUIREMENTS 006020 BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
// EXEC LNKEDT(MAP)                                                            CREATED
LIST        PHASE    BODEAP,*                                                  CREATED
LIST        INCLUDE  BODEAP,L
LIST    AUTOLINK    CLOCK
LIST    AUTOLINK    IBCOM#
LIST    AUTOLINK    PLOT
LIST     REP  000560 0010000,0000     PLOTAPE    22 DEC 68     W/O SENSW
LIST    AUTOLINK    NUMBER
LIST    AUTOLINK    FRXPR#
LIST    AUTOLINK    RCBORG#
LIST    AUTOLINK    USEROPT
LIST    AUTOLINK    UNITAB#
LIST    AUTOLINK    SYMBOL
LIST    AUTOLINK    FRXPI#
LIST    AUTOLINK    ALOG10
LIST    AUTOLINK    EXP
LIST    AUTOLINK    SIN                                                        CREATED
LIST        ENTRY
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SOCORRO COUNTY, NEW MEXICO WATER WELL

USGS TEST WELL #B-5

RMF = 5.4 OHM-M @ 84F
M = 1.5

DATA	DEPTH	RMN	RO	*	F	PDR	SPCOND	TDS	CL	SO4	REMARKS
1	30	10.9	70.0	*	2.3	29.0	342.5	241.	27.	76.	GOOD-SCREEN
2	32	13.0	100.0	*	2.8	25.1	298.4	210.	24.	66.	GOOD-SCREEN
3	34	10.0	50.0	*	2.0	31.0	433.4	306.	34.	96.	GOOD-SCREEN
4	36	7.2	46.0	*	1.4	40.2	319.2	225.	25.	71.	GOOD-SCREEN
5	38	7.0	50.0	*	1.3	41.1	283.2	200.	22.	63.	GOOD-SCREEN
6	40	7.1	60.0	*	1.4	40.6	240.4	169.	19.	53.	GOOD-SCREEN
7	42	7.4	46.0	*	1.4	39.2	330.5	233.	26.	73.	GOOD-SCREEN
8	44	6.8	41.0	*	1.3	42.1	332.4	234.	26.	74.	GOOD-SCREEN
9	46	7.5	39.0	*	1.5	38.7	396.3	279.	31.	88.	GOOD-SCREEN
10	48	6.5	44.0	*	1.2	43.9	291.1	205.	23.	65.	NACCEPT-CLAY
11	50	8.0	43.0	*	1.6	36.7	388.8	274.	31.	86.	GOOD-SCREEN
12	52	8.0	45.0	*	1.6	36.7	371.5	262.	29.	82.	GOOD-SCREEN
13	54	8.1	43.0	*	1.6	36.3	394.6	278.	31.	88.	GOOD-SCREEN
14	56	8.4	40.6	*	1.7	35.3	436.3	308.	34.	97.	GOOD-SCREEN
15	58	8.9	40.0	*	1.8	33.7	473.6	334.	37.	105.	GOOD-SCREEN
16	60	13.0	61.0	*	2.8	24.9	489.2	345.	39.	109.	GOOD-SCREEN
17	62	14.7	45.0	*	3.4	22.3	783.0	552.	62.	174.	PACCEPT
18	64	12.0	48.0	*	2.6	26.6	561.4	396.	44.	125.	GOOD-SCREEN
19	66	16.1	46.0	*	3.8	20.4	872.7	615.	69.	194.	PACCEPT
20	68	15.8	51.0	*	3.7	20.8	765.8	540.	60.	170.	PACCEPT
21	70	17.1	50.0	*	4.2	19.2	877.8	619.	69.	195.	PACCEPT
22	72	13.0	50.0	*	2.9	24.8	596.8	421.	47.	132.	GOOD-SCREEN
23	74	13.0	56.0	*	2.9	24.8	532.9	376.	42.	118.	GOOD-SCREEN
24	76	18.0	60.0	*	4.5	18.2	790.4	557.	62.	175.	PACC/SANDY-CLAY
25	78	24.5	55.0	*	7.2	13.4	1371.6	967.	108.	304.	NACCEPT
26	80	16.6	44.0	*	4.0	19.7	954.4	673.	75.	212.	PACCEPT
27	82	20.0	48.0	*	5.3	16.4	1160.4	818.	92.	258.	NACCEPT
28	84	24.0	49.0	*	7.0	13.6	1494.3	1053.	118.	332.	NACCEPT
29	86	17.0	48.0	*	4.2	19.3	906.4	639.	72.	201.	PACC/SANDY-CLAY
30	88	21.0	50.0	*	5.8	15.5	1200.0	846.	95.	266.	NACCEPT
31	90	18.0	53.0	*	4.6	18.2	894.8	631.	71.	199.	PACC/SANDY-CLAY
32	92	12.0	43.0	*	2.6	26.5	626.7	442.	50.	139.	GOOD-SCREEN
33	94	11.0	50.0	*	2.3	28.4	484.8	342.	38.	108.	GOOD-SCREEN
34	96	13.0	38.0	*	2.9	24.7	785.3	554.	62.	174.	PACC/SANDY-CLAY
35	98	10.0	36.0	*	2.1	30.6	602.0	424.	48.	134.	GOOD-SCREEN
36	100	15.0	49.0	*	3.5	21.7	739.8	522.	58.	164.	PACC/SANDY-CLAY
37	102	12.0	50.0	*	2.6	26.4	539.0	380.	43.	120.	GOOD-SCREEN
38	104	11.0	50.0	*	2.3	28.3	484.8	342.	38.	108.	GOOD-SCREEN
39	106	11.4	46.0	*	2.4	27.5	550.1	388.	43.	122.	GOOD-SCREEN
40	108	10.4	45.0	*	2.2	29.6	504.1	355.	40.	112.	GOOD-SCREEN
41	110	11.1	50.0	*	2.4	28.1	490.1	345.	39.	109.	GOOD-SCREEN
42	112	11.6	48.0	*	2.5	27.1	538.4	380.	43.	120.	GOOD-SCREEN
43	114	11.7	45.0	*	2.5	26.9	580.4	409.	46.	129.	GOOD-SCREEN
44	116	11.3	41.0	*	2.4	27.7	610.6	430.	48.	136.	GOOD-SCREEN
45	118	13.2	41.0	*	3.0	24.3	742.5	523.	59.	165.	PACCEPT
46	120	12.0	42.0	*	2.6	26.3	641.6	452.	51.	142.	GOOD-SCREEN
47	122	13.9	42.0	*	3.2	23.2	776.7	548.	61.	172.	PACCEPT
48	124	13.6	40.0	*	3.1	23.6	791.9	558.	63.	176.	PACCEPT
49	126	7.0	41.0	*	1.4	40.4	345.4	243.	27.	77.	GOOD-SCREEN
50	128	13.0	44.0	*	2.9	24.5	678.2	478.	54.	151.	GOOD-SCREEN
51	130	12.3	42.0	*	2.7	25.7	661.8	467.	52.	147.	GOOD-SCREEN
52	132	12.0	43.0	*	2.6	26.3	626.7	442.	50.	139.	GOOD-SCREEN
53	134	12.2	41.0	*	2.7	25.9	671.0	473.	53.	149.	GOOD-SCREEN
54	136	11.4	35.0	*	2.5	27.4	723.0	510.	57.	160.	PACCEPT
55	138	11.1	33.0	*	2.4	27.9	742.5	523.	59.	165.	PACCEPT
56	140	13.0	31.0	*	2.9	24.5	962.6	679.	76.	214.	PACCEPT
57	142	14.0	29.0	*	3.2	22.9	1135.8	801.	90.	252.	NACCEPT
58	144	12.7	29.0	*	2.8	25.0	998.4	704.	79.	222.	PACC/SANDY-CLAY
59	146	15.5	30.0	*	3.7	20.8	1266.3	893.	100.	281.	NACCEPT
60	148	12.2	28.0	*	2.7	25.8	982.6	693.	78.	218.	PACCEPT
61	150	13.1	11.0	*	3.0	24.3	2740.1	1932.	216.	607.	NACCEPT
62	152	11.0	7.9	*	2.4	28.1	3068.2	2163.	242.	653.	NACCEPT
63	154	8.0	6.5	*	1.6	35.9	2572.2	1813.	203.	571.	NACCEPT
64	156	8.2	8.3	*	1.7	35.2	2074.4	1462.	164.	461.	NACCEPT
65	158	18.0	15.0	*	4.7	17.9	3161.5	2229.	250.	666.	NACCEPT
66	160	22.0	16.0	*	6.3	14.6	4023.3	2836.	471.	786.	NACCEPT
67	162	12.7	13.0	*	2.9	24.9	2227.1	1570.	176.	494.	NACCEPT
68	164	9.5	11.0	*	2.0	31.4	1856.8	1309.	147.	412.	NACCEPT
69	168	13.0	20.0	*	2.9	24.3	1492.1	1052.	118.	331.	NACCEPT
70	170	18.0	23.0	*	4.7	17.9	2061.8	1454.	163.	458.	NACCEPT
71	172	21.0	24.0	*	5.9	15.3	2500.0	1762.	197.	555.	NACCEPT
72	174	16.0	24.0	*	3.9	20.1	1657.4	1168.	131.	368.	NACCEPT
73	176	16.0	24.0	*	3.9	20.1	1657.4	1168.	131.	368.	NACCEPT
74	178	17.1	24.0	*	4.3	18.8	1828.8	1289.	144.	406.	NACCEPT
75	180	19.0	23.0	*	5.1	16.9	2238.9	1578.	177.	497.	NACCEPT-CLAY
76	182	20.0	19.0	*	5.5	16.0	2931.4	2067.	232.	634.	NACCEPT-CLAY
77	184	21.5	15.0	*	6.2	14.9	4145.3	2922.	521.	803.	NACCEPT-CLAY
78	186	18.5	11.0	*	4.9	17.3	4494.5	3169.	664.	852.	NACCEPT
79	188	7.0	8.5	*	1.4	39.9	1665.8	1174.	132.	370.	NACCEPT
80	190	11.8	6.4	*	2.6	26.3	4124.0	2907.	513.	800.	NACCEPT
81	192	8.0	5.0	*	1.7	35.6	3343.9	2357.	264.	691.	NACCEPT-CLAY
82	194	4.8	4.8	*	0.8	60.4	1579.1	1113.	125.	351.	NACCEPT-CLAY
83	196	5.0	5.7	*	0.8	57.0	1449.6	1022.	115.	322.	NACCEPT-CLAY
84	198	13.0	6.5	*	3.0	24.2	4590.9	3237.	703.	865.	NACCEPT
85	200	13.0	6.3	*	3.0	24.2	4736.7	3339.	763.	886.	NACCEPT
86	202	14.0	6.1	*	3.3	22.6	5399.8	3807.	1033.	978.	NACCEPT
87	204	15.2	5.0	*	3.7	21.0	7388.0	5209.	1844.	1256.	NACCEPT-CLAY
88	206	4.0	4.8	*	0.5	65.0	959.2	676.	76.	213.	PACC/SANDY-CLAY
89	208	20.0	6.0	*	5.6	15.9	9282.8	6544.	2617.	1520.	NACCEPT-CLAY
90	210	16.0	7.3	*	4.0	19.9	5449.1	3842.	1053.	985.	NACCEPT
91	212	11.4	6.6	*	2.5	26.9	3833.9	2703.	394.	760.	NACCEPT
92	214	11.0	6.7	*	2.4	27.7	3617.8	2551.	306.	730.	NACCEPT
93	216	12.0	6.7	*	2.7	25.8	4022.3	2836.	471.	786.	NACCEPT
94	218	17.1	6.5	*	4.4	18.6	6752.6	4761.	1585.	1167.	NACCEPT-CLAY
95	220	17.0	6.3	*	4.4	18.7	6906.1	4869.	1648.	1188.	NACCEPT-CLAY
96	222	14.7	6.5	*	3.5	21.6	5420.8	3822.	1042.	981.	NACCEPT-CLAY
97	224	13.0	6.3	*	3.0	24.1	4736.7	3339.	763.	886.	NACCEPT
98	226	12.1	5.4	*	2.7	25.6	5042.5	3555.	887.	928.	NACCEPT
99	228	3.5	4.5	*	0.3	65.0	558.3	394.	44.	124.	GOOD-SCREEN
100	230	4.0	5.0	*	0.5	65.0	920.8	649.	73.	204.	PACC/SANDY-CLAY
101	232	4.7	5.6	*	0.7	61.8	1291.0	910.	102.	287.	NACCEPT
102	234	4.3	6.5	*	0.6	65.0	887.6	626.	70.	197.	PACC/SANDY-CLAY
103	236	6.1	10.0	*	1.2	44.9	1168.0	823.	92.	259.	NACCEPT
104	238	16.0	20.0	*	4.0	19.8	1988.9	1402.	157.	442.	NACCEPT-CLAY
105	240	20.0	23.0	*	5.6	15.8	2421.6	1707.	191.	538.	NACCEPT
106	242	18.0	25.0	*	4.8	17.6	1896.9	1337.	150.	421.	NACCEPT
107	244	14.4	27.0	*	3.5	21.9	1268.1	894.	100.	282.	NACCEPT
108	246	13.6	29.0	*	3.2	23.0	1092.2	770.	86.	242.	PACCEPT
109	248	13.0	30.0	*	3.0	23.9	994.7	701.	79.	221.	PACCEPT
110	250	11.0	28.0	*	2.5	27.5	865.7	610.	68.	192.	PACCEPT
111	252	12.0	32.0	*	2.7	25.6	842.2	594.	67.	187.	PACCEPT
112	254	20.0	36.0	*	5.6	15.8	1547.1	1091.	122.	343.	NACCEPT-CLAY
113	256	20.5	35.0	*	5.9	15.4	1652.5	1165.	131.	367.	NACCEPT-CLAY
114	258	14.0	32.0	*	3.3	22.4	1029.3	726.	81.	229.	PACCEPT
115	260	25.0	40.0	*	7.9	12.6	1941.3	1369.	153.	431.	NACCEPT
116	262	20.0	42.0	*	5.7	15.8	1326.1	935.	105.	294.	NACCEPT

```
 117     264    21.0    40.0  *  6.1   15.0   1500.0     1057.    118.    333.   NACCEPT
 118     266    18.1    40.0  *  4.9   17.4   1195.6      843.     94.    265.   NACCEPT
 119     268    20.8    40.0  *  6.0   15.1   1478.3     1042.    117.    328.    NACCEPT-CLAY
 120     270    20.0    38.0  *  5.7   15.7   1465.7     1033.    116.    325.    NACCEPT-CLAY
 121     272    14.0    40.0  *  3.4   22.3    823.5      581.     65.    183.   PACCEPT
 122     274    12.0    40.0  *  2.7   25.5    673.7      475.     53.    150.   GOOD-SCREEN
 123     276    14.0    36.0  *  3.4   22.3    915.0      645.     72.    203.   PACCEPT
 124     278    13.1    35.0  *  3.1   23.6    861.2      607.     68.    191.   PACCEPT
 125     280    15.0    36.0  *  3.7   20.9   1007.0      710.     80.    224.   PACCEPT
 126     282    13.6    34.0  *  3.2   22.9    931.6      657.     74.    207.   PACCEPT
 127     284    12.0    27.0  *  2.8   25.4    998.1      704.     79.    222.   PACCEPT
 128     286    12.0    28.0  *  2.8   25.4    962.5      679.     76.    214.   PACCEPT
 129     288    13.0    32.0  *  3.1   23.8    932.5      657.     74.    207.   PACCEPT
 130     290    12.0    34.0  *  2.8   25.4    792.6      559.     63.    176.   PACCEPT
 131     290    12.0    34.0  *  2.8   25.4    792.6      559.     63.    176.   PACCEPT
 132     292    11.7    34.0  *  2.7   25.9    768.2      542.     61.    171.   PACCEPT
 133     294    14.0    37.0  *  3.4   22.2   1029.3      726.     81.    229.   PACC/SANDY-CLAY
 134     296    14.0    31.0  *  3.4   22.2   1062.5      749.     84.    236.   PACC/SANDY-CLAY
 135     298    20.0    28.0  *  5.7   15.6   1989.2     1402.    157.    442.    NACCEPT-CLAY
 136     300    16.0    27.0  *  4.1   19.6   1473.3     1039.    116.    327.   NACCEPT
 137     302    17.0    31.0  *  4.5   18.4   1403.5      989.    111.    312.   NACCEPT
 138     304    20.0    31.0  *  5.7   15.6   1796.7     1267.    142.    399.   NACCEPT
 139     306    20.0    30.0  *  5.7   15.6   1856.6     1309.    147.    412.   NACCEPT
 140     308    21.0    30.0  *  6.2   14.9   2000.0     1410.    158.    444.   NACCEPT
 141     310    20.0    21.0  *  5.7   15.6   2652.2     1870.    210.    589.   NACCEPT
 142     312    12.0    20.0  *  2.8   25.3   1347.5      950.    106.    299.   NACCEPT
 143     314    15.0    20.5  *  3.7   20.8   1768.4     1247.    140.    393.   NACCEPT
 144     316    13.3    24.0  *  3.2   23.2   1281.2      903.    101.    284.   NACCEPT
 145     318    11.2    21.0  *  2.6   26.7   1179.4      832.     93.    262.   NACCEPT
 146     320    10.6    21.0  *  2.4   27.9   1104.7      779.     87.    245.   NACCEPT
 147     322    11.5    26.0  *  2.6   26.2    983.6      693.     78.    218.   PACCEPT
 148     324    16.0    30.0  *  4.1   19.5   1326.0      935.    105.    294.   NACCEPT
 149     326    13.0    27.0  *  3.1   23.6   1105.2      779.     87.    245.   NACCEPT
 150     328    13.6    24.0  *  3.3   22.7   1319.8      930.    104.    293.   NACCEPT
 151     330    11.1    22.0  *  2.5   26.9   1113.8      785.     88.    247.   NACCEPT
 152     332    11.2    22.0  *  2.6   26.7   1125.8      794.     89.    250.   NACCEPT
 153     334    10.6    21.0  *  2.4   27.8   1104.7      779.     87.    245.   NACCEPT
 154     336    11.6    22.0  *  2.7   25.9   1174.8      828.     93.    261.   NACCEPT
 155     338    13.1    20.0  *  3.1   23.4   1507.1     1062.    119.    335.   NACCEPT
 156     340    12.1    20.0  *  2.8   25.0   1361.5      960.    108.    302.   NACCEPT
 157     342    12.4    20.0  *  2.9   24.5   1404.1      990.    111.    312.   NACCEPT
 158     344    19.0    21.0  *  5.4   16.3   2452.1     1729.    194.    544.   NACCEPT
 159     346    16.0    21.0  *  4.1   19.4   1894.2     1335.    150.    421.   NACCEPT
 160     348    16.2    20.0  *  4.2   19.2   2025.5     1428.    160.    450.     NACCEPT-CLAY
 161     350    16.0    24.0  *  4.1   19.4   1657.4     1168.    131.    368.   NACCEPT
 162     352    16.0    21.0  *  4.1   19.4   1894.2     1335.    150.    421.   NACCEPT
 163     354    13.3    20.4  *  3.2   23.0   1507.3     1063.    119.    335.   NACCEPT
 164     356    12.0    20.3  *  2.8   25.1   1327.5      936.    105.    295.   NACCEPT
 165     358    12.1    20.0  *  2.8   24.9   1361.5      960.    108.    302.   NACCEPT
 166     360    13.0    20.0  *  3.1   23.4   1492.1     1052.    118.    331.   NACCEPT
 167     362    15.0    19.1  *  3.8   20.6   1898.0     1338.    150.    421.   NACCEPT
 168     364    13.2    19.0  *  3.2   23.1   1602.3     1130.    127.    356.   NACCEPT
 169     366    12.0    19.1  *  2.8   25.0   1410.9      995.    111.    313.   NACCEPT
 170     368    12.8    19.1  *  3.1   23.7   1531.2     1080.    121.    340.   NACCEPT
 171     370    13.5    19.1  *  3.3   22.6   1642.1     1158.    130.    365.   NACCEPT
 172     372    13.0    18.0  *  3.1   23.4   1657.8     1169.    131.    368.   NACCEPT
 173     374    12.0    16.0  *  2.8   25.0   1684.3     1187.    133.    374.   NACCEPT
 174     376    12.1    15.0  *  2.9   24.8   1815.3     1280.    143.    403.   NACCEPT
 175     378    11.8    14.5  *  2.8   25.3   1820.2     1283.    144.    404.   NACCEPT
 176     380    12.8    14.4  *  3.1   23.6   2031.0     1432.    160.    451.   NACCEPT
 177     382    12.3    14.4  *  2.9   24.5   1930.3     1361.    152.    429.   NACCEPT
 178     384    13.1    13.8  *  3.2   23.2   2184.2     1540.    173.    485.   NACCEPT
 179     386    13.1    13.0  *  3.2   23.2   2318.6     1635.    183.    515.   NACCEPT
 180     388    12.4    10.5  *  3.0   24.3   2674.5     1886.    211.    594.   NACCEPT
 181     390     6.0     8.0  *  1.2   44.3   1423.7     1004.    112.    316.     NACCEPT-CLAY
 182     392    10.0    12.0  *  2.3   28.8   1806.0     1273.    143.    401.   NACCEPT
 183     394    11.0    13.5  *  2.6   26.7   1795.5     1266.    142.    399.   NACCEPT
 184     396     9.6    13.0  *  2.2   29.7   1590.2     1121.    126.    353.   NACCEPT
 185     398    10.6    13.5  *  2.5   27.5   1718.4     1211.    136.    381.   NACCEPT
 186     400    11.1    14.0  *  2.6   26.5   1750.2     1234.    138.    389.   NACCEPT
 187     402    11.5    13.6  *  2.7   25.8   1880.4     1326.    149.    417.   NACCEPT
 188     404    11.7    13.6  *  2.8   25.4   1920.5     1354.    152.    426.   NACCEPT
 189     406    11.9    13.6  *  2.8   25.0   1961.1     1383.    155.    435.   NACCEPT
 190     408    11.2    13.5  *  2.6   26.3   1834.7     1293.    145.    407.   NACCEPT
 191     410    12.0    13.3  *  2.9   24.8   2026.2     1429.    160.    450.   NACCEPT
 192     412    11.0    13.0  *  2.6   26.6   1864.6     1315.    147.    414.   NACCEPT
 193     414    12.0    12.3  *  2.9   24.8   2191.0     1545.    173.    486.   NACCEPT
 194     416    11.7    12.4  *  2.8   25.3   2106.3     1485.    166.    468.   NACCEPT
 195     418    12.6    12.0  *  3.0   23.8   2388.4     1684.    189.    530.   NACCEPT
 196     420    11.8    11.0  *  2.8   25.1   2399.4     1692.    190.    533.   NACCEPT
 197     422    10.0     9.0  *  2.3   28.6   2408.0     1698.    190.    535.   NACCEPT
 198     424     9.6     9.3  *  2.2   29.6   2222.9     1567.    176.    493.   NACCEPT
 199     426    11.0    10.3  *  2.6   26.6   2353.3     1659.    186.    522.   NACCEPT
 200     428    11.0    11.6  *  2.6   26.6   2089.6     1473.    165.    464.   NACCEPT
 201     430    11.0    10.8  *  2.6   26.5   2244.4     1582.    177.    498.   NACCEPT
 202     432    10.0    10.3  *  2.3   28.6   2104.1     1483.    166.    467.   NACCEPT
 203     434     9.6    10.1  *  2.2   29.5   2046.8     1443.    162.    454.   NACCEPT
 204     436    10.1    10.4  *  2.3   28.4   2108.1     1486.    167.    468.   NACCEPT
 205     438    11.3    10.7  *  2.7   25.9   2339.7     1650.    185.    519.   NACCEPT
 206     440    11.3    10.7  *  2.7   25.9   2339.7     1650.    185.    519.   NACCEPT
 207     442    12.0    10.3  *  2.9   24.7   2616.4     1845.    207.    581.   NACCEPT
 208     444    12.0     9.7  *  2.9   24.7   2778.3     1959.    219.    613.   NACCEPT
 209     446    10.0     9.0  *  2.3   28.5   2408.0     1698.    190.    535.   NACCEPT
 210     448    11.2     9.2  *  2.7   26.1   2692.2     1898.    213.    598.   NACCEPT
 211     450    12.0     9.2  *  2.9   24.6   2929.3     2065.    231.    634.   NACCEPT
DATA    DEPTH   RMN      RO   *   F    POR   SPCOND      TDS      CL     SO4    REMARKS


                         PROGRAM TIME IN SECONDS =  0.9161670E 02


              PROGRAM BY----

                   RONALD M. BRIMHALL
                   BOX 31 CAMPUS STA.
                   SOCORRO, N. M.    87801
/&

JOB TIME SUMMARY...COMPILE 0128S   ASSEMBLE 0000S   LNKEDT 0039S   UTILS 0000S   USER 0260S        TOTAL TIME  007M 07S
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Secondary Programs

Secondary programs, examples of which are presented in the companion volume [Brimhall, 1969], compare the results of the F-Method of water well resistivity log interpretation with the results of the FF-Method when both methods are applied to the same interpretation problem. Two secondary programs were written; each based on the resistivity logging method selected: FVSFF1 for the induction/proximity log combination and FVSFF2 for the induction/microlog logging combination. Comparisons of the two interpretation methods are made on the basis of TDS concentrations only. Each program presents the calculation results in both table and graph form; one graph is a plot of TDS concentrations determined by both interpretation methods and the other graph is a plot of F vs FF. Each program contains statements that explain the execution of the program.

PRESENTATION AND DISCUSSION OF RESULTS

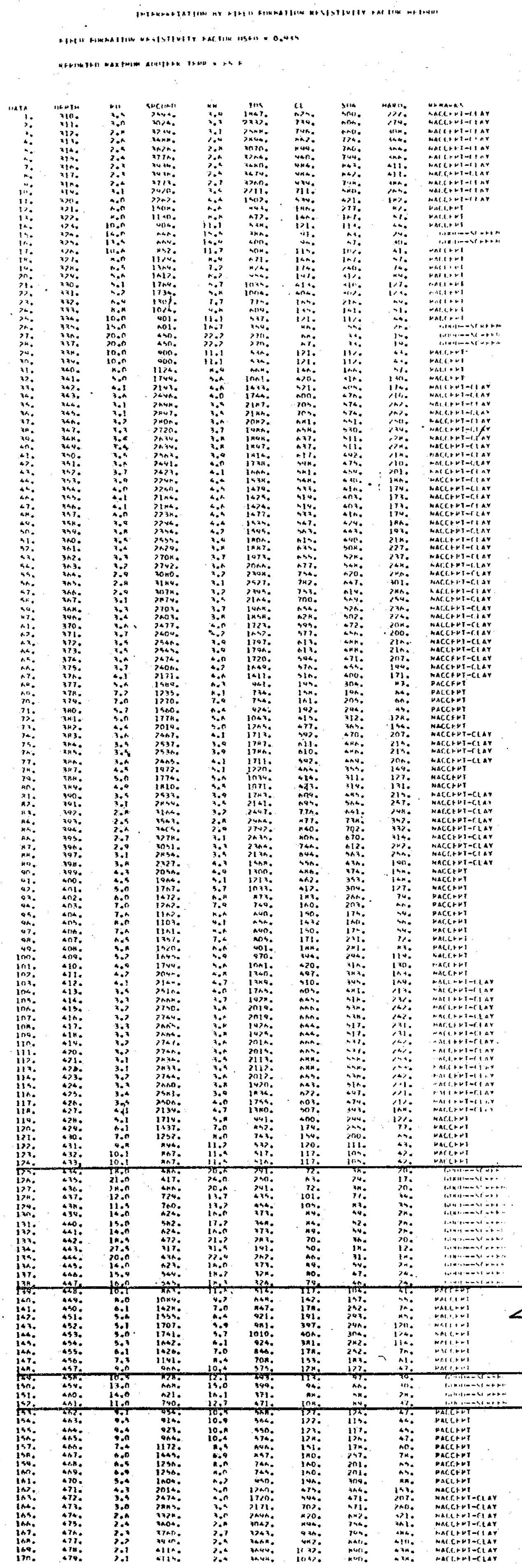
Examples of Adjunctive Interpretation Results

FF-Method (One-log Approach)

Figure 9 illustrates a portion of the tabulated adjunctive interpretation results for the El Paso Natural Gas Company Test Well #3 that is located in Area "W" of the Hueco Bolson near El Paso, Texas. See Appendix C. The dual induction-laterolog with spontaneous potential, shown in the figure, was the only log recorded.

The line printer tabulation includes the following data: (1) data point number, (2) data point depth in feet, (3) the deep depth of investigation induction resistivity as read from the log in ohm-meters; (4) the corresponding calculated values of water specific conductance in micromhos per centimeter, and (5) water resistivity in ohm-meters; (6) the calculated parameters relating to water quality--TDS, Cl, SO_4, and HARD in parts per million; and (7) under REMARKS are listed the corresponding water quality and aquifer classifications. Included are the well identification and some parametric data. A portion of the induction log is included to illustrate the correlation between the tabulated log data and results and the resistivity log. The heavy lines correlate two portions of the aquifer. Notice the pattern of the comments under the column titled REMARKS. The aquifer units which should be screened for production are easily identified.

Figure 10 is an example of the computer plots of the results tabulated in Figure 9. Plotted as a function of well depth are TDS, Cl, SO_4, and spontaneous potential. The concentration scale for the TDS and Cl parameters relating to water quality is 0 to 4000 parts per million, for the SO_4 parameter the scale is 0 to 1000 parts per million. The depth scale is 5 inches per 100 feet on the original plot. 250 parts per million cutoff lines are included on the log for delimiting the maximum Cl and SO_4 concentrations acceptable under the selected quality standards. The cutoff and the graphical presentation make it easy to decide which intervals along the well bore should be screened. A porosity index is not included because, under the FF-Method, the porosity is assumed the same for all aquifer units in the well.



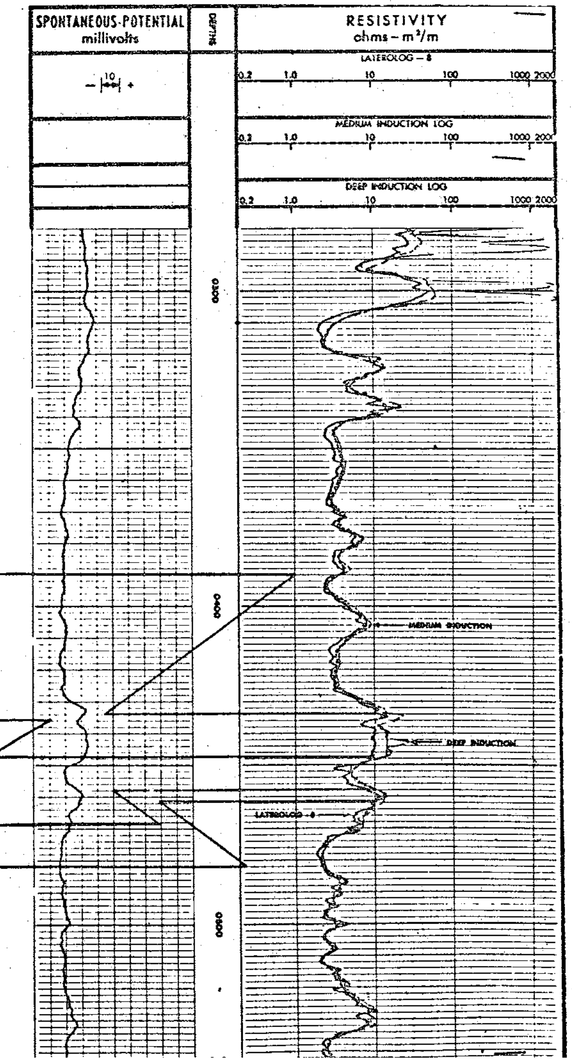
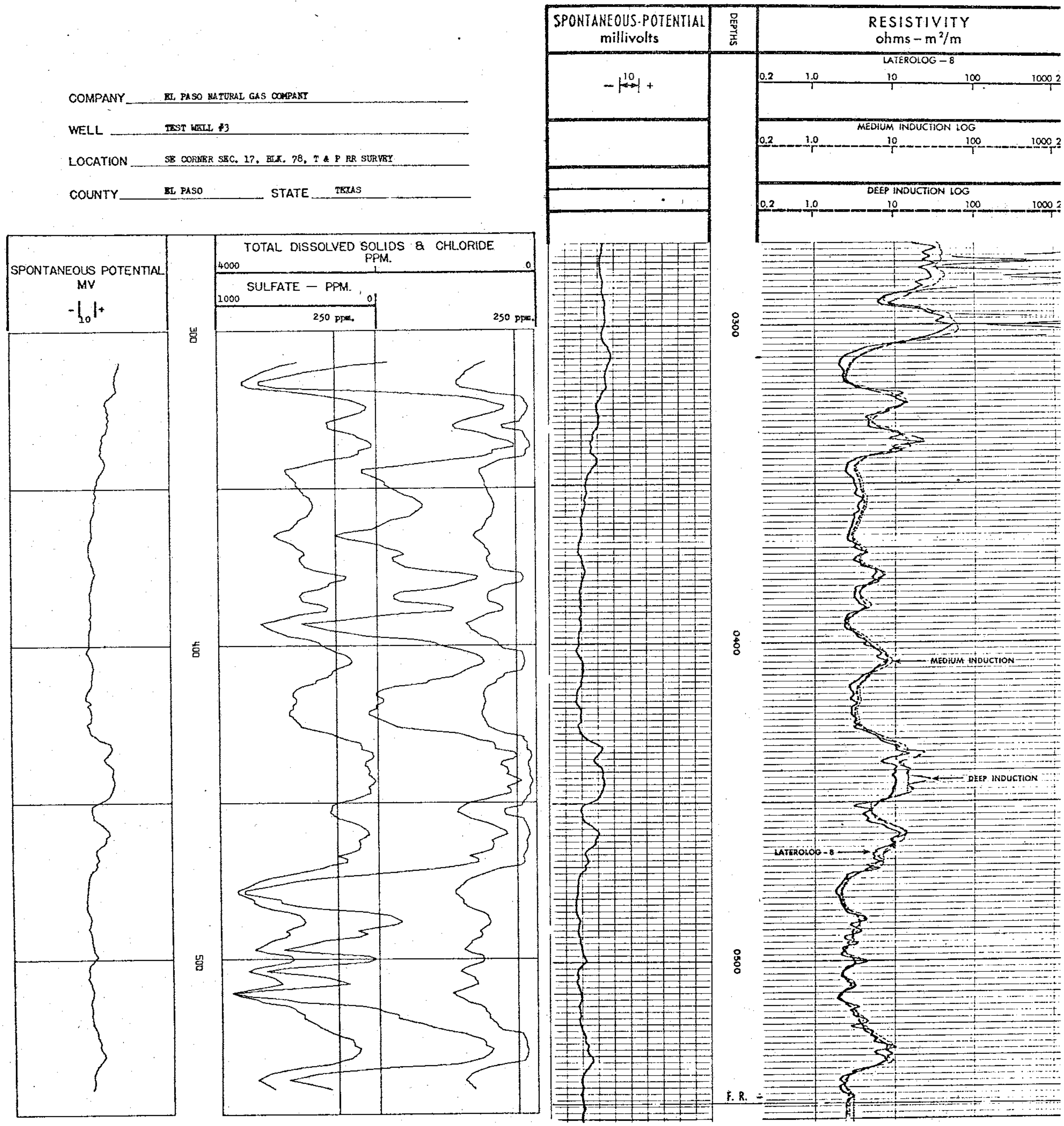


Fig. 9. Example of adjunctive interpretation results. Portion of line printer output and induction log of El Paso Natural Gas Company Test Well #3.



COMPANY EL PASO NATURAL GAS COMPANY

WELL TEST WELL #3

LOCATION SE CORNER SEC. 17, BLK. 78, T & P RR SURVEY

COUNTY EL PASO STATE TEXAS

Fig. 10. Log form of the results tabulated in Figure 9.

F-Method (Two-log Approach)

Figure 11 illustrates a portion of the adjunctive interpretation results for the USGS Test Well #B-5 that is located in the Bosque del Apache Grant, New Mexico. Not shown in this illustration is the microlog that was recorded as part of the logging program. The line printer tabulation includes the following data: (1) data point number, (2) data point depth in feet, (3) micronormal resistivity in ohm-meters, (4) deep depth of investigation induction resistivity as read from the logs in ohm-meters; (5) the corresponding calculated values of the formation resistivity factor, (6) porosity index in percent, and (7) water specific conductance in micromhos per centimeter; (8) the parameters relating to water quality--TDS, Cl, and SO_4 in parts per million; and (9) under REMARKS are listed the corresponding water quality and aquifer unit classifications. Included are the well identification and some parametric data. A portion of the open hole induction log with spontaneous potential is included to illustrate the correlation between the tabulated log data and results and the open hole log. The complete logs are reproduced in Plates IIa and IIb.

Figure 12 is an example of the computer plot of the results tabulated in Figure 11. Plotted as a function of well bore depth are TDS, SO_4, porosity index, and spontaneous potential. The spontaneous potential is included for correlation purposes. The concentration scale for the parameters relating to water quality is 0 to 2000 parts per million, the porosity index scale is 0 to 100 percent. The depth scale is 2 inches per 100 feet on the original plot. A line representing the upper limit of sulfate ion concentration acceptable under the quality standards selected is drawn on the plot at 250 parts per million. This cutoff and the graphical presentation make it easy to decide which intervals along the well bore should be screened for production. The porosity index helps determine lithology.

Examples of other log interpretations by the F-Method are included in the companion volume [Brimhall, 1969].

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                         SOCORRO COUNTY, NEW MEXICO WATER WELL

                                USGS TEST WELL #B-5

              RMF = 5.4 OHM-M @ 84F
                M = 1.5

                                                                                        REMARKS
DATA  DEPTH   RMN     RO   *   F     POR    SPCOND      TDS      CL      SO4
  1     30    10.9   70.0  *  2.3   29.0    342.5      241.     27.     76.   GOOD-SCREEN
  2     32    13.0  100.0  *  2.8   25.1    298.4      210.     24.     66.   GOOD-SCREEN
  3     34    10.0   50.0  *  2.0   31.0    433.4      306.     34.     96.   GOOD-SCREEN
  4     36     7.2   46.0  *  1.4   40.2    319.2      225.     25.     71.   GOOD-SCREEN
  5     38     7.0   50.0  *  1.3   41.1    283.7      200.     22.     63.   GOOD-SCREEN
  6     40     7.1   60.0  *  1.4   40.6    240.4      169.     19.     53.   GOOD-SCREEN
  7     42     7.4   46.0  *  1.4   39.2    330.5      233.     26.     73.   GOOD-SCREEN
  8     44     6.8   41.0  *  1.3   42.1    332.4      234.     26.     74.   GOOD-SCREEN
  9     46     7.5   39.0  *  1.5   38.7    396.3      279.     31.     88.   GOOD-SCREEN
 10     48     6.5   44.0  *  1.2   43.9    291.1      205.     73.     65.     NACCEPT-CLAY
 11     50     8.0   43.0  *  1.6   36.7    388.8      274.     31.     86.   GOOD-SCREEN
 12     52     8.0   45.0  *  1.6   36.7    371.5      262.     29.     82.   GOOD-SCREEN
 13     54     8.1   43.0  *  1.6   36.3    394.6      278.     31.     88.   GOOD-SCREEN
 14     56     8.4   40.6  *  1.7   35.3    436.3      308.     34.     97.   GOOD-SCREEN
 15     58     8.9   40.0  *  1.8   33.7    473.6      334.     37.    105.   GOOD-SCREEN
 16     60    13.0   61.0  *  2.8   24.9    489.2      345.     39.    104.   GOOD-SCREEN
 17     62    14.7   45.0  *  3.4   22.3    783.0      552.     62.    174.    PACCEPT
 18     64    12.0   48.0  *  2.6   26.6    561.4      396.     44.    125.   GOOD-SCREEN
 19     66    16.1   46.0  *  3.8   20.4    872.7      615.     69.    194.    PACCEPT
 20     68    15.8   51.0  *  3.7   20.8    765.8      540.     60.    170.    PACCEPT
 21     70    17.1   50.0  *  4.2   19.2    877.8      619.     69.    195.    PACCEPT
 22     72    13.0   50.0  *  2.9   24.8    596.8      421.     47.    132.   GOOD-SCREEN
 23     74    13.0   56.0  *  2.9   24.8    532.9      376.     42.    118.   GOOD-SCREEN
 24     76    18.0   60.0  *  4.5   18.2    790.4      557.     62.    175.    PACC/SANDY-CLAY
 25     78    24.5   55.0  *  7.2   13.4   1371.6      967.    108.    304.    NACCEPT
 26     80    16.6   44.0  *  4.0   19.7    954.4      673.     75.    212.    PACCEPT
 27     82    20.0   48.0  *  5.3   16.4   1160.4      818.     92.    258.    NACCEPT
 28     84    24.0   49.0  *  7.0   13.6   1494.3     1053.    118.    332.    NACCEPT
 29     86    17.0   48.0  *  4.2   19.3    906.4      639.     72.    201.    PACC/SANDY-CLAY
 30     88    21.0   50.0  *  5.8   15.5   1200.0      846.     95.    266.    NACCEPT
 31     90    18.0   53.0  *  4.6   18.2    894.8      631.     71.    199.    PACC/SANDY-CLAY
 32     92    12.0   43.0  *  2.6   26.5    626.7      442.     50.    139.   GOOD-SCREEN
 33     94    11.0   50.0  *  2.3   28.4    484.8      342.     38.    108.   GOOD-SCREEN
 34     96    13.0   38.0  *  2.9   24.7    785.3      554.     62.    174.    PACC/SANDY-CLAY
 35     98    10.0   36.0  *  2.1   30.6    602.0      424.     48.    134.   GOOD-SCREEN
 36    100    15.0   49.0  *  3.5   21.7    739.8      522.     58.    164.    PACC/SANDY-CLAY
 37    102    12.0   50.0  *  2.6   26.4    539.0      380.     43.    120.   GOOD-SCREEN
 38    104    11.0   50.0  *  2.3   28.3    484.8      342.     38.    108.   GOOD-SCREEN
 39    106    11.4   46.0  *  2.4   27.5    550.1      388.     43.    172.   GOOD-SCREEN
 40    108    10.4   45.0  *  2.2   29.6    504.1      355.     40.    112.   GOOD-SCREEN
 41    110    11.1   50.0  *  2.4   28.1    490.1      345.     39.    109.   GOOD-SCREEN
 42    112    11.6   48.0  *  2.5   27.1    538.4      380.     43.    120.   GOOD-SCREEN
 43    114    11.7   45.0  *  2.5   26.9    580.4      409.     46.    129.   GOOD-SCREEN
 44    116    11.3   41.0  *  2.4   27.7    610.6      430.     48.    136.   GOOD-SCREEN
 45    118    13.2   41.0  *  3.0   24.3    742.5      523.     59.    165.    PACCEPT
 46    120    12.0   42.0  *  2.6   26.3    641.6      452.     51.    142.   GOOD-SCREEN
 47    122    13.9   42.0  *  3.2   23.2    776.7      548.     61.    172.    PACCEPT
 48    124    13.6   40.0  *  3.1   23.6    791.9      558.     63.    176.    PACCEPT
 49    126     7.0   41.0  *  1.4   40.4    345.4      243.     27.     77.   GOOD-SCREEN
 50    128    13.0   44.0  *  2.9   24.5    678.2      478.     54.    151.   GOOD-SCREEN
 51    130    12.3   47.0  *  2.7   25.7    661.8      467.     52.    147.   GOOD-SCREEN
 52    132    12.0   43.0  *  2.6   26.3    626.7      442.     50.    139.   GOOD-SCREEN
 53    134    12.2   41.0  *  2.7   25.9    671.0      473.     53.    149.   GOOD-SCREEN
 54    136    11.4   35.0  *  2.5   27.4    723.0      510.     57.    160.    PACCEPT
 55    138    11.1   33.0  *  2.4   27.9    742.5      523.     59.    165.    PACCEPT
 56    140    13.0   31.0  *  2.9   24.5    962.6      679.     76.    214.    PACCEPT
 57    142    14.0   29.0  *  3.2   22.9   1135.8      801.     90.    252.    NACCEPT
 58    144    12.7   29.0  *  2.8   25.0    998.4      704.     79.    222.    PACC/SANDY-CLAY
 59    146    15.5   30.0  *  3.7   20.8   1266.3      893.    100.    281.    NACCEPT
 60    148    12.2   28.0  *  2.7   25.8    982.6      693.     78.    218.    PACCEPT
 61    150    13.1   11.0  *  3.0   24.3   2740.1     1932.    216.    607.    NACCEPT
 62    152    11.0    7.9  *  2.4   28.1   3068.7     2163.    242.    653.    NACCEPT
 63    154     8.0    6.5  *  1.6   35.9   2572.2     1813.    203.    571.    NACCEPT
 64    156     8.2    8.3  *  1.7   35.2   2074.4     1462.    164.    461.    NACCEPT
 65    158    18.0   15.0  *  4.7   17.9   3161.5     2229.    250.    666.    NACCEPT
 66    160    22.0   16.0  *  6.3   14.6   4023.3     2836.    471.    786.    NACCEPT
 67    162    12.7   13.0  *  2.9   24.9   2227.1     1570.    176.    494.    NACCEPT
 68    164     9.5   11.0  *  2.0   31.4   1856.8     1309.    147.    412.    NACCEPT
 69    168    13.0   20.0  *  2.9   24.3   1492.1     1052.    118.    331.    NACCEPT
 70    170    18.0   23.0  *  4.7   17.9   2061.8     1454.    163.    458.    NACCEPT
 71    172    21.0   24.0  *  5.9   15.3   2500.0     1762.    197.    555.    NACCEPT
 72    174    16.0   24.0  *  3.9   20.1   1657.4     1168.    131.    368.    NACCEPT
 73    176    16.0   24.0  *  3.9   20.1   1657.4     1168.    131.    368.    NACCEPT
 74    178    17.1   24.0  *  4.3   18.8   1828.8     1289.    144.    406.    NACCEPT
 75    180    19.0   23.0  *  5.1   16.9   2238.9     1578.    177.    497.     NACCEPT-CLAY
 76    182    20.0   19.0  *  5.5   16.0   2931.4     2067.    232.    634.     NACCEPT-CLAY
 77    184    21.5   15.0  *  6.2   14.9   4145.3     2922.    521.    803.     NACCEPT-CLAY
 78    186    18.5   11.0  *  4.9   17.3   4494.5     3169.    664.    852.    NACCEPT
 79    188     7.0    8.5  *  1.4   39.9   1665.8     1174.    132.    370.    NACCEPT
 80    190    11.8    6.4  *  2.6   26.3   4124.0     2907.    513.    800.    NACCEPT
 81    192     8.0    5.0  *  1.7   35.6   3343.9     2357.    264.    691.     NACCEPT-CLAY
 82    194     4.8    4.8  *  0.8   60.4   1579.1     1113.    125.    351.     NACCEPT-CLAY
 83    196     5.0    5.7  *  0.8   57.0   1449.6     1022.    115.    322.     NACCEPT-CLAY
 84    198    13.0    6.5  *  3.0   24.2   4590.9     3237.    703.    865.    NACCEPT
 85    200    13.0    6.3  *  3.0   24.2   4736.7     3339.    763.    886.    NACCEPT
 86    202    14.0    6.1  *  3.3   22.6   5399.8     3807.   1033.    978.    NACCEPT
 87    204    15.2    5.0  *  3.7   21.0   7388.0     5209.    844.   1256.     NACCEPT-CLAY
 88    206     4.0    4.8  *  0.5   65.0    959.2      676.     76.    213.    PACC/SANDY-CLAY
 89    208    20.0    6.0  *  5.6   15.9   9282.8     6544.   2617.   1520.     NACCEPT-CLAY
 90    210    16.0    7.3  *  4.0   19.9   5449.1     3842.    053.    985.    NACCEPT
 91    212    11.4    6.6  *  2.5   26.9   3833.9     2703.    394.    760.    NACCEPT
 92    214    11.0    6.7  *  2.4   27.7   3617.8     2551.    306.    730.    NACCEPT
 93    216    12.0    6.7  *  2.7   25.8   4022.3     2836.    471.    786.    NACCEPT
 94    218    17.1    6.5  *  4.4   18.6   6752.6     4761.   1585.   1167.     NACCEPT-CLAY
 95    220    17.0    6.3  *  4.4   18.7   6906.1     4869.   1648.   1188.     NACCEPT-CLAY
 96    222    14.7    6.5  *  3.5   21.6   5420.8     3822.   1042.    981.     NACCEPT-CLAY
 97    224    13.0    6.3  *  3.0   24.1   4736.7     3339.    763.    886.    NACCEPT
 98    226    12.1    5.4  *  2.7   25.6   5042.5     3555.    887.    928.    NACCEPT
 99    228     3.5    4.5  *  0.3   65.0    558.3      394.     44.    124.   GOOD-SCREEN
100    230     4.0    5.0  *  0.5   65.0    920.8      649.     73.    204.    PACC/SANDY-CLAY
101    232     4.7    5.6  *  0.7   61.8   1291.0      910.    102.    287.    NACCEPT
102    234     4.3    6.5  *  0.6   65.0    887.6      626.     70.    197.    PACC/SANDY-CLAY
103    236     6.1   10.0  *  1.2   44.9   1168.0      823.     92.    259.    NACCEPT
104    238    16.0   20.0  *  4.0   19.8   1988.9     1402.    157.    442.     NACCEPT-CLAY
105    240    20.0   23.0  *  5.6   15.8   2421.6     1707.    191.    538.    NACCEPT
106    242    18.0   25.0  *  4.8   17.6   1896.9     1337.    150.    421.    NACCEPT
107    244    14.4   27.0  *  3.5   21.9   1268.1      894.    100.    282.    NACCEPT
108    246    13.6   29.0  *  3.2   23.0   1092.2      770.     86.    242.    PACCEPT
109    248    13.0   30.0  *  3.0   23.9    994.7      701.     79.    221.    PACCEPT
110    250    11.0   28.0  *  2.5   27.5    865.7      610.     68.    192.    PACCEPT
111    252    12.0   32.0  *  2.7   25.6    842.2      594.     67.    187.    PACCEPT
112    254    20.0   36.0  *  5.6   15.8   1547.1     1091.    122.    343.     NACCEPT-CLAY
113    256    20.5   35.0  *  5.9   15.4   1652.5     1165.    131.    367.     NACCEPT-CLAY
114    258    14.0   32.0  *  3.3   22.4   1029.3      726.     81.    229.    PACCEPT
115    260    25.0   40.0  *  7.9   12.6   1941.3     1369.    153.    431.    NACCEPT
116    262    20.0   42.0  *  5.7   15.8   1326.1      935.    105.    294.    NACCEPT
```

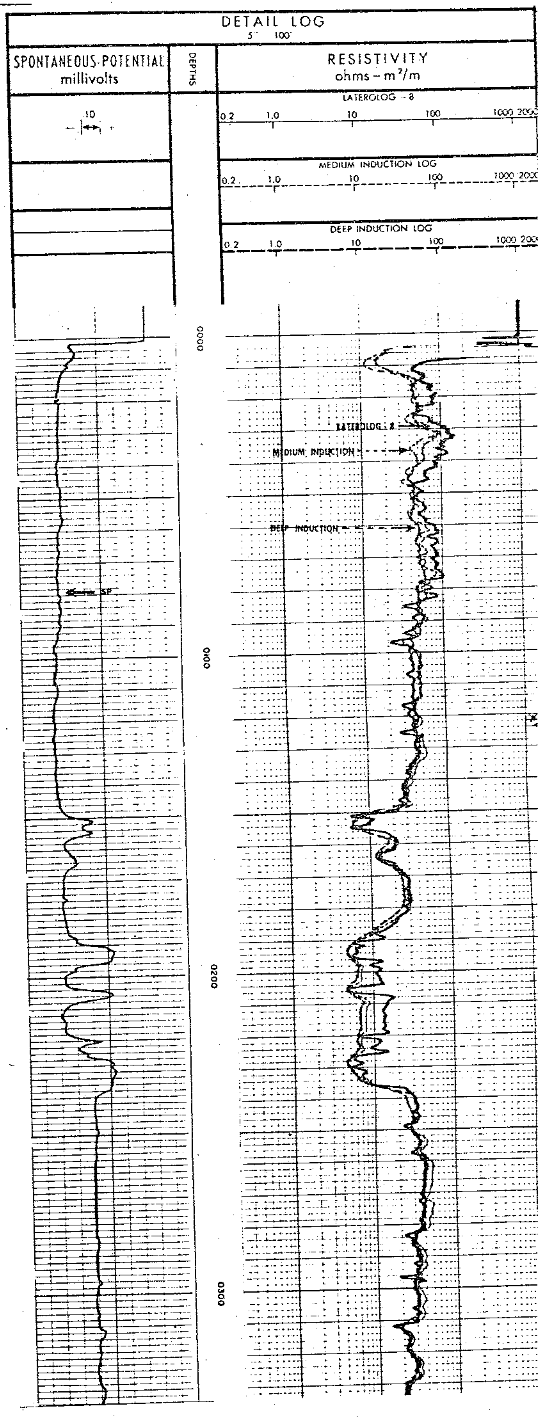

Fig. 11. Example of adjunctive interpretation results. Portion of line printer output and induction log of USGS Test Well #B-5.

COMPANY UNITED STATES GEOLOGICAL SURVEY

WELL TEST WELL #B-5

LOCATION SW 1/4 OF NE 1/4 OF NE 1/4 OF SEC. 8, TWP 6S, RGE. 1E

COUNTY SOCORRO STATE NEW MEXICO

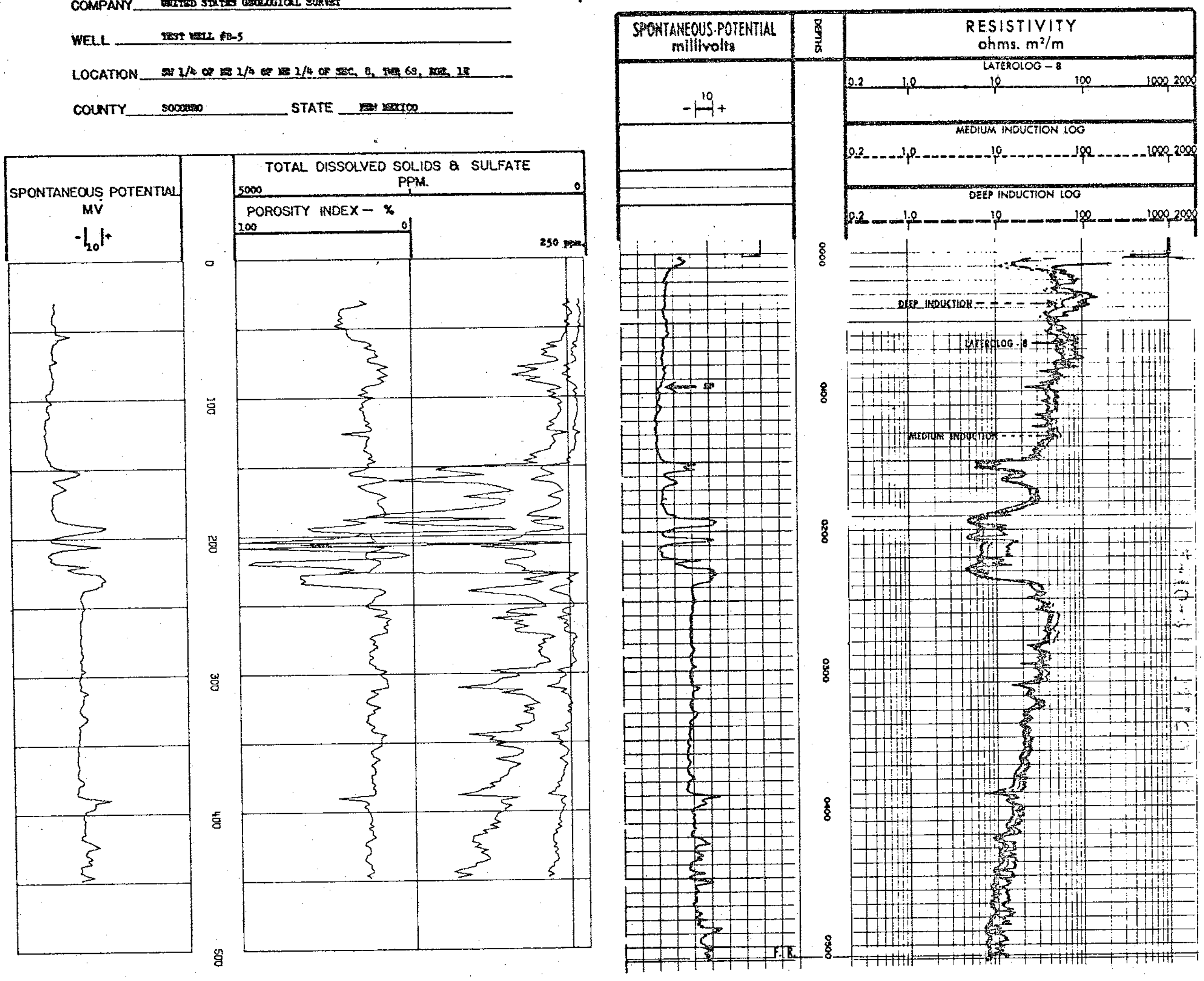

Fig. 12. Log form of the results tabulated in Figure 11.

Comparison of Log Analysis Results With Corresponding Chemical Analysis

Log analysis results relative to chemical analysis results were determined by comparing weighted-average log calculations with the chemical analysis of a water sample obtained during pumping of the well subsequent to the well's completion. This was required by the fact that chemical analysis for a given well is generally performed on a composite sample rather than on separate samples from each water-producing interval. The weighting factor, for each screened interval, was determined as the ratio of the screened interval thickness to the sum total of thicknesses of all the intervals. The example in Table 3 illustrates the method. To justify the use of the weighting factor, three assumptions were necessary. It was assumed that: (1) the permeability is the same for all aquifer units, (2) the energy losses in moving the water from within any aquifer unit to the well bore is the same for all aquifer units screened, and (3) the energy losses in producing the water from the well bore to the surface are negligible.

Percentage deviation between log analysis determined concentrations and chemical analysis determined concentrations was calculated from

$$\% \text{ Deviation} = \frac{(\text{Log conc.} - \text{Chem. conc.})\text{x}100.}{\text{Log conc.}} \qquad (14)$$

The following scheme for comparison standards was used: (1) If the comparison resulted in a percent difference within 10 or 15 percent, the comparison was considered very good, (2) If the comparison was between 15 and 30 percent, the comparison was considered favorable, (3) If the comparison resulted in a percent difference greater than 30 percent, the comparison was not favorable.

Table 4 lists a comparison summary for all wells considered in this thesis, except one, for which the requisite comparison data were available. Comparisons are made between chemical analysis results and log analysis results for both the F- and the FF-Methods.

TABLE 3

EXAMPLE OF CALCULATIONS FOR COMPARISON OF LOG RESULTS RELATIVE TO CHEMICAL ANALYSIS RESULTS: USGS TEST WELL #B-5 SULFATE ION ONLY

(1) Screened Intervals feet	(2) Increment feet	(3) Arithmetic Average SO_4 Conc. from log[a] ppm.	(4) Weighting Factor $(2)/\Sigma(2)$ dimensionless	(5) Weighted Average $(3)\text{x}(4)$ ppm.
55-97	42	180	0.545	98
125-150	25	181	0.325	59
160-170	10	420	0.130	55
	$\Sigma(2)=77$		$\Sigma(4) = 1.000$	$\Sigma(5) = 212^b$

[a] Arithmetic average calculations not shown.

Discussion of Results

USGS Test Well #B-5

Figure 13 and Table 4 illustrate average log analysis results, as determined from the F-Method, compared with the chemical analysis of a pump sample for the USGS Test Well #B-5 which is located in the Bosque del Apache Grant, New Mexico. The well screen was designed by the USGS.

The average log analysis TDS concentration is 610 ppm; the chemical analysis concentration was reported as 719 ppm [Cooper, 1968] for an 18 percent deviation. The average log analysis SO_4 concentration is 212 ppm as compared with 234 ppm reported in the chemical analysis for a 5 percent difference. The log analysis Cl concentration is 85 ppm; the chemical analysis concentration is 82 ppm. The corresponding Cl difference is 4 percent.

Particularly interesting are the TDS, SO_4, and Cl concentrations determined from resistivity logs without applying mud cake corrections to the micronormal resistivity readings. On Figure 13, the points plotted inside the squares correspond to these concentration values. All points plot just below the line representing +30 percent of the abscissa value. The mud cake correction was made assuming a mud cake thickness of 1/8 of an inch. This correction is important if the induction log and the microlog logging program are to give useful interpretation results.

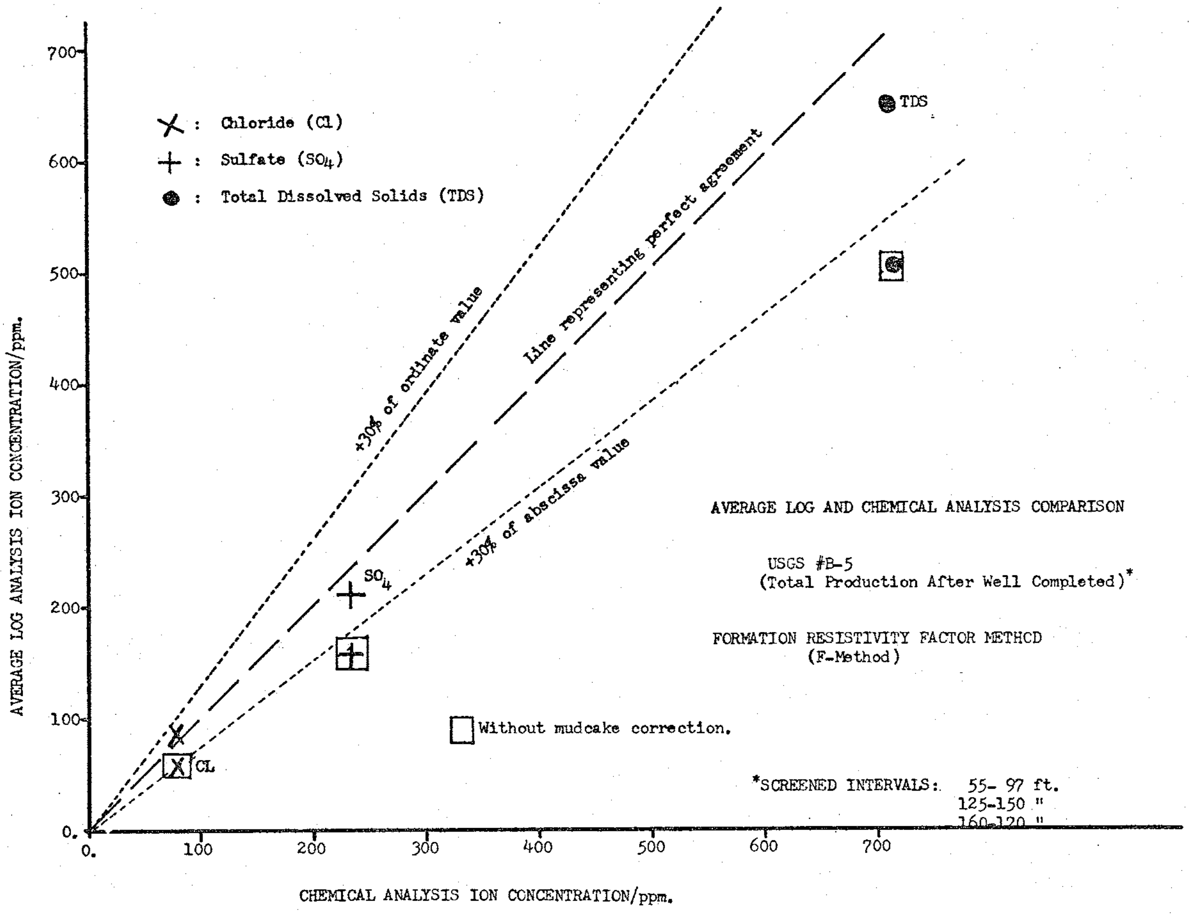

Fig. 13. Weighted average log results compared with chemical analysis of a pump sample for USGS Test Well #B-5, Bosque del Apache Grant, Socorro County, New Mexico.

City of Belen Water Well #4

Figure 14 and Table 4 illustrate the average log analysis results, determined from the F-Method, compared with the chemical analysis of a pump sample for the City of Belen, New Mexico, Water Well #4. The well screen was designed for the intervals listed on the graph by a commercial well screen company.

The average log analysis TDS concentration is 530 ppm as compared with 488 ppm from chemical analysis [Molzen, 1968] for an 8 percent deviation. The average log analysis concentration of SO_4, is 178 ppm as compared with 195 ppm from the chemical analysis for a 10 percent difference. The log analysis average Cl concentration is 24 ppm and 23 ppm from the chemical analysis; from a practicle standpoint, this represents identical results.

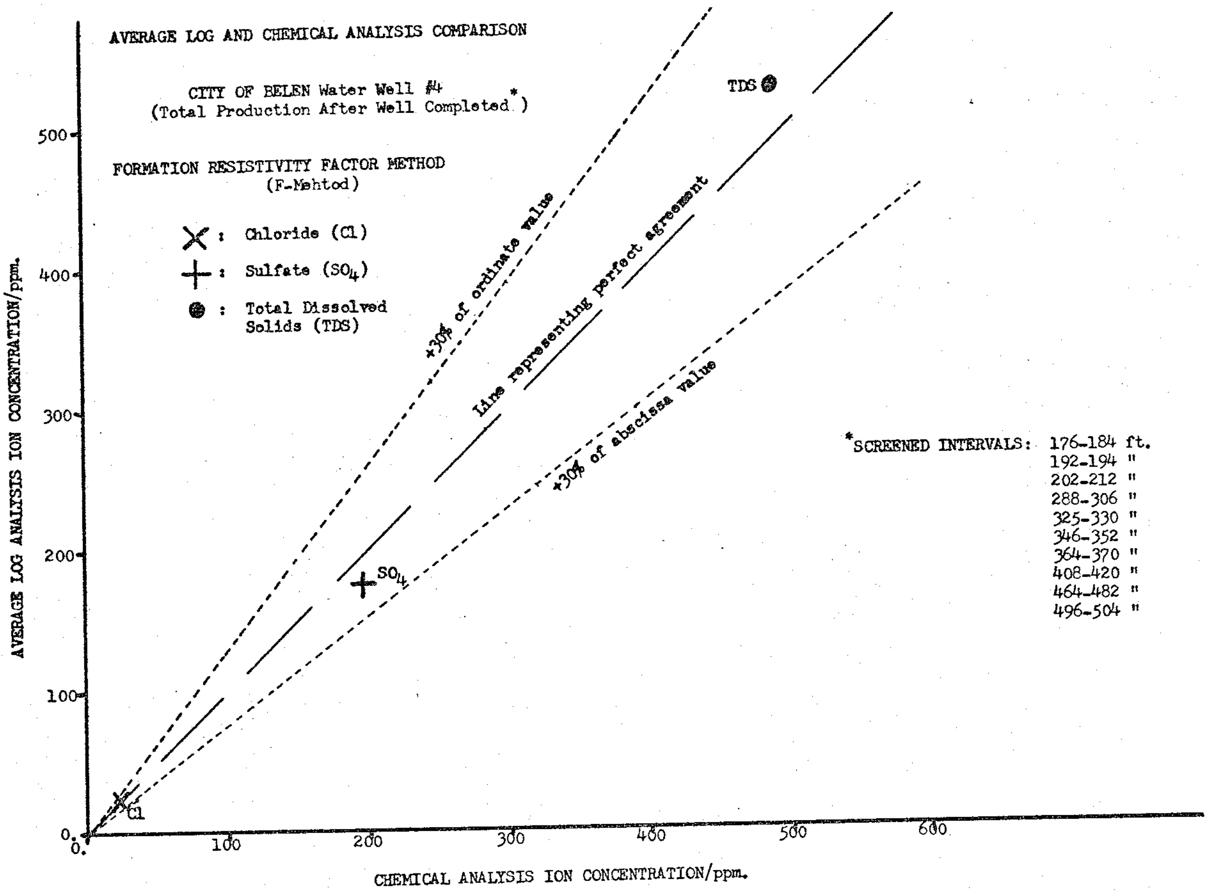

Fig. 14. Weighted average log results compared with chemical analysis of a pump sample for City of Belen Water Well #4, Valencia County, New Mexico.

El Paso Natural Gas Company Test Well #3

Figure 15 and Table 4 illustrate average log analysis results, as determined from the FF-Method, compared with the chemical analysis for the El Paso Natural Gas Company Test Well #3. This well is located in Area "W" of the Hueco Bolson near El Paso, Texas. The comparison is based on the chemical analysis of a drill stem test sample recovered during the test of an aquifer unit between borehole depths of 520 feet and 542 feet. Included on this chart are concentration values of TDS, SO_4, Cl, and HARD as calcium carbonate.

The average log analysis TDS concentration is 713 ppm; the chemical analysis concentration was reported as 635 ppm [Kelly, 1968] for an 11 percent difference. The average log analysis SO_4 concentration is 189 ppm as compared with 135 ppm reported in the chemical analysis for a 29 percent deviation. The log analysis Cl concentration is 154 ppm; the reported chemical analysis concentration is 142 ppm for an 8 percent deviation. The average log analysis HARD concentration is 62 ppm; the reported chemical analysis hardness is 55 ppm, the corresponding deviation is 11 percent.

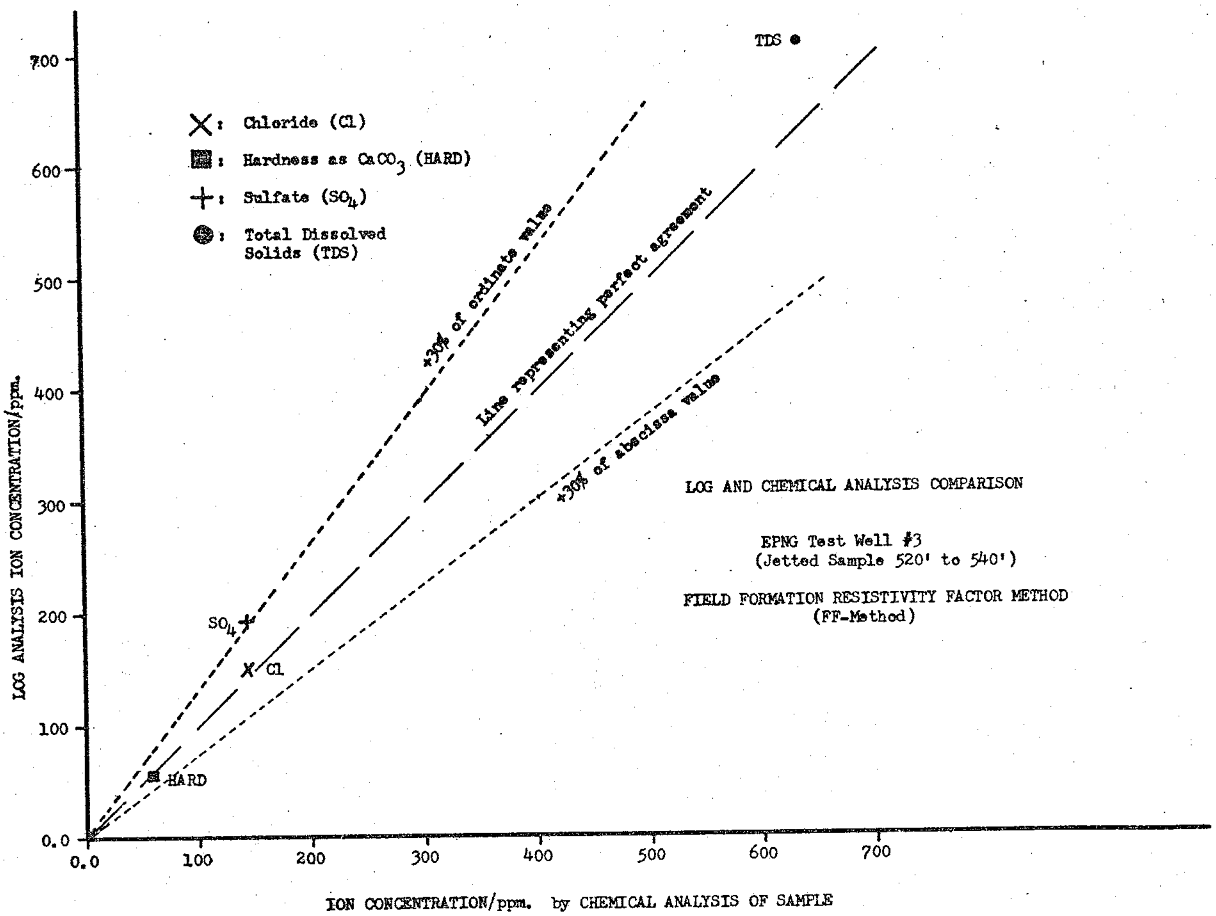

Fig. 15. Weighted average log results compared with chemical analysis of a pump sample for El Paso Natural Gas Company Test Well #3, El Paso County, Texas.

TABLE 4

COMPARISON OF LOG ANALYSES RESULTS WITH THE CORRESPONDING CHEMICAL ANALYSES FOR BOTH F- AND FF-METHODS

Well	F-Method ppm.	FF-Method ppm.	Chem. Anal. ppm.	%Dev. F-	%Dev. FF-
City of Belen Water Well #4					
TDS	530	590	488	8	11
Cl	24	NA	23	(0)	NA
SO_4	178	NA	195	10	NA
City of El Paso Water Well #3 Off.	--Not included here. See Figure 17.--				
El Paso Natural Gas Company T. W. #3					
TDS	NA	713	635	NA	11
Cl	NA	154	142	NA	8
SO_4	NA	189	135	NA	29
HARD	NA	62	55	NA	11
USGS TEST WELL #B-5					
TDS	610	525	719	18	37
Cl	85	NA	82	4	NA
SO_4	245	NA	234	5	NA

[a]NA means Not Available.

City of El Paso Water Well #3 Offset

Log analysis and chemical analysis comparisons for several aquifer units were possible for the City of El Paso Water Well #3 Offset, located in Area "V" of the Hueco Bolson near El Paso, Texas. Drill stem tests were made of aquifer units throughout the extent of the well bore. The results of eight tests were made available for this work [Cliett, 1968]. Figure 16 summarizes the average log analysis results with the chemical analysis of drill stem test samples. Weighted average concentration values for TDS, SO_4, and Cl from the log analysis were plotted as a function of the results of the corresponding chemical analysis. Figure 16-A contains comparative results obtained for TDS concentrations from both the F-Method and the FF-Method. Figure 16-B contains comparative results of SO_4 and Cl concentrations obtained from the F-Method only.

The relative accuracy for this well is classified as being unfavorable. For concentration values of TDS and Cl, the scatter of points about the line of perfect agreement is too great to indicate a favorable comparison. The Cl comparison qualitatively exhibits the better correlation--but, only one quarter of the points approach perfect agreement. The SO_4 comparison is generally linear. However, the SO_4 concentrations determined by chemical analysis are 3.5 times greater than corresponding log-determined concentrations.

Some unknown combination of geologic factors that do not correlate with the basic interpretation control model are partially responsible for this extreme divergence in relative accuracy. A study of the City of El Paso Water Well #3 Offset logs, that I performed which was not a part of the thesis problem, indicated the presence of an annulus of low resistivity fluid between the flushed zone and the uncontaminated zone [Gondouin and Heim, 1964].

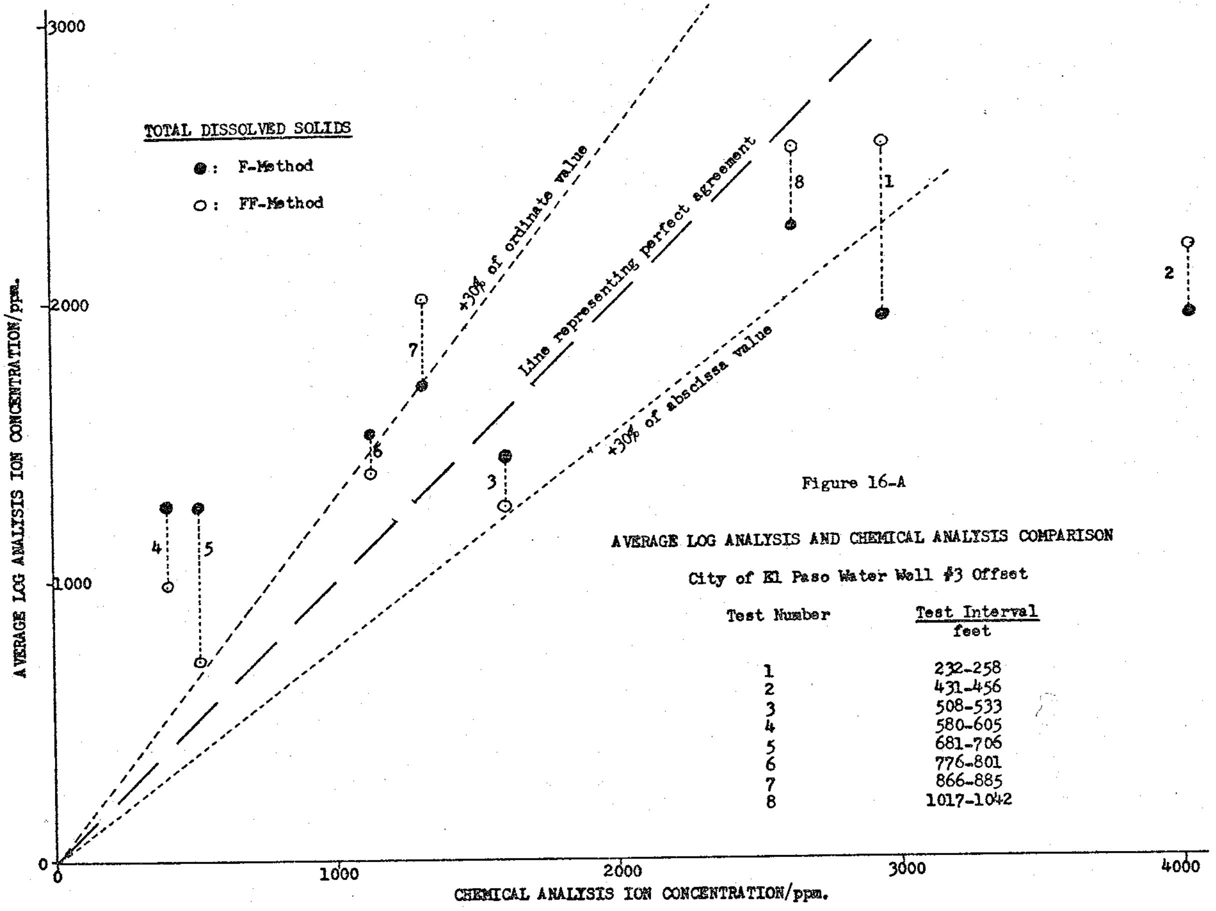

Figure 16-A

AVERAGE LOG ANALYSIS AND CHEMICAL ANALYSIS COMPARISON

City of El Paso Water Well #3 Offset

Test Number	Test Interval feet
1	232-258
2	431-456
3	508-533
4	580-605
5	681-706
6	776-801
7	866-885
8	1017-1042

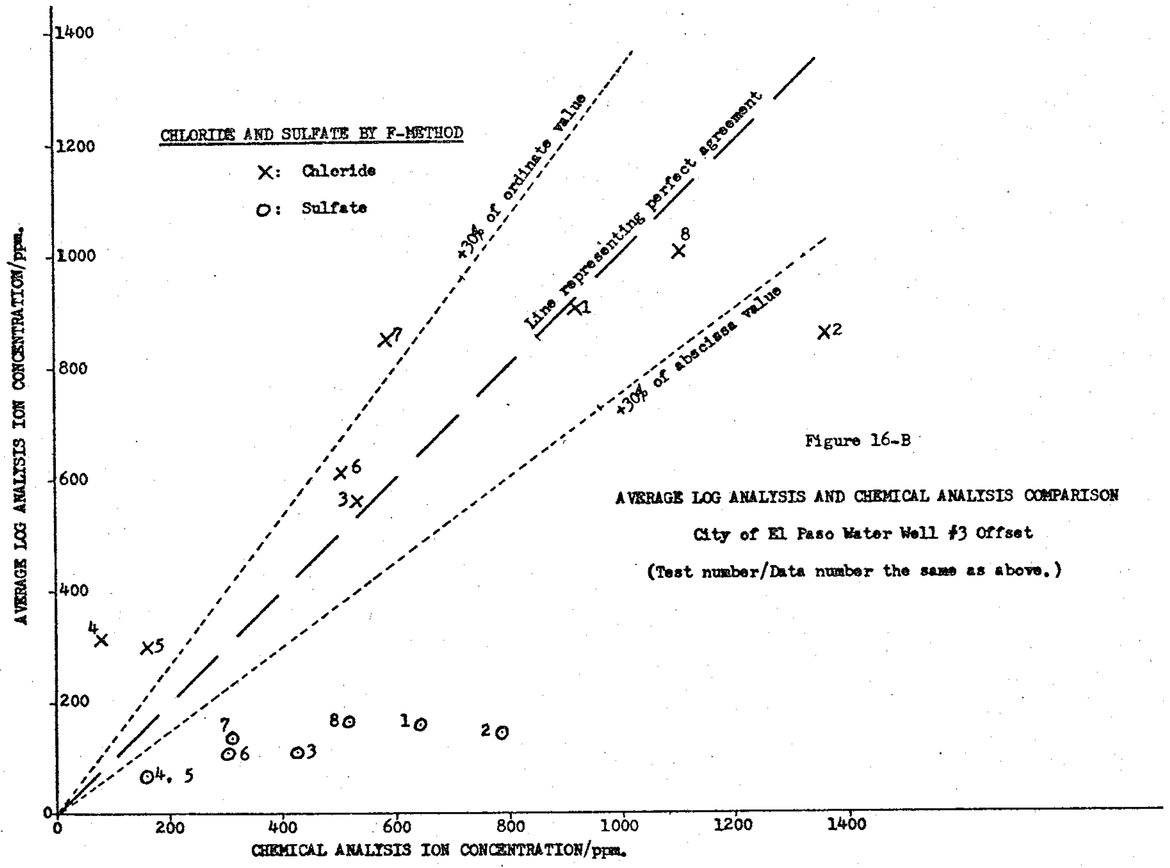

Figure 16-B

AVERAGE LOG ANALYSIS AND CHEMICAL ANALYSIS COMPARISON

City of El Paso Water Well #3 Offset

(Test number/Data number the same as above.)

Fig. 16 Weighted average log results compared with

Comparison of F- and FF-Methods

For the same aquifer units, how does the FF-Method compare with the F-Method in determining concentration values of parameters relating to water quality? Figures 17, 18, and 19 compare the two methods for the TDS content of the following wells: City of Belen Water Well #4, City of El Paso Water Well #3 Offset, and USGS Test Well #B-5. These figures are computer plots of the programs named FVSFF1 and FVSFF2.

Each figure is made up of two graphs. One graph illustrates the comparison of TDS concentrations as determined by both the F-Method (TDSF) and the FF-Method (TDSFF). TDSFF is plotted as ordinate and TDSF is plotted as abscissa. The companion graph compares the field formation resistivity factor, which is assumed the same for all aquifer units, with variation of the formation resistivity factor for each aquifer unit. Field formation resistivity factor is plotted as ordinate and the formation resistivity factor (designated "aquifer-unit formation resistivity factor") is plotted as abscissa. On each graph is one line representing perfect agreement between the two methods and lines representing +20% of the ordinate and the abscissa values. These lines are included on the graphs for relative accuracy determinations. The data points are distinguished as belonging to predominantly clay-bearing beds by (X) or as being gravel and sand beds by (+).

From the graphs labeled 17-A, 18-A, and 19-A, it is obvious that there is not perfect agreement between the two methods; the graphs labeled 17-B, 18-B, and 19-B demonstrate why. The divergence can be explained by noting the definite variation of the formation resistivity factor and by recalling that the field formation resistivity factor is assumed the same for all aquifer units. Therefore, perfect agreement between the two methods would occur only when F equals FF--which occurs infrequently. In some cases, it is possible to determine how many data points have values of F approximating values of FF by examining the density with which F is plotted. For example, notice the dense + pattern about the value of F of 2.8 in Figure 19-B.

Table 5 summarizes the range of F for each well and compares this variation with the corresponding field formation resistivity factor for the three wells for which a method comparison was made. In each case, FF is taken as the arithmetic average of F's for all data points not classified as being predominantly clay bearing.

Table 6 is a summary of the average field formation resistivity factors for sands and gravel aquifers for the various wells located in the geographic areas studied. FF was determined as the arithmetic average of the F's for all data points not classified as being clay bearing. Notice that the values of FF can vary greatly between wells drilled within the same geographic area. FF values for the Bosque del Apache Grant demonstrate this divergence. Extreme divergence in FF values suggests that the wells were drilled into rocks that have different lithologies.

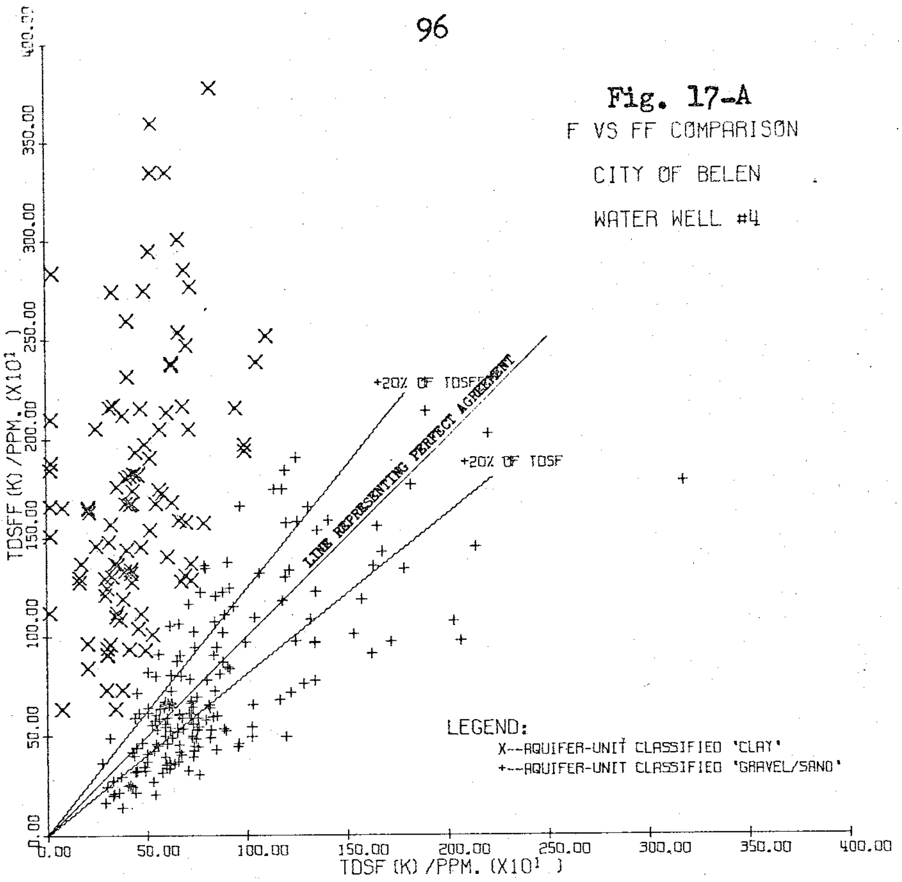

Fig. 17-A

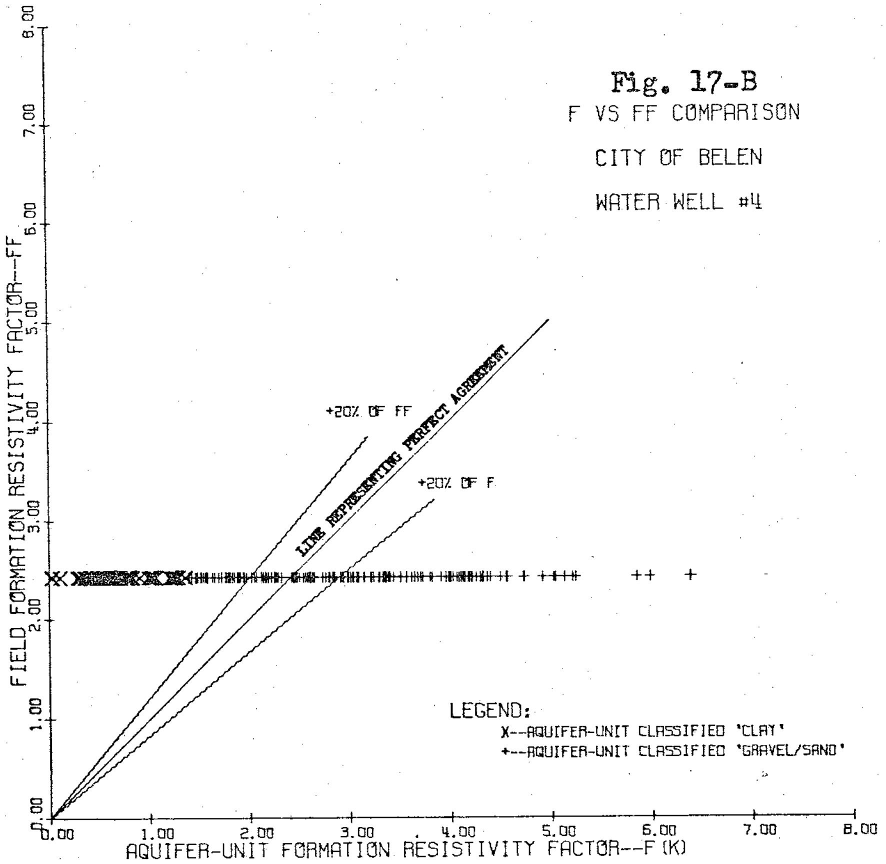

Fig. 17-B

Fig. 17. Comparison of the F- and FF-Methods; City

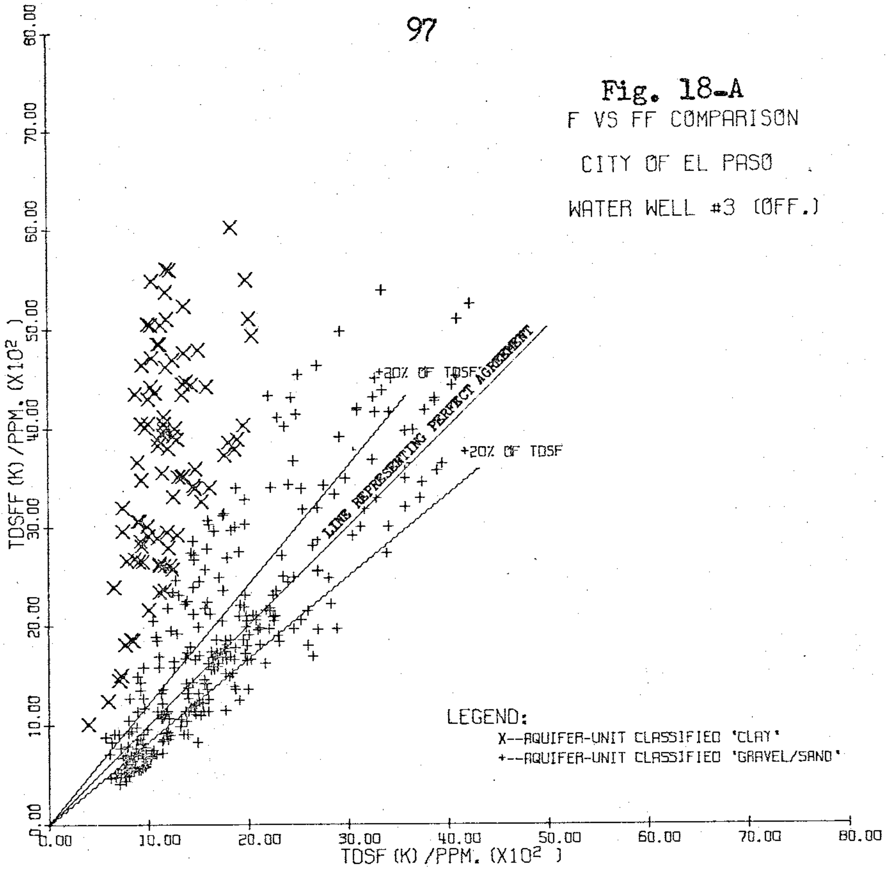

Fig. 18-A

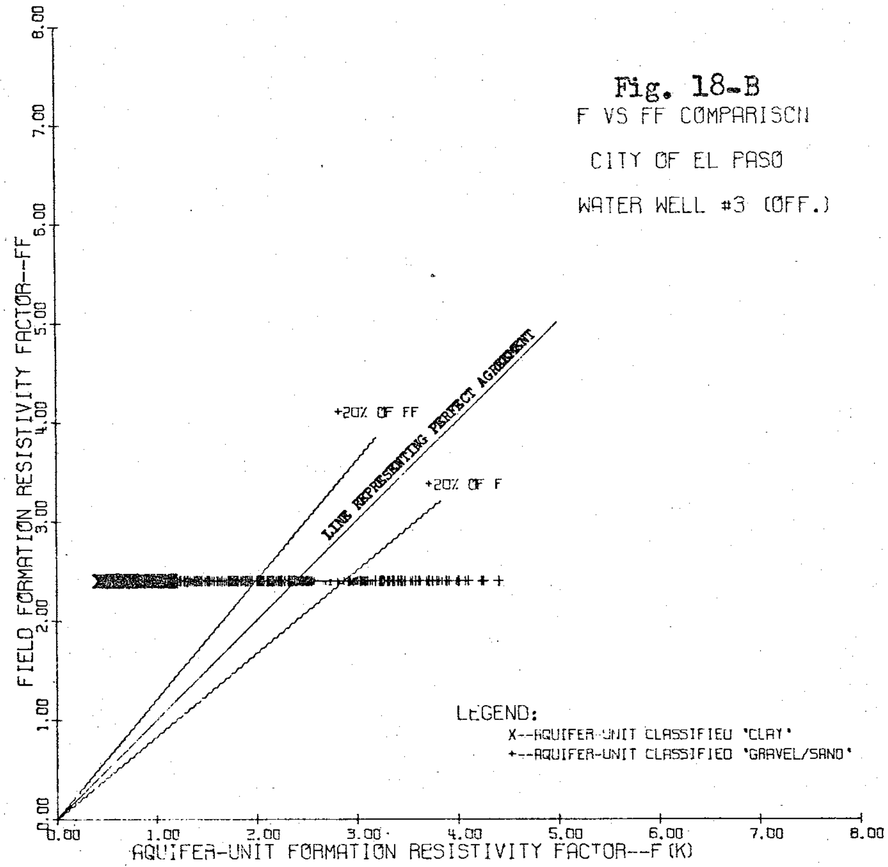

Fig. 18-B

Fig. 18. Comparison of the F- and FF-Methods; City

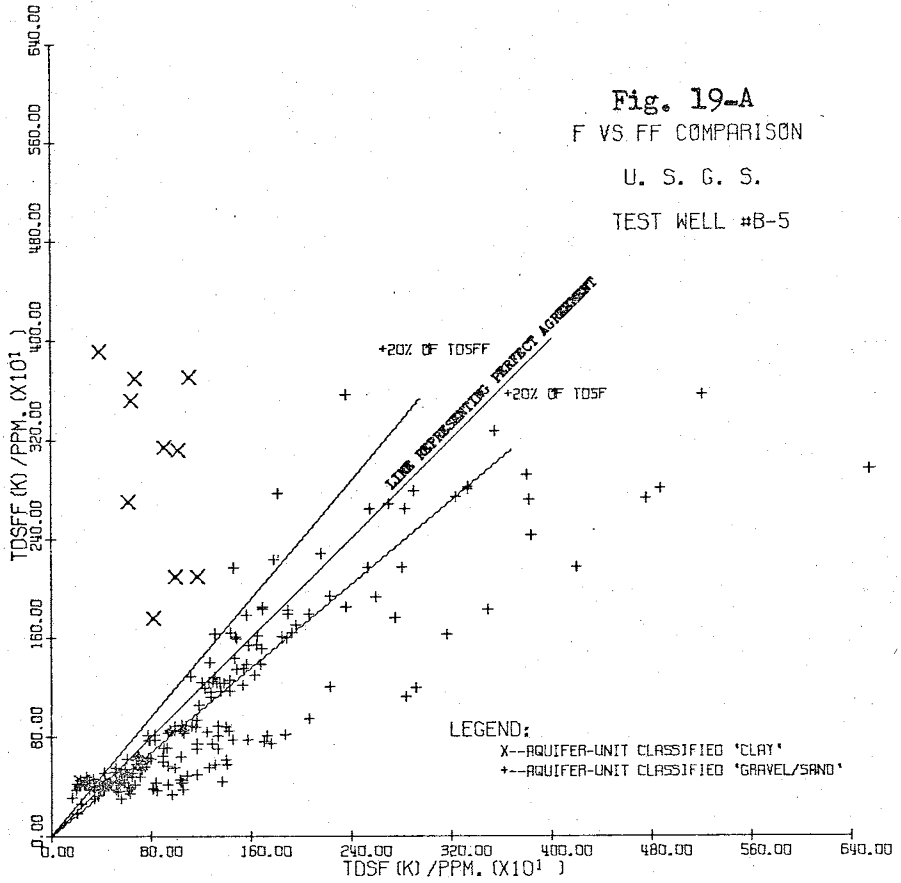

Fig. 19-A

F VS FF COMPARISON

U. S. G. S.

TEST WELL #B-5

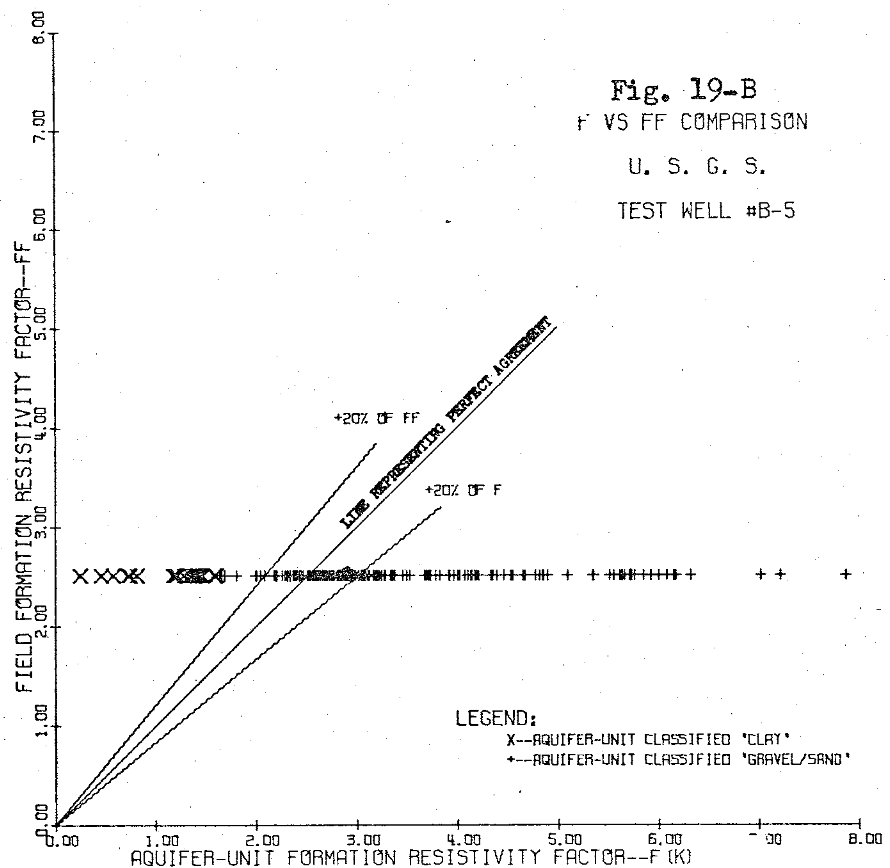

Fig. 19-B

F VS FF COMPARISON

U. S. G. S.

TEST WELL #B-5

TABLE 5

SUMMARY OF VARIATION OF F AND COMPARISON WITH FF. CLAY BEDS ARE EXCLUDED.

Well	Range of F	FF
City of Belen WW #4	1.40-6.40	2.40
City of El Paso WW #3	1.15-4.40	2.40
USGS Test Well #B-5	1.63-7.85	2.50

TABLE 6

SUMMARY OF AVERAGE FIELD FORMATION RESISTIVITY FACTORS FOR SANDS AND GRAVEL IN THE GEOGRAPHIC AREAS STUDIED

Geographic Area	Field Formation	Res. Factor
Bosque del Apache Grant	2.5[a]	3.8[b]
Eastern Valencia County, N. M.	2.4[c]	2.6[d]
Hueco Bolson near El Paso, Tex.	2.4[e]	0.935[f]

[a] USGS Test Well #B-5
[b] USGS Test Well #B-6A
[c] City of Belen Water Well #4
[d] Village of Los Lunas Water Well #3
[e] City of El Paso Water Well #3 (Offset)
[f] El Paso Natural Gas Co. Test Well #3

CONCLUSIONS

Modern electrical resistivity logging techniques are applicable to determining quantitative values of parameters relating to water quality.

Useful water quality determinations are possible only for those cases where the necessary interpretation control data are available.

The assumption, basic to this work, that ground waters within a given geographic area and corresponding aquifer, have characteristic concentrations of ions for a given electrical resistivity is valid for determining values of parameters relating to water quality.

The concept of the formation resistivity factor (F), as applied to water well log analysis, is valid.

The F-Method of determining quantitative values of parameters relating to water quality gave the most useful and the most accurate results. This method of log interpretation is preferred over the FF-Method for the geographic areas studied.

Exclusive dependence on a field formation resistivity factor for determining parameters relating to water quality may give misleading results.

Geohydrogeologic and hydrogeologic data published in reports and data available from private sources are useful to establish interpretation control necessary for meaningful interpretations.

Relative accuracies are, for all cases investigated except one, sufficiently close to support the use of resistivity logs to estimate water quality. The one case of wide divergence in relative accuracy is blamed on the fact that the actual resistivity model differed from the theoretical model.

Log analysis results, when averaged over the production intervals by the procedure described, yield concentration values of parameters that are related to water quality are in satisfactory agreement with ion concentrations derived from chemical analyses of production samples.

Results from resistivity log analysis may not, in all cases where they are applied, be explicitly diagnostic of parameters relating to water quality for each aquifer unit. Results may be qualitative.

Interpretation control data should be considered to represent ionic concentration vs resistivity relationships for the average well within the hydrogeologic domain studied. Thus, interpretation of any given well is relative to the average well.

It has been shown that digital computers are useful in water well resistivity log interpretations.

RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER WORK

Temperature Surveys in Water Wells

I recommend that a continuous temperature survey be included in all water well logging programs which are designed for quantitative aquifer evaluations. Temperature surveys of aquifer units will improve log interpretations.

Suggestions for Further Work

Formation Resistivity Factor for Fresh Water Aquifers

Yamashita [1964] studied the relationship between formation resistivity factor and water resistivity for glass beads and quartz sands. It is suggested that Yamashita's work be expanded to include natural aquifer materials that are saturated with waters of resistivities ranging from about 2 ohm-meters to several hundred ohm-meters.

Permeability as a Function of F

The work of Wyllie and Rose [1950] which relates permeability to F should be re-examined in the laboratory and then field experiments should be performed to determine if aquifer permeability can be estimated from resistivity measurements.

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APPENDIX A

DEFINITIONS OF TERMS AND SYMBOLS

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DEFINITIONS OF TERMS AND SYMBOLS

C_i : Concentration of ion "i"; units arbitrary.

C_w : Specific conductance of water [micromhos/cm].

F_a : Apparent formation resistivity factor $[M^oL^oT^o]$.

F : F-Method formation resistivity factor; ratio of R_{xo}/R_{mf} $[M^oL^oT^o]$.

F_f : Turcan's field formation resistivity factor that is assumed applicable to all aquifer units in a hydrogeologic domain $[M^oL^oT^o]$.

FF : FF-Method formation resistivity factor; the symbol used in the text and adjunctive interpretation programs for the field formation resistivity factor $[M^oL^oT^o]$.

I : Ionic composition of waters for given geographic area.

K : Specific permeability $[M^oL^2T^o]$.

P_d : Displacement pressure $[M^1L^{-1}T^{-2}]$.

Q : Proportionality constant in definition of generalized formation resistivity factor [units unknown].

R_i : Resistivity of invaded zone [ohm-meters].

R_m : Resistivity of drilling fluid at time well is logged [ohm-meters].

R_{mc} : Resistivity of mud cake [ohm-meters].

R_{mf} : Resistivity of invading mud filtrate [ohm-meters].

R_o : Resistivity of uncontaminated zone if 100 percent water saturated [ohm-meters].

R_s : Resistivity of aquifer units adjacent to object bed [ohm-meters].

R_t : Resistivity of uncontaminated zone under any conditions of saturation [ohm-meters].

R_{xo} : Resistivity of the flushed zone [ohm-meters].

R_z : Resistivity of the interstitial fluids in the invaded zone [ohm-meters].

S_i : Interstitial fluid saturation in the invaded zone; assumed equal to 100 percent for aquifers [percent].

S_w : Interstitial fluid saturation in the uncontaminated zone; assumed equal to 100 percent for aquifers [percent].

S_{xo} : Interstitial fluid saturation in the flushed zone; assumed equal to 100 percent for aquifers [percent].

T : Tortuosity; ratio of the length of a tortuos path to the length of a direct path $[M^oL^oT^o]$.

SP : Spontaneous potential [millivolts].

a : An empirically determined formation constant which relates F to Φ.

c : An empirical constant.

d : Diameter of a well bore [inches]

d' : An empirical constant.

d_e : Effective grain diameter of aquifer aggregates $[M^oL^1T^o]$.

h : Aquifer thickness; usually in feet $[M^oL^1T^o]$.

l_i : General expression relating to ionic mobility $[L^2T^{-1}volt^{-1}]$.

m : Cementation exponent in $F = a/\Phi^m$ $[M^oL^oT^o]$.

n : Arbitrary upper limit in a summation; a constant.

t : Temperature of an electrolyte [°F, °C, °K].

ts : Shape factor; and empirical constant $[M^oL^oT^o]$.

z_i : Ionic valence $[M^oL^oT^o]$.

β : Interfacial tension between a solid and a liquid $[M^1L^oT^{-2}]$.

Φ : Aquifer porosity [percent or fraction].

Cl : Chloride ion concentration [ppm.].

HARD : Hardness as clacium carbonate [ppm].

HCO_3 : Bicarbonate ion concentration [ppm].

SO_4 : Sulfate ion concentration [ppm].

TDS : Total dissolved solids concentration [ppm].

TDSF : Concentration of total dissolved solids determined by the F-Method [ppm].

TDSFF: Concentration of total dissolved solids determined by the FF-Method [ppm].

Chem. conc. : Abbreviation for Chemical analysis-determined concentration [ppm].

Flushed zone	:	That portion of the aquifer for which it is presumed all natural aquifer fluids have been displaced by invading drilling mud filtrate--a portion of the invaded zone.
Invaded zone	:	That portion of the aquifer in which there exists a mixture of invading mud filtrate and connate water.
Log conc.	:	Abbreviation for Log analysis determined concentration [ppm].
Uncontaminated zone	:	That portion of the aquifer in which there has been no displacement or contamination of native water.
% Deviation	:	Difference between Log conc. and Chem. conc. relative to Log conc. [percent].
GOOD-SCREEN	:	Designation that the water contained in a given aquifer unit is within the range of acceptability as established in water quality standards.
NACCEPT	:	Designation that the water contained in a given aquifer unit is not within the range of acceptability as established in water quality standards.
NACCEPT-CLAY	:	Designation that an aquifer unit is predominantly clay or clay bearing; the

permeability is presumed very small relative to adjacent sands and gravels

PACCEPT : Designation that the water contained in a given aquifer is between the ranges of acceptability of GOOD-SCREEN and NACCEPT.

PACCEPT/SANDY-CLAY : Designation that an aquifer unit contains water of acceptable quality but the rock matrix of the aquifer contains clay in amounts that could effect the permeability.

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APPENDIX B

INTERPRETATION CONTROL CHARTS

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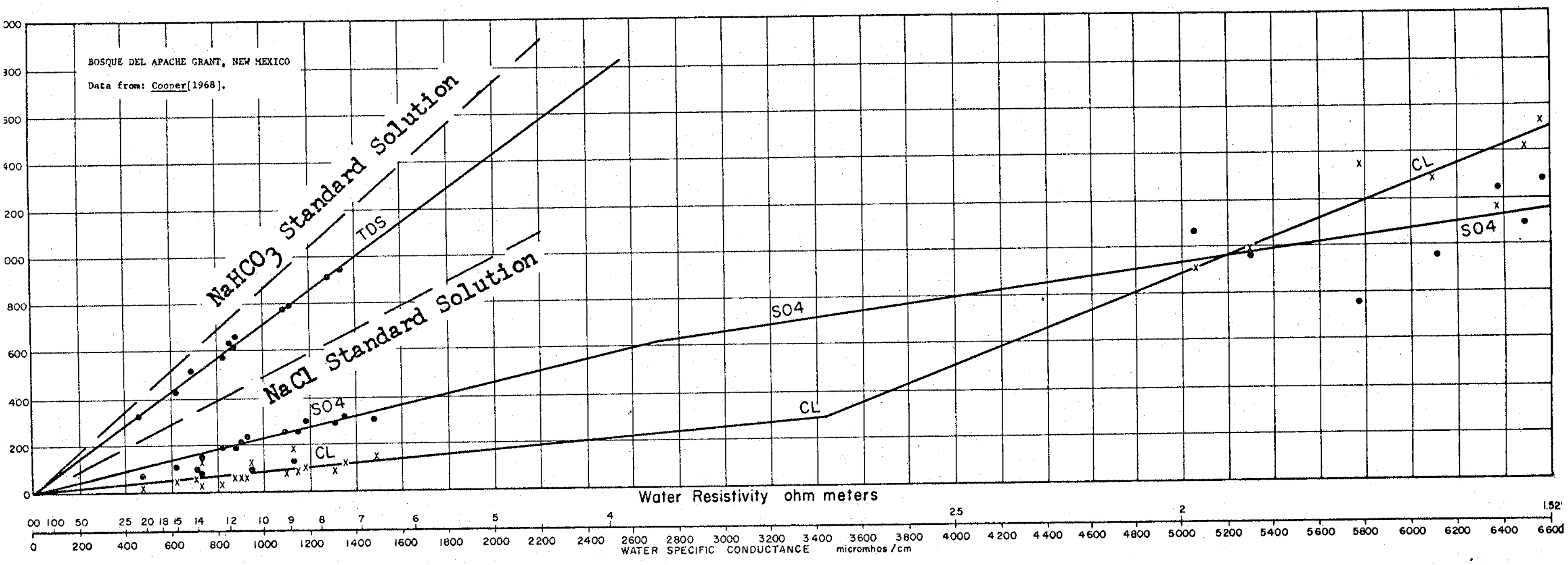
TDS & ION CONCENTRATION vs WATER RESISTIVITY



TEMPERATURE: 77°F (25°C)

adapted from ALGER 1966

TDS & ION CONCENTRATION vs WATER RESISTIVITY

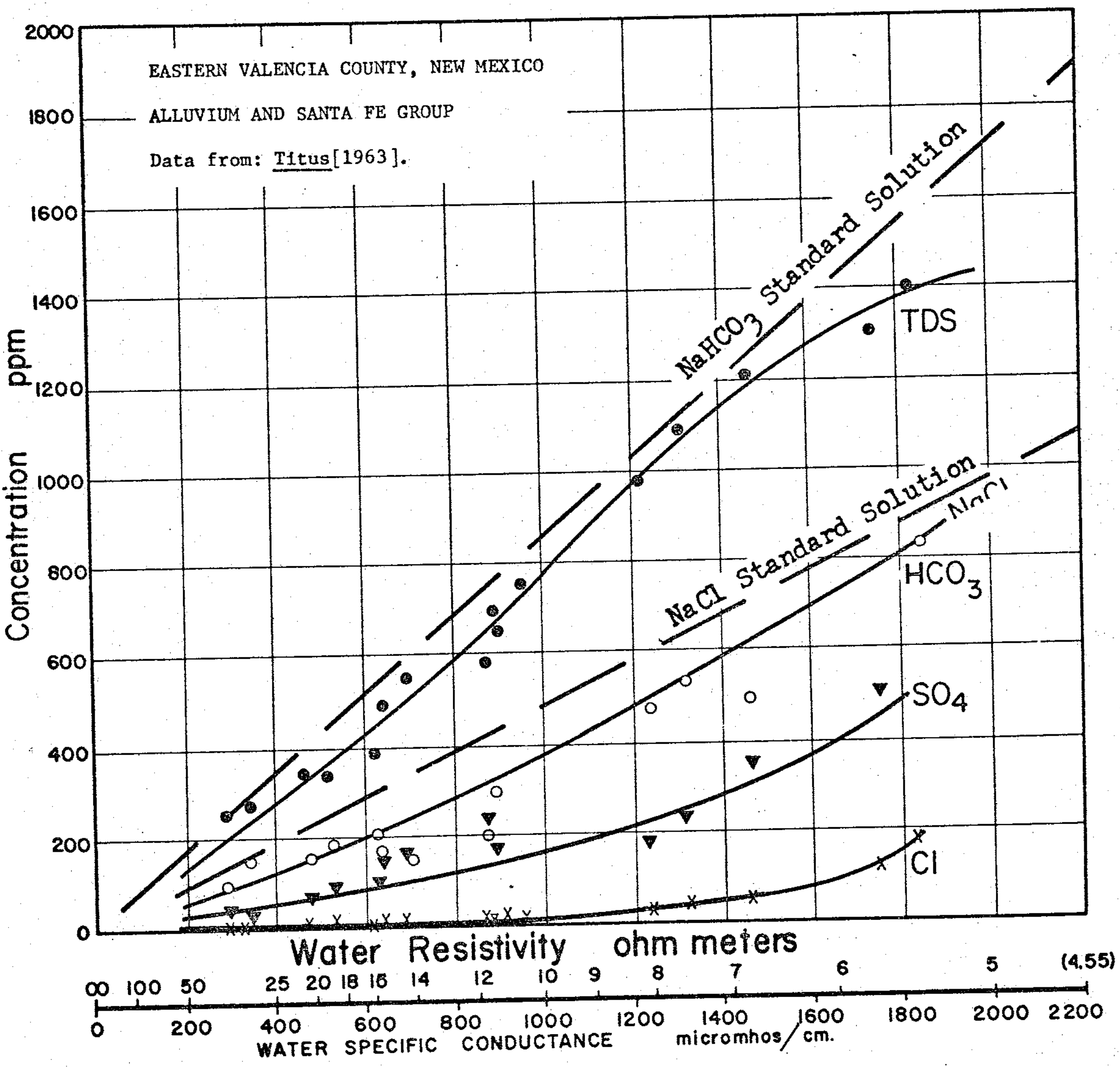


CHART TEMPERATURE: 77°F (25°C)

adapted from ALGER 1966

TDS & Cl vs R_W

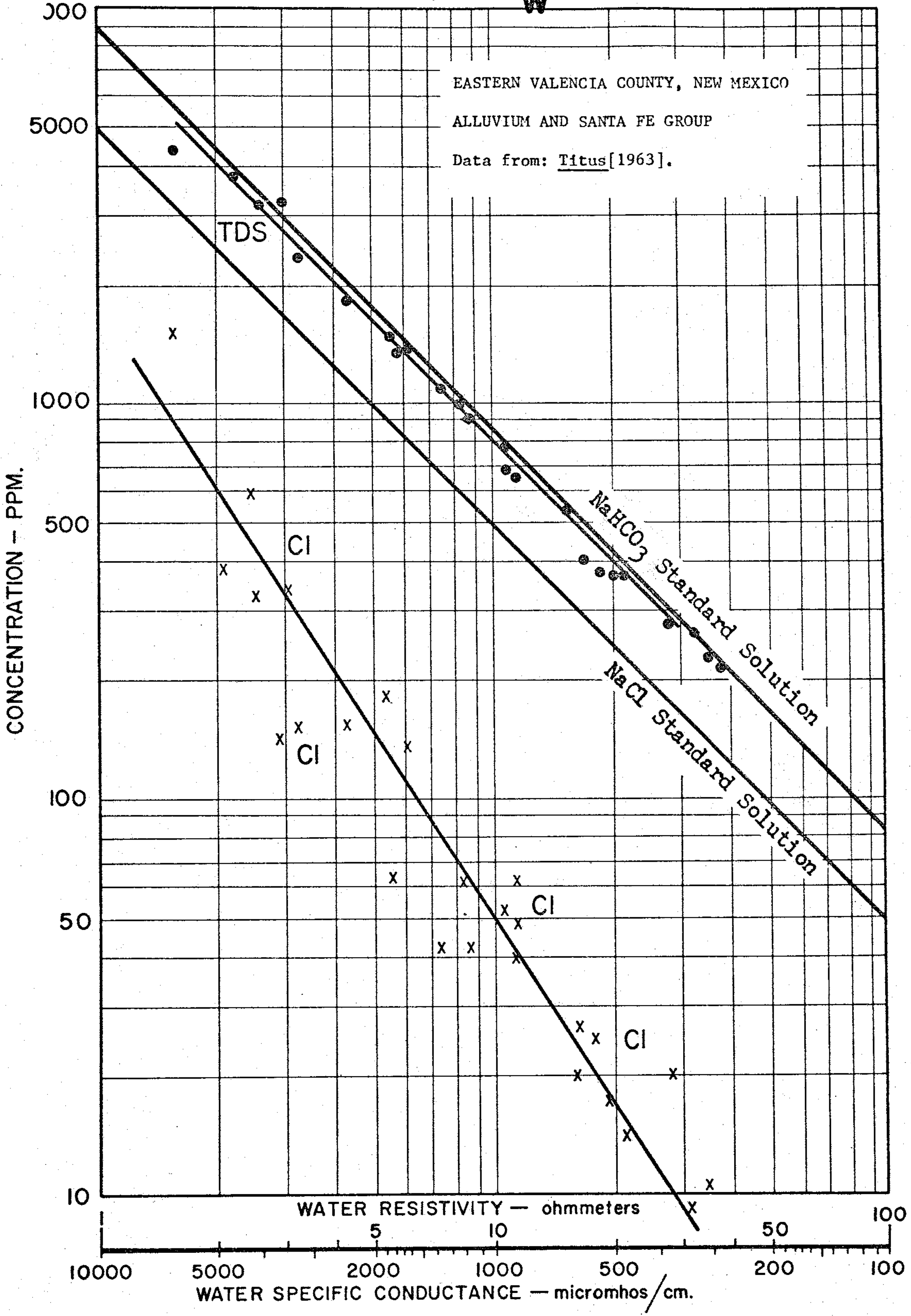


CHART TEMPERATURE : 77°F (25°C)

adapted from : ALGER – 1966

TDS & Cl
vs R_W

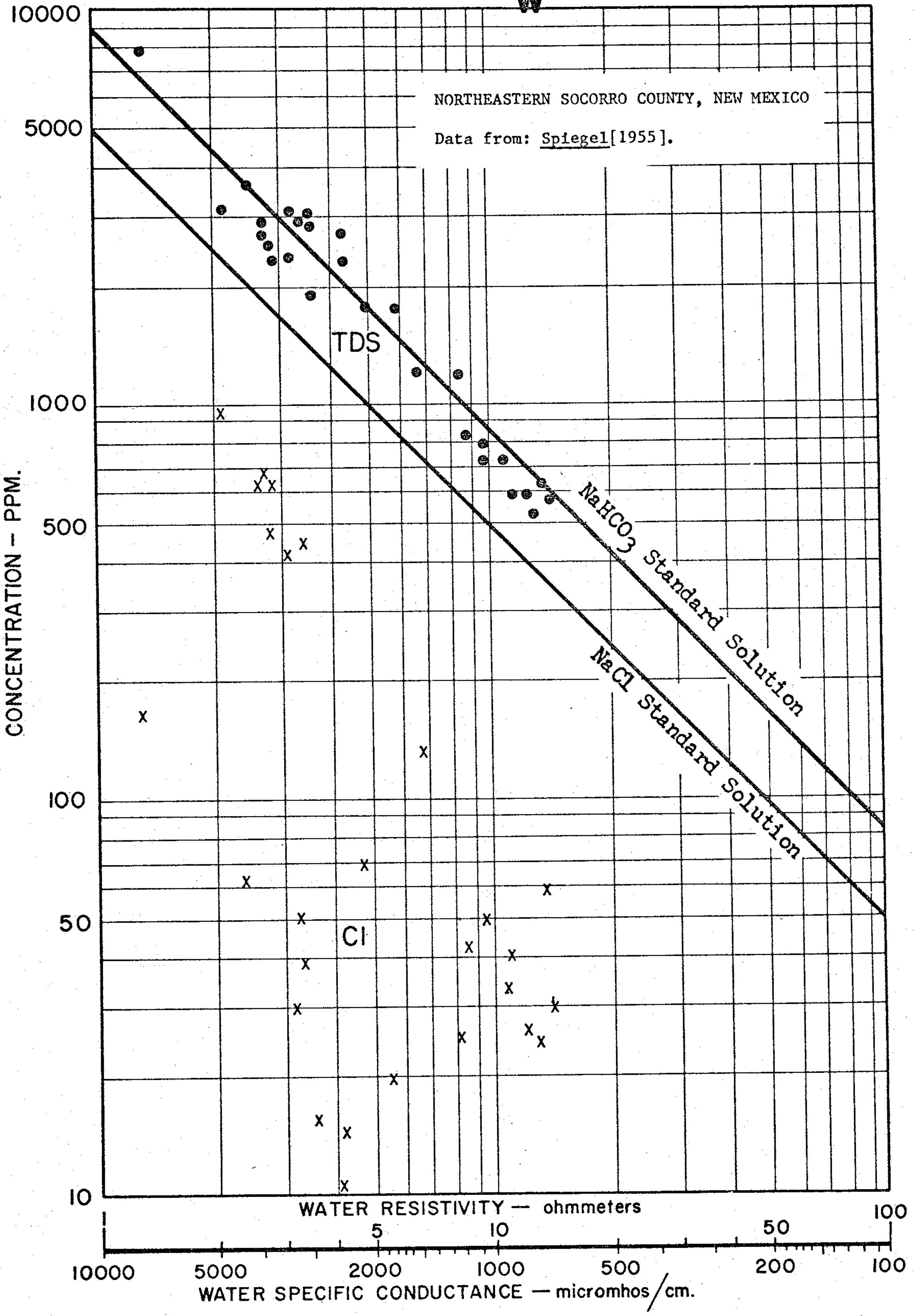


CHART TEMPERATURE : 77°F (25°C)

adapted from : ALGER – 1966

TDS & ION CONCENTRATION vs WATER RESISTIVITY

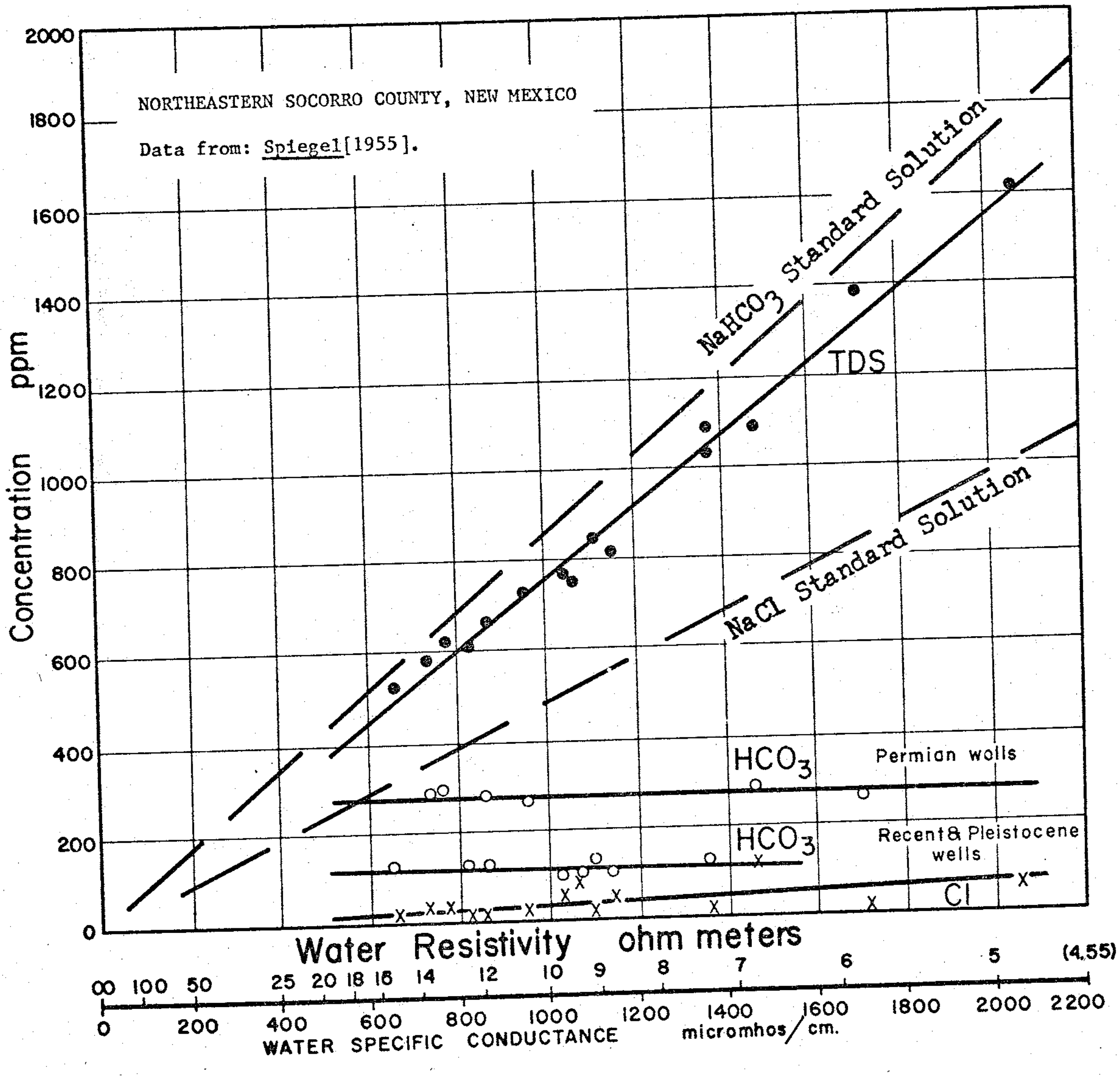


CHART TEMPERATURE: 77°F (25°C)

adapted from ALGER 1966

TDS & Cl vs R_W

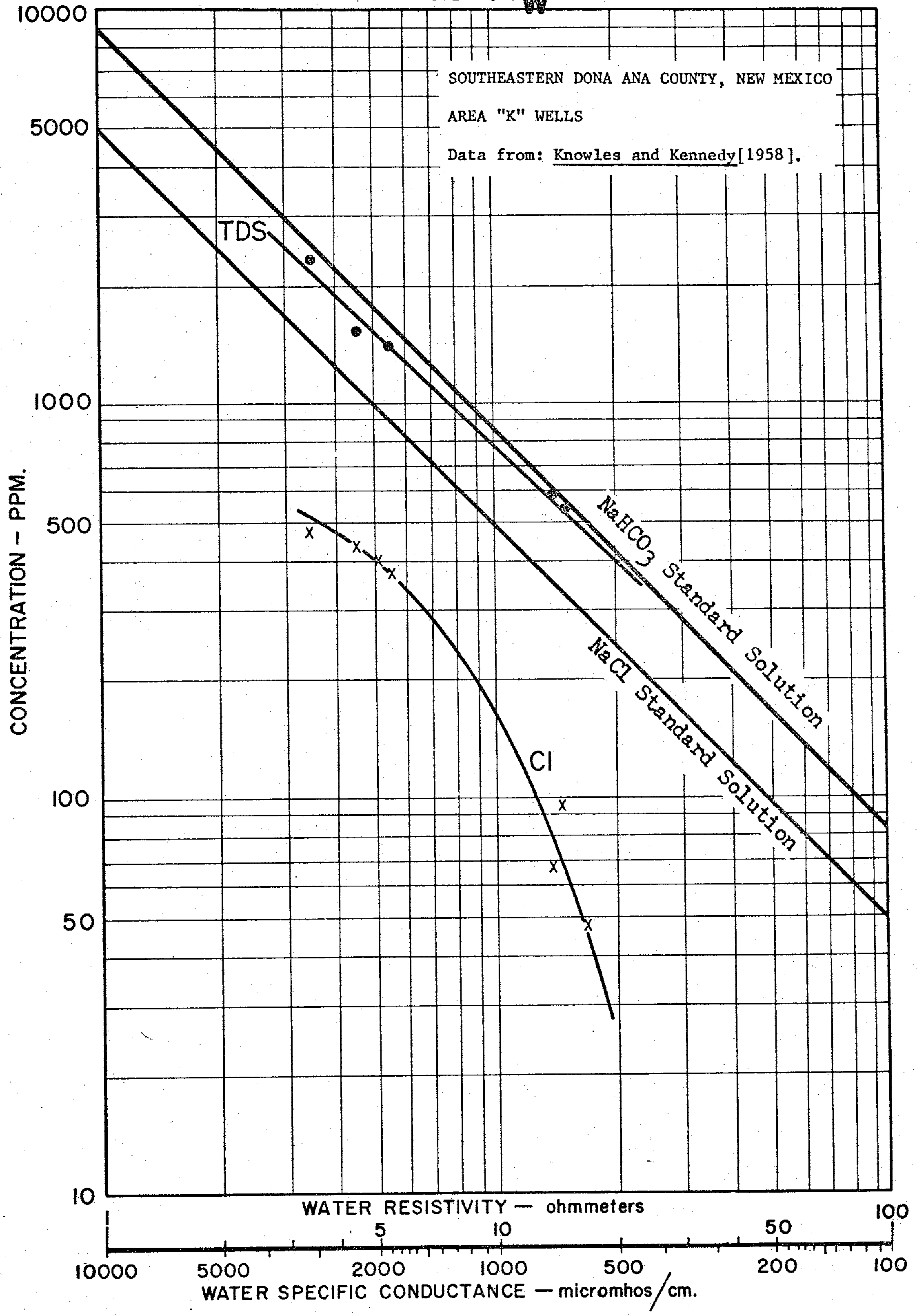


CHART TEMPERATURE : 77°F (25°C)

adapted from : ALGER – 1966

TDS & ION CONCENTRATION vs WATER RESISTIVITY

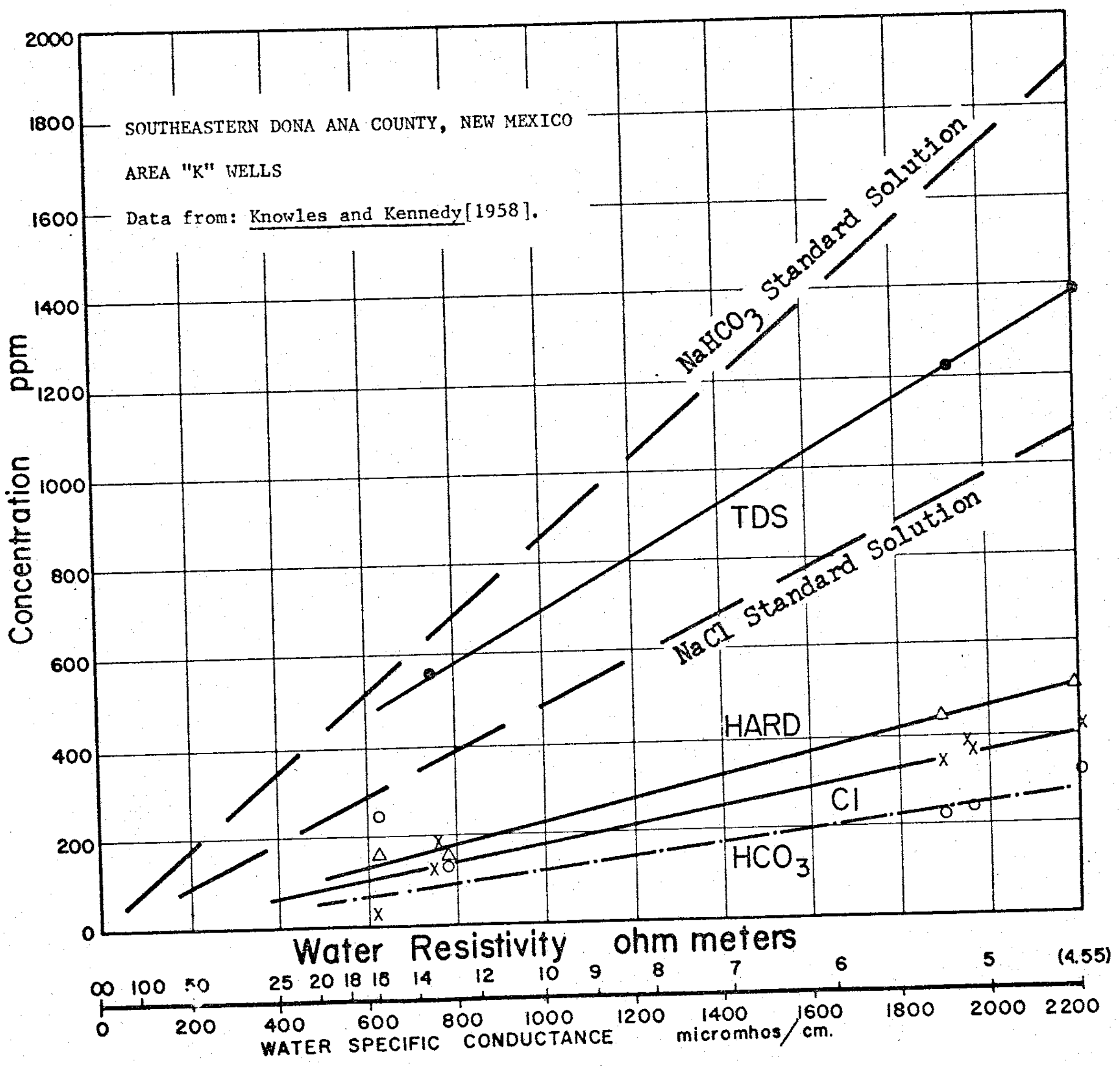


CHART TEMPERATURE: 77°F (25°C)

adapted from ALGER 1966

TDS & ION CONCENTRATION vs WATER RESISTIVITY

TDS & Cl vs R_W

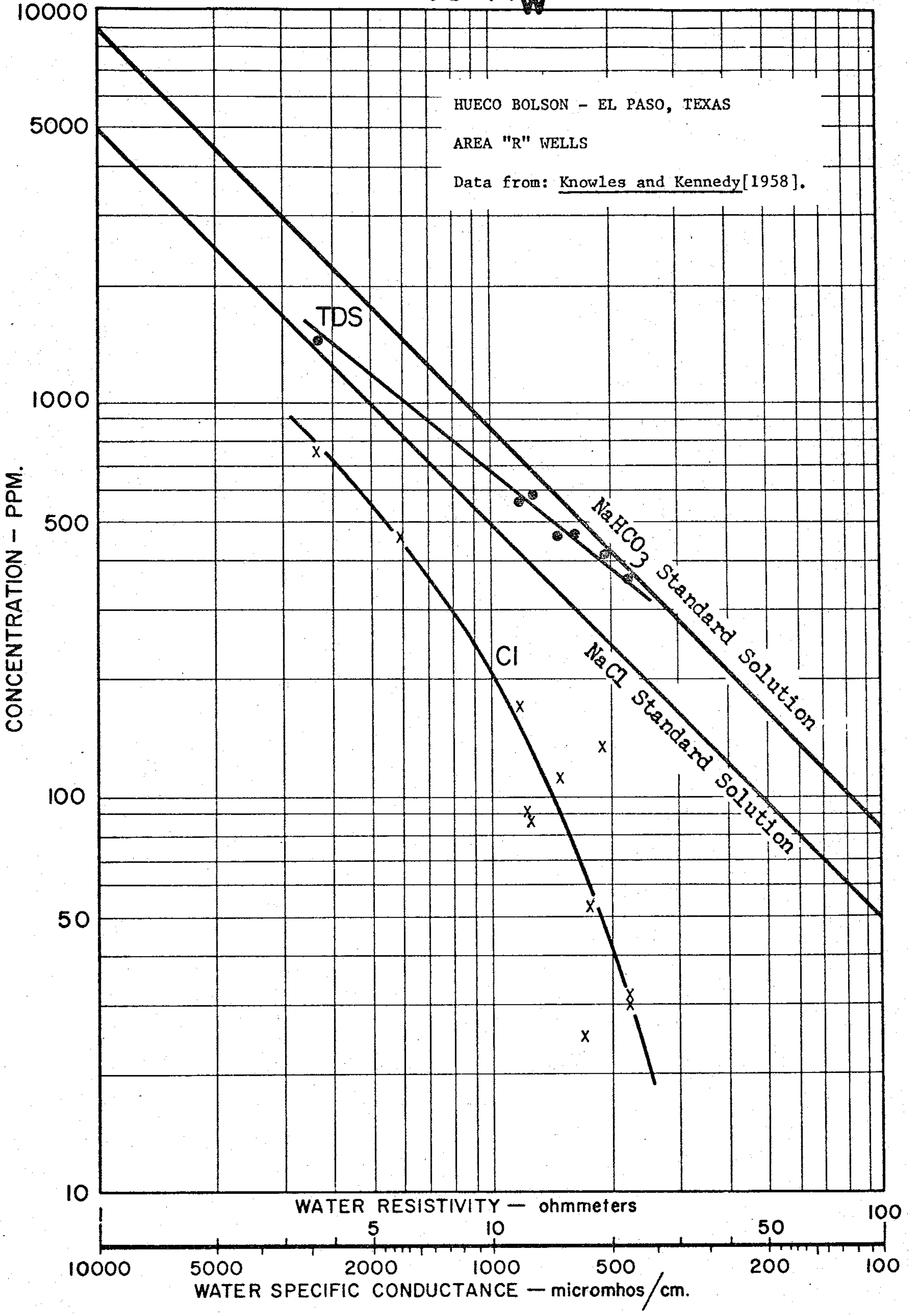


CHART TEMPERATURE : 77°F (25°C)

adapted from ALGER – 1966

TDS & ION CONCENTRATION vs WATER RESISTIVITY

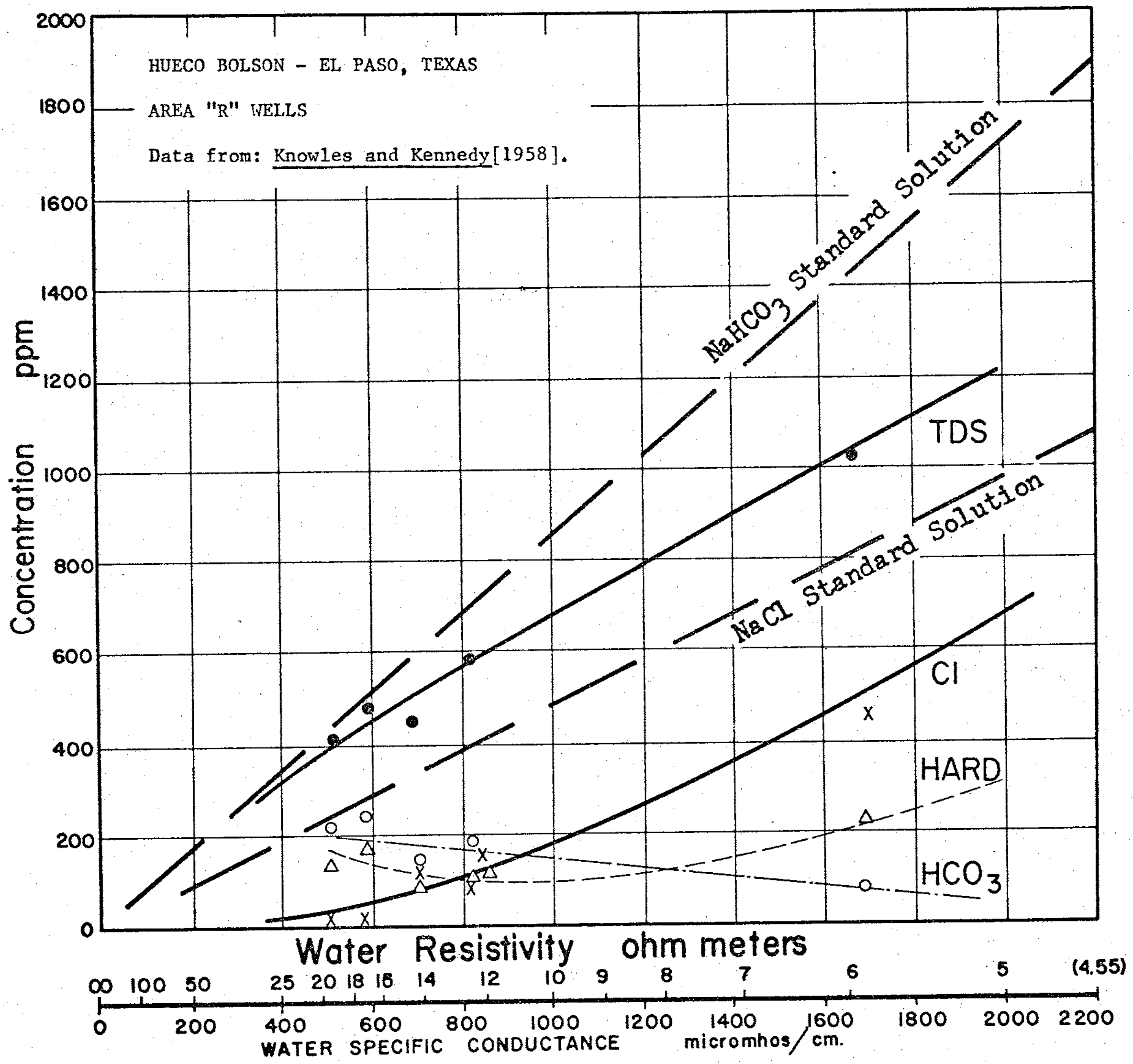


CHART TEMPERATURE: 77°F (25°C)

adapted from ALGER 1966

TDS & Cl
vs R_w

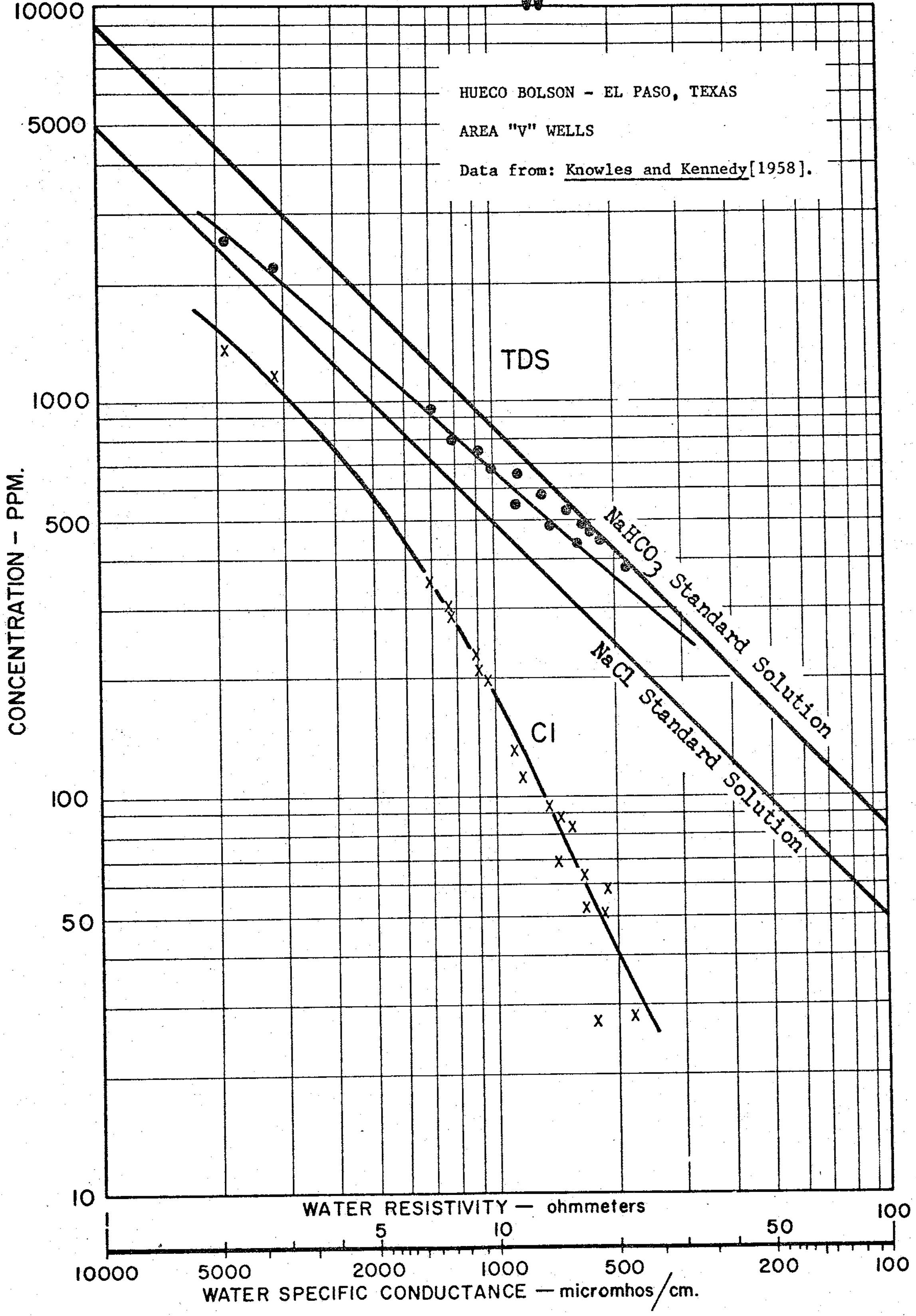


CHART TEMPERATURE : 77°F (25°C)

adapted from : ALGER – 1966

TDS & ION CONCENTRATION vs WATER RESISTIVITY

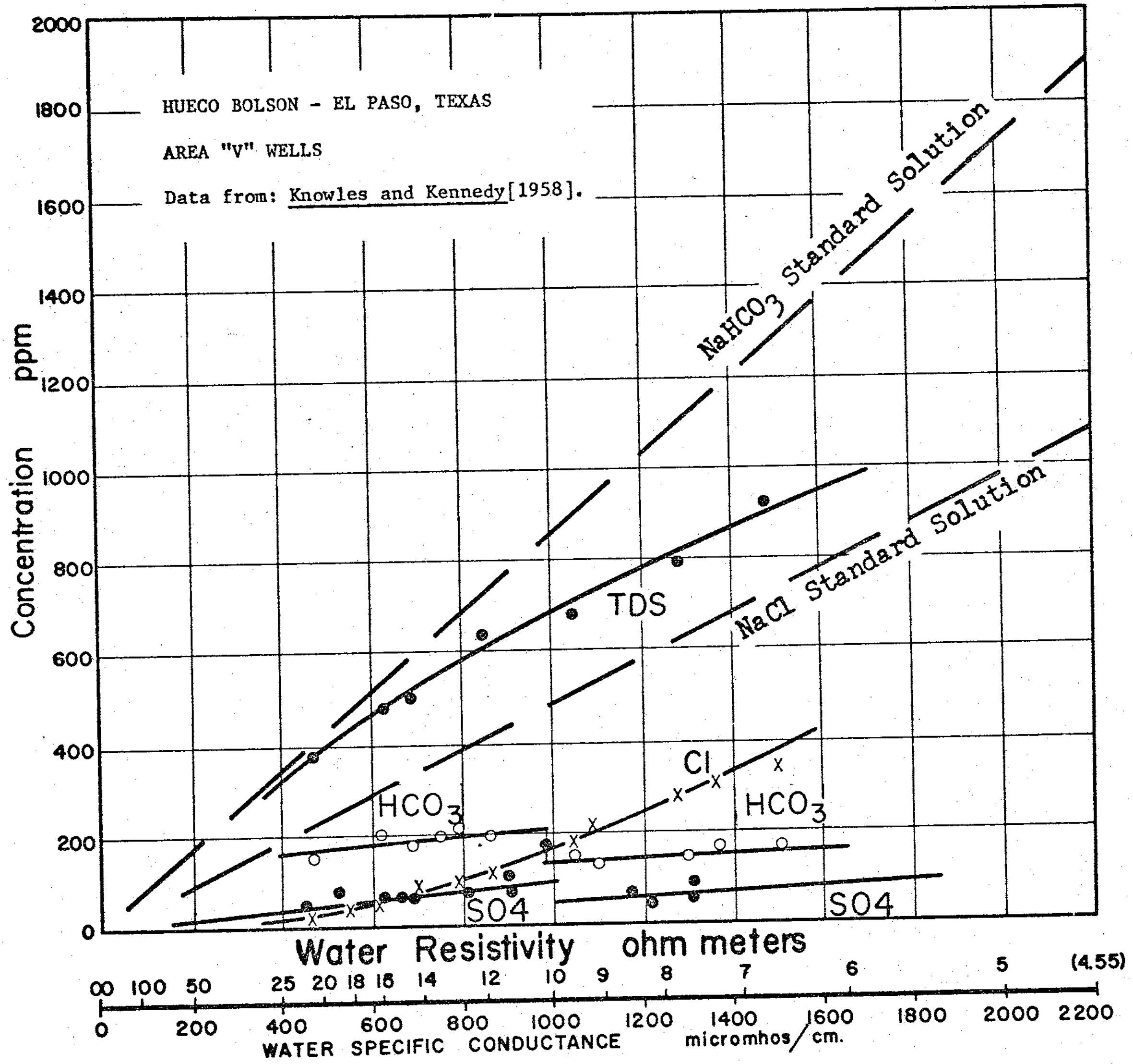


CHART TEMPERATURE: 77°F (25°C)

adapted from ALGER 1966

TDS & ION CONCENTRATION vs WATER RESISTIVITY

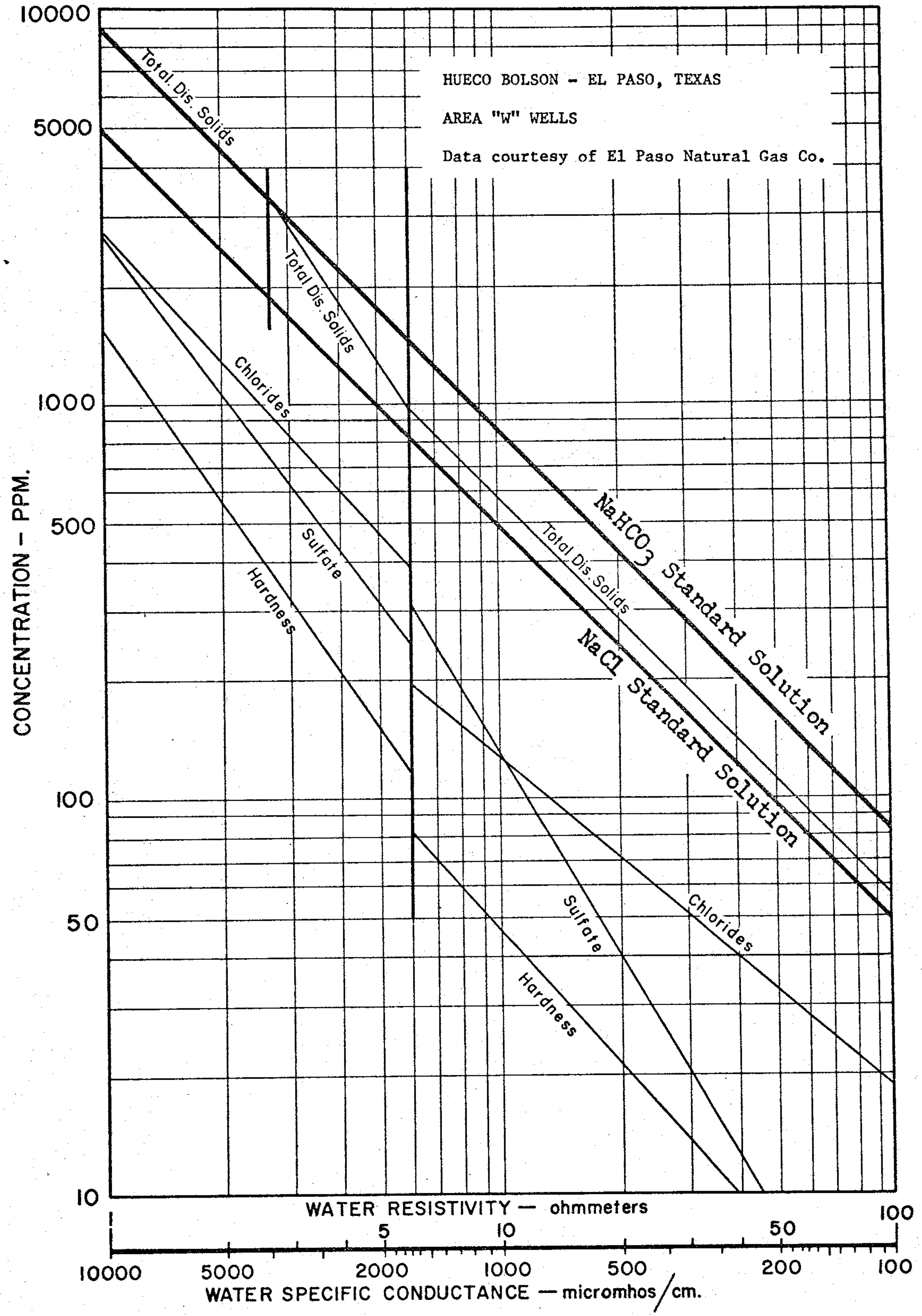


CHART TEMPERATURE : 77°F (25°C)

adapted from : ALGER – 1966

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APPENDIX C

MAP OF HUECO BOLSON NEAR EL PASO, TEXAS

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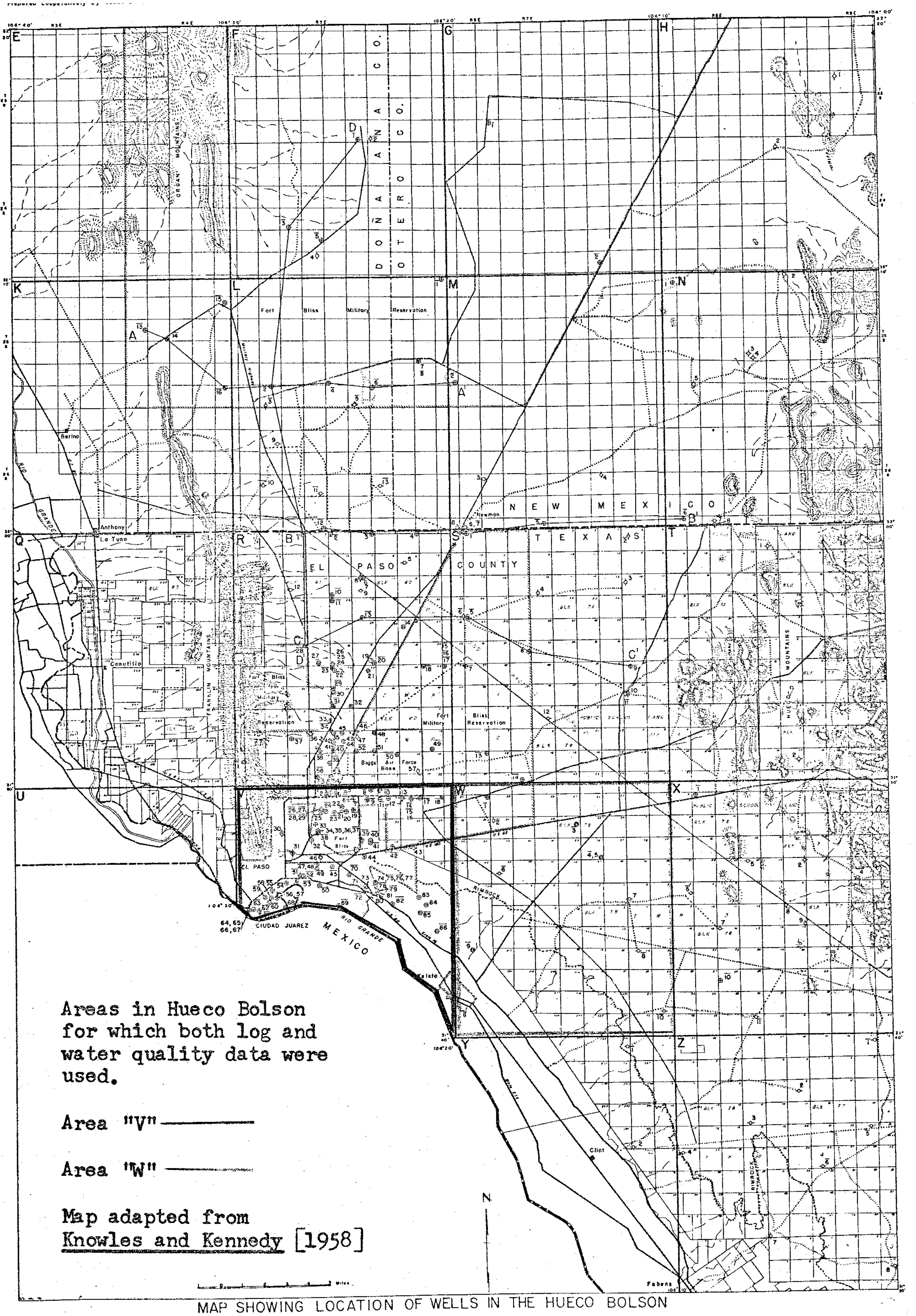

Areas in Hueco Bolson for which both log and water quality data were used.

Area "V" ———

Area "W" ———

Map adapted from Knowles and Kennedy [1958]

MAP SHOWING LOCATION OF WELLS IN THE HUECO BOLSON

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APPENDIX D

SUMMARY--INTERPRETATION CONTROL EQUATIONS

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SUMMARY--INTERPRETATION CONTROL EQUATIONS

Definitions of Symbols

The following symbols are used to represent either quantities determined from resistivity logs or parameters relating to water quality:

Rw : Water resistivity at 77°F--ohm-m.

Cw : Water specific conductance at 77°F--micromhos/cm.

TDS : Total dissolved solids concentration--ppm.

SO4 : Sulfate ion concentration--ppm.

Cl : Chloride ion concentration--ppm.

HARD: Hardness as calcium carbonate--ppm.

HCO3: Bicarbonate ion concentration--ppm.

Bosque del Apache Grant

All chart values of Cw:

$TDS = 0.705Cw$

$Cw < 2700$:

$SO4 = 0.226Cw$

$Cl = 0.079Cw$

$2700 < Cw < 3440$:

$SO4 = 0.1395Cw + 225$

$Cl = 0.079Cw$

<u>$3440 < Cw$:</u>

$$SO4 = 0.1395Cw + 225$$

$$Cl = 0.408Cw - 1170$$

Eastern Valencia County

All chart values of Rw:

$$TDS = 6400/Rw$$

$$Cl = 1100/Rw^{1.55}$$

$Cw < 1400$:

$$SO4 = 0.214Cw$$

$Cw > 1400$:

$$SO4 = 0.575Cw - 505$$

Huecon Bolson Area "V"

All chart values of Rw:

$$TDS = 6350/Rw^{0.955}$$

$0 < Cw < 1000$:

$$SO4 = 0.125Cw$$

$$HCO3 = 0.08125Cw + 130$$

$$Cl = 13752/Rw^{1.936}$$

$1000 < Cw < 1850$:

$$SO4 = 0.05Cw$$

$$HCO3 = 0.0375Cw + 100$$

$$Cl = 13752/Rw^{1.936}$$

$1850 < Cw$:

$$SO4 = 0.50Cw$$

$$HCO3 = 0.0375Cw + 100$$

$$Cl = 3250/Rw^{1.073}$$

$6.17 < Rw$:

$TDS = 5814/Rw^{0.99}$

$Cl = 913/Rw^{0.84}$

$HARD = 826/Rw^{1.223}$

$SO4 = 7690/Rw^{1.756}$

$2.5 < Rw < 6.17$:

$TDS = 14276/Rw^{1.515}$

$Cl = 2704/Rw^{1.085}$

$HARD = 1617/Rw^{1.47}$

$SO4 = 2700/Rw^{1.25}$

$Rw < 2.5$:

$TDS = 8900/Rw^{0.989}$

$Cl = 2704/Rw^{1.085}$

$HARD = 1617/Rw^{1.47}$

$SO4 = 2700/Rw^{1.25}$

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APPENDIX E

DERIVATIONS OF EQUATIONS

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Approximate Equations for Water Quality Parameters--Examples

Linear Grid

Bosque del Apache Grant, Socorro County, New Mexico: Sulfate ion concentration for water specific conductances greater than 2700 micromhos/cm. See Bosque del Apache Grant charts in Appendix B.

Pattern equation: $y = mX + b$.

Given:

X as Cw/micromhos/cm.	y as (SO4)/ppm.
3400	700
5550	1000

(1) $1000 = m \times 5550 + b$

(2) $700 = m \times 3400 + b$ Multiply by (-1) and add

(3) $300 = 2150m$

(4) $m = 300/2150 = 0.1395$ Solve for m.

(5) $1000 = 0.1395 \times 5550 + b$

(6) $b = 1000 - 775 = 225$

Therefore,

$2700 < Cw$:

(7) $\boxed{SO_4 = 0.1395Cw + 225.}$

Log-log Grid

Eastern Valencia County, New Mexico

Total dissolved solids concentration for all chart values of water resistivity. See eastern Valencia County log-log interpretation control chart in Appendix B.

Pattern equation: $y = ax^b$, $\log y = \log a + b\log x$

Given:

x as Rw/ohm-m	y as TDS/ppm
80	80
1	6400

(1) $\log 6400 = \log a + b\log 1$

(2) $\log 800 = \log a + \log 80$

(3) $\log 1 = 0$

$\log a = \log 6400$

(4) $a = 6400$

(5) $\log 800 = \log 6400 = b\log 80$

$1.90309 = 3.80618 + b(1.90309)$

(6) $b = \frac{-3.80618 + 1.90309}{1.90309} = \frac{-1.90309}{1.90309} = -1$

Therefore, for all chart calues of Rw:

(7) $\boxed{\mathrm{TDS} = 6400\mathrm{Rw}^{-1} = 6400/\mathrm{Rw}}$

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APPENDIX F

LOGGING WATER WELLS IN CONSOLIDATED AQUIFERS

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LOGGING WATER WELLS IN CONSOLIDATED AQUIFERS

How Consolidated Aquifers Differ From Unconsolidated Aquifers

Unconsolidated rocks can be of consistant lithology, and homogeneous---even in small volumes. Texture and lithology will be influenced by the method of deposition. Consolidated rocks can be modeled by nonuniform texture and nonuniform lithology---even on a small scale. Nonuniform texture results from nonuniform secondary porosity development from faults, joints, and solution cavities that range in size from small vugs to caverns. The nonuniform lithology results from secondary deposition of gypsum, anhydrite, dolominte, and calcite in porosity voids [Savre, 1963; Havenor, 1968].

Objectives for logging consolidated aquifers can be classified as : (1) correlation of aquifer units and aquifer thickness variation, (2) determining porosity values, (3) lithology determinations, (4) quantitative water quality estimates.

Table 5 lists objectives and corresponding logging programs. I recommend that micro-resistivity devices not be used to determine formation resistivity factors because consolidated aquifers are nonuniform in lithology and texture. Instead, determine true porosity values--not porosity indices or apparent porosities---by the method described; then, calculate values of F from $F = a/\Phi^m$. The problems of determining "a" and "m" are significant.

TABLE 7

PREDETERMINED OBJECTIVES AND CORRESPONDING LOGGING PROGRAMS

Objectives[a]	Logging Programs
Correlation and bed thickness variations	Natural gamma ray and sonic, or density, or neutron logs plus caliper log. The caliper, in many cases, will respond to changes in lithology.
True porosity	Sonic and density and neutron logs. See Tittman et al. [1966]; Kokesh et al. [1965]; Wahl et al. [1964]. Commercial logging companies record a caliper log and natural gamma ray log with sidewall surveys.
Lithology	Same as true porosity.
Water quality	Same as porosity and lithology plus a temperature survey plus either an induction log for boreholes filled with "fresh-water" drilling fluids and air filled boreholes or a laterolog for "saline-water" drilling fluids.

[a] Assuming the most accurate and meaningful results are part of the objectives.

After F and Ro are determined, the adjunctive interpretation procedure is the same as outlined in INTERPRETATION CONTROL DATA and WATER WELL RESISTIVITY LOG INTERPRETATION.

Interpretation Fundamentals

For modeling purposes, many aquifers can be considered as if they were homogeneous in matrix composition; i.e., the proportionate amounts of matrix minerals are the same at any point within the aquifer. This is usually applicable to unconsolidated aquifers. If this condition can be reasonably satisfied, if the physical conditions of the bore hole--washouts, abrupt hole size changes,--are not unfavorable, and if the acoustic travel time or density properties of the aquifer can be accurately measured by the most modern logging devices, then porosity and formation resistivity factor values can be determined on the basis of known "average values" of matrix and interstitial fluid transit times and known matrix and interstitial fluid densities. In effect, the exact mineral composition of the aquifer is known before the well is logged. Usually this is not the case.

The equations used for these calculations are:

$$\Phi_{\text{sonic}} = \frac{\dfrac{\Delta t_{\text{log}}}{\text{microsec./ft.}} - \dfrac{\Delta t_{\text{ave. matrix}}}{\text{microsec./ft.}}}{\dfrac{\Delta t_{\text{fluid}}}{\text{microsec./ft.}} - \dfrac{\Delta t_{\text{ave. matrix}}}{\text{microsec./ft.}}} \qquad (15)$$

$$\Phi_{\text{density}} = \frac{\frac{\rho_{\text{ave. matrix}}}{\text{gm/cc}} - \frac{\rho_{\text{bulk}}}{\text{gm/cc}}}{\frac{\rho_{\text{ave. matrix}}}{\text{gm/cc}} - \frac{\rho_{\text{fluid}}}{\text{gm/cc}}} \qquad (16)$$

Where: Φ_{sonic} : Porosity determined from sonic log.

Φ_{density} : Porosity determined from density log.

Δt_{log} : Aquifer interval transit time from log.

$\Delta t_{\text{ave. matrix}}$: Average matrix interval transit time.

$\rho_{\text{ave. matrix}}$: Average matrix grain density.

Δt_{fluid} : Interstitial fluid interval transit time.

ρ_{bulk} : Aquifer bulk density from the log.

ρ_{fluid} : Interstitial fluid density.

[Tixier et al., 1964].

In case of indurated carbonate and evaporite lithologies, the situation is entirely different. The proportional amounts of matrix minerals are not the same between points within the aquifer and a convenient model similar to the unconsolidated model is not possible. Average acoustic transit times and average grain densities are meaningless; to say nothing of the gypsum effect on the neutron log [Savre, 1963].

The problems of log interpretation in carbonate aquifers with complex lithologies has been discussed by Savre [1963] and Raymer and Biggs [1963]. Basically, both porosity and mineral composition are calculated by a simultaneous trial and error solution of this group of equations:

$$\rho_{bulk} = \Phi\rho_{fluid} + D'\rho_{g(dolo)} + A'\rho_{g(anhy)} + G'\rho_{g(gyp)} + L'\rho_{g(lime)} + \ldots \tag{20}$$

$$\Delta t_{log} = \Phi\Delta t_{fluid} + D'\Delta t_{m(dolo)} + A'\Delta t_{m(anhy)} + G'\Delta t_{m(gyp)} + L'\Delta t_{m(lime)} + \ldots \tag{21}$$

$$\Phi_n = \Phi + 0.49G' \tag{22}$$

$$1 = \Phi + A' + D' + G' + L' + \ldots \tag{23}$$

Where: $\Delta t_{m(\ldots)}$: Mineral (...) matrix interval transit time.

$\rho_{g(\ldots)}$: Mineral (...) matrix or "grain" density.

Φ_n: Porosity determined from neutron log.

Φ: True porosity.

A', D', G', L', etc. are the fraction of bulk volume of anhydrite, dolomite, gypsum, limestone, etc.

The quantities ρ_{bulk}, Δt_{log}, and Φ_n are known from the logs. A qualitative idea of those minerals present in the aquifer matrix must be postulated. Usual values of $\Delta t_{m(\ldots)}$ and $\rho_{m(\ldots)}$ are listed in Table 6.

TABLE 8

USUAL VALUES OF AQUIFER MATRIX MATERIAL INTERVAL TRANSIT TIMES AND GRAIN DENSITIES

Mineral	Matrix Interval Transit Time microsec./ft	Grain Density gm/cc
Anhydrite	50.0	2.98
Dolomite	41.7	2.87
Gypsum	52.7	2.35
Limestone	45.5	2.71
Salt	66.7	2.03
Sandstone	55.5	2.65

Source: Raymer and Biggs [1963].

Practical Considerations in Logging Consolidated Aquifers

Almost all geophysical logs will be in error simply because the borehole exists. This is a specially significant consideration for logging programs oriented toward determining porosity, lithology, and water quality of consolidated aquifers.

A most significant problem associated with consolidated aquifer logging is to drill a borehole sufficiently symmetrical and nonrugose such that meaningful logs can be recorded. Actually, this requirement is basic to all bore hole geophysics: but, is much more critical when logging consolidated aquifers that contain pronounced solution cavities, caves, or even caverns. This is specially true when the objectives are porosity, lithology, and water quality determinations from sidewall logging tools.

It is possible that the inherent characteristics of the aquifer will be such that the "desirable borehole geometries" are not possible. Characteristics of "desirable borehole geometries" are: (1) symmetrical cross section, (2) major diameter less than about 12 inches for ellipse-like cross sections, (3) no abrupt or severe diameter differences over relatively short borehole intervales. A portion of the aquifer may have undergone secondary porosity development of such magnitude that logging tools could not possibly produce meaningful logs. Plate III illustrates this point. Compare the logs for the intervals 265 to 592 feet with the interval 600 to 1142 feet. Notice the caliper response to the borehole cross section.

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New Mexico Bureau
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Geology and Mineral Resources

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

ADDITIONAL PROGRAMS--DIGITAL ANALYSIS OF BOREHOLE-MEASURED AQUIFER RESISTIVITY TO DETERMINE WATER QUALITY

by

Ronald M. Brimhall

The companion volume to the Master of Science Thesis
DIGITAL ANALYSIS OF BOREHOLE-MEASURED AQUIFER
RESISTIVITY TO DETERMINE WATER QUALITY,
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May 1969

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INTRODUCTION

Purpose

ADDITIONAL PROGRAMS--DIGITAL APPLICATION OF BOREHOLE-MEASURED AQUIFER RESISTIVITY TO DETERMINE WATER QUALITY contains the Fortran IV programs for which my Master of Science thesis, DIGITAL APPLICATION OF BOREHOLE-MEASURED AQUIFER RESISTIVITY TO DETERMINE WATER QUALITY [Brimhall, 1969], does not contain.

Portions of the text of the thesis describing computer applications to resistivity log interpretations are repeated here for the purpose of providing greater understanding of the programs and their tabular and graphic results.

The basic data, from which parameters relating to water quality are determined, are presented in resistivity log form; these logs are located inside the back cover.

Geographic Areas from which Resistivity Log and Water Quality Data are Anal Analyzed

Figures 1 and 2 show the areas in New Mexico and west Texas from which induction resistivity logs and published hydrologic data are used in this thesis.

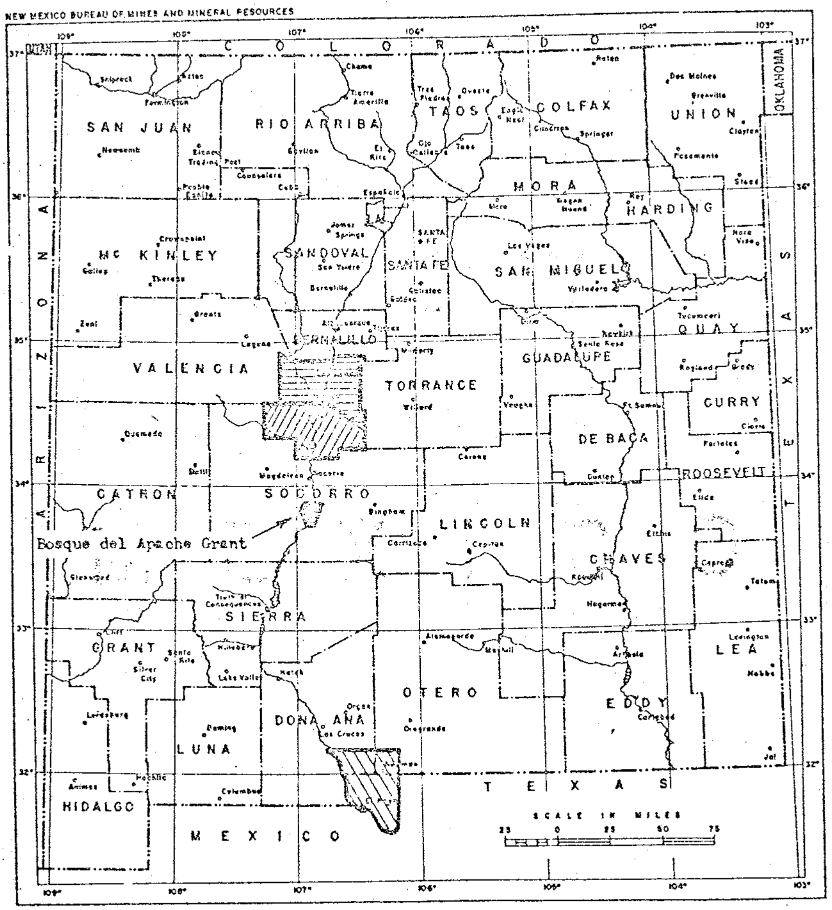
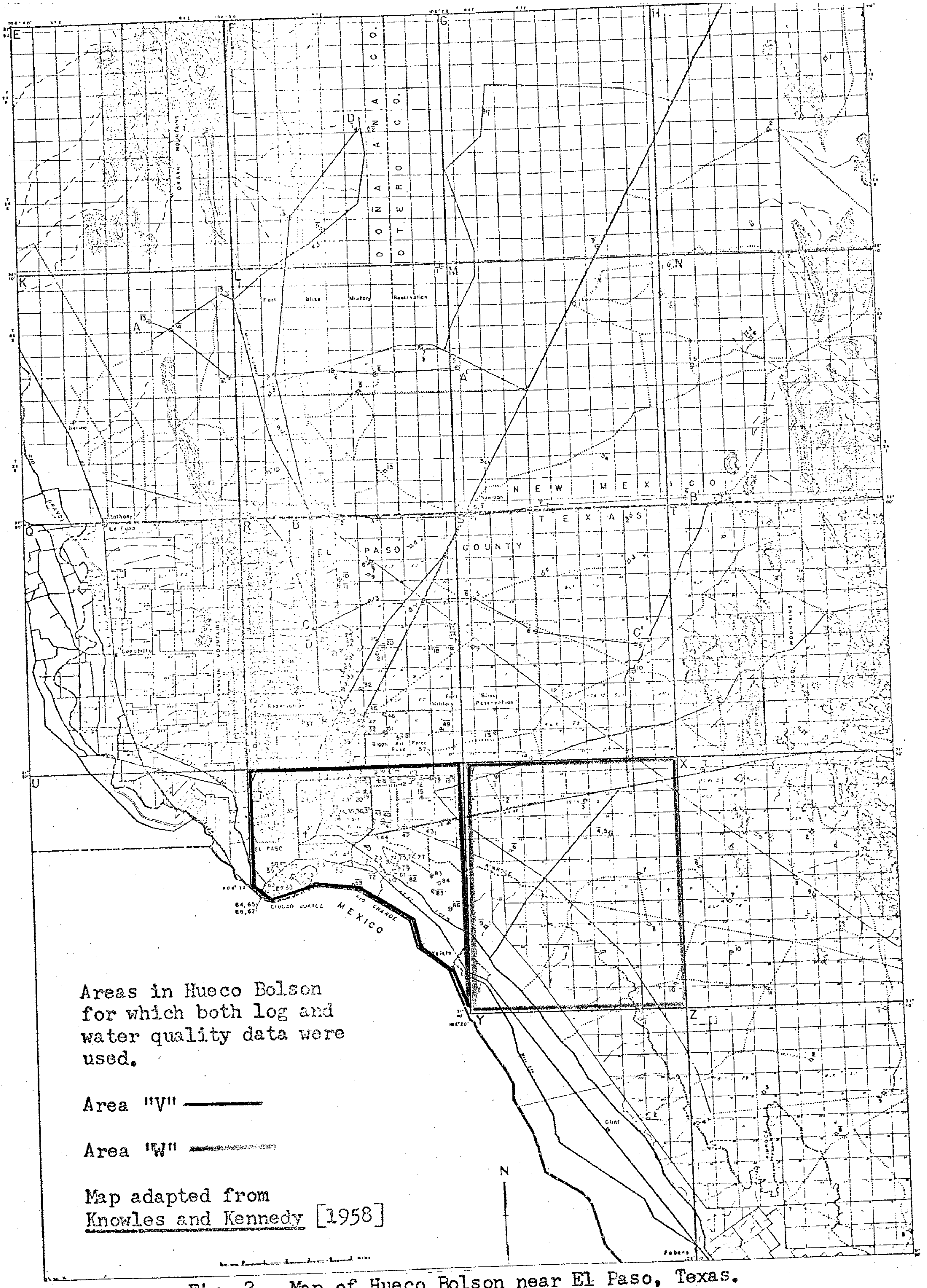


Fig. 1. Areas in New Mexico and west Texas from which resistivity log and water quality data are used in this thesis.



Areas in Hueco Bolson for which both log and water quality data were used.

Area "V" ———

Area "W" ———

Map adapted from Knowles and Kennedy [1958]

Fig. 2. Map of Hueco Bolson near El Paso, Texas.

COMPUTER APPLICATIONS TO RESISTIVITY LOG INTERPRETATIONS AND EXAMPLES OF RESULTS

The computer programs used in the preparation of this volume are of three types:

1. Preliminary programs for determining interpretation control equations and for establishing a mud cake correction relationship for use in R_{xo} determinations from the microlog.

2. Adjunctive interpretation programs for determining those parameters relating to water quality, for calculating porosity indices, for classifying aquifer units as described in the previous section, for tabulating the initial log data and final interpretation results, and for graphically presenting the results as computer plots.

3. Secondary programs for comparing the results of F- and FF-Method of interpretation when both methods are applied to the same interpretation problem. Secondary programs are discussed in the section on presentation and discussion of results.

For a well 1000 feet deep, the machine-time required for the interpretation, without presenting the results in the form of computer plots, is approximately 5 minutes. Plotting the results with a coordinate plotter requires an additional 4 minutes. Computer plots were made at the same scale as the depth scale of the original open hole logs. This facilitates the correlation of results with the original data.

The flow chart, shown in Figure 3, illustrates the main steps performed by the adjunctive interpretation programs. Copies of all programs discussed are preserved on data cards on file in the office of the Ground Water Hydrology department at New Mexico Institute of Mining and Technology.

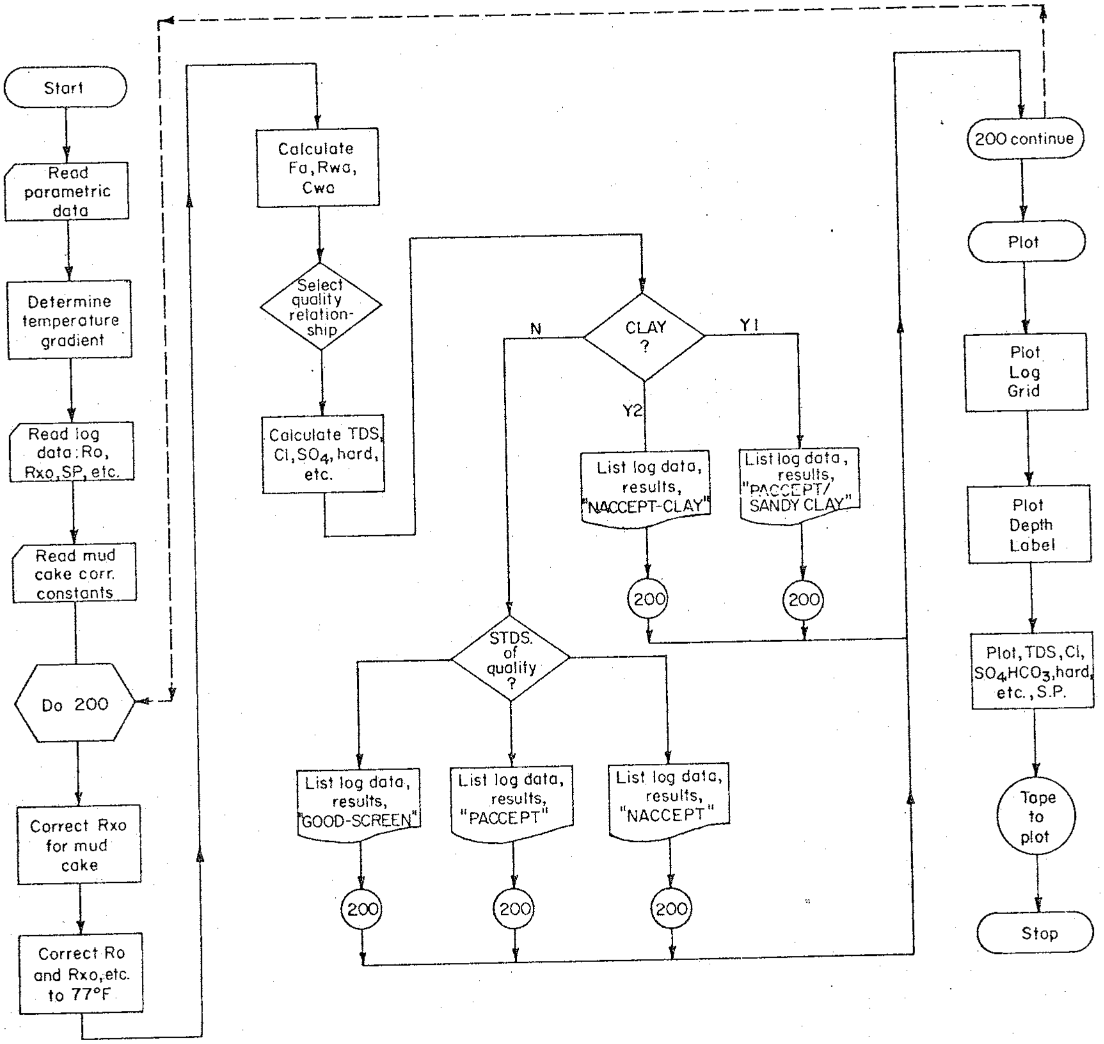


Fig. 3. Skeletal flow chart of adjunctive interpretation program.

Preliminary Programs

Interpretation Control Data--DATFIT

The preliminary program for reducing interpretation control data charts to equation form for use in machine computations was accomplished by using the program named DATFIT. DATFIT determines the coefficients for a polynomial of the general form

$$\frac{\text{Ion Concentration}}{\text{ppm.}} = \sum_{i=1}^{n} e_i C_W^{\,i-1} \qquad (1)$$

by the method of least squares and Gaussian elimination [Rule, 1968]. The e_i ($i = 1, 2, \ldots, n$) are constants; C_W is the specific conductance of the water in micromhos/cm. Comments within DATFIT explain the execution of the program.

The values of the coefficients and the order of the resultant polynomial for each ion relating to water quality was selected on the basis of the corresponding minimum standard deviation. DATFIT determines the values of e_i for a polynomial with maximum order of 9. This represents a ten term polynomial. For the example in the companion volume, the selected equation for TDS, the total dissolved solids in ppm, is

$$\begin{aligned} \text{TDS} = 8.3 &+ 6.8\text{x}10^{-1}C_W + 1.7\text{x}10^{-7}C_W^2 + 2.5\text{x}10^{-10}C_W^3 + \\ &1.7\text{x}10^{-13}C_W^4 + 8.0\text{x}10^{-17}C_W^5 + 4.1\text{x}10^{-20}C_W^6 + \\ &3.7\text{x}10^{-23}C_W^7 + 2.8\text{x}10^{-26}C_W^8 + 1.2\text{x}10^{-29}C_W^9. \end{aligned} \qquad (2)$$

The equation could be simplified to

$$TDS = 0.68C_w$$

without causing appreciable error. The actual equation used in BODEAP, the adjunctive interpretation program for which equation (2) could be used, was $TDS = 0.705C_w$. This is the subjective equation derived from the charts (Appendix B).

The standard deviation, determined for each coefficient and polynomial order set, gives a quantitative measure of accuracy in the determination because it relates the calculated value of the water quality parameter to a corresponding maximum and minimum error. This measure of accuracy is useful-- but not invaluable. An example of DATFIT follows.

```
FORTRAN IV     MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118       NEW MEXICO TECH     PAGE  0001
               C           014P,10,B58,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
               C                 RONALD M. BRIMHALL
               C
               C      PROGRAM DATFIT
               C      DATFIT DETERMINS VALUES OF COEFFICIENTS FOR THE  SERIES
               C             SUM(A(I)*CW(I)**(I-1)), I=1,N.  THE EQUATIONS RESULTING
               C             FROM THIS PROGRAM ARE USED IN ADJUNCTIVE MACHINE INTERPRE-
               C             TATIONS OF ELECTRICAL RESISTIVITY LOGS.
               C      PURPOSE OF DATFIT--REDUCE FIELD WATER QUALITY DATA TO EQUATION
               C             FORM FOR USE IN BODEAP, EVALCO, HUEBO1, AND HUEBO2.
               C
               C      ------------------------------------------------------------
               C      NOTICE--CALCULATION AND PRESENTATION OF RESULTS PROCEDES IN THE
               C             ORDER TDS, SO4, CL, ETC.
               C      ------------------------------------------------------------
               C
               C
               C      ************************************************************
               C      NOMENCLATURE--
               C
               C      A(I,I) = MATRIX OF COEFFICIENTS IN AX=B.  IN COMMON WITH SIMEQ2.
               C      B(I) = VECTOR OF CONSTANTS IN AX=B.  IN COMMON WITH SIMEQ2.
               C      N = NUMBER OF EQUATIONS.  CALCULATED INTERNALLY BY DATFIT.
               C      X(J) = NAME FOR SOECIFIC CONDUCTANCES.  READ IN AS DATA.
               C      Y(J) = GENERAL NAME FOR ANY PARAMETER RELATING TO WATER QUALITY.
               C      XX(L) = COEFFICIENTS OF RESULTANT EQUATION AS DETERMINED BY
               C             SUBROUTINE SIMEQ2.
               C      NPOLY = NUMBER OF POLYNOMIAL TERMS IN THE EQUATIONS AS DETERMINED
               C             BY DATFIT.
               C       T1 = INITIAL PROGRAM EXECUTION TIME AS DETERMINED BY CALL CLOCK.
               C      NDATA = NUMBER OF DATA POINTS--SET IN BY PROGRAMMER.  INTEGER.
               C      DATA = NUMBER OF DATA POINTS.  SET IN BY PROGRAMMER.  REAL.
               C      INDEX = NAME OF UPPER LIMIT IN DO LOOP INDEX.  SET IN BY
               C             PROGRAMMER.
               C      NPARA = NUMBER OF PARAMETERS RELATING TO WATER QUALITY.  EXAMPLE,
               C             TDS, SO4, CL--NPARA = 3
               C      J = SUBSCRIPT NAME.
               C      ITER = DO LOOP INDEX IN DO 200.
               C      NPOL = N-1--NUMBER OF TERMS IN THE RESULTANT POLYNOMIAL WHICH ARE
               C             NOT CONSTANTS.
               C      NADD = NAME OF 2*NPOL.  UPPER LIMIT OF DO 64.
               C      JOB = INDEX OF DO 100
               C      I = NAME OF INTEGER SUBSCRIPT AND DO 62 INDEX.
               C      TEMP = NAME OF TEMPORARY LOCATION FOR A PROGRAM PARAMETER.
               C      K = NAME OF SUBSCRIPT IN SUMX(K).
               C      MAXDIF = THE MAXIMUM DIFFERENCE BETWEEN THE LARGEST AND SMALLEST
               C             VALUE OF CALCULATED PARAMETERS RELATING TO WATER QUALITY.
               C      NN = NPOLY+1--PARAMETER IN CALCULATING AN EXPONENT.
               C      SSQYDI = SUM OF THE SQUARED DIFFERENCE BETWEEN PARAMETERS READ IN
               C             AND CALCULATED FOR DETERMINING THE STANDARD DEVIATION.
               C      SYCALC = TEMPORARY STORAGE FOR DETERMINING SUM(XX(L)*X(K)**LL).
               C      L = SUBSCRIPT OF COEFFICIENT OF A TERM IN THE EQUATION RELATING
               C             WATER QUALITY TO SPECIFIC CONDUCTANCE.
               C      LL = VALUE OF THE EXPONENT IN THE EQUATION YCALC1(J)=
               C             XX(L)*X(K)**LL.
               C      STDEVY = STANDARD DEVIATION OF PARAMETER RELATING TO WATER QUALITY
               C             = SORT(SSQYDI/N).
               C      T2 = FINAL PROGRAM EXECUTION TIME AS DETERMINED BY CALL CLOCK.
               C      TIME = ABS(T1-T2)
               C      SUMX = NAME FOR SUMMATION OF PARAMETERS RELATING TO WATFR QUALITY.

FORTRAN IV     MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118       NEW MEXICO TECH     PAGE  0002
               C      YCALC = VALUE OF ONE TERM IN THE POLYNOMIAL SUM(YCALC1(J)).
               C      YDIF = DIFFERENCE BETWEEN THE PARAMETERS RELATING TO WATER
               C             QUALITY AS READ IN AS DATA AND THE VALUE CALCULATED FROM
               C             SUM(YCALC1(J)).
               C      SQYDIF = SQUARE OF THE DIFFERENCE BETWEEN CALCULATED PARAMETERS
               C             RELATING TO WATER QUALITY AND VALUES READ IN AS DATA.
               C      Y1 = TOTAL DISOLVED SOLIDS.  FIELD DATA PARAMETER RELATING TO
               C             WATER QUALITY FOR WHICH AN APPROXIMATE EQUATION IS WANTED.
               C      Y2 = SO4.  SULFATE ION CONCENTRATION.  FIELD DATA PARAMETER
               C             RELATING TO WATER QUALITY FOR WHICH AN APPROXIMATE EQUATION
               C             IS WANTED.
               C      Y3 = CL.  CHLORIDE ION CONCENTRATION.  FIELD DATA PARAMETER
               C             RELATING TO WATER QUALITY FOR WHICH AN APPROXIMATE
               C             EQUATION IS WANTED.
               C      Y4 = ANY OTHER FIELD DATA PARAMETER RELATING TO WATER QUALITY
               C             FOR WHICH AN APPROXIMATE EQUATION MAY BE WANTED.
               C      ************************************************************
               C
               C
               C      ************************************************************
               C
               C      REFERENCE--
               C      BRIMHALL, R. M., DIGITAL ANALYSIS  OF BOREHOLE-MEASURED AQUIFER
               C             RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER
               C             OF SCIENCE THESIS, NEW MEXICO INSTITUTE OF MINING AND
               C             TECHNOLOGY, SOCORRO, JUNE, 1969.
               C      ************************************************************
               C
               C
               C
               C
               C      THIS EXAMPLE ONLY--DATA FROM COOPER, 1968
               C         TDS, SO4, CL ONLY
               C
               C      #########  PROGRAM DATFIT  #########
 0001                 CALL CLOCK(T1)
 0002                 DIMENSION SUMX(100),YCALC(100),YCALC1(100),YDIF(100),SQYDIF(100)
                     *,Y1(100),Y2(100),Y3(100)
                     *,Y4(100)
 0003                 COMMON A(20,20),B(20),N,X(100),Y(100),XX(100),NPOLY
 0004                 REAL MAXDIF
               C
               C      LIST OF DATA PARAMETRIC TO THIS PROGRAM.
 0005                 NDATA = 20
 0006                 DATA = 20.0
 0007                 INDEX = 9
 0008                 NPARA = 3
               C
               C      READ IN FIELD DATA--VALUES OF PARAMETERS RELATING TO WATER
               C             QUALITY.
 0009                 DO 5 J = 1,NDATA
 0010                 READ(5,63) X(J),Y1(J),Y2(J),Y3(J)
 0011              63 FORMAT(4F5.0)
 0012               5 CONTINUE
               C
               C      PRIMARY DO LOOP FOR ALL CALCULATIONS.
 0013                 DO 200 ITER = 1,INDEX,2
 0014                 N = 1+ITER
 0015                 NPOLY = N
 0016                 NPOL = N-1
```

```
      NADD = 2*NPOL
C
C     SECONDARY DO LOOP FOR ALL CALCULATIONS.
      DO 100 JOB = 1,NPARA
C
C     SELECT VECTOR FOR STORAGE OF PARAMETERS RELATING TO WATER
C             QUALITY.
      IF(JOB.EQ.1)GO TO 1
      IF(JOB.EQ.2)GO TO 2
      IF(JOB.EQ.3)GO TO 3
      IF(JOB.EQ.4)GO TO 4
C
C     BUILD STORAGE VECTOR OF PARAMETERS RELATING TO WATER QUALITY.
    1 DO 201 J = 1,NDATA
  201 Y(J) = Y1(J)
      GO TO 60
    2 DO 202 J = 1,NDATA
  202 Y(J) = Y2(J)
      GO TO 60
    3 DO 203 J = 1,NDATA
  203 Y(J) = Y3(J)
      GO TO 60
    4 DO 204 J = 1,NDATA
  204 Y(J) = Y4(J)
   60 DO 61 I = 1,NPOLY
      SUMX(I) = 0.0
   61 CONTINUE
      DO 62 I = 1,N
      B(I) = 0.0
   62 CONTINUE
C
C     BUILD ARRAYS AND MATRIX BASED IN LEAST SQUARES THEORY.  SEE--
C             RULE, W. D., FORTRAN IV PROGRAMMING, PRINDLE, WEBER, &
C               SCHMIDT, BOSTON, 1968.
C
C
C     SUM FIELD VALUES OF SPECIFIC CONDUCTANCE.
      DO 66 J = 1,NDATA
      TEMP = X(J)
      DO 64 I = 1,NADD
      SUMX(I) = SUMX(I) + TEMP
      TEMP = TEMP*X(J)
   64 CONTINUE
C
C     SUM FIELD VALUES OF PARAMETERS RELATING TO WATER QUALITY.
      TEMP = Y(J)
      DO 65 I = 1,N
C
C     BUILD VECTOR NAMED B.
      B(I) = B(I) + TEMP
      TEMP = TEMP*X(J)
   65 CONTINUE
   66 CONTINUE
C
C     DO LOOPS FOR BUILDING A ARRAY IN AX=B.
      DO 69 I = 1,N
      DO 68 J = 1,NPOLY
      K = I+J-2
      IF(K.NE.0)GO TO 67
      K = K+1
   67 A(I,J) = SUMX(K)

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   68 CONTINUE
   69 CONTINUE
      A(1,1) = DATA
  169 CONTINUE
C
C     SOLVE SIMULTANEOUS LINER EQUATION BY SIMEQ2.
      CALL SIMEQ2
C
      MAXDIF = 0.0
      NN = NPOLY + 1
      SSQYDI = 0.0
C
C     CALCULATE PARAMETERS RELATING TO WATER QUALITY FROM APPROXIMATE
C             EQUATION.
      DO 72 K = 1,NDATA
      SYCALC = 0.0
C
C     CALCULATE EACH TERM IN THE POLYNOMIAL.
      DO 71 J = 1,NPOLY
      L = NPOLY-(NPOLY-J)
      LL = NPOLY-(NN-J)
      YCALC1(J) = XX(L)*X(K)**LL
      SYCALC = SYCALC + YCALC1(J)
   71 CONTINUE
      YCALC(K) = SYCALC
      YDIF(K) = Y(K) - YCALC(K)
C
C     DETERMINE THE MAXIMUM DIFFERENCE.
      IF(YDIF(K)-MAXDIF)271,271,171
  171 MAXDIF = YDIF(K)
  271 SQYDIF(K) = YDIF(K)**2
      SSQYDI = SSQYDI + SQYDIF(K)
   72 CONTINUE
C
C     CALCULATE THE STANDARD DEVIATION.
      STDEVY = SQRT(SSQYDI/N)
C
C     IDENTIFY PROBLEM AND WRITE RESULTS.  ORDER OF CALCULATION OF
C             YCALC IS TDS, SO4, CL, ETC.
C
      WRITE(6,8)
    8 FORMAT('9',/9X,'SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SI
     *MEQ2')
      WRITE(6,80) NPOL
   80 FORMAT(//10X,'ORDER OF RESULTANT POLYNOMIAL = ',I2)
      WRITE(6,81) (XX(I), I=1,N)
   81 FORMAT(//10X,'CUEFFICIENTS',2X,'A1 = ',E14.7,/24X,'A2 = ',E14.7,/2
     *4X,'A3 = ',E14.7,/24X,'A4 = ',E14.7,/24X,'A5 = ',E14.7,/24X,'A6 =
     *',E14.7,/24X,'A7 = ',E14.7,/24X,'A8 = ',E14.7,/24X,'A9 = ',E14.7,/
     *24X,'A10 = ',E14.7)
      WRITE(6,82)
   82 FORMAT(///6X,'I',8X,'X(I)',13X,'Y(I)',11X,'YCALC(I)',10X,'YDIF(I)'
     *,8X,'SQYDIF(I)')
      DO 84 I = 1,NDATA
      WRITE(6,83)I,X(I),Y(I),YCALC(I),YDIF(I),SQYDIF(I)
   83 FORMAT(5X,I2,5(3X,E14.7))
   84 CONTINUE
C
C     WRITE EVALUATION PARAMETERS--MAXIMUM DIFFERENCES, SUM OF SQUARES
C             OF DIFFEKENCE IN CALCULATED PARAMETERS, AND STANDARD
C             DEVIATIONS.
```

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FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118       NEW MEXICO TECH     PAGE  0005

 0094               WRITE(6,89)MAXDIF,SSQYDI,STDEVY
 0095            85 FORMAT(///10X,'MAXDIF = ',E14.7,/10X,'SUM OF (YDIF)**2 = ',E14.7,/
                  *10X,'STDEVY = ',E14.7)
 0096           100 CONTINUE
 0097           200 CONTINUE
              C
              C     PROGRAM IDENTIFICATION
 0098               WRITE(6,9999)
 0099          9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'B
                  *OX 31 CAMPUS STA.',/30X,'SOCORRO, N. M.      87801')
 0100               CALL CLOCK(T2)
 0101               TIME = ABS(T1 - T2)
              C
              C     WRITE PROGRAM EXECUTION TIME.
 0102               WRITE(6,9) TIME
 0103             9 FORMAT(///15X,'PROGRAM TIME IN MINUTES = ',E14.7)
 0104               STOP
 0105               END


                                          COMMON BLOCK /         / MAP SIZE  000B48
SYMBOL     LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION
A          000000        B         000640        N         000690        X         000694        Y         000824
XX         0009B4        NPOLY     000844

                                          SCALAR MAP
SYMBOL     LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION
T1         000174        NDATA     000178        DATA      00017C        INDEX     000180        NPARA     000184
J          000188        ITER      00018C        NPOL      000190        NADD      000194        JOB       000198
I          00019C        TEMP      0001A0        K         0001A4        MAXDIF    0001A8        NN        0001AC
SSQYDI     0001B0        SYCALC    0001B4        L         0001B8        LL        0001BC        STDEVY    0001C0
T2         0001C4        TIME      0001C8

                                          ARRAY MAP
SYMBOL     LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION
SUMX       0001CC        YCALC     00035C        YCALCI    0004EC        YDIF      00067C        SQYDIF    00080C
Y1         00099C        Y2        000B2C        Y3        000C8C        Y4        000E4C

                                          SUBPROGRAMS CALLED
SYMBOL     LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION
CLOCK      000FDC        IBCOM#    000FE0        SIMEQ2    000FE4        FRXPI#    000FE8        SQRT      000FEC

                                          LABEL MAP
LABEL      LOCATION      LABEL     LOCATION      LABEL     LOCATION      LABEL     LOCATION      LABEL     LOCATION
    63     001090            5     00109E            1     001134          201     001140            2     001170
   202     00117C            3     0011AC          203     001188            4     0011E8          204     0011F4
    60     00121E           61     00123E           62     001274           64     0012DA           65     00132C
    66     001342           67     001396           68     0013C4           69     0013D6          169     0013F0
    71     001494          171     0014CE          271     0014DE           72     0014FC            8     001564
    80     0015C8           81     001644           82     0016F8           83     001798           84     0017AE
    85     0017F0          100     00183A          200     00184C         9999     001874            9     001918

  TOTAL MEMORY REQUIREMENTS 0019A4 BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
//SIMEQ2 EXEC FORTRAN(MAP)



FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118       NEW MEXICO TECH     PAGE  0001

 0001                 SUBROUTINE SIMEQ2
              C                    RONALD M. BRIMHALL
              C
              C      SIMEQ2
              C      PURPOSE--SIMEQ2 SLOVES A SYSTEM OF LINEAR SIMULTANEOUS EQUATIONS
              C              BY GAUSSIAN ELIMINATION TECHNIQUES.  SEE--RULE, W. P.,
              C              FORTRAN IV PROGRAMMING, PRINDLE, WEBER, & SCHMIDT,
              C              BOSTON, 1968.
              C
              C
              C      *****************************************************************
              C      NOMENCALTURE--
              C
              C      TEMP1 = TEMPORARY STAORAGE OF MATRIX CALLED A.
              C      TEMP2 = TEMPORARY STORAGE OF VECTOR CALLED B.
              C      A = MATRIX A IN AX=B.
              C      B = VECTOR B IN AX = B.
              C      N = NUMBER OF EQUATIONS.  CALCULATED BY DATFIT.
              C      X = NAME FOR SPECIFIC CONDUCTANCE READ IN AS DATA.
              C      Y = GENERAL NAME FOR ANY PARAMETER RELATING TO  WATER QUALITY.
              C              READ IN AS DATA.
              C      XX = COEFFICIENTS OF RESULTANT APPROXIMATE EQUATION.
              C      NPOLY = NUMBER OF TERMS IN THE EQUATION AS DETERMINED BY DATFIT.
              C      P = NAME OF PIVOT ROW IN ELEMINATION TECHNIQUE.
              C      NTEMP = UPPER LIMIT OF BUILD A MATRIX AND B VECTOR DO LOOP.
              C      I = INDEX FOR PRIMARY DO LOOP.
              C      L = INDEX FOR DO 102 AND MATRIX ROW NUMBER.
              C      J = INDEX FOR DO 101 AND MATRIX COLUMN NUMBER.
              C      CMULT = VARIABLE ELIMINATION COEFFICIENT APPLIED TO A MATRIX AND
              C              B VECTOR IN AX=B.
              C      *****************************************************************
              C
              C
              C      *****************************************************************
              C      REFERENCE--BRIMHALL, R. M., DIGITAL APPLICATION OF BOREHOLE-
              C              MEASURED AQUIFER RESISTIVITY TO DETERMINE WATER QUALITY,
              C              UNPUBLISHED MASTER OF SCIENCE THESIS, NEW MEXICO
              C              INSTITUTE OF MINING AND TECHNOLOGY, SOCORRO, JUNE, L
              C              INSTITUTE OF MINING AND TECHNOLOGY, SOCORRO, JUNE, 1969.
              C      *****************************************************************
              C
              C
              C      ##############  SUBROUTINE SIMEQ2  ##############
              C                        ADJUNCT TO DATFIT
 0002                DIMENSION TEMP1(8,8), TEMP2(8)
 0003                COMMON A(20,20),B(20),N,X(100),Y(100),XX(100),NPOLY
 0004                INTEGER P
 0005                P = 1
 0006                NTEMP = N-1
              C
              C      PRIMARY DO LOOP FOR ALL CALCULATIONS.
 0007             10 DO 30 I = 1,N
 0008                IF(A(P,P).NE.0.0)GO TO 103
              C
              C      BUILD A MATRIX AND B VECTOR OF AX=B.
 0009            100 DO 102 L = 1,N
              C
              C      BUILD A MATRIX.
 0010                DO 101 J = 1,NTEMP
 0011                TEMP1(L,J) = A(P,J)
 0012                A(P,J) = A(P+1,J)
```

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FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118     NEW MEXICO TECH      PAGE  0002

 0013              A(P+1,J) = TEMP1(L,J)
 0014          101 CONTINUE
             C
             C     BUILD B VECTOR.
 0015              TEMP2(L) = B(P)
 0016              B(P) = B(P+1)
 0017              B(P+1) = TEMP2(L)
 0018          102 CONTINUE
 0019          103 IF(I.EQ.P)GO TO 30
 0020              CMULT = A(I,P)/A(P,P)
             C
             C     ELIMINATE TERMS IN A MATRIX NOT ON PRIMARY DIAGONAL.
 0021              DO 20 J = 1,NPOLY
 0022              A(I,J) = A(I,J)-A(P,J)*CMULT
 0023           20 CONTINUE
             C
             C     ELIMINATE TERMS IN B VECTOR NOT ON PRIMARY DIAGONAL.
 0024              B(I) = B(I)-B(P)*CMULT
 0025           30 CONTINUE
 0026              P = P+1
 0027              IF(P-N)10,10,33
             C
             C     CALCULATE COEFFICEINTS OF APPROXIMATE EQUATIONS IN DATFIT.
 0028           33 DO 34 K = 1,N
 0029              XX(K) = B(K)/A(K,K)
 0030           34 CONTINUE
             C
             C     RETURN TO DATFIT.
 0031              RETURN
 0032              END

                                          COMMON BLOCK /          / MAP SIZE  000B48
SYMBOL     LOCATION       SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION
A          000000         B          000640       N          000690       X          000694       Y          000824
XX         0009B4         NPOLY      000844

                                          SCALAR MAP
SYMBOL     LOCATION       SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION
P          000100         NTEMP      000104       I          000108       L          00010C       J          000110
CMULT      000114         K          000118

                                          ARRAY MAP
SYMBOL     LOCATION       SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION
TEMP1      00011C         TEMP2      00021C

                                          LABEL MAP
LABEL      LOCATION       LABEL      LOCATION     LABEL      LOCATION     LABEL      LOCATION     LABEL      LOCATION
    10     00029E           100      0002D6         101      000332         102      00036C         103      00037E
    20     00041A            30      00044E          33      000484          34      0004C2

   TOTAL MEMORY REQUIREMENTS 000510 BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
// EXEC LNKEDT




 69/118                                    58724    LINKAGE EDIT

                                                                COMMON                  004200     000B48
COMMON

LINKAGE EDITOR HIGHEST SEVERITY WAS  0
// EXEC
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

 ORDER OF RESULTANT POLYNOMIAL =  1

 COEFFICIENTS  A1 =  0.6706656E 01
               A2 =  0.6871482E 00
               A3 =

I      X(I)            Y(I)          YCALC(I)         YDIF(I)        SQYDIF(I)
1   0.1000000E 01   0.1000000E 01   0.7393804E 01  -0.6393804E 01   0.4088072E 02
2   0.8830000E 03   0.6160000E 03   0.6134583E 03   0.2541748E 01   0.6460483E 01
3   0.7350000E 03   0.5150000E 03   0.5117603E 03   0.3239746E 01   0.1049595E 02
4   0.8170000E 03   0.5710000E 03   0.5681064E 03   0.2893555E 01   0.8372659E 01
5   0.8880000E 03   0.6220000E 03   0.6168940E 03   0.5105957E 01   0.2607079E 02
6   0.9230000E 03   0.6450000E 03   0.6409441E 03   0.4055908E 01   0.1645038E 02
7   0.9140000E 03   0.6400000E 03   0.6347598E 03   0.5240234E 01   0.2746005E 02
8   0.4750000E 03   0.3720000E 03   0.3331018E 03   0.3889819E 02   0.1513069E 04
9   0.6140000E 03   0.4230000E 03   0.4286155E 03  -0.5615479E 01   0.3153358E 02
10  0.1340000E 04   0.9360000E 03   0.9274849E 03   0.8515137E 01   0.7250755E 02
11  0.1290000E 04   0.9030000E 03   0.8931274E 03   0.9872559E 01   0.9746741E 02
12  0.1360000E 04   0.9520000E 03   0.9412280E 03   0.1077197E 02   0.1160354E 03
13  0.7160000E 03   0.5010000E 03   0.4987046E 03   0.2295410E 01   0.5268908E 01
14  0.7190000E 03   0.5030000E 03   0.5007659E 03   0.2234131E 01   0.4991341E 01
15  0.1130000E 04   0.7900000E 03   0.7831838E 03   0.6816162E 01   0.4646005E 02
16  0.1090000E 04   0.7610000E 03   0.7556980E 03   0.5302002E 01   0.2811122E 02
17  0.1120000E 04   0.7190000E 03   0.7763123E 03  -0.5731226E 02   0.3284695E 04
18  0.1490000E 04   0.1040000E 04   0.1030557E 04   0.9442871E 01   0.8916780E 02
19  0.9440000E 03   0.6600000E 03   0.6553743E 03   0.4625732E 01   0.2139740E 02
20  0.8540000E 03   0.5410000E 03   0.5935310E 03  -0.5253101E 02   0.2759506E 04

  MAXDIF =  0.3889819E 02
  SUM OF (YDIF)**2 =  0.8206391E 04
  STDEVY =  0.6405618E 02
```

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SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

 ORDER OF RESULTANT POLYNOMIAL =  1

 COEFFICIENTS  A1 = -0.2867271E 02
               A2 =  0.2243052E 00
               A3 =

I      X(I)            Y(I)          YCALC(I)         YDIF(I)        SQYDIF(I)
1   0.1000000E 01   0.1000000E 01  -0.2844839E 02   0.2944839E 02   0.8672078E 03
2   0.8830000E 03   0.1820000E 03   0.1693887E 03   0.1261127E 02   0.1590441E 03
3   0.7350000E 03   0.7900000E 02   0.1361916E 03  -0.5719156E 02   0.3270874E 04
4   0.8170000E 03   0.1850000E 03   0.1545846E 03   0.3041541E 02   0.9250967E 03
5   0.8880000E 03   0.2110000E 03   0.1705103E 03   0.4048975E 02   0.1639419E 04
6   0.9230000E 03   0.2190000E 03   0.1783609E 03   0.4063907E 02   0.1651534E 04
7   0.9140000E 03   0.2130000E 03   0.1763422E 03   0.3665781E 02   0.1343795E 04
8   0.4750000E 03   0.7400000E 02   0.7787222E 02  -0.3872223E 01   0.1499411E 02
9   0.6140000E 03   0.1050000E 03   0.1090506E 03  -0.4050644E 01   0.1640771E 02
10  0.1340000E 04   0.2850000E 03   0.2718960E 03   0.1310400E 02   0.1717149E 03
11  0.1290000E 04   0.2900000E 03   0.2606807E 03   0.2931934E 02   0.8596233E 03
12  0.1360000E 04   0.3140000E 03   0.2763821E 03   0.3761792E 02   0.1415108E 04
13  0.7160000E 03   0.9100000E 02   0.1319298E 03  -0.4092976E 02   0.1675245E 04
14  0.7190000E 03   0.1600000E 03   0.1326027E 03   0.2739732E 02   0.7506133E 03
15  0.1130000E 04   0.1250000E 03   0.2247921E 03  -0.9979210E 02   0.9958461E 04
16  0.1090000E 04   0.2320000E 03   0.2158199E 03   0.1618010E 02   0.2617954E 03
17  0.1120000E 04   0.2340000E 03   0.2225491E 03   0.1145094E 02   0.1311241E 03
18  0.1490000E 04   0.2990000E 03   0.3055417E 03  -0.6541748E 01   0.4279446E 02
19  0.9440000E 03   0.1270000E 03   0.1830714E 03  -0.5607135E 02   0.3143996E 04
20  0.8540000E 03   0.1060000E 03   0.1628839E 03  -0.5688388E 02   0.3235776E 04

  MAXDIF =  0.4063907E 02
  SUM OF (YDIF)**2 =  0.3153459E 05
  STDEVY =  0.1255679E 03
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

 ORDER OF RESULTANT POLYNOMIAL =  1

 COEFFICIENTS  A1 = -0.1127260E 01
               A2 =  0.8870375E-01
               A3 =

I        X(I)             Y(I)          YCALC(I)          YDIF(I)         SQYDIF(I)
1    0.1000000E 01   0.1000000E 01  -0.1038556E 01   0.2038556E 01   0.4155710E 01
2    0.8830000E 03   0.6700000E 02   0.7719814E 02  -0.1019814E 02   0.1040020E 03
3    0.7350000E 03   0.1080000E 03   0.6406998E 02   0.4393002E 02   0.1929847E 04
4    0.8170000E 03   0.4400000E 02   0.7134369E 02  -0.2734369E 02   0.7476772E 03
5    0.8880000E 03   0.5500000E 02   0.7764165E 02  -0.2264165E 02   0.5126440E 03
6    0.9230000E 03   0.5000000E 02   0.8074628E 02  -0.3074628E 02   0.9453335E 03
7    0.9140000E 03   0.5800000E 02   0.7994795E 02  -0.2194795E 02   0.4817124E 03
8    0.4750000E 03   0.2900000E 02   0.4100700E 02  -0.1200700E 02   0.1441681E 03
9    0.6140000E 03   0.4800000E 02   0.5333682E 02  -0.5336823E 01   0.2848167E 02
10   0.1340000E 04   0.8300000E 02   0.1177357E 03  -0.3473575E 02   0.1206572E 04
11   0.1290000E 04   0.1080000E 03   0.1133006E 03  -0.5300552E 01   0.2809584E 02
12   0.1360000E 04   0.1210000E 03   0.1195098E 03   0.1490173E 01   0.2220616E 01
13   0.7160000E 03   0.7100000E 02   0.6238460E 02   0.8615402E 01   0.7422514E 02
14   0.7190000E 03   0.3300000E 02   0.6265071E 02  -0.2965071E 02   0.8791646E 03
15   0.1130000E 04   0.1800000E 03   0.9910796E 02   0.8089204E 02   0.6543520E 04
16   0.1090000E 04   0.7900000E 02   0.9555981E 02  -0.1655981E 02   0.2742273E 03
17   0.1120000E 04   0.8200000E 02   0.9822092E 02  -0.1622092E 02   0.2631179E 03
18   0.1490000E 04   0.1340000E 03   0.1310413E 03   0.2958694E 01   0.8753873E 01
19   0.9440000E 03   0.1300000E 03   0.8260905E 02   0.4739095E 02   0.2245902E 04
20   0.8540000E 03   0.1200000E 03   0.7462572E 02   0.4537428E 02   0.2058825E 04

 MAXDIF =  0.8089204E 02
 SUM OF (YDIF)**2 =  0.1848262E 05
 STDEVY =  0.9613171E 02
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

 ORDER OF RESULTANT POLYNOMIAL =  3

 COEFFICIENTS  A1 =  0.3017559E 01
               A2 =  0.8284628E 00
               A3 = -0.2729648E-03
               A4 =  0.1272119E-06
               A5 =

I        X(I)             Y(I)          YCALC(I)          YDIF(I)         SQYDIF(I)
1    0.1000000E 01   0.1000000E 01   0.3845748E 01  -0.2845748E 01   0.8098281E 01
2    0.8830000E 03   0.6160000E 03   0.6093027E 03   0.6697266E 01   0.4485336E 02
3    0.7350000E 03   0.5150000E 03   0.5149861E 03   0.1391602E-01   0.1936555E-03
4    0.8170000E 03   0.5710000E 03   0.5670435E 03   0.3956543E 01   0.1565423E 02
5    0.8880000E 03   0.6220000E 03   0.6125244E 03   0.9475586E 01   0.8978673E 02
6    0.9230000E 03   0.6450000E 03   0.6351721E 03   0.9827881E 01   0.9658723E 02
7    0.9140000E 03   0.6400000E 03   0.6293311E 03   0.1066895E 02   0.1138264E 03
8    0.4750000E 03   0.3720000E 03   0.3485825E 03   0.2341748E 02   0.5483782E 03
9    0.6140000E 03   0.4230000E 03   0.4382329E 03  -0.1523291E 02   0.2320415E 03
10   0.1340000E 04   0.9360000E 03   0.9291069E 03   0.6893066E 01   0.4751436E 02
11   0.1290000E 04   0.9030000E 03   0.8905779E 03   0.1242212E 02   0.1543090E 03
12   0.1360000E 04   0.9520000E 03   0.9448467E 03   0.7153320E 01   0.5116998E 02
13   0.7160000E 03   0.5010000E 03   0.5029539E 03  -0.1953857E 01   0.3817558E 01
14   0.7190000E 03   0.5030000E 03   0.5048535E 03  -0.1853516E 01   0.3435520E 01
15   0.1130000E 04   0.7900000E 03   0.7741851E 03   0.1581494E 02   0.2501124E 03
16   0.1090000E 04   0.7610000E 03   0.7464753E 03   0.1452466E 02   0.2109657E 03
17   0.1120000E 04   0.7190000E 03   0.7672119E 03  -0.4821191E 02   0.2324388E 04
18   0.1490000E 04   0.1040000E 04   0.1052228E 04  -0.1222803E 02   0.1495246E 03
19   0.9440000E 03   0.6600000E 03   0.6488521E 03   0.1114795E 02   0.1242768E 03
20   0.8540000E 03   0.5410000E 03   0.5906787E 03  -0.4967871E 02   0.2467974E 04

 MAXDIF =  0.2341748E 02
 SUM OF (YDIF)**2 =  0.6936707E 04
 STDEVY =  0.4164345E 02
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

 ORDER OF RESULTANT POLYNOMIAL =  3

 COEFFICIENTS  A1 = -0.2721066E 02
               A2 =  0.2208155E 00
               A3 =  0.8030581E-06
               A4 =  0.9264762E-09
               A5 =

 I       X(I)              Y(I)             YCALC(I)          YDIF(I)          SQYDIF(I)
 1    0.1000000E 01    0.1000000E 01   -0.2698984E 02    0.2798984E 02    0.7834309E 03
 2    0.8830000E 03    0.1820000E 03    0.1690334E 03    0.1296658E 02    0.1681323E 03
 3    0.7350000E 03    0.7900000E 02    0.1358904E 03   -0.5689043E 02    0.3236521E 04
 4    0.8170000E 03    0.1850000E 03    0.1542369E 03    0.3076312E 02    0.9463696E 03
 5    0.8880000E 03    0.2110000E 03    0.1701555E 03    0.4084448E 02    0.1668272E 04
 6    0.9230000E 03    0.2190000E 03    0.1780147E 03    0.4098528E 02    0.1679793E 04
 7    0.9140000E 03    0.2130000E 03    0.1759930E 03    0.3700700E 02    0.1369518E 04
 8    0.4750000E 03    0.7400000E 02    0.7795718E 02   -0.3957184E 01    0.1565930E 02
 9    0.6140000E 03    0.1050000E 03    0.1088873E 03   -0.3887268E 01    0.1511085E 02
10    0.1340000E 04    0.2850000E 03    0.2723530E 03    0.1264697E 02    0.1599459E 03
11    0.1290000E 04    0.2900000E 03    0.2609661E 03    0.2903394E 02    0.8429692E 03
12    0.1360000E 04    0.3140000E 03    0.2769138E 03    0.3708618E 02    0.1375385E 04
13    0.7160000E 03    0.9100000E 02    0.1316450E 03   -0.4064500E 02    0.1652016E 04
14    0.7190000E 03    0.1600000E 03    0.1323152E 03    0.2768478E 02    0.7664470E 03
15    0.1130000E 04    0.1250000E 03    0.2246731E 03   -0.9967311E 02    0.9934727E 04
16    0.1090000E 04    0.2320000E 03    0.2156322E 03    0.1636783E 02    0.2679058E 03
17    0.1120000E 04    0.2340000E 03    0.2224117E 03    0.1158829E 02    0.1342884E 03
18    0.1490000E 04    0.2990000E 03    0.3066519E 03   -0.7651855E 01    0.5855089E 02
19    0.9440000E 03    0.1270000E 03    0.1827342E 03   -0.5573419E 02    0.3106300E 04
20    0.8540000E 03    0.1060000E 03    0.1625285E 03   -0.5652852E 02    0.3195473E 04

  MAXDIF =  0.4098528E 02
  SUM OF (YDIF)**2 =  0.3137678E 05
  STDEVY =  0.8856746E 02
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

 ORDER OF RESULTANT POLYNOMIAL =  3

 COEFFICIENTS  A1 = -0.1262794E 01
               A2 =  0.8905315E-01
               A3 = -0.1273179E-06
               A4 = -0.6060162E-10
               A5 =

 I       X(I)              Y(I)             YCALC(I)          YDIF(I)          SQYDIF(I)
 1    0.1000000E 01    0.1000000E 01   -0.1173741E 01    0.2173741E 01    0.4725151E 01
 2    0.8830000E 03    0.6700000E 02    0.7723012E 02   -0.1023012E 02    0.1046553E 03
 3    0.7350000E 03    0.1080000E 03    0.6409840E 02    0.4390160E 02    0.1927350E 04
 4    0.8170000E 03    0.4400000E 02    0.7137558E 02   -0.2737558E 02    0.7494224E 03
 5    0.8880000E 03    0.5500000E 02    0.7767355E 02   -0.2267355E 02    0.5140898E 03
 6    0.9230000E 03    0.5000000E 02    0.8077713E 02   -0.3077713E 02    0.9472317E 03
 7    0.9140000E 03    0.5800000E 02    0.7997913E 02   -0.2197913E 02    0.4830818E 03
 8    0.4750000E 03    0.2900000E 02    0.4100221E 02   -0.1200221E 02    0.1440531E 03
 9    0.6140000E 03    0.4800000E 02    0.5335379E 02   -0.5353790E 01    0.2866306E 02
10    0.1340000E 04    0.8300000E 02    0.1176940E 03   -0.3469398E 02    0.1203672E 04
11    0.1290000E 04    0.1080000E 03    0.1132738E 03   -0.5273773E 01    0.2781268E 02
12    0.1360000E 04    0.1210000E 03    0.1194615E 03    0.1538452E 01    0.2366835E 01
13    0.7160000E 03    0.7100000E 02    0.6241173E 02    0.8588272E 01    0.7375841E 02
14    0.7190000E 03    0.3300000E 02    0.6267804E 02   -0.2967804E 02    0.8807859E 03
15    0.1130000E 04    0.1800000E 03    0.9911722E 02    0.8088278E 02    0.6542023E 04
16    0.1090000E 04    0.7900000E 02    0.9557536E 02   -0.1657536E 02    0.2747424E 03
17    0.1120000E 04    0.8200000E 02    0.9823187E 02   -0.1623187E 02    0.2634736E 03
18    0.1490000E 04    0.1340000E 03    0.1309433E 03    0.3056747E 01    0.9343704E 01
19    0.9440000E 03    0.1300000E 03    0.8263893E 02    0.4736107E 02    0.2243071E 04
20    0.8540000E 03    0.1200000E 03    0.7465797E 02    0.4534203E 02    0.2055899E 04

  MAXDIF =  0.8088278E 02
  SUM OF (YDIF)**2 =  0.1848020E 05
  STDEVY =  0.6797092E 02
```

SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS~~--PROG SIMEQ2~~

```
ORDER OF RESULTANT POLYNOMIAL =  5

COEFFICIENTS  A1 =  0.1558236E 01
              A2 =  0.8009619E 00
              A3 =  0.1175886E-03
              A4 = -0.8789674E-06
              A5 =  0.9150598E-09
              A6 = -0.2752515E-12
              A7 =

 I       X(I)             Y(I)            YCALC(I)          YDIF(I)         SQYDIF(I)
 1   0.1000000E 01   0.1000000E 01   0.2359314E 01   -0.1359314E 01   0.1847734E 01
 2   0.8830000E 03   0.6160000E 03   0.6038779E 03    0.1212207E 02   0.1469446E 03
 3   0.7350000E 03   0.5150000E 03   0.5127927E 03    0.2207275E 01   0.4872065E 01
 4   0.8170000E 03   0.5710000E 03   0.5626018E 03    0.8398193E 01   0.7052965E 02
 5   0.8880000E 03   0.6220000E 03   0.6070620E 03    0.1493799E 02   0.2231435E 03
 6   0.9230000E 03   0.6450000E 03   0.6296086E 03    0.1539136E 02   0.2368939E 03
 7   0.9140000E 03   0.6400000E 03   0.6237666E 03    0.1623340E 02   0.2635232E 03
 8   0.4750000E 03   0.3720000E 03   0.3542717E 03    0.1772827E 02   0.3142915E 03
 9   0.6140000E 03   0.4230000E 03   0.4402532E 03   -0.1725317E 02   0.2976719E 03
10   0.1340000E 04   0.9360000E 03   0.9322222E 03    0.3777832E 01   0.1427201E 02
11   0.1290000E 04   0.9030000E 03   0.8943359E 03    0.8664062E 01   0.7506598E 02
12   0.1360000E 04   0.9520000E 03   0.9471616E 03    0.4838379E 01   0.2340990E 02
13   0.7160000E 03   0.5010000E 03   0.5013906E 03   -0.3906250E 00   0.1525879E 00
14   0.7190000E 03   0.5030000E 03   0.5031890E 03   -0.1889648E 00   0.3570771E-01
15   0.1130000E 04   0.7900000E 03   0.7733818E 03    0.1661816E 02   0.2761633E 03
16   0.1090000E 04   0.7610000E 03   0.7441982E 03    0.1680176E 02   0.2822988E 03
17   0.1120000E 04   0.7190000E 03   0.7660295E 03   -0.4702954E 02   0.2211778E 04
18   0.1490000E 04   0.1040000E 04   0.1037215E 04    0.2785400E 01   0.7758455E 01
19   0.9440000E 03   0.6600000E 03   0.6433647E 03    0.1663525E 02   0.2767314E 03
20   0.8540000E 03   0.5410000E 03   0.5855767E 03   -0.4457666E 02   0.1987079E 04

MAXDIF =  0.1772827E 02
SUM OF (YDIF)**2 =  0.6714457E 04
STDEVY =  0.3345259E 02
```

SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

```
ORDER OF RESULTANT POLYNOMIAL =  5

COEFFICIENTS  A1 = -0.2594556E 02
              A2 =  0.2192631E 00
              A3 =  0.2612746E-06
              A4 =  0.3330418E-09
              A5 =  0.4139130E-12
              A6 =  0.5291487E-15
              A7 =

 I       X(I)             Y(I)            YCALC(I)          YDIF(I)         SQYDIF(I)
 1   0.1000000E 01   0.1000000E 01   -0.2572629E 02   0.2672629E 02   0.7142944E 03
 2   0.8830000E 03   0.1820000E 03    0.1686324E 03   0.1336765E 02   0.1786939E 03
 3   0.7350000E 03   0.7900000E 02    0.1357205E 03  -0.5672046E 02   0.3217210E 04
 4   0.8170000E 03   0.1850000E 03    0.1539254E 03   0.3107462E 02   0.9656316E 03
 5   0.8880000E 03   0.2110000E 03    0.1697488E 03   0.4125119E 02   0.1701661E 04
 6   0.9230000E 03   0.2190000E 03    0.1775736E 03   0.4142644E 02   0.1716150E 04
 7   0.9140000E 03   0.2130000E 03    0.1755598E 03   0.3744017E 02   0.1401766E 04
 8   0.4750000E 03   0.7400000E 02    0.7833287E 02  -0.4332870E 01   0.1877376E 02
 9   0.6140000E 03   0.1050000E 03    0.1089625E 03  -0.3962540E 01   0.1570172E 02
10   0.1340000E 04   0.2850000E 03    0.2727578E 03   0.1224219E 02   0.1498712E 03
11   0.1290000E 04   0.2900000E 03    0.2610894E 03   0.2891064E 02   0.8358252E 03
12   0.1360000E 04   0.3140000E 03    0.2774504E 03   0.3654956E 02   0.1335870E 04
13   0.7160000E 03   0.9100000E 02    0.1315113E 03  -0.4051132E 02   0.1641167E 04
14   0.7190000E 03   0.1600000E 03    0.1321757E 03   0.2782430E 02   0.7741912E 03
15   0.1130000E 04   0.1250000E 03    0.2242856E 03  -0.9928564E 02   0.9857637E 04
16   0.1090000E 04   0.2320000E 03    0.2151913E 03   0.1680870E 02   0.2825322E 03
17   0.1120000E 04   0.2340000E 03    0.2220085E 03   0.1199147E 02   0.1437953E 03
18   0.1490000E 04   0.2990000E 03    0.3083638E 03  -0.9363770E 01   0.8768018E 02
19   0.9440000E 03   0.1270000E 03    0.1822771E 03  -0.5527711E 02   0.3055559E 04
20   0.8540000E 03   0.1060000E 03    0.1621636E 03  -0.5616359E 02   0.3154349E 04

MAXDIF =  0.4142644E 02
SUM OF (YDIF)**2 =  0.3124833E 05
STDEVY =  0.7216684E 02
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIME02

 ORDER OF RESULTANT POLYNOMIAL =  5

 COEFFICIENTS  A1 = -0.1519516E 01
               A2 =  0.8951050E-01
               A3 = -0.1128464E-06
               A4 = -0.9666386E-10
               A5 = -0.7194446E-13
               A6 = -0.3359391E-16
               A7 =

I        X(I)            Y(I)           YCALC(I)         YDIF(I)         SQYDIF(I)
1   0.1000000E 01   0.1000000E 01   -0.1430005E 01   0.2430005E 01   0.5904924E 01
2   0.8830000E 03   0.6700000E 02    0.7730191E 02  -0.1030191E 02   0.1061293E 03
3   0.7350000E 03   0.1080000E 03    0.6414311E 02   0.4385689E 02   0.1923427E 04
4   0.8170000E 03   0.4400000E 02    0.7143820E 02  -0.2743820E 02   0.7528547E 03
5   0.8880000E 03   0.5500000E 02    0.7774583E 02  -0.2274583E 02   0.5173728E 03
6   0.9230000E 03   0.5000000E 02    0.8085178E 02  -0.3085178E 02   0.9518320E 03
7   0.9140000E 03   0.5800000E 02    0.8005331E 02  -0.2205331E 02   0.4863486E 03
8   0.4750000E 03   0.2900000E 02    0.4095766E 02  -0.1195766E 02   0.1429855E 03
9   0.6140000E 03   0.4800000E 02    0.5336180E 02  -0.5361801E 01   0.2874890E 02
10  0.1340000E 04   0.8300000E 02    0.1176122E 03  -0.3461221E 02   0.1198005E 04
11  0.1290000E 04   0.1080000E 03    0.1132345E 03  -0.5234467E 01   0.2739963E 02
12  0.1360000E 04   0.1210000E 03    0.1193604E 03   0.1639572E 01   0.2688196E 01
13  0.7160000E 03   0.7100000E 02    0.6245139E 02   0.8548615E 01   0.7307880E 02
14  0.7190000E 03   0.3300000E 02    0.6271855E 02  -0.2971855E 02   0.8831921E 03
15  0.1130000E 04   0.1800000E 03    0.9916454E 02   0.8083546E 02   0.6534371E 04
16  0.1090000E 04   0.7900000E 02    0.9563440E 02  -0.1663440E 02   0.2767031E 03
17  0.1120000E 04   0.8200000E 02    0.9828244E 02  -0.1628244E 02   0.2651177E 03
18  0.1490000E 04   0.1340000E 03    0.1306795E 03   0.3320511E 01   0.1102579E 02
19  0.9440000E 03   0.1300000E 03    0.8271416E 02   0.4728584E 02   0.2235951E 04
20  0.8540000E 03   0.1200000E 03    0.7472638E 02   0.4527362E 02   0.2049701E 04


   MAXDIF =  0.8083546E 02
   SUM OF (YDIF)**2 =  0.1847282E 05
   STDEVY =  0.5548695E 02
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIME02

 ORDER OF RESULTANT POLYNOMIAL =  7

 COEFFICIENTS  A1 =  0.8322148E 01
               A2 =  0.6839191E 00
               A3 =  0.4766534E-06
               A4 =  0.3068525E-09
               A5 =  0.1900630E-12
               A6 =  0.1151673E-15
               A7 =  0.5486803E-19
               A8 =  0.2285398E-22
               A9 =

I        X(I)            Y(I)           YCALC(I)         YDIF(I)         SQYDIF(I)
1   0.1000000E 01   0.1000000E 01   0.9006067E 01   -0.8006067E 01   0.6409711E 02
2   0.8830000E 03   0.6160000E 03   0.6130178E 03    0.2982178E 01   0.8893384E 01
3   0.7350000E 03   0.5150000E 03   0.5114727E 03    0.3527344E 01   0.1244215E 02
4   0.8170000E 03   0.5710000E 03   0.5677168E 03    0.3283203E 01   0.1077942E 02
5   0.8880000E 03   0.6220000E 03   0.6164509E 03    0.5549072E 01   0.3079219E 02
6   0.9230000E 03   0.6450000E 03   0.6404880E 03    0.4511963E 01   0.2035780E 02
7   0.9140000E 03   0.6400000E 03   0.6343059E 03    0.5694092E 01   0.3242267E 02
8   0.4750000E 03   0.3720000E 03   0.3333362E 03    0.3866382E 02   0.1494891E 04
9   0.6140000E 03   0.4230000E 03   0.4285393E 03   -0.5539307E 01   0.3068391E 02
10  0.1340000E 04   0.9360000E 03   0.9279727E 03    0.8027344E 01   0.6443825E 02
11  0.1290000E 04   0.9030000E 03   0.8933550E 03    0.9645020E 01   0.9302640E 02
12  0.1360000E 04   0.9520000E 03   0.9418347E 03    0.1016528E 02   0.1033330E 03
13  0.7160000E 03   0.5010000E 03   0.4984456E 03    0.2554443E 01   0.6525181E 01
14  0.7190000E 03   0.5030000E 03   0.5005027E 03    0.2497314E 01   0.6236579E 01
15  0.1130000E 04   0.7900000E 03   0.7828911E 03    0.7108887E 01   0.5053627E 02
16  0.1090000E 04   0.7610000E 03   0.7553357E 03    0.5664307E 01   0.3208437E 02
17  0.1120000E 04   0.7190000E 03   0.7760002E 03   -0.5700024E 02   0.3249028E 04
18  0.1490000E 04   0.1040000E 04   0.1032190E 04    0.7810303E 01   0.6100082E 02
19  0.9440000E 03   0.6600000E 03   0.6549150E 03    0.5084961E 01   0.2585683E 02
20  0.8540000E 03   0.5410000E 03   0.5931091E 03   -0.5210913E 02   0.2715361E 04


   MAXDIF =  0.3866382E 02
   SUM OF (YDIF)**2 =  0.8112781E 04
   STDEVY =  0.3184489E 02
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

 ORDER OF RESULTANT POLYNOMIAL =  7

 COEFFICIENTS  A1 = -0.2698245E 02
               A2 =  0.2212576E 00
               A3 =  0.1872508E-06
               A4 =  0.2391705E-09
               A5 =  0.1197204E-12
               A6 =  0.1544755E-15
               A7 =  0.5849630E-19
               A8 =  0.7786941E-22
               A9 =

 I        X(I)              Y(I)           YCALC(I)          YDIF(I)          SQYDIF(I)
 1    0.1000000E 01    0.1000000E 01   -0.2676118E 02    0.2776118E 02    0.7706833E 03
 2    0.8830000E 03    0.1820000E 03    0.1689147E 03    0.1308533E 02    0.1712258E 03
 3    0.7350000E 03    0.7900000E 02    0.1359243E 03   -0.5692429E 02    0.3240374E 04
 4    0.8170000E 03    0.1850000E 03    0.1541863E 03    0.3081372E 02    0.9494854E 03
 5    0.8880000E 03    0.2110000E 03    0.1700317E 03    0.4096831E 02    0.1678402E 04
 6    0.9230000E 03    0.2190000E 03    0.1778569E 03    0.4114314E 02    0.1692758E 04
 7    0.9140000E 03    0.2130000E 03    0.1758437E 03    0.3715630E 02    0.1380590E 04
 8    0.4750000E 03    0.7400000E 02    0.7819366E 02   -0.4193665E 01    0.1758681E 02
 9    0.6140000E 03    0.1050000E 03    0.1090318E 03   -0.4031830E 01    0.1625565E 02
10    0.1340000E 04    0.2850000E 03    0.2724099E 03    0.1259009E 02    0.1585103E 03
11    0.1290000E 04    0.2900000E 03    0.2608796E 03    0.2912036E 02    0.8479954E 03
12    0.1360000E 04    0.3140000E 03    0.2770432E 03    0.3695679E 02    0.1365804E 04
13    0.7160000E 03    0.9100000E 02    0.1316977E 03   -0.4069769E 02    0.1656302E 04
14    0.7190000E 03    0.1600000E 03    0.1323649E 03    0.2763509E 02    0.7636978E 03
15    0.1130000E 04    0.1250000E 03    0.2244076E 03   -0.9940761E 02    0.9881871E 04
16    0.1090000E 04    0.2320000E 03    0.2153676E 03    0.1663237E 02    0.2766355E 03
17    0.1120000E 04    0.2340000E 03    0.2221452E 03    0.1185484E 02    0.1405373E 03
18    0.1490000E 04    0.2990000E 03    0.3075312E 03   -0.8531250E 01    0.7278223E 02
19    0.9440000E 03    0.1270000E 03    0.1825570E 03   -0.5555704E 02    0.3086584E 04
20    0.8540000E 03    0.1060000E 03    0.1624394E 03   -0.5643938E 02    0.3185403E 04


 MAXDIF =  0.4114314E 02
 SUM OF (YDIF)**2 =  0.3135345E 05
 STDEVY =  0.6260336E 02
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

 ORDER OF RESULTANT POLYNOMIAL =  7

 COEFFICIENTS  A1 = -0.1491039E 01
               A2 =  0.8939523E-01
               A3 = -0.6792959E-07
               A4 = -0.5806035E-10
               A5 = -0.3931361E-13
               A6 = -0.2919287E-16
               A7 = -0.1581745E-19
               A8 = -0.7568317E-23
               A9 =

 I        X(I)              Y(I)           YCALC(I)          YDIF(I)          SQYDIF(I)
 1    0.1000000E 01    0.1000000E 01   -0.1401644E 01    0.2401644E 01    0.5767892E 01
 2    0.8830000E 03    0.6700000E 02    0.7730173E 02   -0.1030173E 02    0.1061256E 03
 3    0.7350000E 03    0.1080000E 03    0.6413356E 02    0.4386644E 02    0.1924264E 04
 4    0.8170000E 03    0.4400000E 02    0.7143312E 02   -0.2743312E 02    0.7525759E 03
 5    0.8880000E 03    0.5500000E 02    0.7774603E 02   -0.2274603E 02    0.5173818E 03
 6    0.9230000E 03    0.5000000E 02    0.8085500E 02   -0.3085500E 02    0.9520305E 03
 7    0.9140000E 03    0.5800000E 02    0.8005574E 02   -0.2205574E 02    0.4864556E 03
 8    0.4750000E 03    0.2900000E 02    0.4094716E 02   -0.1194716E 02    0.1427346E 03
 9    0.6140000E 03    0.4800000E 02    0.5334929E 02   -0.5349289E 01    0.2861488E 02
10    0.1340000E 04    0.8300000E 02    0.1176337E 03   -0.3463368E 02    0.1199492E 04
11    0.1290000E 04    0.1080000E 03    0.1132600E 03   -0.5260040E 01    0.2766801E 02
12    0.1360000E 04    0.1210000E 03    0.1193792E 03    0.1620834E 01    0.2627104E 01
13    0.7160000E 03    0.7100000E 02    0.6244107E 02    0.8558929E 01    0.7325526E 02
14    0.7190000E 03    0.3300000E 02    0.6270831E 02   -0.2970831E 02    0.8825837E 03
15    0.1130000E 04    0.1800000E 03    0.9918639E 02    0.8081361E 02    0.6530840E 04
16    0.1090000E 04    0.7900000E 02    0.9565303E 02   -0.1665303E 02    0.2773232E 03
17    0.1120000E 04    0.8200000E 02    0.9830351E 02   -0.1630351E 02    0.2658044E 03
18    0.1490000E 04    0.1340000E 03    0.1306603E 03    0.3339706E 01    0.1115364E 02
19    0.9440000E 03    0.1300000E 03    0.8271927E 02    0.4728073E 02    0.2235468E 04
20    0.8540000E 03    0.1200000E 03    0.7472392E 02    0.4527608E 02    0.2049923E 04


 MAXDIF =  0.8081361E 02
 SUM OF (YDIF)**2 =  0.1847206E 05
 STDEVY =  0.4805212E 02
```

```
SOLUTION OF LINEAR SIMULTANEUUS EQUATIONS--PROG SIME02

 ORDER OF RESULTANT POLYNOMIAL =  9

 COEFFICIENTS  A1 =  0.8334039E 01
               A2 =  0.6842142E 00
               A3 =  0.1752197E-06
               A4 =  0.2458962E-09
               A5 =  0.1730400E-12
               A6 =  0.7965146E-16
               A7 =  0.4110573E-19
               A8 =  0.3646344E-22
               A9 =  0.2835325E-25
               A10 =  0.1187140E-28


 I        X(I)              Y(I)            YCALC(I)          YDIF(I)          SQYDIF(I)
 1    0.1000000E 01     0.1000000E 01    0.9018252E 01   -0.8018252E 01    0.6429236E 02
 2    0.8830000E 03     0.6160000E 03    0.6129966E 03    0.3003418E 01    0.9020519E 01
 3    0.7350000E 03     0.5150000E 03    0.5115037E 03    0.3496338E 01    0.1222438E 02
 4    0.8170000E 03     0.5710000E 03    0.5677219E 03    0.3278076E 01    0.1074578E 02
 5    0.8880000E 03     0.6220000E 03    0.6164280E 03    0.5572021E 01    0.3104741E 02
 6    0.9230000E 03     0.6450000E 03    0.6404512E 03    0.4548828E 01    0.2069183E 02
 7    0.9140000E 03     0.6400000E 03    0.6342729E 03    0.5727051E 01    0.3279910E 02
 8    0.4750000E 03     0.3720000E 03    0.3334119E 03    0.3858813E 02    0.1489044E 04
 9    0.6140000E 03     0.4230000E 03    0.4285991E 03   -0.5599121E 01    0.3135014E 02
10    0.1340000E 04     0.9360000E 03    0.9279692E 03    0.8030762E 01    0.6449313E 02
11    0.1290000E 04     0.9030000E 03    0.8932935E 03    0.9706543E 01    0.9421696E 02
12    0.1360000E 04     0.9520000E 03    0.9418640E 03    0.1013599E 02    0.1027382E 03
13    0.7160000E 03     0.5010000E 03    0.4984824E 03    0.2517578E 01    0.6338200E 01
14    0.7190000E 03     0.5030000E 03    0.5005386E 03    0.2461426E 01    0.6058617E 01
15    0.1130000E 04     0.7900000E 03    0.7827849E 03    0.7215088E 01    0.5205748E 02
16    0.1090000E 04     0.7610000E 03    0.7552375E 03    0.5762451E 01    0.3320584E 02
17    0.1120000E 04     0.7190000E 03    0.7758958E 03   -0.5689575E 02    0.3237126E 04
18    0.1490000E 04     0.1040000E 04    0.1032615E 04    0.7384766E 01    0.5453476E 02
19    0.9440000E 03     0.6600000E 03    0.6548694E 03    0.5130615E 01    0.2632321E 02
20    0.8540000E 03     0.5410000E 03    0.5930999E 03   -0.5209985E 02    0.2714395E 04


  MAXDIF =  0.3858813E 02
  SUM OF (YDIF)**2 =  0.8092695E 04
  STDEVY =  0.2844766E 02
```

```
SOLUTION OF LINEAR SIMULTANEUUS EQUATIONS--PROG SIME02

 ORDER OF RESULTANT POLYNOMIAL =  9

 COEFFICIENTS  A1 = -0.2720018E 02
               A2 =  0.2219570E 00
               A3 = -0.6961551E-07
               A4 =  0.3701971E-10
               A5 =  0.1054364E-12
               A6 =  0.1194370E-15
               A7 =  0.1354627E-19
               A8 =  0.2134880E-22
               A9 =  0.3000318E-25
               A10 =  0.4156218E-28


 I        X(I)              Y(I)            YCALC(I)          YDIF(I)          SQYDIF(I)
 1    0.1000000E 01     0.1000000E 01   -0.2697821E 02    0.2797821E 02    0.7827800E 03
 2    0.8830000E 03     0.1820000E 03    0.1689272E 03    0.1307278E 02    0.1708977E 03
 3    0.7350000E 03     0.7900000E 02    0.1359814E 03   -0.5698143E 02    0.3246883E 04
 4    0.8170000E 03     0.1850000E 03    0.1542247E 03    0.3077527E 02    0.9471169E 03
 5    0.8880000E 03     0.2110000E 03    0.1700419E 03    0.4095805E 02    0.1677562E 04
 6    0.9230000E 03     0.2190000E 03    0.1778490E 03    0.4115100E 02    0.1693405E 04
 7    0.9140000E 03     0.2130000E 03    0.1758407E 03    0.3715927E 02    0.1380811E 04
 8    0.4750000E 03     0.7400000E 02    0.7822627E 02   -0.4226273E 01    0.1786137E 02
 9    0.6140000E 03     0.1050000E 03    0.1090917E 03   -0.4091660E 01    0.1674167E 02
10    0.1340000E 04     0.2850000E 03    0.2721763E 03    0.1282373E 02    0.1644481E 03
11    0.1290000E 04     0.2900000E 03    0.2606360E 03    0.2936401E 02    0.8622451E 03
12    0.1360000E 04     0.3140000E 03    0.2768232E 03    0.3717676E 02    0.1382111E 04
13    0.7160000E 03     0.9100000E 02    0.1317571E 03   -0.4075706E 02    0.1661138E 04
14    0.7190000E 03     0.1600000E 03    0.1324240E 03    0.2757599E 02    0.7604351E 03
15    0.1130000E 04     0.1250000E 03    0.2242507E 03   -0.9925073E 02    0.9850707E 04
16    0.1090000E 04     0.2320000E 03    0.2152425E 03    0.1675749E 02    0.2808135E 03
17    0.1120000E 04     0.2340000E 03    0.2219962E 03    0.1200383E 02    0.1440919E 03
18    0.1490000E 04     0.2990000E 03    0.3076091E 03   -0.8609131E 01    0.7411713E 02
19    0.9440000E 03     0.1270000E 03    0.1825371E 03   -0.5553706E 02    0.3084365E 04
20    0.8540000E 03     0.1060000E 03    0.1624646E 03   -0.5646455E 02    0.3188246E 04


  MAXDIF =  0.4115100E 02
  SUM OF (YDIF)**2 =  0.3138673E 05
  STDEVY =  0.5602385E 02
```

```
SOLUTION OF LINEAR SIMULTANEOUS EQUATIONS--PROG SIMEQ2

 ORDER OF RESULTANT POLYNOMIAL =  9

 COEFFICIENTS  A1 = -0.1511896E 01
               A2 =  0.8935070E-01
               A3 = -0.2443136E-07
               A4 = -0.3781883E-10
               A5 = -0.3937708E-13
               A6 = -0.2212596E-16
               A7 = -0.1148678E-19
               A8 = -0.1046890E-22
               A9 = -0.8185138E-26
               A10 = -0.3945437E-29


I        X(I)              Y(I)            YCALC(I)          YDIF(I)          SQYDIF(I)
1    0.1000000E 01    0.1000000E 01   -0.1422545E 01    0.2422545E 01    0.5868726E 01
2    0.8830000E 03    0.6700000E 02    0.7728966E 02   -0.1028966E 02    0.1058770E 03
3    0.7350000E 03    0.1080000E 03    0.6411238E 02    0.4388762E 02    0.1926123E 04
4    0.8170000E 03    0.4400000E 02    0.7141682E 02   -0.2741682E 02    0.7516821E 03
5    0.8880000E 03    0.5500000E 02    0.7773430E 02   -0.2273430E 02    0.5168481E 03
6    0.9230000E 03    0.5000000E 02    0.8084549E 02   -0.3084549E 02    0.9514441E 03
7    0.9140000E 03    0.5800000E 02    0.8004568E 02   -0.2204568E 02    0.4860122E 03
8    0.4750000E 03    0.2900000E 02    0.4091728E 02   -0.1191728E 02    0.1420216E 03
9    0.6140000E 03    0.4800000E 02    0.5332271E 02   -0.5322708E 01    0.2833121E 02
10   0.1340000E 04    0.8300000E 02    0.1175728E 03   -0.3457280E 02    0.1195278E 04
11   0.1290000E 04    0.1080000E 03    0.1132235E 03   -0.5223541E 01    0.2728537E 02
12   0.1360000E 04    0.1210000E 03    0.1193056E 03    0.1694351E 01    0.2870826E 01
13   0.7160000E 03    0.7100000E 02    0.6241891E 02    0.8581085E 01    0.7363501E 02
14   0.7190000E 03    0.3300000E 02    0.6268631E 02   -0.2968631E 02    0.8812769E 03
15   0.1130000E 04    0.1800000E 03    0.9918143E 02    0.8081857E 02    0.6531641E 04
16   0.1090000E 04    0.7900000E 02    0.9564938E 02   -0.1664938E 02    0.2772019E 03
17   0.1120000E 04    0.8200000E 02    0.9829907E 02   -0.1629907E 02    0.2656597E 03
18   0.1490000E 04    0.1340000E 03    0.1304466E 03    0.3553391E 01    0.1262658E 02
19   0.9440000E 03    0.1300000E 03    0.8271104E 02    0.4728896E 02    0.2236245E 04
20   0.8540000E 03    0.1200000E 03    0.7470999E 02    0.4529001E 02    0.2051185E 04


 MAXDIF =  0.8081857E 02
 SUM OF (YDIF)**2 =  0.1846908E 05
 STDEVY =  0.4297566E 02


                  PROGRAM BY----

                       RONALD M. BRIMHALL
                       BOX 31 CAMPUS STA.
                       SOCORRO, N. M.     87801


           PROGRAM TIME IN MINUTES =  0.1736836E 03
/&
JOB TIME SUMMARY...COMPILE 0128S   ASSEMBLE 0000S   LNKEDT 0017S   UTILS 0000S   USER 0182S        TOTAL TIME  005M 27S
```

Microlog Mud Cake
Correction--MUDCAK

The preliminary program for reducing mud cake correction charts, as they appear in interpretation-chart manuals, to equation form for use in machine computations was accomplished by using the program MUDCAK. MUDCAK calculates the coefficients for a 6th order and seven term polynomial for a given mudcake thickness. Mud cake thickness and the ratios of microinverse resistivity to mud cake resistivity and micronormal resistivity to mud cake resistivity are the parameters for calculating the ratio flushed zone resistivity to mud cake resistivity [Schlumberger, 1968]. The "apparent" true flushed zone resistivity can be calculated because mud cake resistivity is known. The example presented is for a mud cake thickness of 1/8 inches; the mud cake thickness used exclusively for the machine interpretations. Knowledge of the physical character of drilling fluid, and the type of lithology and qualitative permeability characteristics of aquifers are necessary before MUDCAK is applied. Comments within MUDCAK explain the execution of the program.

For the purpose of allowing me the maximum in discretionary authority in applying computer techniques to water well log interpretations, DATFIT and MUDCAK are not written into the adjunctive interpretation programs as subroutines.

```
FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118       NEW MEXICO TECH     PAGE  0001
                 C            014P,10,B58,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
                 C       R. M. BRIMHALL  RXO/RMC VS R2/RMC COEFFICIENTS TMC = 1/8 IN.
                 C
                 C       PROGRAM MUDCAK
                 C
                 C       PURPOSE OF MUDCAK--REDUCES PORTION OF MUDCAKE CORRECTION CHART TO
                 C       EQUATION FORM FOR USE IN PROGRAMS NAMED 8ODEAP' AND EVALCO.
                 C
                 C       ****************************************************************
                 C       REFERENCE--BRIMHALL, R. M., DIGITAL ANALYSIS  OF BOREHOLE-
                 C       MEASURED AQUIFER RESISTIVITY TO DETERMINE WATER QUALITY, UN-
                 C       PUBLISHED MASTER OF SCIENCE THESIS, NEW MEXICO INSTITUTE OF
                 C       MINING AND TECHNOLOGY, SOCORRO, JUNE, 1969.
                 C       ****************************************************************
                 C
                 C       SOLVE LINEAR SIMULTANEOUS EQUATIONS.
                 C
                 C       ****************************************************************
                 C       NOMENCLATURE--
                 C
                 C            N = NUMBER OF DATA POINTS.
                 C            I = ITERATION INDEX.
                 C            KS = OUTPUT DIGIT INDICATES A SINGULAR SET OF EQUATIONS IN
                 C               SIMQ.
                 C            X(I) = SUBSCRIPTED VARIABLE NAME FOR RMN/RMC.
                 C            Y(I) = SUBSCRIPTED VARIABLE NAME FOR RMI/RMC.
                 C            B(I) = VECTOR OF ORIGINAL CONSTANTS IN SUM(X(I)**I/Y(I)) =
                 C              B(I) = 1.0
                 C            A(I,I) = MATRIX OF COEFFICIENTS IN SIMQ.
                 C
                 C            SIMQ = SUBROUTINE SIMQ--USED TO OBTAIN A SOLUTIOON OF A SET
                 C              OF SIMULTANEOUS LINEAR EQUATIONS AX=B.  SOURCE--SUBROUTINES
                 C         AND FUNCTIONS AVAILABLE ON LINE AT NEW MEXICO INSTITUTE OF
                 C         MINING AND TECHNOLOGY, COMP. SCI. DEPT., MAY 1, 1968.
                 C       ****************************************************************
                 C
                 C       ##########  PROGRAM MUDCAK  ##########
   0001                  CALL CLOCK(T1)
   0002                  TMC = 0.125
   0003                  DIMENSION X(7),Y(7),B(7),A(7,7)
   0004                      N = 7
                 C
                 C       READ CHART DATA
   0005                       READ(5,1)(X(I),Y(I), I = 1,N)
   0006               1      FORMAT(2F6.2)
                 C
                 C       SET UP A MATRIX
   0007                      DO 10 I = 1,N
   0008                      A(I,1) = X(I)**6/Y(I)
   0009                      A(I,2) = X(I)**5/Y(I)
   0010                      A(I,3) = X(I)**4/Y(I)
   0011                      A(I,4) = X(I)**3/Y(I)
   0012                      A(I,5) = X(I)**2/Y(I)
   0013                      A(I,6) = X(I)/Y(I)
   0014                      A(I,7) = 1.0/Y(I)
                 C
                 C       SET UP B VECTOR
   0015                      B(I) = 1.0
   0016              10      CONTINUE
                 C


FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118       NEW MEXICO TECH     PAGE  0002
                 C       CALCULATE COEFFICIENTS FOR SUM(A(I)*X**(I-1)), I=1,N.
   0017                      CALL SIMQ(A,B,N,KS)
   0018                      IF(KS.NE.0.0)GO TO 7
   0019                      N = 7
                 C
                 C       WRITE STATEMENTS FOR IDENTIFICATION PURPOSES.
   0020                  WRITE(6,4)
   0021                4 FORMAT('4',10X,'COEFFICIENTS FOR A MUD CAKE CORRECTION EQUATION OF
                        * FORM RXO = (SUM(A(I)*(RMN(I)/RMC(I))**(I-1))/RMC(I))  I=1,7')
   0022                  WRITE(6,5)
   0023                5 FORMAT(//15X,'ADAPTED FROM SCHLUMBERGER LOG INTERPRETATION CHARTS,
                        * 1968, PAGE 34.')
   0024                  WRITE(6,6) TMC
   0025                6 FORMAT(//20X,'MUD CAKE THICKNESS FOR WHICH THIS CORRECTION IS VALI
                        *D = ',E11.4)
   0026                      WRITE(6,2)(B(I), I = 1,N)
   0027                2     FORMAT(///,24X,'A = ',E14.7,//25X,'B = ',E14.7,//25X,'C = ',
                        *     E14.7,//25X,'D = ',E14.7,//25X,'E = ',E14.7,//25X,'F = ',E14.7
                        *     ,//25X,'G = ',E14.7)
   0028                      GO TO 11
   0029                7     WRITE(6,3)
   0030                3     FORMAT(24X,'KS = ',E14.7,5X,'SINGULAR SET')
   0031               11 CONTINUE
   0032                  CALL CLOCK(T2)
   0033                  TIME = T1-T2
   0034                  WRITE(6,12)TIME
   0035               12 FORMAT(/////20X,'PROGRAM EXECUTION TIME = ',E14.7)
   0036                  STOP
   0037                  END


                                           SCALAR MAP
 SYMBOL      LOCATION        SYMBOL     LOCATION      SYMBOL     LOCATION        SYMBOL     LOCATION        SYMBOL     LOCATION
 T1          000104          TMC        000108        N          00010C          I          000110          KS         000114
 T2          000118          TIME       00011C

                                           ARRAY MAP
 SYMBOL      LOCATION        SYMBOL     LOCATION      SYMBOL     LOCATION        SYMBOL     LOCATION        SYMBOL     LOCATION
 X           000120          Y          00013C        B          000158          A          000174

                                           SUBPROGRAMS CALLED
 SYMBOL      LOCATION        SYMBOL     LOCATION      SYMBOL     LOCATION        SYMBOL     LOCATION        SYMBOL     LOCATION
 CLOCK       000238          IBCOM#     00023C        SIMQ       000240

                                           LABEL MAP
 LABEL       LOCATION        LABEL      LOCATION      LABEL      LOCATION        LABEL      LOCATION        LABEL      LOCATION
     1       0002DC             10      000376            4      0003D8              5      00046C              6      0004DC
     2       00056C              7      0005D8            3      0005EC             11      000612             12      000648

   TOTAL MEMORY REQUIREMENTS 0006C0 BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
// EXEC LNKEDT(MAP)
```

```
COEFFICIENTS FOR A MUD CAKE CORRECTION EQUATION OF FORM RXO = (SUM(A(I)*(RMN(I)/RMC(I))**(I-1))/RMC(I))  I=1,7

     ADAPTED FROM SCHLUMBERGER LOG INTERPRETATION CHARTS, 1968, PAGE 34.

          MUD CAKE THICKNESS FOR WHICH THIS CORRECTION IS VALID =  0.1250E 00

               A = -0.3299839E-04
                B =  0.1307268E-01
                C = -0.2115985E 00
                D =  0.1284551E 01
                E = -0.3342364E 01
                F =  0.5336034E 01
                G = -0.1959661E 01


          PROGRAM EXECUTION TIME =  0.7132812E 01
/&
JOB TIME SUMMARY...COMPILE 0036S   ASSEMBLE 0000S   LNKEDT 0023S   UTILS 0000S   USER 0015S        TOTAL TIME  001M 14S
```

Adjunctive Interpretation Programs

Adjunctive interpretation programs were written for each geographic area studied: BODEAP for the Bosque del Apache Grant, Socorro County, New Mexico; EVALCO for eastern Valencia County, New Mexico; and HUEBO1 [Brimhall, 1969] and HUEBO2 for the Hueco Bolson near El Paso, Texas. HUEBO1 applies the F-Method of interpretation; HUEBO2 applies the FF-Method. Each program presents the results in tabular and graphic (computer plot) form; each contains sufficient comments to explain its function and execution.

These programs are easily modified for application to geographic areas other than those discussed.

USGS Test Well #B-6A(Relocated)

```
FORTRAN IV     MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118        NEW MEXICO TECH     PAGE  0001
C               014P,10,B58,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
C         RONALD M. BRIMHALL - ELECTRIC LOG INTERPRETATION PROGRAM
C         WATER QUALITY & POROSITY ESTIMATIONS FROM INDUCTION & MICROLOG
C
C         ------------------------------------------------------------------
C         THIS PROGRAM PRINTS OUT SPECIFIC CONDUCTANCE IN THE RESULTS
C         ------------------------------------------------------------------
C
C
C         $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C         SOCORRO COUNTY NEW MEXICO WATER WELL (USGS TEST WELL #B-6A (RELO.)
C         $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
C
C
C
C
C
C         ******************************************************************
C         PURPOSE OF BODEAP---
C              BODEAP DETERMINES QUANTITATIVE VALUES OF PARAMETERS RELATING
C         TO WATER QUALITY--TOTAL DISSOLVED SOLIDS, SULFATE, AND CHLORIDE
C         CONCENTRATIONS IN UNITS OF PARTS PER MILLION.  BODEAP IS APPLI-
C         CABLE TO THE BOSQUE DEL APACHE GRANT, SOCORRO COUNTY, NEW MEXICO
C         (BRIMHALL, 1969,, COOPER, 1968).  RESISTIVITY DATA FROM A MACRO-
C         RESISTIVITY LOG AND A MICROLOG ARE NECESSARY FOR BODEAP.  THE
C         APPARENT FORMATION RESISTIVITY FACTOR METHOD FOR CALCULATING
C         QUANTITATIVE VALUES OF TDS, ETC. IS USED IN BODEAP.  WATER AT EACH
C         DATA POINT IS CLASSIFIED AS TO ITS ACCEPTABILITY BASED ON US
C         PUBLIC HEALTH SERVICE STANDARDS (TODD, 1959).  EACH AQUIFER UNIT
C         IS EXAMINED FOR CLAY AND A POROSITY INDEX IS DETERMINED.  CALCU-
C         CATION RESULTS ARE PRESENTED IN TABLE AND LOG FORM.
C
C
C         ******************************************************************
C         REFERENCES---
C
C         BRIMHALL, R. M., DIGITAL ANALYSIS  OF BOREHOLE-MEASURED AQUIFER
C         RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER OF
C         SCIENCE THESIS, N. MEX. INST. MINING AND TECH., SOCORRO, JUNE 1969.
C
C         COOPER, J. B., GROUND-WATER EXPLORATION IN THE BOSQUE DEL APACHE
C         GRANT, SOCORRO COUNTY, NEW MEXICO, USGS OPEN FILE REPORT,
C         ALBUQUERQUE, 1968.
C
C         TODD, D. K., GROUND WATER HYDROLOGY, WILEY, NEW YORK, 1959.
C         ******************************************************************
C
C
C
C         ******************************************************************
C         NOMENCLATURE--
C
C              SCACAR QUANTITIES--
C         T1 = INITIAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
C         N = NUMBER OF DATA POINTS AND DO 200 ITERATIONS.
C         K = SUBSCRIPT FOR SUBSCRIPTED VARIABLES.
C         AVTEMP = AVERAGE SURFACE TEMPERATURE FOR CALCULATING GRAD.
C         TD = TOTAL DEPTH OF WELL FOR CALCULATING GRAD.
C         BHT = BOTTOM HOLE TEMPERATUEE FOR CALCULATING GRAD.
C         RMF = MUD FILTRATE RESISTIVITY--OHM-METERS.
```

```
FORTRAN IV     MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118        NEW MEXICO TECH     PAGE  0002
C         AM = CEMENTATION EXPONENT IN F = A/POR**AM.
C         RMC = MUD CAKE RESISTIVITY--OHM-METERS.
C         A = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
C         B = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
C         C = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
C         D = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
C         E = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
C         Q = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
C         G = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
C         GRAD = TEMPERATURE GRADIENT OF AQUIFER.
C         Y = ORDINATE POSITION OF FPN--INCHES.
C         HEIGHT = HEIGHT OF NUMERICS WRITTEN BY CALL NUMBER--INCHES.
C         THETA = ANGLE WITH RESPECT TO CAL COMP COORDINATES FOR WRITING
C              FPN--DEGREES.
C         NN = NUMBER OF ØECIMAL DIGITS TO RIGHT OF DECIMAL IN FPN (-1 SUP-
C              PRESSES DECIMAL POINT.)
C         I = SUBSCRIPT FOR ABSCISSA OF FPN.
C         T2 = FINAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
C         TIME = PROGRAM EXECUTION TIME--SECONDS.
C
C
C         SUBSCRIPTED VARIABLES---
C
C         IDATA = DATA POINT NUMBER.
C         JDEPTH = DATA PUINT DEPTH----FEET.
C         RMN = MICRONORMAL RESISTIVITY READ FROM MICROLOG--OHM-METERS.
C         RO = DEEP INDUCTION RESISTIVITY--OHM-METERS.
C         F = APPARENT FORMATION RESISTIVITY FACTOR.
C         TDS = TOTAL DISSOLVED SOLIDS CONCENTRATION--PPM.
C         RW = WATER RESISTIVITY--OHM-METERS.
C         POR = POROSITY INDEX CALCULATED FROM F = A/POR**AM.
C         SPCOND = SPECIFIC CONDUCTANCE OF WATER--MICROMHOS/CM.
C         CL = CHLORIDE CUNCENTRATION--PPM.
C         SO4 = SULFATE CUNCENTRATION--PPM.
C         RXOC = MICRONORMAL RESISTIVITY CORRECTED FOR TEMPERATURE AND
C                MUDCAKE--OHM/METERS.
C         ROC = TEMPERATURE CORRECTED DEEP INDUCTION RESISTIVITY--OHM-METERS
C         TDSP = TDS RESCALED FOR PLOT--INCHES.
C         SO4P = SO4 RESCALED FOR PLOT--INCHES.
C         PORP = POROSITY INDEX RESCALLED FOR PLOT--INCHES.
C         ABC = DATA POINT DEPTH RESCALED TO 2 INCHES/100 FEET.
C         X = ABSCISSA POSITION OF FPN--INCHES.
C         FPN = DEPTH LABEL--A FLOATING POINT NUMBER.
C         RMI1 = MICROINVERSE RESISTIVITY AS READ FORM MICROLOG--OHM-METERS.
C         RXOR = 1.15*RMN--AN EMPIRICAL RESISTIVITY USED TO DEFINE AQUIFER
C         UNITS THAT MAY BE CLASSIFIED AS SANDY-CLAY.
C         SP = DEFLECTION OF SP CURVE FROM LEFT EDGE OF TRACK I--INCHES.
C         W = RATIO RMN/RMC--A PARAMETER IN MUD CAKE CORRECTIONS.
C         RXO1 = MICRONORMAL RESISTIVITY CORRECTED FOR MUD CAKE--OHM-METERS.
C         ******************************************************************
C
C
C         ******************************************************************
C         SUBPROGRAMS CALLED--
C
C              CLOCK
C              IBCOM#
C              SETMSG
C              PLOT
C              NUMBER
```

```
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C           FRXPR#
C      ************************************************************************
C
C
C
       CALL CLOCK(T1)
       DIMENSION IDATA(300),JDEPTH(300),RMN(300),RO(300),F(300),TDS(300),
      *RW(300),POR(300),SPCOND(300),CL(300),RXOC(300),ROC(300),TDSP(300),
      *SO4P(300),PORP(300),ABC(300),X(6),FPN(6)
      *,SO4(300)
      *,RMI1(300),RXOR(300)
      *,SP(300)
      *,W(300),RXO1(300)
C
C      PARAMETRIC DATA.
       N = 241
       AVTEMP = 72.
       TD = 509
       BHT = 84.
       RMF = 3.28
       AM = 1.5
       RMC = 6.5
C
C      READ FROM DATA CARDS--DATA POINT NUMBER, DEPTH, MICORNORMAL,
C      INDUCTION, AND MICROINVERSE RESISTIVITIES, AND SP.
       READ(5,1)(IDATA(K),JDEPTH(K),RMN(K),RO(K),RMI1(K),SP(K),K=1,N)
     1 FORMAT(2I4,3F5.1,F4.2)
C
C      WRITE PROBLEM IDENTIFICATION .
       WRITE(6,2)
     2 FORMAT('9',///40X,'SOCORRO COUNTY, NEW MEXICO WATER WELL',//49X,'U
      *SGS TEST WELL #8-6A (RELOCATED)')
C
C      WRITE SOME PARAMETRIC DATA.
       WRITE(6,600)
   600 FORMAT(///29X,'RMF = 3.3 OHM-M @ 79F',/31X,'M = 1.5',////)
C
C      LABEL LINE PRINTER OUTPUT.
       WRITE(6,610)
   610 FORMAT(     4X,'DATA',5X,'DEPTH',5X,'RMN',7X,'RO',3X,'*',3X,'F',6X,
      *'POR',4X,'SPCOND',7X,'TDS',8X,'CL',7X,'SO4',6X,'REMARKS')
C
C      CONSTANTS FOR MUD CAKE THICKNESS OF 1/8 INCHES
       A = -0.3299839E-04
       B = +0.1307268E-01
       C = -0.2115985E+00
       D = 0.1284551E+01
       E = -0.3342364E+01
       Q = +0.5336034E+01
       G = -0.1959661E+01
C
C      DETERMINE TEMPERATURE GRADIENT.
       GRAD = (BHT-AVTEMP)/TD
C
C      PRIMARY DO LOOP.
       DO 40 K = 1,N
C
C      MUDCAKE CORRECTION FOR TMC = 1/8 INCH ASSUMED
       W(K) = RMN(K)/RMC
       RXO1(K) = (A*W(K)**6+B*W(K)**5+C*W(K)**4+D*W(K)**3+E*W(K)**2+Q*W(K


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      *)+G)*RMC
C
C      ADAPTED FROM SCHLUMBERGER, 'LOG INTERPRETATION CHARTS', P. 34,
C      1968.
       IF(RXO1(K).LE.0.0)GO TO 611
C
C      TEMPERATURE CORRECTIONS TO RO, RXO1, RMI1.
C            TEMPERATURE CORRECTIONS ARE TO 77 F.
   700  ROC(K) = RO(K)*(AVTEMP + GRAD*JDEPTH(K))/77.
       RXOR(K) = 1.15*RMN(K)
       RXOC(K) = RXO1(K)*(AVTEMP+GRAD*JDEPTH(K))/77.
       RMI1(K) = RMI1(K)*(AVTEMP+GRAD*JDEPTH(K))/77.
       GO TO 701
   611 RXO1(K) = RMN(K)
       GO TO 700
C
C      DETERMINE APPARENT FORMATION RESISTIVITY FACTOR.
   701 F(K) = RXOC(K)/RMF
C
C      DETERMINE WATER RESISTIVITY.
       RW(K) = ROC(K)/F(K)
C
C      DETERMINE WATER SPECIFIC CONDUCTANCE.
       SPCOND(K) = 10000.00/RW(K)
C
C      SELECT PROPER INTERPRETATION CONTROL EQUATIONS.
       IF(SPCOND(K).LT.2700.)GO TO 6000
       IF(SPCOND(K).GE.2700..AND.SPCOND(K).LE.3440.)GO TO 6010
       IF(SPCOND(K).GT.3440.)GO TO 6020
  6000 TDS(K) = 0.705*SPCOND(K)
  6001 SO4(K) = 0.222*SPCOND(K)
  6002 CL(K) = 0.079*SPCOND(K)
       GO TO 705
  6010 TDS(K) = 0.705*SPCOND(K)
  6011 SO4(K) = 0.1395*SPCOND(K) + 225.
  6012 CL(K) = 0.079*SPCOND(K)
       GO TO 705
  6020 TDS(K) = 0.705*SPCOND(K)
  6021 SO4(K) = 0.1395*SPCOND(K) + 225.
  6022 CL(K) = 0.408*SPCOND(K) - 1170.
       GO TO 705
C
C      DETERMINE POROSITY INDEX.
   705 POR(K) = 50.0/(F(K)**(1.0/AM))
C
C      CLAY IDENTIFICATION POROSITY INDEX = 65%.
       IF(POR(K).GT.65.)POR(K) = 65.
C
C      RESCALE ABC, POR, TDS, SO4 FOR PLOT.
C
C      POROSITY, TRACK II, 100 - 0%.
C      TDS, SO4, TRACKS II & III, 5000 - 0 PPM.
C      SP, TRACK I, 10 MILLIVOLTS PER LOG DIVISION.
       ABC(K) = JDEPTH(K)*0.02
       PORP(K) = (5.75 - (2.5E-02)*POR(K))
       TDSP(K) = (8.25 - (1.0E-03)*TDS(K))
       SO4P(K) = (8.25 - (1.0E-03)*SO4(K))
C
C      TEST FOR CLAY.
       IF(RMI1(K).GT.RXOR(K))GO TO 800
```

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0062                IF(RMI1(K).LE.RXOR(K).AND.RMI1(K).GE.RMN(K).AND.TDS(K).LT.775..AND
                   *.TDS(K).GE.500..AND.SO4(K).LT.250.)GO TO 810
0063                IF(RMI1(K).LT.RMN(K))GO TO 3
             C
             C      IF NO CLAY, TEST AND CLASSIFY WATER QUALITY.
0064              3 IF(TDS(K).GE.1000.)GO TO 4
0065                IF(SO4(K).GE.250.)GO TO 4
0066                IF(TDS(K).LT.775..AND.TDS(K).GE.500.)GO TO 6
0067                IF(TDS(K).LT.500.)GO TO 5
0068              4 WRITE(6,10)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),T
                   *DS(K),CL(K),SO4(K)
0069             10 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                   *7.0,2(5X,F5.0),5X,'NACCEPT')
0070                GO TO 40
0071              5 WRITE(6,20)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),T
                   *DS(K),CL(K),SO4(K)
0072             20 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                   *7.0,2(5X,F5.0),4X,'GOOD-SCREEN')
0073                GO TO 40
0074              6 WRITE(6,30)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),T
                   *DS(K),CL(K),SO4(K)
0075             30 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                   *7.0,2(5X,F5.0),5X,'PACCEPT')
0076                GO TO 40
0077            800 WRITE(6,910)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),
                   *TDS(K),CL(K),SO4(K)
0078            910 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                   *7.0,2(5X,F5.0),6X,'NACCEPT-CLAY')
0079                GO TO 40
0080            810 WRITE(6,811)IDATA(K),JDEPTH(K),RMN(K),RO(K),F(K),POR(K),SPCOND(K),
                   *TDS(K),CL(K),SO4(K)
0081            811 FORMAT(4X,I4,6X,I4,2(4X,F5.1),2X,'*',2X,F3.1,4X,F4.1,4X,F6.1,5X,F
                   *7.0,2(5X,F5.0),5X,'PACC/SANDY-CLAY')
0082                GO TO 40
0083             40 CONTINUE
             C
             C      WRITE COLUMN IDENTIFICATION.
0084                WRITE(6,610)
             C
             C      DETERMINE PROGRAM EXECUTION TIME.
0085                CALL CLOCK(T2)
0086                TIME = T1-T2
0087                WRITE(6,90)TIME
0088             90 FORMAT(/////40X,'PROGRAM TIME IN SECONDS = ',E14.7)
             C
             C      IDENTIFY PROGRAMMER.
0089                WRITE(6,9999)
0090           9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'B
                   *OX 31 CAMPUS STA.',/30X,'SOCORRO, N. M.   87801')
             C
             C
             C
             C
             C      PLOT RESULTS IN LOG (GRAPHIC) FORM.
             C      LOG GRID SCALE--2 INCHES PER 100 FEET.
0091                CALL PLOT(0.,-15.,-3)
0092                CALL PLOT(15.,1.4,-3)
             C
             C
             C      ESTABLISH LOG GRID


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             C
0093                CALL PLOT(0.,2.5,2)
0094                CALL PLOT(0.,3.25,3)
0095                CALL PLOT(0.,8.25,2)
0096                CALL PLOT(10.,8.25,2)
0097                CALL PLOT(10.,3.25,2)
0098                CALL PLOT(0.,3.25,2)
0099                CALL PLOT(0.,2.5,3)
0100                CALL PLOT(10.,2.5,2)
0101                CALL PLOT(10.,0.,2)
0102                CALL PLOT(0.,0.,2)
0103                CALL PLOT(0.,5.75,3)
0104                CALL PLOT(10.,5.75,2)
0105                CALL PLOT(10.,8.,3)
0106                CALL PLOT(0.,8.,2)
0107                CALL PLOT(1.,8.25,3)
0108                CALL PLOT(1.,3.25,2)
0109                CALL PLOT(1.,2.5,3)
0110                CALL PLOT(1.,0.,2)
0111                CALL PLOT(2.,0.,3)
0112                CALL PLOT(2.,2.5,2)
0113                CALL PLOT(2.,3.25,3)
0114                CALL PLOT(2.,8.25,2)
0115                CALL PLOT(3.,8.25,3)
0116                CALL PLOT(3.,3.25,2)
0117                CALL PLOT(3.,2.5,3)
0118                CALL PLOT(3.,0.,2)
0119                CALL PLOT(4.,0.,3)
0120                CALL PLOT(4.,2.5,2)
0121                CALL PLOT(4.,3.25,3)
0122                CALL PLOT(4.,8.25,2)
0123                CALL PLOT(5.,8.25,3)
0124                CALL PLOT(5.,3.25,2)
0125                CALL PLOT(5.0,2.5,3)
0126                CALL PLOT(5.,0.,2)
0127                CALL PLOT(6.,0.,3)
0128                CALL PLOT(6.,2.5,2)
0129                CALL PLOT(6.,3.25,3)
0130                CALL PLOT(6.,8.25,2)
0131                CALL PLOT(7.,8.25,3)
0132                CALL PLOT(7.,3.25,2)
0133                CALL PLOT(7.,2.50,3)
0134                CALL PLOT(7.,0.,2)
0135                CALL PLOT(8.,0.,3)
0136                CALL PLOT(8.,2.5,2)
0137                CALL PLOT(8.,3.25,3)
0138                CALL PLOT(8.,8.25,2)
0139                CALL PLOT(9.,8.25,3)
0140                CALL PLOT(9.,3.25,2)
0141                CALL PLOT(9.,2.5,3)
0142                CALL PLOT(9.,0.,2)
0143                CALL PLOT(10.,0.,3)
0144                CALL PLOT(10.,2.5,2)
0145                CALL PLOT(10.,3.25,3)
0146                CALL PLOT(10.,8.25,2)
             C
             C
             C      *****DEPTH LABEL*****
             C
0147                Y = 2.835
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 0148            HEIGHT = 0.10
 0149            THETA = 0.
 0150            NN = -1
 0151            N = 6
 0152            READ(5,9998)(X(I),FPN(I), I = 1,N)
 0153       9998 FORMAT(F4.2,F4.0)
 0154                DO 1000  I = 1,N
 0155                CALL NUMBER(X(I),Y,HEIGHT,FPN(I),THETA,NN)
 0156       1000 CONTINUE
           C
           C
           C     *****LINE GENERATION*****
           C
           C
           C     SP LINE GENERATION
           C
 0157            N = 240
 0158            CALL PLOT(ABC(1),SP(1),3)
 0159                DO 1002  K = 2,N
 0160                CALL PLOT(ABC(K),SP(K),2)
 0161       1002 CONTINUE
           C
           C     POROSITY INDEX LINE PLOT
           C
 0162            CALL PLOT(ABC(1),PORP(1),3)
 0163                DO 1001  K = 2,N
 0164                CALL PLOT(ABC(K),PORP(K),2)
 0165       1001 CONTINUE
           C
           C     TDS LINE GENERATION
           C
 0166            CALL PLOT(ABC(1),TDSP(1),3)
 0167                DO 1003  K = 2,N
 0168                CALL PLOT(ABC(K),TDSP(K),2)
 0169       1003 CONTINUE
           C
           C     S04 LINE GENERATION
           C
 0170            CALL PLOT(ABC(1),S04P(1),3)
 0171                DO 1004  K = 2,N
 0172                CALL PLOT(ABC(K),S04P(K),2)
 0173       1004 CONTINUE
           C
           C     FILE MARK.
 0174            CALL PLOT(20.,0.,999)
 0175            STOP
 0176            END

                                         SCALAR MAP
 SYMBOL    LOCATION       SYMBOL    LOCATION    SYMBOL    LOCATION    SYMBOL    LOCATION    SYMBOL    LOCATION
 T1        00019C         N         0001A0      AVTEMP    0001A4      TD        0001A8      BHT       0001AC
 RMF       0001B0         AM        0001B4      RMC       0001B8      K         0001BC      A         0001C0
 B         0001C4         C         0001C8      D         0001CC      E         0001D0      Q         0001D4
 G         0001D8         GRAD      0001DC      T2        0001E0      TIME      0001E4      Y         0001E8
 HEIGHT    0001EC         THETA     0001F0      NN        0001F4      I         0001F8

                                         ARRAY MAP
 SYMBOL    LOCATION       SYMBOL    LOCATION    SYMBOL    LOCATION    SYMBOL    LOCATION    SYMBOL    LOCATION


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 IDATA     0001FC         JDEPTH    0006AC      RMN       00085C      RO        00100C      F         0014BC
 TDS       00196C         RW        001E1C      POR       0022CC      SPCOND    00277C      CL        002C2C
 RXOC      0030DC         ROC       00358C      TDSP      003A3C      S04P      003EEC      PORP      00439C
 ABC       00484C         X         004CFC      FPN       004D14      S04       004D2C      RM11      0051DC
 RXOR      00568C         SP        005B3C      W         005FEC      RX01      00649C

                                     SUBPROGRAMS CALLED
 SYMBOL    LOCATION       SYMBOL    LOCATION    SYMBOL    LOCATION    SYMBOL    LOCATION    SYMBOL    LOCATION
 CLOCK     00694C         IBCOM#    006950      PLOT      006954      NUMBER    006958      FRXPR#    00695C

                                         LABEL MAP
 LABEL     LOCATION       LABEL     LOCATION    LABEL     LOCATION    LABEL     LOCATION    LABEL     LOCATION
     1     006D68             2     006D94        600     006E08        610     006E54        700     006F96
   611     00705C           701     007076       6000     007100       6001     007124       6002     007134
  6010     00714E          6011     007172       6012     007186       6020     0071A0       6021     0071C4
  6022     0071D8           705     0071F6          3     007366          4     0073D6         10     007460
     5     0074AC            20     007530          6     007580         30     007604        800     007650
   910     0076D4           810     007724        811     0077A8         40     0077FC         90     007864
  9999     0078A8          9998     007BC8       1000     007C10       1002     007C82       1001     007CEC
  1003     007D56          1004     007DB4

   TOTAL MEMORY REQUIREMENTS 007F14 BYTES

 COMPILER HIGHEST SEVERITY CODE WAS  0
 // EXEC LNKEDT(MAP)
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                 SOCORRO COUNTY, NEW MEXICO WATER WELL

                    USGS TEST WELL #B-6A (RELOCATED)


          RMF = 3.3 OHM-M @ 79F
            M = 1.5


DATA   DEPTH   RMN     RO   *   F     POR   SPCOND      TDS     CL     SO4    REMARKS
  1      20    20.0   33.0  *  9.0   11.5   2910.2     2052.   230.   631.    NACCEPT
  2      22    20.0   41.0  *  9.0   11.5   2342.4     1651.   185.   520.    NACCEPT
  3      24     8.1   54.0  *  2.8   25.0    555.7      392.    44.   123.   GOOD-SCREEN
  4      26     4.0   27.0  *  0.6   65.0    241.1      170.    19.    54.   GOOD-SCREEN
  5      28    14.0   34.0  *  5.4   16.2   1697.2     1196.   134.   377.    NACCEPT
  6      30    16.0   40.0  *  6.5   14.3   1727.9     1218.   137.   384.    NACCEPT
  7      32    17.0   42.0  *  7.1   13.5   1794.2     1265.   142.   398.    NACCEPT
  8      34    18.0   41.5  *  7.7   12.8   1974.6     1392.   156.   438.    NACCEPT
  9      36    13.0   28.0  *  5.0   17.2   1875.5     1322.   148.   416.    NACCEPT
 10      38    10.8   30.5  *  4.0   19.9   1379.7      973.   109.   306.    NACCEPT
 11      40    15.0   51.0  *  6.0   15.2   1239.8      874.    98.   275.    NACCEPT
 12      42    13.4   57.0  *  5.2   16.7    957.0      675.    76.   212.    PACCEPT
 13      44    10.0   45.0  *  3.7   21.1    855.7      603.    68.   190.     NACCEPT-CLAY
 14      46     9.6   63.0  *  3.5   21.7    583.1      411.    46.   129.   GOOD-SCREEN
 15      48    13.0   72.0  *  5.0   17.1    729.4      514.    58.   162.     NACCEPT-CLAY
 16      50    28.0   60.0  *  ***    8.2   2643.6     1864.   209.   587.    NACCEPT
 17      52    16.0   40.0  *  6.6   14.2   1727.9     1218.   137.   384.    NACCEPT
 18      54    19.0   36.0  *  8.5   12.0   2468.0     1740.   195.   548.    NACCEPT
 19      56    14.0   36.0  *  5.5   16.1   1602.9     1130.   127.   356.    NACCEPT
 20      58    14.6   37.0  *  5.8   15.5   1648.1     1162.   130.   366.    NACCEPT
 21      60    14.8   41.6  *  5.9   15.3   1492.7     1052.   118.   331.    NACCEPT
 22      62    11.3   35.0  *  4.2   19.1   1267.4      894.   100.   281.    NACCEPT
 23      64    12.0   34.0  *  4.5   18.2   1400.9      988.   111.   311.    NACCEPT
 24      66    14.0   40.0  *  5.5   16.0   1442.6     1017.   114.   320.    NACCEPT
 25      68    15.2   44.0  *  6.2   14.9   1463.2     1032.   116.   325.    NACCEPT
 26      70     8.3   40.0  *  3.0   24.3    773.1      545.    61.   172.    PACC/SANDY-CLAY
 27      72    10.0   39.0  *  3.7   21.0    987.3      696.    78.   219.    PACCEPT
 28      74    11.7   37.0  *  4.4   18.5   1249.0      881.    99.   277.    NACCEPT
 29      76    10.8   35.0  *  4.0   19.7   1202.3      848.    95.   267.    NACCEPT
 30      78    10.4   38.0  *  3.9   20.3   1060.1      747.    84.   235.    PACC/SANDY-CLAY
 31      80    12.0   40.5  *  4.6   18.2   1176.0      829.    93.   261.    NACCEPT
 32      82    13.9   37.0  *  5.5   16.1   1545.1     1089.   122.   343.    NACCEPT
 33      84    14.0   35.0  *  5.5   16.0   1648.7     1162.   130.   366.    NACCEPT
 34      86    11.5   32.0  *  4.4   18.8   1415.1      998.   112.   314.    NACCEPT
 35      88    11.5   33.0  *  4.4   18.7   1372.2      967.   108.   305.    NACCEPT
 36      90    11.6   30.6  *  4.4   18.6   1495.0     1054.   118.   332.    NACCEPT
 37      92    11.0   30.0  *  4.1   19.4   1432.9     1010.   113.   318.    NACCEPT
 38      94    12.0   29.0  *  4.6   18.1   1642.4     1158.   130.   365.     NACCEPT-CLAY
 39      96    11.0   26.0  *  4.1   19.4   1653.4     1166.   131.   367.    NACCEPT
 40      98    11.0   26.0  *  4.1   19.4   1653.4     1166.   131.   367.    NACCEPT
 41     100     9.5   25.0  *  3.5   21.7   1451.6     1023.   115.   322.    NACCEPT
 42     102     9.5   24.0  *  3.5   21.7   1512.1     1066.   119.   336.    NACCEPT
 43     104     9.6   22.5  *  3.6   21.5   1632.6     1151.   129.   362.    NACCEPT
 44     106     9.7   22.0  *  3.6   21.3   1689.8     1191.   133.   375.    NACCEPT
 45     108     9.6   23.5  *  3.6   21.5   1563.1     1102.   123.   347.    NACCEPT
 46     110    10.2   23.5  *  3.8   20.5   1676.3     1182.   132.   372.    NACCEPT
 47     112    12.0   23.5  *  4.6   18.0   2026.8     1429.   160.   450.    NACCEPT
 48     114    15.0   21.0  *  6.1   14.9   3011.0     2123.   238.   645.    NACCEPT
 49     116    14.6   20.4  *  5.9   15.3   2989.1     2107.   236.   642.    NACCEPT
 50     118    10.5   17.0  *  4.0   20.0   2396.0     1689.   189.   532.    NACCEPT
 51     120    13.0   13.6  *  5.1   16.9   3861.4     2722.   405.   764.    NACCEPT
 52     122    10.1   11.5  *  3.8   20.6   3386.9     2388.   268.   697.    NACCEPT
 53     124    14.7   12.5  *  6.0   15.2   4922.9     3471.   839.   912.    NACCEPT
 54     126    12.5   13.0  *  4.9   17.4   3849.1     2714.   400.   762.    NACCEPT
 55     128    14.8   13.0  *  6.0   15.1   4776.7     3368.   779.   891.    NACCEPT
 56     130    13.2   13.0  *  5.2   16.6   4117.5     2903.   510.   799.    NACCEPT
 57     132    12.5   11.0  *  4.9   17.4   4548.9     3207.   686.   860.    NACCEPT
 58     134    10.5    8.0  *  4.0   19.9   5091.6     3590.   907.   935.    NACCEPT
 59     136     5.0    6.4  *  1.3   41.6   2109.8     1487.   167.   468.    NACCEPT
 60     138     6.0    7.1  *  1.9   32.5   2744.9     1935.   217.   608.    NACCEPT
 61     140     8.0    9.0  *  2.9   24.6   3282.8     2314.   259.   683.    NACCEPT
 62     142    12.0   11.6  *  4.7   17.9   4106.0     2895.   505.   798.    NACCEPT
 63     144    11.7   10.7  *  4.5   18.3   4319.1     3045.   592.   828.    NACCEPT
 64     146    12.0   10.6  *  4.7   17.9   4493.4     3168.   663.   852.    NACCEPT
 65     148    11.3    9.1  *  4.3   18.8   4874.6     3437.   819.   905.    NACCEPT
 66     150    22.0    8.8  *  ***   10.2   ******     8900.  3981.  1986.    NACCEPT
 67     152    11.2    8.8  *  4.3   18.9   4988.6     3517.   865.   921.    NACCEPT
 68     154     9.0    7.3  *  3.3   22.3   4667.3     3290.   734.   876.    NACCEPT
 69     156     6.0    6.0  *  1.9   32.4   3248.1     2290.   257.   678.    NACCEPT
 70     158     4.0    5.8  *  0.6   65.0   1122.3      791.    89.   249.    NACCEPT
 71     160     3.2    7.1  *  1.0   51.4   1374.1      969.   109.   305.     NACCEPT-CLAY
 72     162     9.5   10.4  *  3.6   21.4   3489.4     2460.   254.   712.    NACCEPT
 73     164     9.1   34.5  *  3.4   22.1   1000.5      705.    79.   222.    PACC/SANDY-CLAY
 74     166    16.0   46.7  *  6.8   13.9   1480.0     1043.   117.   329.    NACCEPT
 75     168    20.0   43.0  *  9.5   11.2   2233.4     1575.   176.   496.    NACCEPT
 76     170    21.0   36.5  *  ***   10.6   2834.8     1999.   224.   620.    NACCEPT
 77     172    15.0   41.5  *  6.2   14.7   1523.6     1074.   120.   338.    NACCEPT
 78     174    14.7   44.5  *  6.1   15.0   1382.8      975.   109.   307.    NACCEPT
 79     176    16.8   48.0  *  7.3   13.3   1543.4     1088.   122.   343.    NACCEPT
 80     178    17.0   47.1  *  7.5   13.1   1600.0     1128.   126.   355.    NACCEPT
 81     180    16.0   45.5  *  6.8   13.9   1519.0     1071.   120.   337.    NACCEPT
 82     182    15.1   46.0  *  6.3   14.6   1387.0      978.   110.   308.    NACCEPT
 83     184    12.1   46.0  *  4.8   17.6   1045.8      737.    83.   232.    PACCEPT
 84     186    19.0   47.0  *  8.8   11.7   1890.4     1333.   149.   420.    NACCEPT
 85     188    19.8   46.5  *  9.4   11.2   2033.9     1434.   161.   452.    NACCEPT
 86     190    20.5   47.5  *  9.9   10.8   2099.5     1480.   166.   466.    NACCEPT
 87     192    15.0   55.0  *  6.3   14.7   1149.7      811.    91.   255.    NACCEPT
 88     194    18.0   55.0  *  8.1   12.3   1489.9     1050.   118.   331.    NACCEPT
 89     196    13.0   55.0  *  5.2   16.6    954.8      673.    75.   212.    PACC/SANDY-CLAY
 90     198    12.7   51.0  *  5.1   16.9   1000.4      705.    79.   222.    PACC/SANDY-CLAY
 91     200    12.0   50.0  *  4.7   17.7    952.6      672.    75.   211.    PACC/SANDY-CLAY
 92     202    12.7   48.5  *  5.1   16.9   1052.0      742.    83.   234.    PACCEPT
 93     204    11.2   44.0  *  4.4   18.7    997.7      703.    79.   221.    PACC/SANDY-CLAY
 94     206    10.0   48.0  *  3.8   20.4    802.2      566.    63.   178.    PACC/SANDY-CLAY
 95     208    11.0   48.0  *  4.3   18.9    895.6      631.    71.   199.    PACCEPT
 96     210    11.0   46.0  *  4.3   18.9    934.5      659.    74.   207.    PACCEPT
 97     212     9.0   42.5  *  3.4   22.1    801.7      565.    63.   178.    PACC/SANDY-CLAY
 98     214    10.9   44.0  *  4.3   19.0    966.7      682.    76.   215.    PACCEPT
 99     216    10.0   43.5  *  3.9   20.3    885.2      624.    70.   197.     NACCEPT-CLAY
100     218    11.3   41.0  *  4.4   18.5   1081.9      763.    85.   240.    PACCEPT
101     220    10.0   20.0  *  3.9   20.3   1925.2     1357.   152.   427.    NACCEPT
102     222     8.0    8.9  *  3.0   24.2   3319.7     2340.   262.   688.     NACCEPT-CLAY
103     224     7.2   10.0  *  2.6   26.6   2574.3     1815.   203.   571.    NACCEPT
104     226     8.0   18.5  *  3.0   24.2   1597.1     1126.   126.   355.    NACCEPT
105     228    10.2   33.0  *  4.0   20.0   1193.7      842.    94.   265.    NACCEPT
106     230    10.1   43.0  *  3.9   20.1    905.8      639.    72.   201.    PACC/SANDY-CLAY
107     232    11.2   40.6  *  4.4   18.6   1081.3      762.    85.   240.    PACC/SANDY-CLAY
108     234    13.0   40.1  *  5.3   16.5   1309.6      923.   103.   291.    NACCEPT
109     236    10.7   40.6  *  4.2   19.2   1025.4      723.    81.   228.    PACC/SANDY-CLAY
110     238    10.9   40.1  *  4.3   18.9   1060.7      748.    84.   235.    PACC/SANDY-CLAY
111     240    10.1   42.5  *  3.9   20.1    916.4      646.    72.   203.    PACC/SANDY-CLAY
112     242    14.0   39.5  *  5.8   15.4   1460.8     1030.   115.   324.    NACCEPT
113     244    10.7   39.0  *  4.2   19.2   1067.4      753.    84.   237.    PACCEPT
114     246    15.5   38.1  *  6.7   14.1   1735.7     1224.   137.   385.     NACCEPT-CLAY
115     248    18.0   38.3  *  8.3   12.2   2139.5     1508.   169.   475.     NACCEPT-CLAY
116     250    12.5   35.1  *  5.1   17.0   1425.6     1005.   113.   316.    NACCEPT
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DATA	DEPTH	RMN	RO	*	F	POR	SPCOND	TDS	CL	SO4	REMARKS
117	252	11.5	35.0	*	4.6	18.1	1293.8	912.	102.	287.	NACCEPT
118	254	14.0	35.1	*	5.8	15.4	1644.0	1159.	130.	365.	NACCEPT
119	256	13.0	39.0	*	5.3	16.4	1346.5	949.	106.	299.	NACCEPT
120	258	12.1	24.0	*	4.9	17.4	2004.4	1413.	158.	445.	NACCEPT
121	260	8.0	12.0	*	3.0	24.0	2462.1	1736.	195.	547.	NACCEPT
122	262	7.0	12.5	*	2.5	27.0	1980.3	1396.	156.	440.	NACCEPT-CLAY
123	264	11.0	21.1	*	4.4	18.7	2037.3	1436.	161.	452.	NACCEPT-CLAY
124	266	14.3	26.5	*	6.0	15.1	2238.7	1578.	177.	497.	NACCEPT
125	268	13.8	26.0	*	5.8	15.6	2178.4	1536.	172.	484.	NACCEPT
126	270	14.0	27.0	*	5.9	15.4	2137.2	1507.	169.	474.	NACCEPT
127	272	15.1	24.0	*	6.5	14.4	2658.5	1874.	210.	590.	NACCEPT
128	274	8.0	14.0	*	3.0	24.0	2110.4	1488.	167.	469.	NACCEPT
129	276	9.0	14.0	*	3.5	21.8	2433.7	1716.	192.	540.	NACCEPT
130	278	15.2	20.7	*	6.6	14.3	3110.1	2193.	246.	659.	NACCEPT
131	280	18.0	19.0	*	8.4	12.1	4312.9	3041.	590.	827.	NACCEPT
132	282	14.0	26.0	*	5.9	15.3	2219.4	1565.	175.	493.	NACCEPT
133	284	11.2	20.0	*	4.5	18.4	2195.0	1547.	173.	487.	NACCEPT
134	286	10.0	20.0	*	3.9	20.1	1925.2	1357.	152.	427.	NACCEPT
135	288	11.3	21.0	*	4.5	18.2	2112.3	1489.	167.	469.	NACCEPT
136	290	11.1	20.5	*	4.4	18.5	2119.2	1494.	167.	470.	NACCEPT
137	292	11.2	19.1	*	4.5	18.4	2298.4	1620.	182.	510.	NACCEPT
138	294	13.5	20.0	*	5.6	15.8	2753.4	1941.	218.	609.	NACCEPT
139	296	14.0	18.5	*	5.9	15.3	3119.1	2199.	246.	660.	NACCEPT
140	298	15.5	17.0	*	6.8	13.9	3889.9	2742.	417.	768.	NACCEPT
141	300	15.5	17.5	*	6.8	13.9	3778.8	2664.	372.	752.	NACCEPT
142	302	14.2	21.0	*	6.0	15.1	2799.1	1973.	221.	615.	NACCEPT
143	304	9.3	21.0	*	3.6	21.1	1685.9	1189.	133.	374.	NACCEPT
144	306	13.0	20.0	*	5.4	16.2	2625.8	1851.	207.	583.	NACCEPT
145	308	7.6	11.2	*	2.8	24.9	2470.7	1742.	195.	548.	NACCEPT-CLAY
146	310	14.2	7.0	*	6.1	15.1	8397.3	5920.	2256.	1396.	NACCEPT
147	312	5.0	7.9	*	1.4	40.1	1709.2	1205.	135.	379.	NACCEPT
148	314	11.0	13.5	*	4.4	18.5	3184.3	2245.	252.	669.	NACCEPT
149	316	10.2	18.0	*	4.1	19.6	2188.5	1543.	173.	486.	NACCEPT
150	318	16.0	19.2	*	7.1	13.5	3599.8	2538.	299.	727.	NACCEPT
151	320	15.8	17.1	*	7.0	13.6	3971.3	2800.	450.	779.	NACCEPT
152	322	11.0	16.0	*	4.4	18.5	2686.7	1894.	212.	596.	NACCEPT
153	324	11.0	16.0	*	4.4	18.5	2686.7	1894.	212.	596.	NACCEPT
154	326	11.0	15.0	*	4.4	18.5	2865.8	2020.	226.	625.	NACCEPT-CLAY
155	328	14.1	15.0	*	6.0	15.1	3882.7	2737.	414.	767.	NACCEPT
156	330	11.0	15.0	*	4.5	18.5	2865.8	2020.	226.	625.	NACCEPT-CLAY
157	332	13.0	15.0	*	5.4	16.2	3501.0	2468.	258.	713.	NACCEPT
158	334	10.7	15.2	*	4.3	18.9	2738.8	1931.	216.	607.	NACCEPT
159	336	10.2	14.0	*	4.1	19.6	2813.8	1984.	222.	618.	NACCEPT
160	338	10.0	13.5	*	4.0	19.8	2852.2	2011.	225.	623.	NACCEPT
161	340	12.7	12.0	*	5.3	16.4	4251.7	2997.	565.	818.	NACCEPT
162	342	10.0	10.1	*	4.0	19.8	3812.4	2688.	385.	757.	NACCEPT
163	344	10.8	13.0	*	4.4	18.7	3237.0	2282.	256.	677.	NACCEPT
164	346	13.6	12.5	*	5.8	15.5	4447.1	3135.	644.	845.	NACCEPT
165	348	10.7	12.3	*	4.3	18.8	3384.6	2386.	267.	697.	NACCEPT
166	350	11.0	12.0	*	4.5	18.4	3582.3	2526.	292.	725.	NACCEPT
167	352	10.2	8.3	*	4.1	19.5	4746.2	3346.	766.	887.	NACCEPT
168	354	7.0	9.5	*	2.6	26.6	2605.7	1837.	206.	578.	NACCEPT
169	356	10.0	14.1	*	4.0	19.8	2730.8	1925.	216.	606.	NACCEPT
170	358	11.0	15.0	*	4.5	18.4	2865.8	2020.	226.	625.	NACCEPT
171	360	13.5	15.1	*	5.8	15.6	3646.9	2571.	318.	734.	NACCEPT
172	362	13.0	14.0	*	5.5	16.1	3751.1	2645.	360.	748.	NACCEPT
173	364	9.0	12.5	*	3.6	21.4	2725.7	1922.	215.	605.	NACCEPT
174	366	9.2	12.5	*	3.7	21.1	2796.8	1972.	221.	615.	NACCEPT
175	368	9.1	12.3	*	3.6	21.2	2806.2	1978.	222.	616.	NACCEPT
176	370	10.2	12.0	*	4.1	19.4	3282.8	2314.	259.	683.	NACCEPT
177	372	12.5	12.0	*	5.2	16.6	4169.8	2940.	531.	807.	NACCEPT
178	374	10.8	12.5	*	4.4	18.6	3366.5	2373.	266.	695.	NACCEPT
179	376	12.4	13.0	*	5.2	16.7	3811.6	2687.	385.	757.	NACCEPT
180	378	11.0	12.6	*	4.5	18.3	3411.7	2405.	270.	701.	NACCEPT
181	380	11.0	12.5	*	4.5	18.3	3439.0	2424.	272.	705.	NACCEPT
182	382	15.1	12.5	*	6.7	14.1	5104.2	3598.	913.	937.	NACCEPT-CLAY
183	384	10.5	12.5	*	4.3	18.9	3258.6	2297.	257.	680.	NACCEPT
184	386	9.5	12.1	*	3.8	20.5	2999.2	2114.	237.	643.	NACCEPT
185	388	9.6	12.1	*	3.9	20.3	3035.8	2140.	240.	648.	NACCEPT
186	390	9.4	13.0	*	3.8	20.6	2757.5	1944.	218.	610.	NACCEPT
187	392	10.1	13.0	*	4.1	19.5	2996.1	2112.	237.	643.	NACCEPT
188	394	9.0	13.1	*	3.6	21.3	2600.9	1834.	205.	577.	NACCEPT-CLAY
189	396	9.5	13.1	*	3.8	20.4	2770.2	1953.	219.	611.	NACCEPT
190	398	10.0	13.0	*	4.1	19.6	2961.9	2088.	234.	638.	NACCEPT
191	400	9.7	12.6	*	3.9	20.1	2950.4	2080.	233.	637.	NACCEPT
192	402	9.5	11.5	*	3.8	20.4	3155.7	2225.	249.	665.	NACCEPT
193	404	9.5	10.1	*	3.8	20.4	3593.1	2533.	296.	726.	NACCEPT
194	406	9.0	8.5	*	3.6	21.2	4008.4	2826.	465.	784.	NACCEPT
195	408	8.1	8.1	*	3.2	23.1	3704.6	2612.	341.	742.	NACCEPT-CLAY
196	410	8.0	8.5	*	3.1	23.3	3475.9	2451.	248.	710.	NACCEPT
197	412	10.1	10.1	*	4.1	19.4	3856.3	2719.	403.	763.	NACCEPT
198	414	11.9	10.0	*	5.0	17.1	4715.6	3324.	754.	883.	NACCEPT
199	416	14.4	9.4	*	6.4	14.6	6369.4	4490.	1429.	1114.	NACCEPT
200	418	10.0	9.5	*	4.1	19.5	4053.2	2857.	484.	790.	NACCEPT
201	420	10.1	10.0	*	4.1	19.4	3894.9	2746.	419.	768.	NACCEPT
202	422	10.8	10.2	*	4.5	18.4	4125.6	2909.	513.	801.	NACCEPT
203	424	12.3	10.3	*	5.2	16.6	4763.7	3358.	774.	890.	NACCEPT
204	426	12.1	10.5	*	5.1	16.8	4581.5	3230.	699.	864.	NACCEPT
205	428	11.6	10.1	*	4.9	17.4	4529.5	3193.	678.	857.	NACCEPT
206	430	11.5	10.0	*	4.8	17.5	4528.3	3192.	678.	857.	NACCEPT
207	432	10.5	9.6	*	4.3	18.8	4243.0	2991.	561.	817.	NACCEPT
208	434	10.5	9.6	*	4.4	18.8	4243.0	2991.	561.	817.	NACCEPT
209	436	10.3	9.5	*	4.3	19.0	4193.6	2956.	541.	810.	NACCEPT
210	438	10.0	9.2	*	4.1	19.5	4185.3	2951.	538.	809.	NACCEPT
211	440	10.1	8.4	*	4.2	19.3	4636.8	3269.	722.	872.	NACCEPT
212	442	10.2	8.5	*	4.2	19.2	4634.5	3267.	721.	872.	NACCEPT
213	444	10.0	8.6	*	4.1	19.4	4477.3	3157.	657.	850.	NACCEPT
214	446	9.5	9.0	*	3.9	20.2	4032.2	2843.	475.	787.	NACCEPT
215	448	10.0	9.1	*	4.1	19.4	4231.3	2983.	556.	815.	NACCEPT
216	450	9.5	8.4	*	3.9	20.2	4320.2	3046.	593.	828.	NACCEPT
217	452	9.5	6.0	*	3.9	20.2	6048.4	4264.	1298.	1069.	NACCEPT
218	454	5.1	6.5	*	1.5	37.8	2175.6	1534.	172.	483.	NACCEPT-CLAY
219	456	10.1	7.3	*	4.2	19.3	5335.5	3762.	1007.	969.	NACCEPT
220	458	11.1	7.1	*	4.7	17.9	6118.7	4314.	1326.	1079.	NACCEPT
221	460	10.6	7.2	*	4.4	18.5	5719.6	4032.	1164.	1023.	NACCEPT
222	462	10.7	7.1	*	4.5	18.4	5863.4	4134.	1222.	1043.	NACCEPT
223	464	13.0	8.2	*	5.7	15.7	6404.3	4515.	1443.	1118.	NACCEPT
224	466	12.0	8.1	*	5.1	16.8	5880.2	4146.	1229.	1045.	NACCEPT
225	468	12.0	6.5	*	5.1	16.8	7327.6	5166.	1820.	1247.	NACCEPT
226	470	9.0	7.4	*	3.7	21.0	4604.2	3246.	709.	867.	NACCEPT-CLAY
227	472	11.7	7.4	*	5.0	17.1	6245.2	4403.	1378.	1096.	NACCEPT
228	474	13.6	7.5	*	6.0	15.1	7411.9	5225.	1854.	1259.	NACCEPT
229	476	12.5	7.7	*	5.4	16.2	6498.4	4581.	1481.	1132.	NACCEPT
230	478	11.5	7.5	*	4.9	17.3	6037.7	4257.	1293.	1067.	NACCEPT
231	480	11.0	7.0	*	4.7	17.9	6141.1	4329.	1336.	1082.	NACCEPT
232	482	10.5	7.1	*	4.4	18.6	5737.0	4045.	1171.	1025.	NACCEPT
233	484	11.0	7.0	*	4.7	17.9	6141.1	4329.	1336.	1082.	NACCEPT-CLAY
234	486	10.7	7.0	*	4.5	18.3	5947.2	4193.	1256.	1055.	NACCEPT-CLAY
235	488	10.5	7.0	*	4.4	18.6	5818.9	4102.	1204.	1037.	NACCEPT-CLAY
236	490	9.6	7.0	*	4.0	19.9	5247.6	3700.	971.	957.	NACCEPT
237	492	9.0	7.0	*	3.7	20.9	4867.3	3431.	816.	904.	NACCEPT
238	494	11.1	7.0	*	4.7	17.8	6206.1	4375.	1362.	1091.	NACCEPT-CLAY
239	496	11.0	6.9	*	4.7	17.9	6230.1	4392.	1372.	1094.	NACCEPT-CLAY
240	498	11.0	6.6	*	4.7	17.9	6513.2	4592.	1487.	1134.	NACCEPT
241	500	11.0	6.5	*	4.7	17.9	6613.4	4662.	1528.	1148.	NACCEPT

```
                PROGRAM BY----

                     RONALD M. BRIMHALL
                     BOX 31 CAMPUS STA.
                     SOCORRO, N. M.   87801

 0A217I
/&
JOB TIME SUMMARY...COMPILE 0130S   ASSEMBLE 0000S   LNKEDT 0041S   UTILS 0000S   USER 0221S        TOTAL TIME  006M 32S
```

COMPANY UNITED STATES GEOLOGICAL SURVEY

WELL TEST WELL #B-6A

LOCATION NW, NW, NE SEC. 8, TWP. 6S, RGE. 1E

COUNTY SOCORRO STATE NEW MEXICO

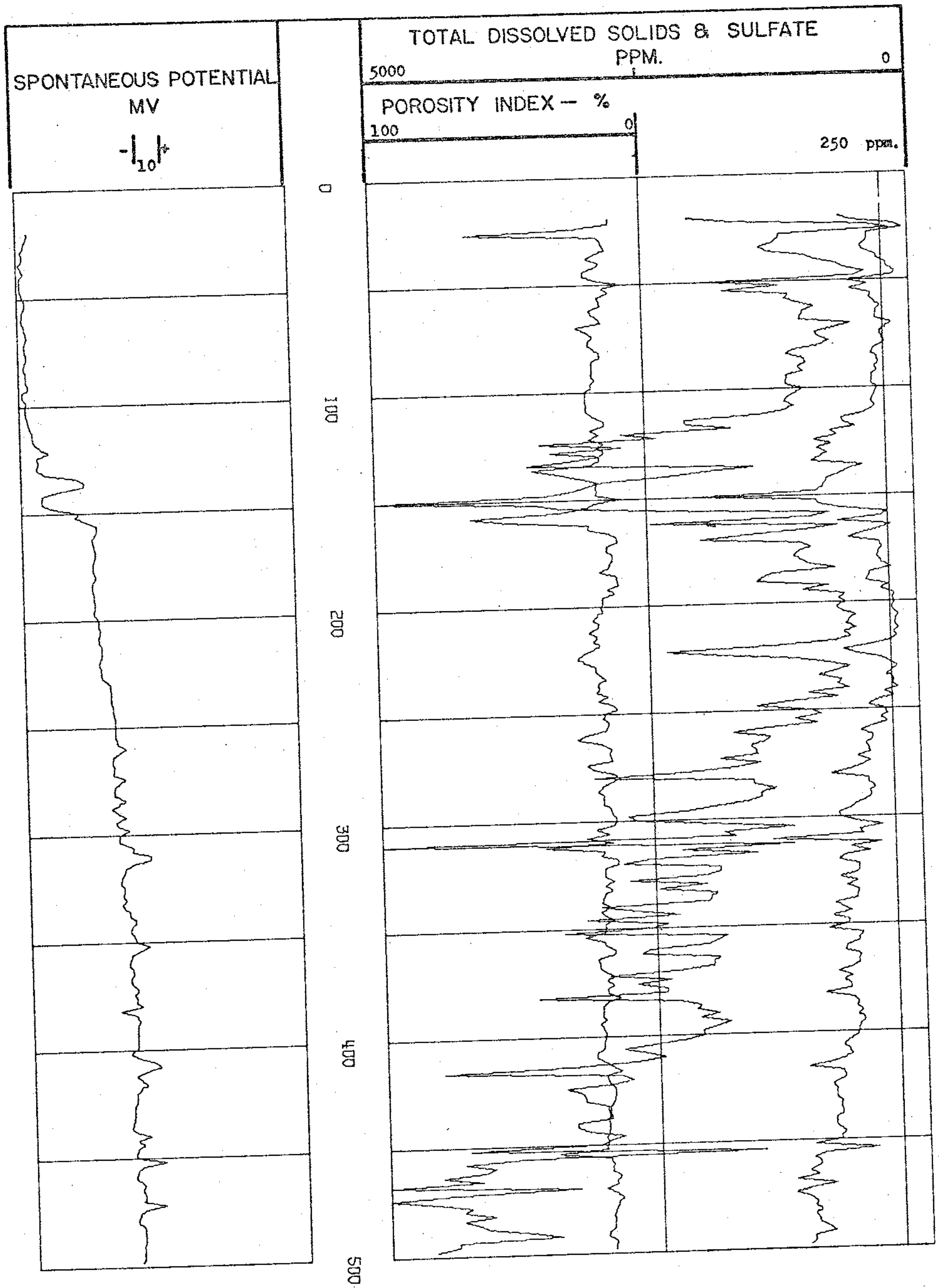

Fig. 4. Computer plot of the results of the adjunctive interpretation program BODEAP: USGS Test Well #B-6A (Relocated); Plates Ia and Ib.

City of Belen Water Well #4

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FORTRAN IV    MODEL 44  PS       VERSION 3   LEVEL 1   DATE  69119       NEW MEXICO TECH     PAGE  0001
                C          D14P,10,B58,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
                C     RONALD M. BRIMHALL - ELECTRIC LOG INTERPRETATION PROGRAM FOR WATER
                C                         WELLS
                C     ****************************************************************
                C     VALENCIA COUNTY NEW MEXICO - CITY OF BELEN WATER WELL #4
                C     ****************************************************************
                C
                C
                C
                C
                C
                C     RESISTIVITY LOG INTERPRETATION PROGRAM EVALCO---
                C
                C
                C     ****************************************************************
                C     PURPOSE OF EVALCO--
                C          EVALCO DETERMINES QUANTITATIVE VALUES OF PARAMETERS RE-
                C     LATING TO WATER QUALITY--TOTAL DISOLVED SOLIDS, SULFATE, AND
                C     CHLORIDE CONCENTRATIONS IN UNITS OF PARTS PER MILLION.  EVALCO
                C     IS APPLICABLE TO EASTERN VALENCIA COUNTY, NEW MEXICO (BRIMHALL,
                C     1969,, TITUS, 1963).  RESISTIVITY DATA FROM A MACRORESISTIVITY LOG
                C     AND A MICROLOG ARE NECESSARY FOR EVALCO.  THE APPARENT FORMATION
                C     RESISTIVITY FACTOR METHOD IS USED FOR CALCULATING TDS, ETC. BY
                C     EVALCO.  WATER AT EACH DATA POINT IS CLASSIFIED AS TO ITS ACCEPT-
                C     ABILITY BASED ON US PUBLIC HEALTH SERVICE STANDARDS (TODD, 1959).
                C     EACH AQUIFER UNIT IS EXAMINED FOR CLAY AND A POROSITY INDEX IS DE-
                C     TERMINED.  CALCULATION RESULTS ARE PRESENTED IN TABLE AND LOG
                C     FORM.
                C     ****************************************************************
                C
                C
                C     ****************************************************************
                C     REFERENCES--
                C
                C     BRIMHALL, R. M., DIGITAL ANALYSIS OF BOREHOLE-MEASURED AQUIFER
                C     RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER OF
                C     SCIENCE THESIS, N. MEX. INST. MINING AND TECH., SOCORRO, JUNE 1969.
                C
                C
                C     TITUS, F. B., GEOLOGY AND GROUND-WATER CONDITIONS IN EASTERN
                C     VALENCIA COUNTY, NEW MEXICO, N. MEX. INST. MIN. AND TECH., STATE
                C     BUR. MINES AND MIN. RES., GROUND-WATER RPT. 7, 1963.
                C
                C
                C     TODD, D. K., GROUND WATER HYDROLOGY, WILEY, NEW YORK, 1959.
                C     ****************************************************************
                C
                C
                C
                C     ****************************************************************
                C     NOMENCLATURE--
                C
                C          SCALAR QUANTITIES--
                C     T1 = INITIAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
                C     N = NUMBER OF DATA POINTS AND DO 200 ITERATIONS.
                C     K = SUBSCRIPT FOR SUBSCRIPTED VARIABLES.
                C     AVTEMP = AVERAGE SURFACE TEMPERATURE FOR CALCULATING GRAD.
                C     TD = TOTAL DEPTH OF WELL FOR CALCULATING GRAD.
                C     BHT = BOTTOM HOLE TEMPERATUEE FOR CALCULATING GRAD.
                C     RMF = MUD FILTRATE RESISTIVITY--OHM-METERS.
                C     AM = CEMENTATION EXPONENT IN F = A/POR**AM.


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                C     RMC = MUD CAKE RESISTIVITY--OHM-METERS.
                C     A = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C     B = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C     C = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C     D = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C     E = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C     O = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C     G = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C     GRAD = TEMPERATURE GRADIENT OF AQUIFER.
                C     Y = ORDINATE POSITION OF FPN--INCHES.
                C     HEIGHT = HEIGHT OF NUMERICS WRITTEN BY CALL NUMBER--INCHES.
                C     THETA = ANGLE WITH RESPECT TO CAL COMP COORDINATES FOR WRITTING
                C          FPN--DEGREES.
                C     NN = NUMBER OF DECIMAL DIGITS TO RIGHT OF DECIMAL IN FPN (-1 SUP-
                C          PRESSES DECIMAL POINT.)
                C     I = SUBSCRIPT FOR ABSCISSA OF FPN.
                C     T2 = FINAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
                C     TIME = PROGRAM EXECUTION TIME--SECONDS.
                C
                C
                C     SUBSCRIPTED VARIABLES---
                C
                C     IDATA = DATA POINT NUMBER.
                C     JDEPTH = DATA POINT DEPTH----FEET.
                C     RMN = MICRONORMAL RESISTIVITY READ FROM MICROLOG--OHM-METERS.
                C     RO = DEEP INDUCTION RESISTIVITY--OHM-METERS.
                C     F = APPARENT FORMATION RESISTIVITY FACTOR.
                C     TDS = TOTAL DISSOLVED SOLIDS CONCENTRATION--PPM.
                C     RW = WATER RESISTIVITY--OHM-METERS.
                C     POR = POROSITY INDEX CALCULATED FROM F = A/POR**AM.
                C     SPCOND = SPECIFIC CONDUCTANCE OF WATER--MICROMHOS/CM.
                C     CL = CHLORIDE CONCENTRATION--PPM.
                C     SO4 = SULFATE CONCENTRATION--PPM.
                C     RXOC = MICRONORMAL RESISTIVITY CORRECTED FOR TEMPERATURE AND
                C             MUDCAKE--OHM/METERS.
                C     ROC = TEMPERATURE CORRECTED DEEP INDUCTION RESISTIVITY--OHM-METERS
                C     TDSP = TDS RESCALED FOR PLOT--INCHES.
                C     SO4P = SO4 RESCALED FOR PLOT--INCHES.
                C     PORP = POROSITY INDEX RESCALLED FOR PLOT--INCHES.
                C     ABC = DATA POINT DEPTH RESCALED TO 2 INCHES/100 FEET.
                C     X = ABSCISSA POSITION OF FPN--INCHES.
                C     FPN = DEPTH LABEL--A FLOATING POINT NUMBER.
                C     RMI1 = MICROINVERSE RESISTIVITY AS READ FORM MICROLOG--OHM-METERS.
                C     RXOR = 1.15*RMN--AN EMPIRICAL RESISTIVITY USED TO DEFINE AQUIFER
                C     UNITS THAT MAY BE CLASSIFIED AS SANDY-CLAY.
                C     SP = DEFLECTION OF SP CURVE FROM LEFT EDGE OF TRACK I--INCHES.
                C     W = RATIO RMN/RMC--A PARAMETER IN MUD CAKE CORRECTIONS.
                C     RX01 = MICRONORMAL RESISTIVITY CORRECTED FOR MUD CAKE--OHM-METERS.
                C     ****************************************************************
                C
                C
                C     ****************************************************************
                C     SUBPROGRAMS CALLED--
                C
                C          CLOCK
                C          IBCOM#
                C          SETMSG
                C          PLOT
                C          NUMBER
                           FRXPR#
```

```
FORTRAN IV     MODEL 44  PS        VERSION 3   LEVEL 1   DATF  69119       NEW MFXICO TECH     PAGE  0003
                C      ***************************************************************
                C
                C
                C
 0001                  CALL CLOCK(T1)
 0002                  DIMENSION IDATA(291), DEPTH(291),RMN(291),RO(291),F(291),TDS(291),
                      *CL(291),SO4(291),RW(291),POR(291),SPCOND(291),RXOC(291),ROC(291)
                      *,TDSP(291),SO4P(291),PORP(291),ABC(291),X(7),FPN(7),SP(291)
                      *,W(500),RXO1(500)
                C
                C      PARAMETRIC DATA.
 0003                  N = 291
 0004                  RMC = 14.0
 0005                  RMF = 9.66
                C      (RMF ABOVE CORRECTED TO 77 F)
 0006                  AM = 1.5
 0007                  AVTEMP = 72.
 0008                  TD = 607.
 0009                  BHT = 80.
 0010                  ROCL = 18.0
                C
                C      READ FROM DATA CARDS--DATA POINT NUMBER, DEPTH, MICORNORMAL,
                C      INDUCTION, AND MICROINVERSE RESISTIVITIES, AND SP.
 0011                  READ(5,1)(IDATA(K),DEPTH(K),RMN(K),RO(K),SP(K), K = 1,N)
 0012                1 FORMAT(I4,F5.0,F4.1,F5.1,F4.2)
                C
                C      WRITE PROBLEM IDENTIFICATION .
                C
                C      WRITE SOME PARAMETRIC DATA.
                C
                C      LABEL LINE PRINTER OUTPUT.
 0013                  WRITE(6,2)
 0014                2 FORMAT('9',//41X,'VALENCIA COUNTY NEW MEX. WATER WELL',//46X,'CITY
                      * OF BELEN WATER WELL #4',////10X,'RMF = 10.8 OHM-M @ AQUIFER TEMP.
                      *(69 F)',/12X,'M = 1.5',///4X,'DATA',3X,'DEPTH',4X,'RMN',6X,'RO',5X
                      *,'F',5X,'POR',6X,'RW',4X,'SPCOND',4X,'TDS',5X,'CL',6X,'SO4',4X,'RE
                      *MARKS')
                C
                C      CONSTANTS FOR MUD CAKE THICKNESS OF 1/8 INCHES
 0015                  A = -0.3299839E-04
 0016                  B = +0.1307268E-01
 0017                  C = -0.2115985E+00
 0018                  D = 0.1284551E+01
 0019                  E = -0.3342364E+01
 0020                  O = +0.5336034E+01
 0021                  G = -0.1959661E+01
                C
                C      DETERMINE TEMPERATURE GRADIENT.
 0022                  GRAD = (BHT-AVTEMP)/TD
                C
                C      PRIMARY DO LOOP.
 0023                  DO 200 K = 1,N
                C
                C      RESCALE ABC, POR, TDS, SO4 FOR PLOT.
 0024                  ABC(K) = DEPTH(K)*0.02
                C      MUDCAKE CORRECTION FOR TMC = 1/8 INCH ASSUMED
                C      ADAPTED FROM SCHLUMBERGER, 'LOG INTERPRETATION CHARTS', P. 34,
                C      1968.
 0025                  W(K) = RMN(K)/RMC
 0026                  RXO1(K) = (A*W(K)**6+B*W(K)**5+C*W(K)**4+D*W(K)**3+E*W(K)**2+O*W(K


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                      *)+G)*RMC
                C
                C      ALLOW ALL POINTS TO BE CALCULABLE.
 0027                  IF(RXO1(K).LE.0.0)GO TO 611
                C
                C      TEMPERATURE CORRECTIONS TO RO, RXO1.
                C             TEMPERATURE CORRECTIONS ARE TO 77 F.
 0028              700 ROC(K) = RO(K)*(AVTEMP + GRAD*DEPTH(K))/77.
 0029                  RXOC(K) = RXO1(K)*(AVTEMP + GRAD*DEPTH(K))/77.
 0030                  GO TO 701
 0031              611 RXO1(K) = RMN(K)
 0032                  GO TO 700
                C
                C      DETERMINE APPARENT FORMATION RESISTIVITY FACTOR.
 0033              701 F(K) = RXOC(K)/RMF
                C
                C      DETERMINE WATER RESISTIVITY.
 0034                  RW(K)=ROC(K)/F(K)
 0035                  TDS(K) = 6400./RW(K)
 0036                  TDSP(K) = (8.25-(1.25E-03)*TDS(K))
 0037                  CL(K) = 1100./RW(K)**1.55
                C
                C      DETERMINE WATER SPECIFIC CONDUCTANCE.
 0038                  SPCOND(K) = 10000.0/RW(K)
                C
                C      SELECT PROPER INTERPRETATION CONTROL EQUATIONS.
 0039                  IF(SPCOND(K).LE.1400.)GO TO 702
 0040                  IF(SPCOND(K).GT.1400.)GO TO 703
 0041              702 SO4(K) = 0.214*SPCOND(K)
 0042                  SO4P(K) = (8.25-(1.25E-03)*SO4(K))
 0043                  GO TO 705
 0044              703 SO4(K) = 0.575*SPCOND(K) - 505.
 0045                  SO4P(K) = (8.25-(1.25E-03)*SO4(K))
 0046                  GO TO 705
                C
                C      DETERMINE POROSITY INDEX.
 0047              705 POR(K) = 30.0/(F(K)**(1.0/AM))
                C
                C      CLAY IDENTIFICATION POROSITY INDEX = 65%.
 0048                  IF(POR(K).GT.65.)POR(K) = 65.
 0049                  PORP(K) = (5.75 - (2.5E-02)*POR(K))
                C
                C      TEST FOR CLAY.
 0050                  IF(RO(K).LE.ROCL)GO TO 1000
                C
                C      IF NO CLAY, TEST AND CLASSIFY WATER QUALITY.
 0051                  IF(TDS(K).GE.1000.)GO TO 10
 0052                  IF(TDS(K).LT.1000..AND.TDS(K).GE.500.)GO TO 20
 0053                  IF(TDS(K).LT.500.)GO TO 30
 0054               10 WRITE(6,11)IDATA(K),DEPTH(K),RMN(K),RO(K),F(K),POR(K),RW(K),SPCOND
                      *(K),TDS(K),CL(K),SO4(K)
 0055               11 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,3(3X,F5
                      *.0),3X,'NACCEPT')
 0056                  GO TO 200
 0057               20 WRITE(6,21)IDATA(K),DEPTH(K),RMN(K),RO(K),F(K),POR(K),RW(K),SPCOND
                      *(K),TDS(K),CL(K),SO4(K)
 0058               21 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,3(3X,F5
                      *.0),3X,'PACCEPT')
 0059                  GO TO 200
```

```
     *(K),TDS(K),CL(K),SO4(K)
   31 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,3(3X,F5
     $.0),5X,'GOOD-SCREEN')
      GO TO 200
 1000 WRITE(6,111)IDATA(K),DEPTH(K),RMN(K),RO(K),F(K),POR(K),RW(K),SPCON
     *D(K),TDS(K),CL(K),SO4(K)
  111 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,3(3X,F5
     *.0),3X,'NACCEPT-CLAY')
      GO TO 200
  200 CONTINUE
C
C     WRITE COLUMN IDENTIFICATION.
      WRITE(6,400)
  400 FORMAT(4X,'DATA',3X,'DEPTH',4X,'RMN',6X,'RO',5X,'F',5X,'POR',6X,'R
     *W',4X,'SPCOND',4X,'TDS',5X,'CL',6X,'SO4',4X,'REMARKS')
C
C     DETERMINE PROGRAM EXECUTION TIME.
      CALL CLOCK(T2)
      TIME = T1-T2
      WRITE(6,610)TIME
  610 FORMAT(////40X,'PROGRAM TIME IN SECONDS = ',E14.7)
C
C     IDENTIFY PROGRAMMER.
      WRITE(6,9999)
 9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'B
     *OX 31 CAMPUS STA.',/30X,'SOCORRO, N. M.   87801')
C
C
C     ***********INTERPRETATION PLOT PROGRAM**********
C
C     PLOT RESULTS IN LOG (GRAPHIC) FORM.
C
C     LOG GRID SCALE--2 INCHES PER 100 FEET.
C
C     POROSITY, TRACK II, 100 - 0%.
C     TDS, SO4, TRACKS II & III, 5000 - 0 PPM.
C     SP, TRACK I, 10 MILLIVOLTS PER LOG DIVISION.
      CALL SETMSG(29,'R. BRIMHALL CITY OF BELEN LOG')
      CALL PLOT(0.,-15.,-3)
      CALL PLOT(15.,1.4,-3)
C
C
C     ESTABLISH LOG GRID
C
      CALL PLOT(0.,2.5,2)
      CALL PLOT(0.,3.25,3)
      CALL PLOT(0.,8.25,2)
      CALL PLOT(12.,8.25,2)
      CALL PLOT(12.,3.25,2)
      CALL PLOT(0.,3.25,2)
      CALL PLOT(0.,2.5,3)
      CALL PLOT(12.,2.5,2)
      CALL PLOT(12.,0.,2)
      CALL PLOT(0.,0.,2)
      CALL PLOT(0.,5.75,3)
      CALL PLOT(12.,5.75,2)
      CALL PLOT(12.,7.9375,3)
      CALL PLOT(0.,7.9375,2)
      CALL PLOT(1.,8.25,3)
      CALL PLOT(1.,3.25,2)
```

```
      CALL PLOT(1.,2.5,3)
      CALL PLOT(1.,0.,2)
      CALL PLOT(2.,0.,3)
      CALL PLOT(2.,2.5,2)
      CALL PLOT(2.,3.25,3)
      CALL PLOT(2.,8.25,2)
      CALL PLOT(3.,8.25,3)
      CALL PLOT(3.,3.25,2)
      CALL PLOT(3.,2.5,3)
      CALL PLOT(3.,0.,2)
      CALL PLOT(4.,0.,3)
      CALL PLOT(4.,2.5,2)
      CALL PLOT(4.,3.25,3)
      CALL PLOT(4.,8.25,2)
      CALL PLOT(5.,8.25,3)
      CALL PLOT(5.,3.25,2)
      CALL PLOT(5.0,2.5,3)
      CALL PLOT(5.,0.,2)
      CALL PLOT(6.,0.,3)
      CALL PLOT(6.,2.5,2)
      CALL PLOT(6.,3.25,3)
      CALL PLOT(6.,8.25,2)
      CALL PLOT(7.,8.25,3)
      CALL PLOT(7.,3.25,2)
      CALL PLOT(7.,2.50,3)
      CALL PLOT(7.,0.,2)
      CALL PLOT(8.,0.,3)
      CALL PLOT(8.,2.5,2)
      CALL PLOT(8.,3.25,3)
      CALL PLOT(8.,8.25,2)
      CALL PLOT(9.,8.25,3)
      CALL PLOT(9.,3.25,2)
      CALL PLOT(9.,2.5,3)
      CALL PLOT(9.,0.,2)
      CALL PLOT(10.,0.,3)
      CALL PLOT(10.,2.5,2)
      CALL PLOT(10.,3.25,3)
      CALL PLOT(10.,8.25,2)
      CALL PLOT(11.,8.25,3)
      CALL PLOT(11.,3.25,2)
      CALL PLOT(11.,2.5,3)
      CALL PLOT(11.,0.,2)
C
C
C     *****DEPTH LABEL*****
C
      Y = 2.835
      HEIGHT = 0.10
      THETA = 0.
      NN = -1
      N = 7
      READ(5,9998)(X(I),FPN(I), I = 1,N)
 9998 FORMAT(F5.1,F4.0)
         DO 1010  I = 1,N
          CALL NUMBER(X(I),Y,HEIGHT,FPN(I),THETA,NN)
 1010 CONTINUE
C
C
C     *****LINE GENERATION*****
C
```

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               C
               C      SP LINE GENERATION
               C
 0146                 CALL PLOT(ABC(1),SP(1),3)
 0147                 N = 290
 0148                     DO 1002  K = 2,N
 0149                     CALL PLOT(ABC(K),SP(K),2)
 0150            1002 CONTINUE
               C
               C      POROSITY INDEX LINE PLOT
               C
 0151                 CALL PLOT(ABC(1),PORP(1),3)
 0152                 N = 290
 0153                     DO 1001  K = 2,N
 0154                     CALL PLOT(ABC(K),PORP(K),2)
 0155            1001 CONTINUE
               C
               C      TDS LINE GENERATION
               C
 0156                 CALL PLOT(ABC(1),TDSP(1),3)
 0157                 N = 290
 0158                     DO 1003  K = 2,N
 0159                     CALL PLOT(ABC(K),TDSP(K),2)
 0160            1003 CONTINUE
               C
               C      SO4 LINE GENERATION
               C
 0161                 CALL PLOT(ABC(1),SO4P(1),3)
 0162                 N = 290
 0163                     DO 1004  K = 2,N
 0164                     CALL PLOT(ABC(K),SO4P(K),2)
 0165            1004 CONTINUE
               C
               C      FILE MARK.
 0166                 CALL PLOT(25.,0.,999)
 0167                 STOP
 0168                 END

                                           SCALAR MAP
SYMBOL     LOCATION       SYMBOL    LOCATION      SYMBOL    LOCATION       SYMBOL    LOCATION       SYMBOL    LOCATION
T1         000178         N         00017C        RMC       000180         RMF       000184         AM        000188
AVTEMP     00018C         TD        000190        BHT       000194         ROCL      000198         K         00019C
A          0001A0         B         0001A4        C         0001A8         D         0001AC         E         0001B0
Q          0001B4         G         0001B8        GRAD      0001BC         T2        0001C0         TIME      0001C4
Y          0001C8         HEIGHT    0001CC        THETA     0001D0         NN        0001D4         I         0001D8

                                           ARRAY MAP
SYMBOL     LOCATION       SYMBOL    LOCATION      SYMBOL    LOCATION       SYMBOL    LOCATION       SYMBOL    LOCATION
IDATA      0001DC         DEPTH     000668        RMN       000AF4         RO        000F80         F         00140C
TDS        001898         CL        001D24        SO4       002180         RW        00263C         POR       002AC8
SPCOND     002F54         RXOC      0033E0        ROC       00386C         TDSP      003CF8         SO4P      004184
PORP       004610         ABC       004A9C        X         004F28         FPN       004F44         SP        004F60
W          0053EC         RX01      005BBC

                                        SUBPROGRAMS CALLED
SYMBOL     LOCATION       SYMBOL    LOCATION      SYMBOL    LOCATION       SYMBOL    LOCATION       SYMBOL    LOCATION
CLOCK      00638C         IBCOM#    006390        SETMSG    006394         PLOT      006398         NUMBER    00639C
FRXPR#     0063A0


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                                           LABEL MAP
LABEL      LOCATION       LABEL     LOCATION      LABEL     LOCATION       LABEL     LOCATION       LABEL     LOCATION
     1     006B08             2     006834          700     006A12           611     006A64           701     006A86
   702     006B40           703     006B7C          705     006BBC            10     006CA4            11     006D30
    20     006D74            21     006DFC           30     006E40            31     006EC8          1000     006F10
   111     006F98           200     006FE4          400     007014           610     0070AC          9999     0070F0
  9998     00743C          1010     00747C         1002     0074EE          1001     007568          1003     0075EE
  1004     007674

   TOTAL MEMORY REQUIREMENTS 0077D4 BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
// EXEC LNKEDT(MAP)
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VALENCIA COUNTY NEW MEX. WATER WELL

CITY OF BELEN WATER WELL #4

RMF = 10.8 OHM-M @ AQUIFER TEMP.(69 F)
M = 1.5

DATA	DEPTH	RMN	RO	F	POR	RW	SPCOND	TDS	CL	SO4	REMARKS
1	20.	24.0	68.0	3.0	14.4	21.3	469.3	300.	10.	100.	GOOD-SCREEN
2	22.	23.5	60.0	2.9	14.7	19.3	519.0	332.	11.	111.	GOOD-SCREEN
3	24.	19.0	25.0	2.3	17.3	10.3	973.4	623.	30.	208.	PACCEPT
4	26.	20.0	14.0	2.4	16.6	5.4	1846.1	1182.	80.	557.	NACCEPT-CLAY
5	28.	10.0	12.3	0.8	35.9	15.1	662.2	424.	16.	142.	NACCEPT-CLAY
6	30.	10.0	15.0	0.8	35.8	18.4	543.0	348.	12.	116.	NACCEPT-CLAY
7	32.	8.0	26.0	0.3	65.0	83.0	120.4	77.	1.	26.	GOOD-SCREEN
8	34.	32.0	46.0	4.3	11.4	10.1	992.4	635.	31.	212.	PACCEPT
9	36.	32.0	17.0	4.3	11.4	3.7	2685.3	1719.	143.	1039.	NACCEPT-CLAY
10	38.	10.0	7.6	0.8	35.8	9.3	1071.7	686.	35.	229.	NACCEPT-CLAY
11	40.	18.0	7.7	2.1	18.0	3.4	2961.6	1895.	167.	1198.	NACCEPT-CLAY
12	42.	8.0	6.0	0.3	65.0	19.2	521.8	334.	11.	112.	NACCEPT-CLAY
13	44.	8.0	8.0	0.3	65.0	25.6	391.4	250.	7.	84.	NACCEPT-CLAY
14	46.	14.0	23.0	1.5	22.6	14.2	705.7	452.	18.	151.	GOOD-SCREEN
15	48.	26.0	51.0	3.3	13.5	14.5	687.9	440.	17.	147.	GOOD-SCREEN
16	50.	30.0	65.0	4.0	12.0	15.5	644.9	413.	16.	138.	GOOD-SCREEN
17	52.	30.0	66.0	4.0	12.0	15.7	635.2	407.	15.	136.	GOOD-SCREEN
18	54.	30.0	65.0	4.0	12.0	15.5	644.9	413.	16.	138.	GOOD-SCREEN
19	56.	30.0	81.0	4.0	12.0	19.3	517.5	331.	11.	111.	GOOD-SCREEN
20	58.	42.0	116.0	6.4	8.7	17.2	582.6	373.	13.	125.	GOOD-SCREEN
21	60.	42.0	80.0	6.4	8.7	11.8	844.8	541.	24.	181.	PACCEPT
22	62.	32.0	18.0	4.3	11.3	3.9	2536.1	1623.	131.	953.	NACCEPT-CLAY
23	64.	15.0	13.6	1.7	21.1	7.6	1321.5	846.	48.	283.	NACCEPT-CLAY
24	66.	6.0	19.5	0.6	42.8	31.4	318.5	204.	5.	68.	GOOD-SCREEN
25	68.	29.0	25.0	3.8	12.3	6.2	1605.5	1028.	65.	418.	NACCEPT
26	70.	32.0	9.2	4.3	11.3	2.0	4961.9	3176.	371.	2348.	NACCEPT-CLAY
27	72.	5.0	9.3	0.5	48.2	18.0	556.6	356.	13.	119.	NACCEPT-CLAY
28	74.	10.0	14.6	0.8	35.7	17.9	557.9	357.	13.	119.	NACCEPT-CLAY
29	76.	13.0	12.7	1.4	24.4	8.8	1133.7	726.	38.	243.	NACCEPT-CLAY
30	78.	7.0	14.6	0.0	65.0	491.0	20.4	13.	0.	4.	NACCEPT-CLAY
31	80.	23.5	40.0	3.0	14.6	12.8	778.5	498.	21.	167.	GOOD-SCREEN
32	82.	32.0	100.0	4.3	11.3	21.9	456.5	292.	9.	98.	GOOD-SCREEN
33	84.	31.0	66.0	4.2	11.6	15.1	663.0	424.	16.	142.	GOOD-SCREEN
34	86.	20.0	39.0	2.5	16.5	15.1	662.7	424.	16.	142.	GOOD-SCREEN
35	88.	20.0	37.0	2.5	16.5	14.3	698.5	447.	18.	149.	GOOD-SCREEN
36	90.	28.0	50.0	3.7	12.7	13.0	768.1	492.	21.	164.	GOOD-SCREEN
37	92.	28.0	50.0	3.7	12.7	13.0	768.1	492.	21.	164.	GOOD-SCREEN
38	94.	29.0	39.0	3.8	12.3	9.7	1029.2	659.	32.	220.	PACCEPT
39	96.	30.0	40.0	4.0	11.9	9.5	1048.0	671.	33.	224.	PACCEPT
40	98.	24.0	55.0	3.0	14.3	17.2	580.3	371.	13.	124.	GOOD-SCREEN
41	100.	29.5	78.0	3.9	12.1	19.0	525.9	337.	11.	113.	GOOD-SCREEN
42	102.	35.0	75.0	4.9	10.4	14.5	688.8	441.	17.	147.	GOOD-SCREEN
43	104.	34.0	60.0	4.7	10.7	12.1	826.7	529.	23.	177.	PACCEPT
44	106.	31.2	46.0	4.2	11.5	10.4	959.4	614.	29.	205.	PACCEPT
45	108.	26.0	50.0	3.3	13.4	14.3	701.6	449.	18.	150.	GOOD-SCREEN
46	110.	30.0	75.0	4.0	11.9	17.9	558.9	358.	13.	120.	GOOD-SCREEN
47	112.	40.0	53.0	6.0	9.1	8.4	1184.6	758.	40.	254.	PACCEPT
48	114.	30.0	33.0	4.0	11.9	7.9	1270.3	813.	45.	272.	PACCEPT
49	116.	14.0	33.0	1.6	22.4	20.3	491.9	315.	10.	105.	GOOD-SCREEN
50	118.	24.0	38.0	3.0	14.3	11.9	839.8	537.	24.	180.	PACCEPT
51	120.	23.0	27.0	2.9	14.7	8.9	1125.0	720.	37.	241.	PACCEPT
52	122.	18.0	25.0	2.2	17.8	11.0	912.2	584.	27.	195.	PACCEPT
53	124.	20.0	35.0	2.5	16.4	13.5	738.4	473.	19.	158.	GOOD-SCREEN
54	126.	32.0	51.0	4.4	11.2	11.2	895.1	573.	26.	192.	PACCEPT
55	128.	30.0	40.0	4.0	11.9	9.5	1048.0	671.	33.	224.	PACCEPT
56	130.	31.0	38.0	4.2	11.5	8.7	1151.5	737.	39.	246.	PACCEPT
57	132.	26.5	27.0	3.4	13.2	7.5	1329.5	851.	48.	285.	PACCEPT
58	134.	28.0	16.0	3.7	12.6	4.2	2400.4	1536.	120.	875.	NACCEPT-CLAY
59	136.	9.0	12.5	0.5	44.7	21.8	459.0	294.	9.	98.	NACCEPT-CLAY
60	138.	10.0	13.6	0.8	35.4	16.7	598.9	383.	14.	128.	NACCEPT-CLAY
61	140.	10.0	17.2	0.8	35.4	21.1	473.5	303.	10.	101.	NACCEPT-CLAY
62	142.	19.0	25.0	2.3	17.0	10.3	973.4	623.	30.	208.	PACCEPT
63	144.	18.6	29.0	2.3	17.3	12.2	818.1	524.	23.	175.	PACCEPT
64	146.	23.0	30.0	2.9	14.7	9.9	1012.5	648.	32.	217.	PACCEPT
65	148.	25.0	13.6	3.2	13.8	4.1	2461.8	1576.	125.	911.	NACCEPT-CLAY
66	150.	26.0	29.5	3.4	13.3	8.4	1189.2	761.	41.	254.	PACCEPT
67	152.	33.0	15.0	4.6	10.9	3.2	3173.2	2031.	186.	1320.	NACCEPT-CLAY
68	154.	10.0	12.2	0.8	35.3	15.0	667.6	427.	17.	143.	NACCEPT-CLAY
69	156.	16.0	15.0	1.9	19.6	7.6	1309.2	838.	47.	280.	NACCEPT-CLAY
70	158.	16.0	17.0	1.9	19.6	8.7	1155.2	739.	39.	247.	NACCEPT-CLAY
71	160.	20.0	16.6	2.5	16.3	6.4	1557.0	996.	62.	390.	NACCEPT-CLAY
72	162.	15.0	15.7	1.7	20.8	8.7	1144.8	733.	38.	245.	NACCEPT-CLAY
73	164.	11.0	22.0	1.0	30.0	21.2	471.6	302.	10.	101.	GOOD-SCREEN
74	166.	20.0	9.1	2.5	16.3	3.5	2840.2	1818.	156.	1128.	NACCEPT-CLAY
75	168.	25.0	12.0	3.2	13.7	3.6	2790.1	1786.	152.	1099.	NACCEPT-CLAY
76	170.	10.0	9.2	0.8	35.2	11.3	885.3	567.	26.	189.	NACCEPT-CLAY
77	172.	9.3	9.6	0.6	41.0	14.8	675.0	432.	17.	144.	NACCEPT-CLAY
78	174.	15.0	13.1	1.7	20.8	7.3	1372.0	878.	51.	294.	NACCEPT-CLAY
79	176.	26.0	27.0	3.4	13.3	7.7	1299.3	832.	47.	278.	PACCEPT
80	178.	24.0	30.0	3.1	14.2	9.4	1063.8	681.	34.	228.	PACCEPT
81	180.	22.5	32.0	2.9	14.9	10.8	925.4	592.	27.	198.	PACCEPT
82	182.	28.0	33.0	3.7	12.5	8.6	1163.8	745.	39.	249.	PACCEPT
83	184.	18.0	25.0	2.2	17.7	11.0	912.2	584.	27.	195.	PACCEPT
84	186.	18.0	12.0	2.2	17.7	5.3	1900.4	1216.	84.	588.	NACCEPT-CLAY
85	188.	14.0	8.7	1.6	22.2	5.4	1865.7	1194.	82.	568.	NACCEPT-CLAY
86	190.	5.0	10.2	0.5	47.6	19.7	507.4	325.	11.	109.	NACCEPT-CLAY
87	192.	16.0	25.0	1.9	19.6	12.7	785.5	503.	21.	168.	PACCEPT
88	194.	23.0	27.0	2.9	14.6	8.9	1125.0	720.	37.	241.	PACCEPT
89	196.	13.5	19.5	1.5	23.1	12.7	786.0	503.	21.	168.	PACCEPT
90	198.	17.5	10.4	2.1	18.1	4.7	2118.2	1356.	99.	713.	NACCEPT-CLAY
91	200.	10.0	11.0	0.8	35.1	13.5	740.4	474.	19.	158.	NACCEPT-CLAY
92	202.	22.0	26.0	2.8	15.1	9.0	1109.8	710.	36.	238.	PACCEPT
93	204.	36.0	36.0	5.2	10.0	6.7	1493.9	956.	58.	354.	PACCEPT
94	206.	28.0	30.0	3.7	12.5	7.8	1280.2	819.	45.	274.	PACCEPT
95	208.	24.0	27.0	3.1	14.1	8.5	1182.0	756.	40.	253.	PACCEPT
96	210.	26.0	30.0	3.4	13.3	8.6	1169.4	748.	40.	250.	PACCEPT
97	212.	20.0	30.0	2.5	16.2	11.6	861.5	551.	25.	184.	PACCEPT
98	214.	24.0	25.0	3.1	14.1	7.8	1276.6	817.	45.	273.	PACCEPT
99	216.	17.0	22.0	2.1	18.5	10.4	965.6	618.	29.	207.	PACCEPT
100	218.	22.0	22.0	2.8	15.1	7.6	1311.6	839.	47.	281.	PACCEPT
101	220.	21.0	13.0	2.7	15.6	4.8	2103.8	1346.	98.	705.	NACCEPT-CLAY
102	222.	10.0	9.5	0.8	35.0	11.7	857.3	549.	24.	183.	NACCEPT-CLAY
103	224.	11.0	10.0	1.0	29.8	9.6	1037.5	664.	33.	222.	NACCEPT-CLAY
104	226.	7.3	9.6	0.1	65.0	81.9	122.2	78.	1.	26.	NACCEPT-CLAY
105	228.	16.0	9.6	1.9	19.5	4.9	2045.6	1309.	94.	671.	NACCEPT-CLAY
106	230.	8.0	9.6	0.3	65.0	30.7	326.1	209.	5.	70.	NACCEPT-CLAY
107	232.	13.0	11.7	1.4	23.9	8.1	1230.6	788.	43.	263.	NACCEPT-CLAY
108	234.	12.0	10.1	1.2	26.4	8.1	1232.9	789.	43.	264.	NACCEPT-CLAY
109	236.	14.0	9.1	1.6	22.1	5.6	1783.7	1142.	76.	521.	NACCEPT-CLAY
110	238.	9.1	8.7	0.6	42.9	14.5	688.2	440.	17.	147.	NACCEPT-CLAY
111	240.	9.5	11.0	0.7	38.8	15.8	633.2	405.	15.	135.	NACCEPT-CLAY
112	242.	13.0	15.0	1.4	23.9	10.4	959.9	614.	29.	205.	NACCEPT-CLAY
113	244.	18.0	17.5	2.2	17.6	7.7	1303.1	834.	47.	279.	NACCEPT-CLAY
114	246.	17.5	10.0	2.2	18.0	4.5	2202.9	1410.	105.	762.	NACCEPT-CLAY
115	248.	6.0	9.5	0.6	41.8	15.3	653.8	418.	16.	140.	NACCEPT-CLAY
116	250.	18.0	12.2	2.2	17.6	5.3	1869.2	1196.	82.	570.	NACCEPT-CLAY
117	252.	16.2	12.0	2.0	19.2	6.0	1663.6	1065.	68.	452.	NACCEPT-CLAY
118	254.	14.0	8.3	1.6	22.0	5.1	1955.7	1252.	88.	619.	NACCEPT-CLAY

119	256.	6.0	9.1	0.6	41.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
120	258.	14.0	11.5	1.6	22.0	7.1	1411.5	903.	53.	307.	[illegible]
121	260.	16.0	10.0	1.9	19.4	5.1	1963.8	1257.	88.	624.	NACCEPT-CLAY
122	262.	6.0	8.0	0.6	41.8	12.9	776.4	497.	21.	166.	NACCEPT-CLAY
123	264.	7.0	8.4	0.0	65.0	282.5	35.4	23.	0.	8.	NACCEPT-CLAY
124	266.	6.5	8.3	0.7	39.6	12.3	810.7	519.	22.	173.	NACCEPT-CLAY
125	268.	8.0	9.6	0.3	65.0	30.7	326.1	209.	5.	70.	NACCEPT-CLAY
126	270.	10.5	9.4	0.9	31.9	10.1	987.3	632.	30.	211.	NACCEPT-CLAY
127	272.	6.6	7.7	0.7	39.2	11.3	887.3	568.	26.	190.	NACCEPT-CLAY
128	274.	9.0	8.7	0.6	44.0	15.2	659.5	422.	16.	141.	NACCEPT-CLAY
129	276.	13.0	9.5	1.4	23.8	6.6	1515.6	970.	59.	366.	NACCEPT-CLAY
130	278.	12.0	8.0	1.2	26.2	6.4	1556.6	996.	62.	390.	NACCEPT-CLAY
131	280.	7.0	7.5	0.0	65.0	252.2	39.6	25.	0.	8.	NACCEPT-CLAY
132	282.	6.0	11.5	0.6	41.7	18.5	540.1	346.	12.	116.	NACCEPT-CLAY
133	284.	23.0	24.0	3.0	14.5	7.9	1265.6	810.	45.	271.	PACCEPT
134	286.	22.0	30.0	2.8	15.0	10.4	961.9	616.	29.	206.	PACCEPT
135	288.	23.0	35.0	3.0	14.5	11.5	867.9	555.	25.	186.	PACCEPT
136	290.	27.0	40.0	3.6	12.7	10.9	918.0	588.	27.	196.	PACCEPT
137	292.	32.0	40.0	4.5	11.0	8.8	1141.2	730.	38.	244.	PACCEPT
138	294.	30.0	30.0	4.1	11.7	7.2	1397.4	894.	52.	299.	PACCEPT
139	296.	25.0	27.0	3.3	13.5	8.1	1240.0	794.	43.	265.	PACCEPT
140	298.	20.0	28.0	2.5	16.1	10.8	923.1	591.	27.	198.	PACCEPT
141	300.	29.0	35.0	4.0	12.0	8.7	1146.8	734.	38.	245.	PACCEPT
142	302.	24.0	34.0	3.1	14.0	10.7	938.6	601.	28.	201.	PACCEPT
143	304.	22.0	34.0	2.8	14.9	11.8	848.7	543.	24.	182.	PACCEPT
144	306.	30.0	22.0	4.1	11.6	5.2	1905.5	1220.	84.	591.	NACCEPT
145	308.	22.0	11.0	2.9	14.9	3.8	2623.3	1679.	138.	1003.	NACCEPT-CLAY
146	310.	5.5	8.1	0.6	44.0	14.2	702.9	450.	18.	150.	NACCEPT-CLAY
147	312.	6.0	8.6	0.6	41.5	13.8	722.2	462.	19.	155.	NACCEPT-CLAY
148	314.	7.0	8.5	0.0	65.0	285.9	35.0	22.	0.	7.	NACCEPT-CLAY
149	316.	6.0	12.0	0.6	41.5	19.3	517.6	331.	11.	111.	NACCEPT-CLAY
150	318.	24.0	28.0	3.2	13.9	8.8	1139.8	729.	38.	244.	PACCEPT
151	320.	30.0	23.0	4.1	11.6	5.5	1822.7	1166.	79.	543.	NACCEPT
152	322.	15.0	17.3	1.8	20.4	9.6	1038.9	665.	33.	222.	NACCEPT-CLAY
153	324.	16.0	14.1	1.9	19.3	7.2	1392.8	891.	52.	298.	NACCEPT-CLAY
154	326.	16.5	19.5	2.0	18.7	9.5	1048.6	671.	33.	224.	PACCEPT
155	328.	18.0	23.5	2.3	17.4	10.3	970.4	621.	30.	208.	PACCEPT
156	330.	18.0	24.0	2.3	17.4	10.5	950.2	608.	29.	203.	PACCEPT
157	332.	23.5	16.0	3.1	14.1	5.1	1946.3	1246.	87.	614.	NACCEPT-CLAY
158	334.	11.0	14.0	1.0	29.4	13.5	741.1	474.	19.	159.	NACCEPT-CLAY
159	336.	12.2	12.2	1.3	25.5	9.5	1053.4	674.	34.	225.	NACCEPT-CLAY
160	338.	8.0	11.4	0.3	65.0	36.4	274.6	176.	4.	59.	NACCEPT-CLAY
161	340.	8.0	12.0	0.3	65.0	38.3	260.9	167.	4.	56.	NACCEPT-CLAY
162	342.	13.5	12.7	1.5	22.7	8.3	1206.9	772.	41.	258.	NACCEPT-CLAY
163	344.	13.0	11.6	1.4	23.6	8.1	1241.2	794.	43.	266.	NACCEPT-CLAY
164	346.	10.0	16.2	0.8	34.5	19.9	502.8	322.	11.	108.	NACCEPT-CLAY
165	348.	23.0	30.0	3.0	14.4	9.9	1012.5	648.	32.	217.	PACCEPT
166	350.	33.0	36.0	4.7	10.6	7.6	1322.1	846.	48.	283.	PACCEPT
167	352.	35.0	16.0	5.1	10.1	3.1	3228.9	2067.	191.	1352.	NACCEPT-CLAY
168	354.	20.0	10.0	2.6	16.0	3.9	2584.6	1654.	135.	981.	NACCEPT-CLAY
169	356.	7.0	10.3	0.0	65.0	346.4	28.9	18.	0.	6.	NACCEPT-CLAY
170	358.	10.0	9.0	0.8	34.5	11.1	905.0	579.	27.	194.	NACCEPT-CLAY
171	360.	12.0	8.0	1.2	26.0	6.4	1556.6	996.	62.	390.	NACCEPT-CLAY
172	362.	5.0	10.5	0.5	46.6	20.3	493.0	315.	10.	105.	NACCEPT-CLAY
173	364.	18.0	27.0	2.3	17.3	11.8	844.6	541.	24.	181.	PACCEPT
174	366.	29.6	35.0	4.1	11.7	8.5	1177.2	753.	40.	252.	PACCEPT
175	368.	30.0	36.5	4.2	11.6	8.7	1148.5	735.	38.	246.	PACCEPT
176	370.	32.0	28.5	4.6	10.9	6.2	1601.7	1025.	64.	416.	NACCEPT
177	372.	25.0	16.0	3.3	13.4	4.8	2092.5	1339.	97.	698.	NACCEPT-CLAY
178	374.	10.0	17.0	0.8	34.4	20.9	479.1	307.	10.	103.	NACCEPT-CLAY
179	376.	29.0	29.0	4.0	11.9	7.2	1384.1	886.	51.	296.	PACCEPT
180	378.	26.0	34.0	3.5	13.0	9.7	1031.8	660.	33.	221.	PACCEPT
181	380.	26.0	31.0	3.5	13.0	8.8	1131.7	724.	38.	242.	PACCEPT
182	382.	30.0	20.0	4.2	11.5	4.8	2096.1	1341.	98.	700.	NACCEPT
183	384.	20.0	18.3	2.6	15.9	7.1	1412.3	904.	53.	307.	PACCEPT
184	386.	20.0	23.0	2.6	15.9	8.9	1123.7	719.	37.	240.	PACCEPT
185	388.	20.0	19.1	2.6	15.9	7.4	1353.2	866.	50.	290.	PACCEPT
186	390.	15.0	17.7	1.8	20.3	9.8	1015.4	650.	32.	217.	NACCEPT-CLAY
187	392.	21.0	24.0	2.7	15.3	8.8	1139.6	729.	38.	244.	PACCEPT
188	394.	17.0	23.0	2.1	18.1	10.8	923.6	591.	27.	198.	PACCEPT
189	396.	25.0	16.0	3.4	13.4	4.8	2092.5	1339.	97.	698.	NACCEPT-CLAY
190	398.	10.0	12.1	0.8	34.3	14.9	673.1	431.	17.	144.	NACCEPT-CLAY
191	400.	9.6	11.6	0.7	37.2	16.1	621.1	397.	15.	133.	NACCEPT-CLAY
192	402.	11.0	11.0	1.0	29.2	10.6	943.2	604.	28.	202.	NACCEPT-CLAY
193	404.	9.0	9.2	0.6	43.3	16.0	623.7	399.	15.	133.	NACCEPT-CLAY
194	406.	10.0	10.0	0.8	34.3	12.3	814.5	521.	23.	174.	NACCEPT-CLAY
195	408.	5.0	16.0	0.5	46.4	30.9	323.5	207.	5.	69.	NACCEPT-CLAY
196	410.	29.0	42.0	4.0	11.8	10.5	955.7	612.	29.	205.	PACCEPT
197	412.	31.0	46.0	4.4	11.2	10.5	951.3	609.	29.	204.	PACCEPT
198	414.	25.0	48.0	3.4	13.4	14.3	697.5	446.	18.	149.	GOOD-SCREEN
199	416.	30.0	45.0	4.2	11.5	10.7	931.6	596.	28.	199.	PACCEPT
200	418.	15.0	42.0	1.8	20.2	23.4	427.9	274.	8.	92.	GOOD-SCREEN
201	420.	38.0	31.1	5.9	9.2	5.3	1870.7	1197.	82.	571.	NACCEPT
202	422.	19.0	26.0	2.5	16.5	10.7	935.9	599.	28.	200.	PACCEPT
203	424.	19.0	17.7	2.5	16.5	7.3	1374.8	880.	51.	294.	NACCEPT-CLAY
204	426.	10.0	17.0	0.8	34.2	20.9	479.1	307.	10.	103.	NACCEPT-CLAY
205	428.	16.0	25.0	2.0	19.0	12.7	785.5	503.	21.	168.	PACCEPT
206	430.	18.0	14.0	2.3	17.2	6.1	1628.9	1042.	66.	432.	NACCEPT-CLAY
207	432.	14.0	8.8	1.6	21.6	5.4	1844.5	1181.	80.	556.	NACCEPT-CLAY
208	434.	4.0	10.5	0.4	53.7	25.4	394.4	252.	7.	84.	NACCEPT-CLAY
209	436.	15.0	25.0	1.8	20.2	13.9	718.9	460.	19.	154.	GOOD-SCREEN
210	438.	15.0	26.0	1.8	20.2	14.5	691.3	442.	17.	148.	GOOD-SCREEN
211	440.	16.6	15.0	2.1	18.4	7.3	1373.8	879.	51.	294.	NACCEPT-CLAY
212	442.	22.0	11.3	2.9	14.7	3.9	2553.6	1634.	133.	963.	NACCEPT-CLAY
213	444.	8.0	12.0	0.3	64.6	38.3	260.9	167.	4.	56.	NACCEPT-CLAY
214	446.	12.0	21.0	1.3	25.7	16.9	593.0	380.	14.	127.	GOOD-SCREEN
215	448.	20.0	23.0	2.6	15.8	8.9	1123.7	719.	37.	240.	PACCEPT
216	450.	20.0	22.0	2.6	15.8	8.5	1174.8	752.	40.	251.	PACCEPT
217	452.	17.3	23.0	2.2	17.7	10.6	944.2	604.	28.	202.	PACCEPT
218	454.	12.2	24.0	1.3	25.2	18.7	535.5	343.	12.	115.	GOOD-SCREEN
219	456.	17.0	24.0	2.2	18.0	11.3	885.2	566.	26.	189.	PACCEPT
220	458.	21.0	26.0	2.8	15.2	9.5	1051.9	673.	34.	225.	PACCEPT
221	460.	34.0	31.0	5.0	10.2	6.2	1600.1	1024.	64.	415.	NACCEPT
222	462.	20.0	25.0	2.6	15.8	9.7	1033.8	662.	33.	221.	PACCEPT
223	464.	20.0	28.0	2.6	15.8	10.8	923.1	591.	27.	198.	PACCEPT
224	466.	20.0	38.0	2.6	15.8	14.7	680.1	435.	17.	146.	GOOD-SCREEN
225	468.	29.0	43.0	4.1	11.8	10.7	933.4	597.	28.	200.	PACCEPT
226	470.	25.0	44.0	3.4	13.3	13.1	760.9	487.	20.	163.	GOOD-SCREEN
227	472.	35.0	47.0	5.2	9.9	9.1	1099.2	703.	36.	235.	PACCEPT
228	474.	30.0	41.0	4.3	11.4	9.8	1022.5	654.	32.	219.	PACCEPT
229	476.	23.0	31.0	3.1	14.1	10.2	979.8	627.	30.	210.	PACCEPT
230	478.	26.0	31.0	3.6	12.8	8.8	1131.7	724.	38.	242.	PACCEPT
231	480.	34.0	33.0	5.0	10.2	6.7	1503.1	962.	58.	359.	PACCEPT
232	482.	24.0	41.0	3.2	13.7	12.8	778.4	498.	21.	167.	GOOD-SCREEN
233	484.	29.0	20.0	4.1	11.7	5.0	2006.9	1284.	91.	649.	NACCEPT
234	486.	26.0	10.5	3.6	12.8	3.0	3341.1	2138.	201.	1416.	NACCEPT-CLAY
235	488.	6.0	6.0	0.6	40.7	9.7	1035.2	663.	33.	222.	NACCEPT-CLAY
236	490.	6.0	5.5	0.6	40.7	8.9	1129.3	723.	37.	242.	NACCEPT-CLAY
237	492.	3.6	7.0	0.4	57.2	18.8	532.4	341.	12.	114.	NACCEPT-CLAY
238	494.	10.0	14.0	0.8	34.0	17.2	581.8	372.	13.	124.	NACCEPT-CLAY
239	496.	14.0	19.0	1.7	21.4	11.7	854.3	547.	24.	183.	PACCEPT
240	498.	17.0	23.0	2.2	17.9	10.8	923.6	591.	27.	198.	PACCEPT
241	500.	18.0	26.0	2.3	17.1	11.4	877.1	561.	25.	188.	PACCEPT
242	502.	17.0	25.0	2.2	17.9	11.8	849.7	544.	24.	182.	PACCEPT
243	504.	22.0	14.0	2.9	14.6	4.9	2061.1	1319.	95.	680.	NACCEPT-CLAY
244	506.	20.0	7.5	2.6	15.7	2.9	3446.1	2205.	211.	1476.	NACCEPT-CLAY
245	508.	6.5	7.1	0.7	38.5	10.6	947.7	607.	29.	203.	NACCEPT-CLAY
246	510.	8.0	9.3	0.3	64.1	29.7	336.7	215.	6.	72.	NACCEPT-CLAY
247	512.	13.0	13.0	1.5	23.2	9.0	1107.5	709.	36.	237.	NACCEPT-CLAY
248	514.	12.0	15.0	1.3	25.5	12.0	830.2	531.	23.	178.	NACCEPT-CLAY
249	516.	20.0	25.0	2.6	15.7	9.7	1033.8	662.	33.	221.	PACCEPT

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 251    520.   17.0   16.0   2.2   17.9     7.5   1327.7    850.    48.   284.   NACCEPT-CLAY
 252    522.   15.0    9.6   1.8   20.0     5.3   1872.2   1198.    82.   571.   NACCEPT-CLAY
 253    524.    9.0    5.3   0.6   42.7     9.2   1082.7    693.    35.   232.   NACCEPT-CLAY
 254    526.    4.1    5.5   0.4   52.2    13.0    771.7    494.    21.   165.   NACCEPT-CLAY
 255    528.    3.4    7.0   0.4   59.2    19.9    502.8    322.    11.   108.   NACCEPT-CLAY
 256    530.   11.0    6.0   1.1   28.8     5.8   1729.2   1107.    72.   489.   NACCEPT-CLAY
 257    532.    5.0    4.0   0.5   45.7     7.7   1294.0    828.    46.   277.   NACCEPT-CLAY
 258    534.    3.4    4.2   0.4   59.1    11.9    838.0    536.    24.   179.   NACCEPT-CLAY
 259    536.    5.0    7.0   0.5   45.7    13.5    739.4    473.    19.   158.   NACCEPT-CLAY
 260    538.   12.0   11.5   1.3   25.5     9.2   1082.8    693.    35.   232.   NACCEPT-CLAY
 261    540.   12.0   11.0   1.3   25.5     8.8   1132.0    725.    38.   242.   NACCEPT-CLAY
 262    542.   11.0    7.0   1.1   28.7     6.7   1482.2    949.    57.   347.   NACCEPT-CLAY
 263    544.    3.6    5.8   0.4   56.9    15.6    642.5    411.    16.   138.   NACCEPT-CLAY
 264    546.    6.5    6.1   0.7   38.3     9.1   1103.1    706.    36.   236.   NACCEPT-CLAY
 265    548.    4.1    7.1   0.4   52.1    16.7    597.8    383.    14.   128.   NACCEPT-CLAY
 266    550.    4.1    4.5   0.4   52.1    10.6    943.2    604.    28.   202.   NACCEPT-CLAY
 267    552.    3.6    4.5   0.4   56.8    12.1    828.2    530.    23.   177.   NACCEPT-CLAY
 268    554.    4.0    6.5   0.4   53.0    15.7    637.0    408.    15.   136.   NACCEPT-CLAY
 269    556.    6.0   11.0   0.6   40.4    17.7    564.7    361.    13.   121.   NACCEPT-CLAY
 270    558.   11.0    9.5   1.1   28.7     9.2   1092.1    699.    36.   234.   NACCEPT-CLAY
 271    560.   11.0    6.3   1.1   28.7     6.1   1646.8   1054.    67.   442.   NACCEPT-CLAY
 272    562.    7.0    5.3   0.0   65.0   178.2     56.1     36.     0.    12.   NACCEPT-CLAY
 273    564.    5.0    5.0   0.5   45.6     9.7   1035.2    663.    33.   222.   NACCEPT-CLAY
 274    566.    4.0    5.1   0.4   52.9    12.3    811.9    520.    22.   174.   NACCEPT-CLAY
 275    568.    6.0    6.3   0.6   40.3    10.1    985.9    631.    30.   211.   NACCEPT-CLAY
 276    570.    5.0    8.3   0.5   45.6    16.0    623.6    399.    15.   133.   NACCEPT-CLAY
 277    572.    9.0   12.4   0.6   42.5    21.6    462.7    296.     9.    99.   NACCEPT-CLAY
 278    574.   11.0   14.4   1.1   28.6    13.9    720.5    461.    19.   154.   NACCEPT-CLAY
 279    576.   12.0   16.1   1.3   25.4    12.9    773.4    495.    21.   166.   NACCEPT-CLAY
 280    578.   13.0   16.5   1.5   23.0    11.5    872.6    558.    25.   187.   NACCEPT-CLAY
 281    580.   15.6   13.0   2.0   19.1     6.8   1460.0    934.    56.   334.   NACCEPT-CLAY
 282    582.    9.0   12.0   0.6   42.5    20.9    478.2    306.    10.   102.   NACCEPT-CLAY
 283    584.   11.0   16.0   1.1   28.6    15.4    648.4    415.    16.   139.   NACCEPT-CLAY
 284    586.   17.0   19.0   2.2   17.7     8.9   1118.1    716.    37.   239.   PACCEPT
 285    588.   14.5   12.0   1.8   20.5     7.0   1426.1    913.    54.   315.   NACCEPT-CLAY
 286    590.   10.0    7.3   0.8   33.6     9.0   1115.7    714.    37.   239.   NACCEPT-CLAY
 287    592.    6.0    6.3   0.6   40.2    10.1    985.9    631.    30.   211.   NACCEPT-CLAY
 288    594.    7.0    9.0   0.0   65.0   302.7     33.0     21.     0.     7.   NACCEPT-CLAY
 289    596.   13.0   14.0   1.5   23.0     9.7   1028.4    658.    32.   220.   NACCEPT-CLAY
 290    598.   15.0   18.6   1.9   19.8    10.3    966.3    618.    29.   207.   PACCEPT
 291    600.   18.7   19.1   2.5   16.4     8.0   1250.2    800.    44.   268.   PACCEPT
DATA   DEPTH    RMN     RO     F    POR      RW   SPCOND     TDS     CL    SO4   REMARKS


                              PROGRAM TIME IN SECONDS =  0.1356680E 03


                PROGRAM BY----

                     RONALD M. BRIMHALL
                     BOX 31 CAMPUS STA.
                     SOCORRO, N. M.    87801
/&
JOB TIME SUMMARY...COMPILE 0128S   ASSEMBLE 0000S   LNKEDT 0042S   UTILS 0000S   USER 0212S        TOTAL TIME  006M 22S
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COMPANY CITY OF BELEN

WELL WATER WELL #4

LOCATION NOT AVAILABLE

COUNTY VALENCIA STATE NEW MEXICO

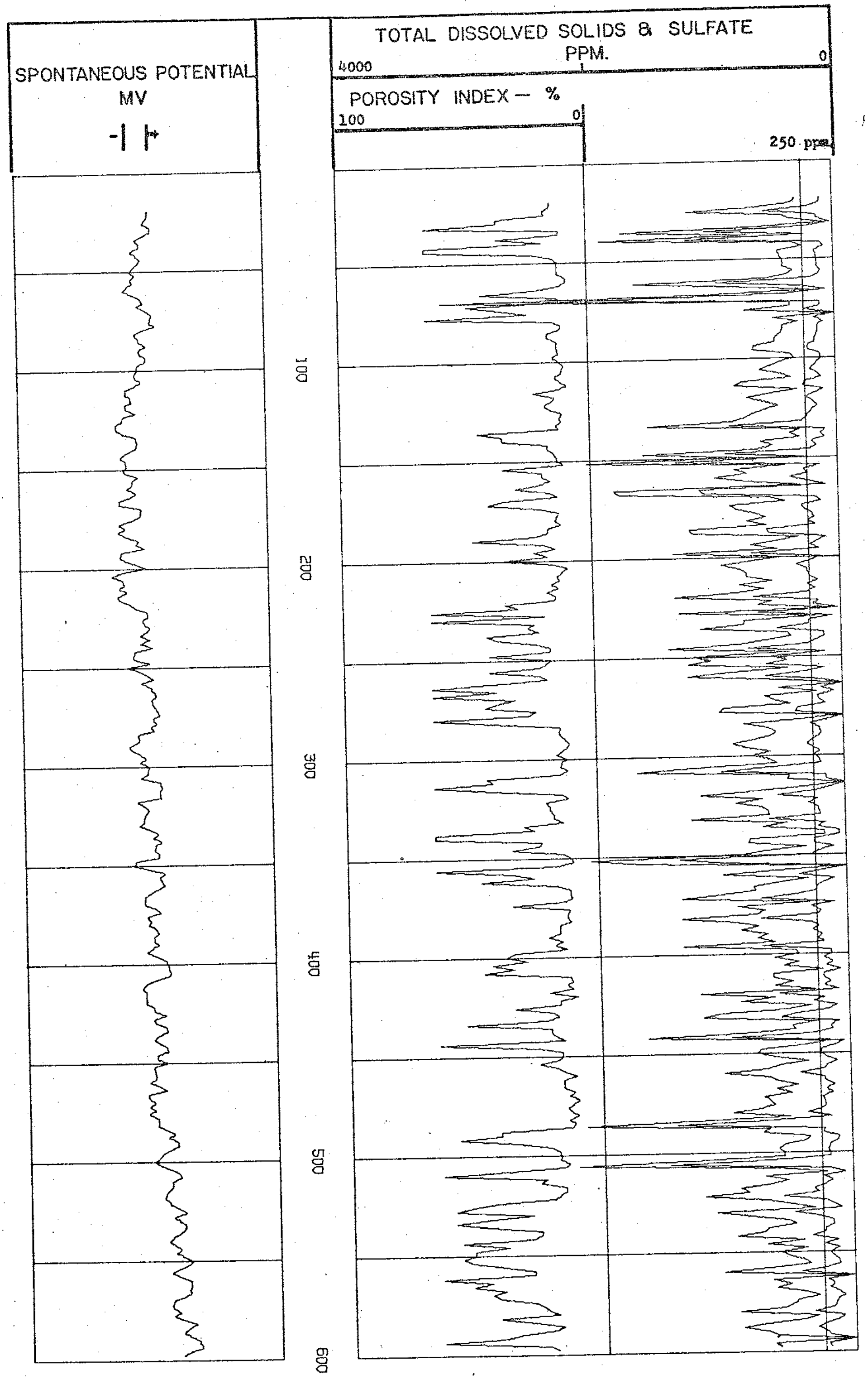

Fig. 5. Computer plot of the results of the adjunctive

Village of Los Lunas Water Well #3

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FORTRAN IV    MODEL 44  PS       VERSION 3   LEVEL 1   DATE  69119      NEW MEXICO TECH     PAGE  0001
                C          014P,10,B58,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
                C       RONALD M. BRIMHALL - ELECTRIC LOG INTERPRETATION PROGRAM FOR WATER
                C                         WELLS
                C
                C                 VALENCIA COUNTY NEW MEXICO
                C                 VILLAGE OF LOS LUNAS WATER WELL #4
                C
                C
                C       RESISTIVITY LOG INTERPRETATION PROGRAM EVALCO---
                C
                C
                C       ***************************************************************
                C       PURPOSE OF EVALCO--
                C             EVALCO DETERMINES QUANTITATIVE VALUES OF PARAMETERS RE-
                C       LATING TO WATER QUALITY--TOTAL DISOLVED SOLIDS, SULFATE, AND
                C       CHLORIDE CONCENTRATIONS IN UNITS OF PARTS PER MILLION.  EVALCO
                C       IS APPLICABLE TO EASTERN VALENCIA COUNTY, NEW MEXICO (BRIMHALL,
                C       1969,, TITUS, 1963).  RESISTIVITY DATA FROM A MACRORESISTIVITY LOG
                C       AND A MICROLOG ARE NECESSARY FOR EVALCO.  THE APPARENT FORMATION
                C       RESISTIVITY FACTOR METHOD IS USED FOR CALCULATING TDS, ETC. BY
                C       EVALCO.  WATER AT EACH DATA POINT IS CLASSIFIED AS TO ITS ACCEPT-
                C       ABILITY BASED ON US PUBLIC HEALTH SERVICE STANDARDS (TODD, 1959).
                C       EACH AQUIFER UNIT IS EXAMINED FOR CLAY AND A POROSITY INDEX IS DE-
                C       TERMINED.  CALCULATION RESULTS ARE PRESENTED IN TABLE AND LOG
                C       FORM.
                C       ***************************************************************
                C
                C
                C       ***************************************************************
                C       REFERENCES--
                C
                C       BRIMHALL, R. M., DIGITAL ANALYSIS   OF BOREHOLE-MEASURED AQUIFER
                C       RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER OF
                C       SCIENCE THESIS, N. MEX. INST. MINING AND TECH., SOCORRO, JUNE 1969.
                C
                C
                C       TITUS, F. B., GEOLOGY AND GROUND-WATER CONDITIONS IN EASTERN
                C       VALENCIA COUNTY, NEW MEXICO, N. MEX. INST. MIN. AND TECH., STATE
                C       BUR. MINES AND MIN. RES., GROUND-WATER RPT. 7, 1963.
                C
                C
                C       TODD, D. K., GROUND WATER HYDROLOGY, WILEY, NEW YORK, 1959.
                C       ***************************************************************
                C
                C
                C
                C       ***************************************************************
                C       NOMENCLATURE--
                C
                C             SCALAR QUANTITIES--
                C       T1 = INITIAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
                C       N = NUMBER OF DATA POINTS AND DO 200 ITERATIONS.
                C       K = SUBSCRIPT FOR SUBSCRIPTED VARIABLES.
                C       AVTEMP = AVERAGE SURFACE TEMPERATURE FOR CALCULATING GRAD.
                C       TD = TOTAL DEPTH OF WELL FOR CALCULATING GRAD.
                C       BHT = BOTTOM HOLE TEMPERATUEE FOR CALCULATING GRAD.
                C       RMF = MUD FILTRATE RESISTIVITY--OHM-METERS.
                C       AM = CEMENTATION EXPONENT IN F = A/POR**AM.
                C       RMC = MUD CAKE RESISTIVITY--OHM-METERS.
                C       A = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
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FORTRAN IV    MODEL 44  PS       VERSION 3   LEVEL 1   DATE  69119      NEW MEXICO TECH     PAGE  0002
                C       B = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C       C = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C       D = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C       E = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C       Q = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C       G = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
                C       GRAD = TEMPERATURE GRADIENT OF AQUIFER.
                C       Y = ORDINATE POSITION OF FPN--INCHES.
                C       HEIGHT = HEIGHT OF NUMERICS WRITTEN BY CALL NUMBER--INCHES.
                C       THETA = ANGLE WITH RESPECT TO CAL COMP COORDINATES FOR WRITTING
                C             FPN--DEGREES.
                C       NN = NUMBER OF DECIMAL DIGITS TO RIGHT OF DECIMAL IN FPN (-1 SUP-
                C             PRESSES DECIMAL POINT.)
                C       I = SUBSCRIPT FOR ABSCISSA OF FPN.
                C       T2 = FINAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
                C       TIME = PROGRAM EXECUTION TIME--SECONDS.
                C
                C
                C       SUBSCRIPTED VARIABLES---
                C
                C       IDATA = DATA POINT NUMBER.
                C       JDEPTH = DATA POINT DEPTH----FEET.
                C       RMN = MICRONORMAL RESISTIVITY READ FROM MICROLOG--OHM-METERS.
                C       RO = DEEP INDUCTION RESISTIVITY--OHM-METERS.
                C       F = APPARENT FORMATION RESISTIVITY FACTOR.
                C       TDS = TOTAL DISSOLVED SOLIDS CONCENTRATION--PPM.
                C       RW = WATER RESISTIVITY--OHM-METERS.
                C       POR = POROSITY INDEX CALCULATED FROM F = A/POR**AM.
                C       SPCOND = SPECIFIC CONDUCTANCE OF WATER--MICROMHOS/CM.
                C       CL = CHLORIDE CONCENTRATION--PPM.
                C       SO4 = SULFATE CONCENTRATION--PPM.
                C       RXOC = MICRONORMAL RESISTIVITY CORRECTED FOR TEMPERATURE AND
                C               MUDCAKE--OHM/METERS.
                C       ROC = TEMPERATURE CORRECTED DEEP INDUCTION RESISTIVITY--OHM-METERS
                C       TDSP = TDS RESCALED FOR PLOT--INCHES.
                C       SO4P = SO4 RESCALED FOR PLOT--INCHES.
                C       PORP = POROSITY INDEX RESCALLED FOR PLOT--INCHES.
                C       ABC = DATA POINT DEPTH RESCALED TO 2 INCHES/100 FEET.
                C       X = ABSCISSA POSITION OF FPN--INCHES.
                C       FPN = DEPTH LABEL--A FLOATING POINT NUMBER.
                C       RMI1 = MICROINVERSE RESISTIVITY AS READ FORM MICROLOG--OHM-METERS.
                C       RXOR = 1.15*RMN--AN EMPIRICAL RESISTIVITY USED TO DEFINE AQUIFER
                C       UNITS THAT MAY BE CLASSIFIED AS SANDY-CLAY.
                C       SP = DEFLECTION OF SP CURVE FROM LEFT EDGE OF TRACK I--INCHES.
                C       W = RATIO RMN/RMC--A PARAMETER IN MUD CAKE CORRECTIONS.
                C       RXO1 = MICRONORMAL RESISTIVITY CORRECTED FOR MUD CAKE--OHM-METERS.
                C       ***************************************************************
                C
                C
                C       ***************************************************************
                C       SUBPROGRAMS CALLED--
                C
                C             CLOCK
                C             IBCOM#
                C             SETMSG
                C             PLOT
                C             NUMBER
                C             FRXPR#
                C       ***************************************************************
                C
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FORTRAN IV    MODEL 44  PS       VERSION 3   LEVEL 1   DATE  69119       NEW MEXICO TECH    PAGE  0003

             C
             C
 0001               CALL CLOCK(T1)
 0002               DIMENSION IDATA(500),DEPTH(500),RMN(500),RO(500),F(500),TDS(500),
                   *CL(500),SO4(500),RW(500),POR(500),SPCOND(500),RXOC(500),ROC(500),
                   *TDSP(500),SO4P(500),PORP(500),ABC(500),X(7),FPN(7),SP(500)
                   *,W(500),RXO1(500)
             C
             C      PARAMETRIC DATA.
 0003               N = 285
 0004               RMF = 8.5
             C      (RMF ABOVE CORRECTED TO 77 F)
 0005               AM = 1.5
 0006               AVTEMP = 72.
 0007               TD = 620.
 0008               BHT = 80.
 0009               ROCL = 18.0
 0010               RMC = 9.0
             C
             C      READ FROM DATA CARDS--DATA POINT NUMBER, DEPTH, MICORNORMAL,
             C      INDUCTION, AND SP.
 0011               READ(5,1)(IDATA(K),DEPTH(K),RMN(K),RO(K),SP(K), K = 1,N)
 0012             1 FORMAT(I4,F5.0,2F5.1,F4.2)
             C
             C      WRITE PROBLEM IDENTIFICATION .
 0013               WRITE(6,2)
 0014             2 FORMAT('9',//41X,'VALENCIA COUNTY NEW MEXICO')
 0015               WRITE(6,23)
 0016            23 FORMAT(//42X,'VILLAGE OF LOS LUNAS WATER WELL #3')
             C
             C      WRITE SOME PARAMETRIC DATA.
 0017               WRITE(6,24)
 0018            24 FORMAT(////11X,'RMF = 8.5 OHM-M @ 77F',//12X,'M = 1.5')
             C
             C      LABEL LINE PRINTER OUTPUT.
 0019               WRITE(6,25)
 0020            25 FORMAT(///4X,'DATA',3X,'DEPTH',4X,'RMN',6X,'RO',5X,'F',5X,'POR',6X
                   *,'RW',4X,'SPCOND',4X,'TDS',5X,'CL',6X,'SO4',4X,'REMARKS')
             C
             C      CONSTANTS FOR MUD CAKE THICKNESS OF 1/8 INCHES
 0021               A = -0.3299839E-04
 0022               B = +0.1307268E-01
 0023               C = -0.2115985E+00
 0024               D = 0.1284551E+01
 0025               E = -0.3342364E+01
 0026               O = +0.5336034E+01
 0027               G = -0.1959661E+01
             C
             C      DETERMINE TEMPERATURE GRADIENT.
 0028               GRAD = (BHT-AVTEMP)/TD
             C
             C      PRIMARY DO LOOP.
 0029               DO 200 K = 1,N
             C
             C
             C      RESCALE ABC, POR, TDS, SO4 FOR PLOT.
 0030               ABC(K) = DEPTH(K)*0.02
             C
             C
             C      MUDCAKE CORRECTION FOR TMC = 1/8 INCH ASSUMED
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             C      ADAPTED FROM SCHLUMBERGER, 'LOG INTERPRETATION CHARTS', P. 34,
             C      1968.
 0031               W(K) = RMN(K)/RMC
 0032               RXO1(K) = (A*W(K)**6+B*W(K)**5+C*W(K)**4+D*W(K)**3+E*W(K)**2+O*W(K
                   *)+G)*RMC
             C
             C      ALLOW ALL POINTS TO BE CALCULABLE.
 0033               IF(RXO1(K).LE.0.0)GO TO 611
             C
             C      TEMPERATURE CORRECTIONS TO RO, RXO1.
             C           TEMPERATURE CORRECTIONS ARE TO 77 F.
 0034           700 ROC(K) = RO(K)*(AVTEMP + GRAD*DEPTH(K))/77.
 0035               RXOC(K) = RXO1(K)*(AVTEMP + GRAD*DEPTH(K))/77.
 0036               GO TO 701
 0037           611 RXO1(K) = RMN(K)
 0038               GO TO 700
             C
             C      DETERMINE APPARENT FORMATION RESISTIVITY FACTOR.
 0039           701 F(K) = RXOC(K)/RMF
             C
             C      DETERMINE WATER RESISTIVITY.
 0040               RW(K)=ROC(K)/F(K)
 0041               TDS(K) = 6400./RW(K)
 0042               TDSP(K) = (8.25-(1.25E-03)*TDS(K))
 0043               CL(K) = 1100./RW(K)**1.55
             C
             C      DETERMINE WATER SPECIFIC CONDUCTANCE.
 0044               SPCOND(K) = 10000.0/RW(K)
             C
             C      SELECT PROPER INTERPRETATION CONTROL EQUATIONS.
 0045               IF(SPCOND(K).LE.1400.)GO TO 702
 0046               IF(SPCOND(K).GT.1400.)GO TO 703
 0047           702 SO4(K) = 0.214*SPCOND(K)
 0048               SO4P(K) = (8.25-(1.25E-03)*SO4(K))
 0049               GO TO 705
 0050           703 SO4(K) = 0.575*SPCOND(K) - 505.
 0051               SO4P(K) = (8.25-(1.25E-03)*SO4(K))
 0052               GO TO 705
             C
             C      DETERMINE POROSITY INDEX.
 0053           705 POR(K) = 30.0/(F(K)**(1.0/AM))
             C
             C      CLAY IDENTIFICATION POROSITY INDEX = 65%.
 0054               IF(POR(K).GT.65.)POR(K) = 65.
 0055               PORP(K) = (5.75 - (2.5E-02)*POR(K))
             C
             C      TEST FOR CLAY.
 0056               IF(RO(K).LE.ROCL)GO TO 1000
             C
             C      IF NO CLAY, TEST AND CLASSIFY WATER QUALITY.
 0057               IF(TDS(K).GE.1000.)GO TO 10
 0058               IF(TDS(K).LT.1000..AND.TDS(K).GE.500.)GO TO 20
 0059               IF(TDS(K).LT.500.)GO TO 30
 0060            10 WRITE(6,11)IDATA(K),DEPTH(K),RMN(K),RO(K),F(K),POR(K),RW(K),SPCOND
                   *(K),TDS(K),CL(K),SO4(K)
 0061            11 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,3(3X,F5
                   *.0),3X,'NACCEPT')
 0062               GO TO 200
 0063            20 WRITE(6,21)IDATA(K),DEPTH(K),RMN(K),RO(K),F(K),POR(K),RW(K),SPCOND
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0064           21 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,3(3X,F5
                 *.0),3X,'PACCEPT')
0065              GO TO 200
0066           30 WRITE(6,31)IDATA(K),DEPTH(K),RMN(K),RO(K),F(K),POR(K),RW(K),SPCOND
                 *(K),TDS(K),CL(K),SO4(K)
0067           31 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,3(3X,F5
                 $.0),5X,'GOOD-SCREEN')
0068              GO TO 200
0069         1000 WRITE(6,111)IDATA(K),DEPTH(K),RMN(K),RO(K),F(K),POR(K),RW(K),SPCON
                 *D(K),TDS(K),CL(K),SO4(K)
0070          111 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,3(3X,F5
                 *.0),3X,'NACCEPT-CLAY')
0071              GO TO 200
0072          200 CONTINUE
            C
            C     WRITE COLUMN IDENTIFICATION.
0073              WRITE(6,400)
0074          400 FORMAT(4X,'DATA',3X,'DEPTH',4X,'RMN',6X,'RO',5X,'F',5X,'POR',6X,'R
                 *W',4X,'SPCOND',4X,'TDS',5X,'CL',6X,'SO4',4X,'REMARKS')
            C
            C     DETERMINE PROGRAM EXECUTION TIME.
0075              CALL CLOCK(T2)
0076              TIME = T1-T2
0077              WRITE(6,610)TIME
0078          610 FORMAT(////40X,'PROGRAM TIME IN SECONDS = ',E14.7)
            C
            C     IDENTIFY PROGRAMMER.
0079              WRITE(6,9999)
0080         9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'B
                 *OX 31 CAMPUS STA.',/30X,'SOCORRO, N. M.   87801')
            C
            C
            C     ***********INTERPRETATION PLOT PROGRAM**********
            C     PLOT RESULTS IN LOG (GRAPHIC) FORM.
            C
            C     POROSITY, TRACK II, 100 - 0%.
            C     TDS, SO4, TRACKS II & III, 5000 - 0 PPM.
            C     SP, TRACK I, 10 MILLIVOLTS PER LOG DIVISION.
0081              CALL SETMSG(29,'R. BRIMHALL LOS LUNAS W.W. #3')
0082              CALL PLOT(0.,-15.,-3)
0083              CALL PLOT(15.,1.4,-3)
            C
            C
            C     ESTABLISH LOG GRID
            C
            C     LOG GRID SCALE--2 INCHES PER 100 FEET.
0084              CALL PLOT(0.,2.5,2)
0085              CALL PLOT(0.,3.25,3)
0086              CALL PLOT(0.,8.25,2)
0087              CALL PLOT(13.,8.25,2)
0088              CALL PLOT(13.,3.25,2)
0089              CALL PLOT(0.,3.25,2)
0090              CALL PLOT(0.,2.5,3)
0091              CALL PLOT(13.,2.5,2)
0092              CALL PLOT(13.,0.,2)
0093              CALL PLOT(0.,0.,2)
0094              CALL PLOT(0.,5.75,3)
0095              CALL PLOT(13.,5.75,2)
0096              CALL PLOT(13.,7.9375,3)
0097              CALL PLOT(0.,7.9375,2)


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0098              CALL PLOT(1.,8.25,3)
0099              CALL PLOT(1.,3.25,2)
0100              CALL PLOT(1.,2.5,3)
0101              CALL PLOT(1.,0.,2)
0102              CALL PLOT(2.,0.,3)
0103              CALL PLOT(2.,2.5,2)
0104              CALL PLOT(2.,3.25,3)
0105              CALL PLOT(2.,8.25,2)
0106              CALL PLOT(3.,8.25,3)
0107              CALL PLOT(3.,3.25,2)
0108              CALL PLOT(3.,2.5,3)
0109              CALL PLOT(3.,0.,2)
0110              CALL PLOT(4.,0.,3)
0111              CALL PLOT(4.,2.5,2)
0112              CALL PLOT(4.,3.25,3)
0113              CALL PLOT(4.,8.25,2)
0114              CALL PLOT(5.,8.25,3)
0115              CALL PLOT(5.,3.25,2)
0116              CALL PLOT(5.0,2.5,3)
0117              CALL PLOT(5.,0.,2)
0118              CALL PLOT(6.,0.,3)
0119              CALL PLOT(6.,2.5,2)
0120              CALL PLOT(6.,3.25,3)
0121              CALL PLOT(6.,8.25,2)
0122              CALL PLOT(7.,8.25,3)
0123              CALL PLOT(7.,3.25,2)
0124              CALL PLOT(7.,2.50,3)
0125              CALL PLOT(7.,0.,2)
0126              CALL PLOT(8.,0.,3)
0127              CALL PLOT(8.,2.5,2)
0128              CALL PLOT(8.,3.25,3)
0129              CALL PLOT(8.,8.25,2)
0130              CALL PLOT(9.,8.25,3)
0131              CALL PLOT(9.,3.25,2)
0132              CALL PLOT(9.,2.5,3)
0133              CALL PLOT(9.,0.,2)
0134              CALL PLOT(10.,0.,3)
0135              CALL PLOT(10.,2.5,2)
0136              CALL PLOT(10.,3.25,3)
0137              CALL PLOT(10.,8.25,2)
0138              CALL PLOT(11.,8.25,3)
0139              CALL PLOT(11.,3.25,2)
0140              CALL PLOT(11.,2.5,3)
0141              CALL PLOT(11.,0.,2)
0142              CALL PLOT(12.,0.,3)
0143              CALL PLOT(12.,2.5,2)
0144              CALL PLOT(12.,3.25,3)
0145              CALL PLOT(12.,8.25,2)
            C
            C
            C     *****DEPTH LABEL*****
            C
0146              Y = 2.835
0147              HEIGHT = 0.10
0148              THETA = 0.
0149              NN = -1 .
0150              N = 7
0151              READ(5,9998)(X(I),EPN(I), I = 1,N)
0152         9998 FORMAT(F5.1,F4.0)
0153                 DO 1010  I = 1,N
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FORTRAN IV    MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69119       NEW MEXICO TECH    PAGE  0007

 0154                CALL NUMBER(X(I),Y,HEIGHT,FPN(I),THETA,NN)
 0155          1010 CONTINUE
              C
              C
              C      *****LINE GENERATION*****
              C
              C
              C      SP LINE GENERATION
              C
 0156                CALL PLOT(ABC(1),SP(1),3)
 0157                N = 285
 0158                    DO 1002  K = 2,N
 0159                    CALL PLOT(ABC(K),SP(K),2)
 0160           1002 CONTINUE
              C
              C      POROSITY INDEX LINE PLOT
              C
 0161                CALL PLOT(ABC(1),PORP(1),3)
 0162                N = 285
 0163                    DO 1001  K = 2,N
 0164                    CALL PLOT(ABC(K),PORP(K),2)
 0165           1001 CONTINUE
              C
              C      TDS LINE GENERATION
              C
 0166                CALL PLOT(ABC(1),TDSP(1),3)
 0167                N = 285
 0168                    DO 1003  K = 2,N
 0169                    CALL PLOT(ABC(K),TDSP(K),2)
 0170           1003 CONTINUE
              C
              C      SO4 LINE GENERATION
              C
 0171                CALL PLOT(ABC(1),SO4P(1),3)
 0172                N = 285
 0173                    DO 1004  K = 2,N
 0174                    CALL PLOT(ABC(K),SO4P(K),2)
 0175           1004 CONTINUE
              C
              C      FILE MARK.
 0176                CALL PLOT(25.,0.,999)
 0177                STOP
 0178                END

                                             SCALAR MAP
SYMBOL     LOCATION        SYMBOL     LOCATION    SYMBOL     LOCATION      SYMBOL     LOCATION     SYMBOL     LOCATION
T1         00018C          N          000190      RMF        000194        AM         000198       AVTEMP     00019C
TD         0001A0          BHT        0001A4      ROCL       0001A8        RMC        0001AC       K          0001B0
A          0001B4          B          0001B8      C          0001BC        D          0001C0       E          0001C4
Q          0001C8          G          0001CC      GRAD       0001D0        T2         0001D4       TIME       0001D8
Y          0001DC          HEIGHT     0001E0      THETA      0001E4        NN         0001E8       I          0001EC

                                             ARRAY MAP
SYMBOL     LOCATION        SYMBOL     LOCATION    SYMBOL     LOCATION      SYMBOL     LOCATION     SYMBOL     LOCATION
IDATA      0001F0          DEPTH      0009C0      RMN        001190        RO         001960       F          002130
TDS        002900          CL         0030D0      SO4        0038A0        RW         004070       POR        004840
SPCOND     005010          RXOC       0057E0      ROC        005FB0        TDSP       006780       SO4P       006F50
PORP       007720          ABC        007EF0      X          0086C0        FPN        0086DC       SP         0086F8


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 W          008EC8          RX01       009698
                                           SUBPROGRAMS CALLED
 SYMBOL     LOCATION        SYMBOL     LOCATION    SYMBOL     LOCATION      SYMBOL     LOCATION     SYMBOL     LOCATION
 CLOCK      009E68          IBCOM#     009E6C      SETMSG     009E70        PLOT       009E74       NUMBER     009E78
 FRXPR#     009E7C

                                              LABEL MAP
 LABEL      LOCATION        LABEL      LOCATION    LABEL      LOCATION      LABEL      LOCATION     LABEL      LOCATION
     1      00A320              2      00A350         23      00A394           24      00A3DC          25      00A424
   700      00A586            611      00A5D8        701      00A5FE          702      00A6B4         703      00A6F4
   705      00A738             10      00A824         11      00A8B4           20      00A8F8          21      00A984
    30      00A9C8             31      00AA54       1000      00AA9C          111      00AB28         200      00AB74
   400      00ABA4            610      00AC3C       9999      00AC80         9998      00AFF8        1010      00B040
  1002      00B0B2           1001      00B124       1003      00B196         1004      00B210

   TOTAL MEMORY REQUIREMENTS 00B368 BYTES

 COMPILER HIGHEST SEVERITY CODE WAS  0
 // EXEC LNKEDT(MAP)
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VALENCIA COUNTY NEW MEXICO

VILLAGE OF LOS LUNAS WATER WELL #3

RMF = 8.5 OHM-M @ 77F

M = 1.5

DATA	DEPTH	RMN	RO	F	POR	RW	SPCOND	TDS	CL	SO4	REMARKS
1	50.	30.0	430.0	5.5	9.7	74.2	134.9	86.	1.	29.	GOOD-SCREEN
2	52.	29.0	350.0	5.2	10.0	63.6	157.3	101.	2.	34.	GOOD-SCREEN
3	54.	27.1	360.0	4.7	10.7	72.5	137.9	88.	1.	30.	GOOD-SCREEN
4	56.	30.9	360.0	5.7	9.4	59.3	168.5	108.	2.	36.	GOOD-SCREEN
5	58.	27.2	365.0	4.7	10.7	73.1	136.8	88.	1.	29.	GOOD-SCREEN
6	60.	26.0	425.0	4.4	11.2	91.1	109.7	70.	1.	23.	GOOD-SCREEN
7	62.	28.9	480.0	5.2	10.0	87.6	114.1	73.	1.	24.	GOOD-SCREEN
8	64.	33.1	420.0	6.4	8.7	62.4	160.3	103.	2.	34.	GOOD-SCREEN
9	66.	30.1	420.0	5.5	9.6	72.1	138.8	89.	1.	30.	GOOD-SCREEN
10	68.	29.9	515.0	5.5	9.7	89.3	112.0	72.	1.	24.	GOOD-SCREEN
11	70.	29.4	470.0	5.3	9.8	83.6	119.6	77.	1.	26.	GOOD-SCREEN
12	72.	27.0	530.0	4.7	10.7	107.3	93.2	60.	1.	20.	GOOD-SCREEN
13	74.	29.1	500.0	5.2	9.9	90.3	110.7	71.	1.	24.	GOOD-SCREEN
14	76.	30.2	490.0	5.6	9.6	83.6	119.6	77.	1.	26.	GOOD-SCREEN
15	78.	26.9	440.0	4.7	10.8	89.6	111.6	71.	1.	24.	GOOD-SCREEN
16	80.	28.5	450.0	5.1	10.1	83.9	119.1	76.	1.	25.	GOOD-SCREEN
17	82.	29.8	370.0	5.4	9.7	64.5	155.1	99.	2.	33.	GOOD-SCREEN
18	84.	26.0	410.0	4.4	11.1	87.9	113.8	73.	1.	24.	GOOD-SCREEN
19	86.	26.5	425.0	4.6	10.9	88.5	112.9	72.	1.	24.	GOOD-SCREEN
20	88.	25.0	450.0	4.2	11.6	102.3	97.7	63.	1.	21.	GOOD-SCREEN
21	90.	25.1	530.0	4.2	11.5	119.8	83.5	53.	1.	18.	GOOD-SCREEN
22	92.	28.0	530.0	5.0	10.3	101.6	98.5	63.	1.	21.	GOOD-SCREEN
23	94.	34.0	527.0	6.7	8.5	75.2	133.0	85.	1.	28.	GOOD-SCREEN
24	96.	29.0	200.0	5.2	9.9	36.3	275.3	176.	4.	59.	GOOD-SCREEN
25	98.	29.4	28.0	5.3	9.8	5.0	2008.1	1285.	91.	650.	NACCEPT
26	100.	11.8	26.0	1.6	21.7	15.2	656.2	420.	16.	140.	GOOD-SCREEN
27	102.	28.0	90.0	5.0	10.3	17.2	579.8	371.	13.	124.	GOOD-SCREEN
28	104.	26.5	420.0	4.6	10.9	87.5	114.3	73.	1.	24.	GOOD-SCREEN
29	106.	28.0	415.0	5.0	10.3	79.5	125.7	80.	1.	27.	GOOD-SCREEN
30	108.	24.9	380.0	4.2	11.6	86.9	115.1	74.	1.	25.	GOOD-SCREEN
31	110.	32.1	505.0	6.1	9.0	78.6	127.3	81.	1.	27.	GOOD-SCREEN
32	112.	33.0	350.0	6.4	8.7	52.2	191.5	123.	2.	41.	GOOD-SCREEN
33	114.	30.8	90.0	5.8	9.3	14.9	670.8	429.	17.	144.	GOOD-SCREEN
34	116.	26.0	42.0	4.5	11.1	9.0	1110.4	711.	36.	238.	PACCEPT
35	118.	10.0	17.0	1.3	24.9	12.3	812.5	520.	22.	174.	NACCEPT-CLAY
36	120.	13.0	25.0	1.8	20.1	13.1	765.1	490.	20.	164.	GOOD-SCREEN
37	122.	18.2	45.0	2.7	15.4	15.8	632.2	405.	15.	135.	GOOD-SCREEN
38	124.	19.5	62.0	3.0	14.5	20.0	501.1	321.	11.	107.	GOOD-SCREEN
39	126.	20.2	50.0	3.1	14.1	15.4	650.9	417.	16.	139.	GOOD-SCREEN
40	128.	20.9	38.0	3.3	13.6	11.2	896.7	574.	26.	192.	PACCEPT
41	130.	22.0	38.0	3.5	13.0	10.4	962.4	616.	29.	206.	PACCEPT
42	132.	40.0	55.0	8.5	7.2	6.2	1609.4	1030.	65.	420.	NACCEPT
43	134.	37.0	140.0	7.6	7.8	17.7	566.5	363.	13.	121.	GOOD-SCREEN
44	136.	39.1	160.0	8.2	7.4	18.7	536.0	343.	12.	115.	GOOD-SCREEN
45	138.	38.0	170.0	7.9	7.6	20.6	484.6	310.	10.	104.	GOOD-SCREEN
46	140.	39.1	90.0	8.2	7.4	10.5	952.9	610.	29.	204.	PACCEPT
47	142.	30.0	67.0	5.6	9.6	11.6	865.5	554.	25.	185.	PACCEPT
48	144.	23.0	43.0	3.7	12.5	11.0	905.7	580.	27.	194.	PACCEPT
49	146.	22.2	36.0	3.6	12.9	9.7	1028.8	658.	32.	220.	PACCEPT
50	148.	14.0	36.0	2.0	18.9	17.3	578.8	370.	13.	124.	GOOD-SCREEN
51	150.	24.2	43.0	4.0	11.9	10.3	974.9	624.	30.	209.	PACCEPT
52	152.	22.0	47.0	3.5	13.0	12.9	778.1	498.	21.	167.	GOOD-SCREEN
53	154.	25.0	48.5	4.2	11.5	11.0	906.9	580.	27.	194.	PACCEPT
54	156.	26.0	54.0	4.5	11.0	11.6	863.7	553.	25.	185.	PACCEPT
55	158.	25.3	50.0	4.3	11.3	11.2	895.4	573.	26.	192.	PACCEPT
56	160.	23.9	45.0	4.0	12.0	10.9	914.8	585.	27.	196.	PACCEPT
57	162.	21.2	43.0	3.3	13.4	12.4	808.0	517.	22.	173.	PACCEPT
58	164.	24.1	47.0	4.0	11.9	11.3	886.6	567.	26.	190.	PACCEPT
59	166.	26.8	45.0	4.7	10.7	9.2	1084.9	694.	35.	232.	PACCEPT
60	168.	27.0	43.0	4.8	10.6	8.7	1148.2	735.	38.	246.	PACCEPT
61	170.	24.7	40.6	4.2	11.6	9.4	1064.1	681.	34.	228.	PACCEPT
62	172.	22.0	40.0	3.5	13.0	10.9	914.2	585.	27.	196.	PACCEPT
63	174.	23.0	38.0	3.8	12.4	9.8	1024.8	656.	32.	219.	PACCEPT
64	176.	17.6	39.0	2.6	15.7	14.3	699.7	448.	18.	150.	GOOD-SCREEN
65	178.	23.1	36.0	3.8	12.4	9.2	1088.5	697.	35.	233.	PACCEPT
66	180.	19.0	20.0	2.9	14.8	6.7	1502.2	961.	58.	359.	PACCEPT
67	182.	14.0	11.0	2.0	18.8	5.3	1894.2	1212.	83.	584.	NACCEPT-CLAY
68	184.	11.0	10.0	1.5	22.8	6.4	1564.9	1002.	62.	395.	NACCEPT-CLAY
69	186.	21.0	10.6	3.3	13.5	3.1	3235.4	2071.	191.	1355.	NACCEPT-CLAY
70	188.	13.0	9.7	1.8	19.9	5.1	1971.8	1262.	89.	629.	NACCEPT-CLAY
71	190.	7.0	9.6	0.7	37.5	13.0	771.3	494.	21.	165.	NACCEPT-CLAY
72	192.	7.0	9.9	0.7	37.5	13.4	748.0	479.	20.	160.	NACCEPT-CLAY
73	194.	18.0	10.7	2.7	15.4	3.8	2622.3	1678.	138.	1003.	NACCEPT-CLAY
74	196.	18.0	25.0	2.7	15.4	8.9	1122.4	718.	37.	240.	PACCEPT
75	198.	20.0	20.0	3.1	14.1	6.2	1606.0	1028.	65.	418.	NACCEPT
76	200.	14.0	19.6	2.0	18.8	9.4	1063.1	680.	34.	228.	PACCEPT
77	202.	25.5	27.5	4.4	11.2	6.1	1647.3	1054.	67.	442.	NACCEPT
78	204.	25.0	37.0	4.3	11.4	8.4	1188.7	761.	41.	254.	PACCEPT
79	206.	23.8	45.0	4.0	12.0	11.0	909.2	582.	27.	195.	PACCEPT
80	208.	26.0	42.0	4.5	11.0	9.0	1110.4	711.	36.	238.	PACCEPT
81	210.	22.0	34.0	3.5	12.9	9.3	1075.6	688.	35.	230.	PACCEPT
82	212.	23.0	32.0	3.8	12.4	8.2	1217.0	779.	42.	260.	PACCEPT
83	214.	23.1	34.0	3.8	12.3	8.7	1152.6	738.	39.	247.	PACCEPT
84	216.	20.9	36.0	3.3	13.5	10.6	946.5	606.	28.	203.	PACCEPT
85	218.	21.5	39.5	3.4	13.2	11.2	896.7	574.	26.	192.	PACCEPT
86	220.	23.0	43.0	3.8	12.4	11.0	905.7	580.	27.	194.	PACCEPT
87	222.	26.1	42.0	4.6	10.9	9.0	1116.9	715.	37.	239.	PACCEPT
88	224.	22.1	40.0	3.6	12.8	10.9	920.1	589.	27.	197.	PACCEPT
89	226.	23.2	37.0	3.8	12.2	9.4	1065.7	682.	34.	228.	PACCEPT
90	228.	21.9	36.0	3.5	12.9	9.9	1009.4	646.	31.	216.	PACCEPT
91	230.	25.5	37.5	4.4	11.2	8.3	1208.0	773.	42.	259.	PACCEPT
92	232.	27.8	40.0	5.0	10.2	7.7	1290.4	826.	46.	276.	PACCEPT
93	234.	27.0	40.0	4.8	10.5	8.1	1234.4	790.	43.	264.	PACCEPT
94	236.	29.0	39.8	5.4	9.8	7.2	1383.4	885.	51.	296.	PACCEPT
95	238.	24.0	40.1	4.0	11.8	9.7	1032.8	661.	33.	221.	PACCEPT
96	240.	33.0	40.0	6.5	8.6	6.0	1675.6	1072.	69.	458.	NACCEPT
97	242.	36.0	37.0	7.4	7.9	4.9	2060.4	1319.	95.	680.	NACCEPT
98	244.	19.6	22.0	3.1	14.3	7.0	1421.7	910.	53.	312.	PACCEPT
99	246.	16.0	13.0	2.4	16.9	5.3	1871.7	1198.	82.	571.	NACCEPT-CLAY
100	248.	12.0	10.0	1.7	21.1	5.7	1740.8	1114.	73.	496.	NACCEPT-CLAY
101	250.	13.0	10.0	1.9	19.8	5.2	1912.7	1224.	85.	595.	NACCEPT-CLAY
102	252.	10.0	10.2	1.3	24.6	7.4	1354.2	867.	50.	290.	NACCEPT-CLAY
103	254.	11.4	10.4	1.6	21.9	6.4	1573.0	1007.	63.	399.	NACCEPT-CLAY
104	256.	10.3	7.0	1.4	23.9	4.9	2053.4	1314.	95.	676.	NACCEPT-CLAY
105	258.	6.0	6.0	0.5	49.7	12.5	798.9	511.	22.	171.	NACCEPT-CLAY
106	260.	6.0	5.0	0.5	49.7	10.4	958.7	614.	29.	205.	NACCEPT-CLAY
107	262.	5.6	6.0	0.4	59.5	16.4	609.6	390.	14.	130.	NACCEPT-CLAY
108	264.	14.0	7.5	2.0	18.6	3.6	2778.2	1778.	151.	1092.	NACCEPT-CLAY
109	266.	12.0	11.0	1.7	21.0	6.3	1582.5	1013.	63.	405.	NACCEPT-CLAY
110	268.	12.8	18.0	1.8	20.0	9.6	1043.6	668.	33.	223.	NACCEPT-CLAY
111	270.	17.3	26.0	2.6	15.8	9.7	1027.7	658.	32.	220.	PACCEPT
112	272.	20.3	30.0	3.2	13.8	9.2	1092.1	699.	36.	234.	PACCEPT
113	274.	21.9	33.0	3.6	12.9	9.1	1101.1	705.	36.	236.	PACCEPT
114	276.	26.0	19.0	4.6	10.9	4.1	2454.6	1571.	125.	906.	NACCEPT

115	278.	10.0	16.0	1.4	24.5	11.6	863.3	553.	25.	185.	NACCEPT-CLAY
116	280.	16.8	19.6	2.5	16.1	7.6	1315.7	842.	47.	282.	PACCEPT
117	282.	20.0	19.8	3.2	13.9	6.2	1622.2	1038.	66.	428.	NACCEPT
118	284.	16.0	20.2	2.4	16.8	8.3	1204.6	771.	41.	258.	PACCEPT
119	286.	29.0	26.0	5.4	9.7	4.7	2117.7	1355.	99.	713.	NACCEPT
120	288.	23.6	16.0	4.0	12.0	4.0	2526.0	1617.	130.	947.	NACCEPT-CLAY
121	290.	9.0	13.0	1.2	27.1	11.0	912.2	584.	27.	195.	NACCEPT-CLAY
122	292.	17.5	15.0	2.7	15.6	5.5	1806.6	1156.	78.	534.	NACCEPT-CLAY
123	294.	13.0	20.0	1.9	19.7	10.5	956.3	612.	29.	205.	PACCEPT
124	296.	16.0	20.0	2.4	16.8	8.2	1216.6	779.	42.	260.	PACCEPT
125	298.	20.0	14.0	3.2	13.9	4.4	2294.3	1468.	112.	814.	NACCEPT-CLAY
126	300.	20.0	7.0	3.2	13.9	2.2	4588.6	2937.	329.	2133.	NACCEPT-CLAY
127	302.	6.0	6.5	0.5	49.5	13.6	737.5	472.	19.	158.	NACCEPT-CLAY
128	304.	10.7	7.5	1.5	23.0	5.0	2014.3	1289.	92.	653.	NACCEPT-CLAY
129	306.	13.0	6.5	1.9	19.6	3.4	2942.6	1883.	165.	1187.	NACCEPT-CLAY
130	308.	8.0	6.0	1.0	30.8	6.2	1623.4	1039.	66.	428.	NACCEPT-CLAY
131	310.	9.0	6.0	1.2	27.0	5.1	1976.5	1265.	89.	631.	NACCEPT-CLAY
132	312.	7.0	6.0	0.7	37.0	8.1	1234.1	790.	43.	264.	NACCEPT-CLAY
133	314.	11.8	7.5	1.7	21.2	4.4	2274.7	1456.	111.	803.	NACCEPT-CLAY
134	316.	13.0	11.0	1.9	19.6	5.8	1738.8	1113.	73.	495.	NACCEPT-CLAY
135	318.	16.5	22.0	2.5	16.3	8.7	1147.1	734.	38.	245.	PACCEPT
136	320.	18.0	24.0	2.8	15.2	8.6	1169.1	748.	39.	250.	PACCEPT
137	322.	20.9	23.0	3.4	13.3	6.8	1481.4	948.	57.	347.	PACCEPT
138	324.	18.0	21.0	2.8	15.2	7.5	1336.1	855.	49.	286.	PACCEPT
139	326.	27.0	25.0	4.9	10.4	5.1	1975.0	1264.	89.	631.	NACCEPT
140	328.	17.5	28.0	2.7	15.5	10.3	967.8	619.	29.	207.	PACCEPT
141	330.	21.3	30.0	3.5	13.1	8.6	1165.6	746.	39.	249.	PACCEPT
142	332.	24.0	33.0	4.1	11.7	8.0	1255.1	803.	44.	269.	PACCEPT
143	334.	23.2	36.0	3.9	12.1	9.1	1095.3	701.	36.	234.	PACCEPT
144	336.	24.1	38.0	4.1	11.7	9.1	1096.6	702.	36.	235.	PACCEPT
145	338.	22.8	39.5	3.8	12.3	10.3	973.7	623.	30.	208.	PACCEPT
146	340.	24.5	40.0	4.2	11.5	9.4	1067.2	683.	34.	228.	PACCEPT
147	342.	27.5	36.0	5.0	10.2	7.1	1410.3	903.	53.	306.	PACCEPT
148	344.	28.0	26.0	5.2	10.0	5.0	2007.1	1285.	91.	649.	NACCEPT
149	346.	16.0	18.0	2.4	16.7	7.4	1351.8	865.	49.	289.	NACCEPT-CLAY
150	348.	19.0	19.0	3.0	14.5	6.3	1581.2	1012.	63.	404.	NACCEPT
151	350.	23.0	27.0	3.9	12.2	6.9	1442.4	923.	55.	324.	PACCEPT
152	352.	24.1	31.0	4.1	11.6	7.4	1344.2	860.	49.	288.	PACCEPT
153	354.	27.0	20.0	4.9	10.4	4.1	2468.7	1580.	126.	915.	NACCEPT
154	356.	14.0	8.0	2.1	18.5	3.8	2604.6	1667.	137.	993.	NACCEPT-CLAY
155	358.	5.0	6.0	0.2	65.0	32.6	307.1	197.	5.	66.	NACCEPT-CLAY
156	360.	7.0	6.0	0.7	36.8	8.1	1234.1	790.	43.	264.	NACCEPT-CLAY
157	362.	5.9	7.0	0.4	51.1	15.5	645.0	413.	16.	138.	NACCEPT-CLAY
158	364.	16.0	13.0	2.4	16.6	5.3	1871.7	1198.	82.	571.	NACCEPT-CLAY
159	366.	17.5	22.0	2.7	15.5	8.1	1231.8	788.	43.	264.	PACCEPT
160	368.	17.5	21.0	2.7	15.5	7.7	1290.4	826.	46.	276.	PACCEPT
161	370.	16.0	18.0	2.4	16.6	7.4	1351.8	865.	49.	289.	NACCEPT-CLAY
162	372.	18.5	10.0	2.9	14.8	3.4	2904.0	1859.	162.	1165.	NACCEPT-CLAY
163	374.	9.0	9.5	1.2	26.8	8.0	1248.3	799.	44.	267.	NACCEPT-CLAY
164	376.	23.0	16.0	3.9	12.1	4.1	2434.0	1558.	123.	895.	NACCEPT-CLAY
165	378.	30.0	31.0	5.8	9.3	5.3	1870.7	1197.	82.	571.	NACCEPT
166	380.	32.2	40.0	6.5	8.7	6.2	1614.7	1033.	65.	423.	NACCEPT
167	382.	29.0	43.0	5.5	9.6	7.8	1280.5	819.	45.	274.	PACCEPT
168	384.	37.0	44.0	7.9	7.5	5.5	1802.6	1154.	77.	531.	NACCEPT
169	386.	28.1	53.0	5.2	9.9	10.1	990.0	634.	31.	212.	PACCEPT
170	388.	28.0	30.0	5.2	10.0	5.7	1739.5	1113.	73.	495.	NACCEPT
171	390.	30.0	16.0	5.8	9.3	2.8	3624.4	2320.	228.	1579.	NACCEPT-CLAY
172	392.	17.6	14.0	2.7	15.4	5.1	1949.2	1248.	87.	616.	NACCEPT-CLAY
173	394.	19.2	23.0	3.0	14.3	7.6	1324.0	847.	48.	283.	PACCEPT
174	396.	20.0	32.0	3.2	13.8	10.0	1003.8	642.	31.	215.	PACCEPT
175	398.	23.0	39.0	3.9	12.1	10.0	998.6	639.	31.	214.	PACCEPT
176	400.	25.5	32.0	4.5	10.9	7.1	1415.6	906.	53.	309.	PACCEPT
177	402.	20.0	31.0	3.2	13.8	9.7	1036.1	663.	33.	222.	PACCEPT
178	404.	25.4	39.0	4.5	11.0	8.7	1154.7	739.	39.	247.	PACCEPT
179	406.	22.3	44.0	3.7	12.5	11.8	847.1	542.	24.	181.	PACCEPT
180	408.	20.5	44.0	3.3	13.5	13.3	754.4	483.	20.	161.	GOOD-SCREEN
181	410.	24.0	33.0	4.2	11.6	8.0	1255.1	803.	44.	269.	PACCEPT
182	412.	17.0	27.0	2.6	15.8	10.3	968.8	620.	30.	207.	PACCEPT
183	414.	23.0	28.0	3.9	12.1	7.2	1390.9	890.	52.	298.	PACCEPT
184	416.	21.2	40.0	3.5	13.0	11.5	868.5	556.	25.	186.	PACCEPT
185	418.	20.7	46.0	3.4	13.3	13.7	731.1	468.	19.	156.	GOOD-SCREEN
186	420.	20.0	42.0	3.2	13.7	13.1	764.8	489.	20.	164.	GOOD-SCREEN
187	422.	21.4	20.0	3.5	12.9	5.7	1759.6	1126.	74.	507.	NACCEPT
188	424.	8.0	16.0	1.0	30.4	16.4	608.8	390.	14.	130.	NACCEPT-CLAY
189	426.	20.0	16.0	3.2	13.7	5.0	2007.5	1285.	91.	649.	NACCEPT-CLAY
190	428.	14.6	10.0	2.2	17.7	4.6	2187.0	1400.	104.	753.	NACCEPT-CLAY
191	430.	10.0	7.0	1.4	24.1	5.1	1973.2	1263.	89.	630.	NACCEPT-CLAY
192	432.	8.0	7.5	1.0	30.4	7.7	1298.7	831.	46.	278.	NACCEPT-CLAY
193	434.	7.2	8.1	0.8	34.9	10.3	974.3	624.	30.	209.	NACCEPT-CLAY
194	436.	10.0	11.0	1.4	24.1	8.0	1255.7	804.	44.	269.	NACCEPT-CLAY
195	438.	10.0	18.0	1.4	24.1	13.0	767.4	491.	21.	164.	NACCEPT-CLAY
196	440.	23.3	29.0	4.0	11.9	7.3	1368.1	876.	50.	293.	PACCEPT
197	442.	18.6	33.0	3.0	14.6	11.3	886.0	567.	26.	190.	PACCEPT
198	444.	25.0	34.0	4.4	11.1	7.7	1293.6	828.	46.	277.	PACCEPT
199	446.	25.5	36.0	4.6	10.9	7.9	1258.3	805.	44.	269.	PACCEPT
200	448.	27.5	38.0	5.1	10.1	7.5	1336.1	855.	49.	286.	PACCEPT
201	450.	20.0	37.0	3.2	13.7	11.5	868.1	556.	25.	186.	PACCEPT
202	452.	20.0	37.0	3.2	13.7	11.5	868.1	556.	25.	186.	PACCEPT
203	454.	20.4	38.0	3.3	13.4	11.5	867.9	555.	25.	186.	PACCEPT
204	456.	21.0	37.0	3.5	13.1	10.8	926.9	593.	28.	198.	PACCEPT
205	458.	21.5	36.0	3.6	12.8	10.2	983.9	630.	30.	211.	PACCEPT
206	460.	20.0	36.0	3.3	13.7	11.2	892.2	571.	26.	191.	PACCEPT
207	462.	24.2	39.0	4.2	11.4	9.3	1074.9	688.	35.	230.	PACCEPT
208	464.	25.1	36.0	4.5	11.0	8.1	1229.0	787.	43.	263.	PACCEPT
209	466.	18.0	27.0	2.8	14.9	9.6	1039.2	665.	33.	222.	PACCEPT
210	468.	13.0	19.0	1.9	19.3	9.9	1006.7	644.	31.	215.	PACCEPT
211	470.	16.0	21.0	2.5	16.4	8.6	1158.7	742.	39.	248.	PACCEPT
212	472.	23.0	27.0	3.9	12.0	6.9	1442.4	923.	55.	324.	PACCEPT
213	474.	21.2	32.0	3.5	13.0	9.2	1085.7	695.	35.	232.	PACCEPT
214	476.	27.0	37.0	5.0	10.2	7.5	1334.4	854.	48.	286.	PACCEPT
215	478.	28.0	37.0	5.3	9.9	7.1	1410.4	903.	53.	306.	PACCEPT
216	480.	19.0	35.0	3.1	14.3	11.6	858.4	549.	24.	184.	PACCEPT
217	482.	19.3	36.0	3.1	14.1	11.7	851.6	545.	24.	182.	PACCEPT
218	484.	28.9	34.0	5.6	9.6	6.2	1610.9	1031.	65.	421.	NACCEPT
219	486.	22.0	29.0	3.7	12.5	7.9	1261.0	807.	44.	270.	PACCEPT
220	488.	21.0	26.0	3.5	13.0	7.6	1319.0	844.	48.	282.	PACCEPT
221	490.	21.4	24.0	3.6	12.8	6.8	1466.4	938.	56.	338.	PACCEPT
222	492.	12.0	21.0	1.8	20.5	12.1	828.9	531.	23.	177.	PACCEPT
223	494.	17.0	26.0	2.7	15.6	9.9	1006.1	644.	31.	215.	PACCEPT
224	496.	22.0	34.0	3.7	12.5	9.3	1075.6	688.	35.	230.	PACCEPT
225	498.	20.0	32.0	3.3	13.6	10.0	1003.8	642.	31.	215.	PACCEPT
226	500.	24.0	16.0	4.2	11.5	3.9	2588.5	1657.	135.	983.	NACCEPT-CLAY
227	502.	12.0	6.0	1.8	20.5	3.4	2901.3	1857.	162.	1163.	NACCEPT-CLAY
228	504.	4.0	6.0	0.5	49.0	12.8	784.3	502.	21.	168.	NACCEPT-CLAY
229	506.	10.0	7.0	1.4	23.9	5.1	1973.2	1263.	89.	630.	NACCEPT-CLAY
230	508.	19.2	10.0	3.1	14.1	3.3	3045.1	1949.	174.	1246.	NACCEPT-CLAY
231	510.	6.0	10.0	0.5	48.3	20.9	479.4	307.	10.	103.	NACCEPT-CLAY
232	512.	18.0	16.0	2.9	14.9	5.7	1753.7	1122.	74.	503.	NACCEPT-CLAY
233	514.	20.0	10.6	3.3	13.6	3.3	3030.2	1939.	173.	1237.	NACCEPT-CLAY
234	516.	10.0	10.0	1.4	23.8	7.2	1381.3	884.	51.	296.	NACCEPT-CLAY
235	518.	19.4	16.0	3.2	13.9	5.2	1928.9	1235.	86.	604.	NACCEPT-CLAY
236	520.	24.4	46.0	4.3	11.3	10.8	922.4	590.	27.	197.	PACCEPT
237	522.	27.1	57.0	5.1	10.2	11.5	871.1	557.	25.	186.	PACCEPT
238	524.	17.0	14.0	2.7	15.6	5.4	1868.5	1196.	82.	569.	NACCEPT-CLAY
239	526.	6.0	6.0	0.5	48.2	12.5	798.9	511.	22.	171.	NACCEPT-CLAY
240	528.	6.4	6.0	0.6	42.1	10.2	979.2	627.	30.	210.	NACCEPT-CLAY
241	530.	13.0	13.0	2.0	19.2	6.8	1471.3	942.	56.	341.	NACCEPT-CLAY
242	532.	21.0	29.0	3.5	13.0	8.5	1182.6	757.	40.	253.	PACCEPT
243	534.	24.0	30.0	4.2	11.4	7.2	1380.6	884.	51.	295.	PACCEPT
						31.3	319.6	205.	5.	68.	NACCEPT-CLAY

```
 247    542.   15.0   21.0   2.3   17.1    9.3   1074.5   688.    35.    230.   PACCEPT
 248    544.   21.5   26.0   3.6   17.7    7.3   1362.3   872.    50.    242.   PACCEPT
 249    546.   20.0   28.0   3.3   13.5    8.7   1147.2   734.    38.    245.   PACCEPT
 250    548.   22.0   27.0   3.6   12.4    7.4   1354.4   867.    50.    290.   PACCEPT
 251    550.   18.0   26.0   2.9   14.8    9.3   1079.2   691.    35.    231.   PACCEPT
 252    552.   17.0   27.0   2.7   15.5   10.3    968.8   620.    30.    207.   PACCEPT
 253    554.   19.0   27.1   3.1   14.1    9.0   1108.6   710.    36.    237.   PACCEPT
 254    556.   18.6   24.0   3.0   14.4    8.2   1218.3   780.    42.    261.   PACCEPT
 255    558.   17.0   22.0   2.7   15.5    8.4   1189.0   761.    41.    254.   PACCEPT
 256    560.   19.0   22.5   3.1   14.1    7.5   1335.3   855.    49.    286.   PACCEPT
 257    562.   17.0   25.0   2.7   15.5    9.6   1046.4   670.    33.    224.   PACCEPT
 258    564.   15.0   26.0   2.3   17.1   11.5    867.9   555.    25.    186.   PACCEPT
 259    566.   16.6   13.0   2.6   15.8    5.1   1955.4  1251.    88.    619.   NACCEPT-CLAY
 260    568.    5.0    6.0   0.2   65.0   32.6    307.1   197.     5.     66.   NACCEPT-CLAY
 261    570.    5.0    6.5   0.2   65.0   35.3    283.4   181.     4.     61.   NACCEPT-CLAY
 262    572.   11.2   12.0   1.7   21.5    7.5   1333.8   854.    48.    285.   NACCEPT-CLAY
 263    574.   11.1   20.0   1.6   21.6   12.6    791.4   506.    22.    169.   PACCEPT
 264    576.   17.0   24.0   2.7   15.5    9.2   1090.0   698.    35.    233.   PACCEPT
 265    578.   12.1   18.0   1.8   20.2   10.2    976.7   625.    30.    209.   NACCEPT-CLAY
 266    580.   16.0    9.0   2.5   16.2    3.7   2703.6  1730.   145.   1050.   NACCEPT-CLAY
 267    582.    5.0    7.0   0.2   65.0   38.0    263.2   168.     4.     56.   NACCEPT-CLAY
 268    584.   10.0    8.0   1.4   23.7    5.8   1726.6  1105.    72.    488.   NACCEPT-CLAY
 269    586.   18.0    7.0   2.9   14.8    2.5   4008.4  2565.   267.   1800.   NACCEPT-CLAY
 270    588.    5.0    6.0   0.2   65.0   32.6    307.1   197.     5.     66.   NACCEPT-CLAY
 271    590.    6.0    6.0   0.5   47.9   12.5    798.9   511.    22.    171.   NACCEPT-CLAY
 272    592.    6.0    6.0   0.5   47.9   12.5    798.9   511.    22.    171.   NACCEPT-CLAY
 273    594.   11.0   12.0   1.6   21.8    7.7   1304.0   835.    47.    279.   NACCEPT-CLAY
 274    596.   22.0   30.0   3.6   12.4    8.2   1219.0   780.    42.    261.   PACCEPT
 275    598.   21.3   33.0   3.6   12.7    9.4   1059.6   678.    34.    227.   PACCEPT
 276    600.   19.7   32.0   3.3   13.6   10.2    984.0   630.    30.    211.   PACCEPT
 277    602.   11.2   30.0   1.7   21.4   18.7    533.5   341.    12.    114.      GOOD-SCREEN
 278    604.   24.0   28.0   4.3   11.4    6.8   1479.2   947.    57.    346.   PACCEPT
 279    606.   23.0   26.0   4.0   11.8    6.7   1497.9   959.    58.    356.   PACCEPT
 280    608.   19.4   26.0   3.2   13.8    8.4   1187.0   760.    40.    254.   PACCEPT
 281    610.   20.4   25.0   3.4   13.2    7.6   1319.1   844.    48.    282.   PACCEPT
 282    612.   21.0   26.0   3.6   12.9    7.6   1319.0   844.    48.    282.   PACCEPT
 283    614.   24.2   26.0   4.4   11.3    6.2   1612.4  1032.    65.    422.   NACCEPT
 284    616.   14.0   26.0   2.2   17.9   12.5    801.4   513.    22.    172.   PACCEPT
 285    618.   12.0   26.0   1.8   20.2   14.9    669.5   429.    17.    143.      GOOD-SCREEN
DATA   DEPTH    RMN     RD     F    POR     RW   SPCOND    TDS     CL     SO4   REMARKS


                         PROGRAM TIME IN SECONDS =  0.1242344E 03


              PROGRAM BY----

                   RONALD M. BRIMHALL
                   BOX 31 CAMPUS STA.
                   SOCORRO, N. M.   87801
/&                                                                                          TOTAL TIME  006M 01S
JOB TIME SUMMARY...COMPILE 0128S   ASSEMBLE 0000S   LNKEDT 0043S   UTILS 0000S   USER 0190S
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COMPANY VILLAGE OF LOS LUNAS

WELL WATER WELL #3

LOCATION SEC. 9, TWP. 7N, RGE. 2E
NORTHWEST OF LOS LUNAS, NEW MEXICO

COUNTY VALENCIA STATE NEW MEXICO

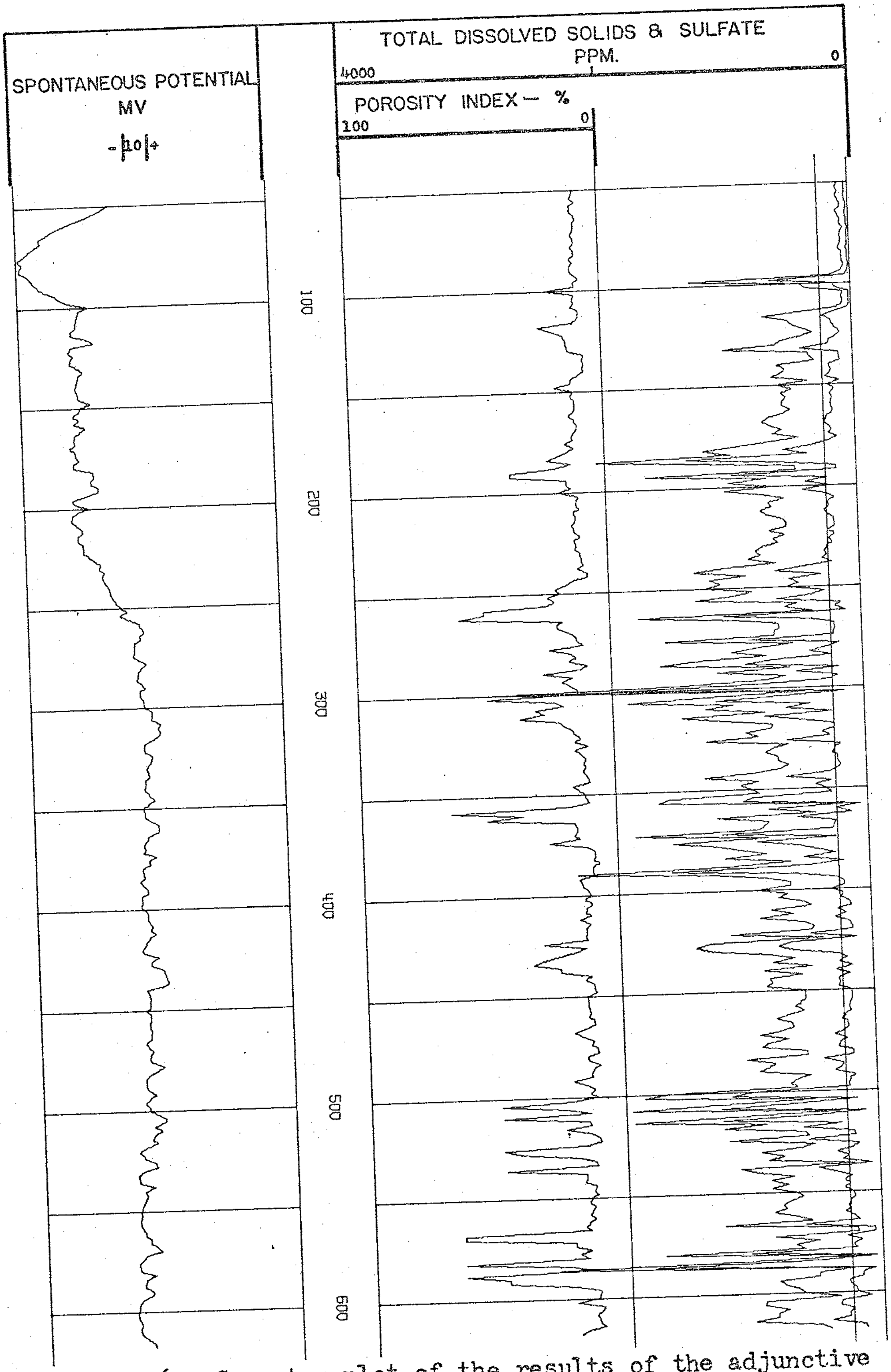

Fig. 6. Computer plot of the results of the adjunctive
EVALCO. Village of Los Lunas Water

Hueco Bolson near El Paso, Texas--HUEB01

City of El Paso Water Well #3 Offset

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FORTRAN IV    MODEL 44  PS       VERSION 3   LEVEL 1   DATE  69121       NEW MEXICO TECH     PAGE 0001
          C            014P,10,B58,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
          C      RONALD M. BRIMHALL - ELECTRIC LOG INTERPRETATION PROGRAM FOR WATER
          C                       WELLS
          C      AQUIFER PARAMETERS DETERMINED   F, POROSITY INDEX, TDS, CL, SO4,
          C                                      HCO3.
          C
          C
          C      ******************************************************************
          C      CITY OF EL PASO PUBLIC SERVICE BOARD     WATER WELL #3 (OFFSET)
          C      HUECO BOLSON 'V' WELL    WITH PLOTTER PROGRAM
          C      ******************************************************************
          C
          C
          C      RESISTIVITY LOG INTERPRETATION PROGRAM HUEB01---
          C      ******************************************************************
          C      PURPOSE OF HUEB01---
          C           HUEB01 DETERMINES QUANTITATIVE VALUES OF PARAMETERS RELATING
          C      TO WATER QUALITY--TOTAL DISSOLVED SOLIDS, SULFATE, CHLORIDE, AND
          C      BICARBONATE CONCENTRATIONS IN UNITS OF PARTS PER MILLION.  HUEB01
          C      IS APPLICABLE TO AREA ''V'' OF THE HUECO BOLSON NEAR EL PASO,
          C      TEXAS (BRIMHALL, 1969,, KNOWLES & KENNEDY, 1956).  RESISTIVITY
          C      DATA FROM A MACRORESISTIVITY LOG AND A PROXIMITY LOG ARE NECESSARY
          C      FOR HUEB01.  THE APPARENT FORMATION RESISTIVITY FACTOR METHOD FOR
          C      CALCULATING QUANTITATIVE VALUES OF TDS, ETC. IS USED IN HUEB01.
          C      WATER AT EACH DATA POINT IS CLASSIFIED AS TO ITS ACCEPTABILITY
          C      BASED ON US PUBLIC HEALTH SERVICE STANDARDS (TODD, 1959).  EACH
          C      AQUIFER UNIT IS EXAMINED FOR CLAY AND A POROSITY INDEX IS DETER-
          C      MINED.  CALCULATION RESULTS ARE PRESENTED IN TABLE AND LOG FORM.
          C      ******************************************************************
          C
          C
          C      ******************************************************************
          C      REFERENCES---
          C      BRIMHALL, R. M., DIGITAL ANALYSIS  OF BOREHOLE-MEASURED AQUIFER
          C      RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER OF
          C      SCIENCE THESIS, N. MEX. INST. MINING AND TECH., SOCORRO, JUNE 1969.
          C
          C      KNOWLES, D. B., AND R. A. KENNEDY, GROUND-WATER RESOURCES OF THE
          C      HUECO BOLSON NORTHEAST OF EL PASO, TEXAS, USGS WATER SUPPLY PAPER
          C      1426, 1956.
          C
          C      TODD, D. K., GROUND WATER HYDROLOGY, WILEY, NEW YORK, 1959.
          C      ******************************************************************
          C
          C
          C
          C      ******************************************************************
          C      NOMENCLATURE--
          C
          C           SCALAR QUANTITIES--
          C      T1 = INITIAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
          C      N = NUMBER OF DATA POINTS AND DO 200 ITERATIONS.
          C      RMF = MUD FILTRATE RESISTIVITY--OHM-METERS.
          C      AM = CEMENTATION EXPONENT IN F = A/POR**AM.
          C      AVTEMP = AVERAGE SURFACE TEMPERATURE FOR CALCULATING GRAD.
          C      TD = TOTAL DEPTH OF WELL FOR CALCULATING GRAD.
          C      BHT = BOTTOM HOLE TEMPERATUEE FOR CALCULATING GRAD.
          C      ROCL = AQUIFER RESISTIVITY BELOW WHICH AQUIFER CLASSIFIED CLAY--
          C           OHM-METERS.
          C      K = SUBSCRIPT FOR SUBSCRIPTED VARIABLES.

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          C      GRAD = TEMPERATURE GRADIENT OF AQUIFER.
          C      Y = ORDINATE POSITION OF FPN--INCHES.
          C      HEIGHT = HEIGHT OF NUMERICS WRITTEN BY CALL NUMBER--INCHES.
          C      THETA = ANGLE WITH RESPECT TO CAL COMP COORDINATES FOR WRITING
          C           FPN--DEGREES.
          C      NN = NUMBER OF DECIMAL DIGITS TO RIGHT OF DECIMAL IN FPN (-1 SUP-
          C           PRESSES DECIMAL POINT.)
          C      I = SUBSCRIPT FOR ABSCISSA OF FPN.
          C      T2 = FINAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
          C      TIME = PROGRAM EXECUTION TIME--SECONDS.
          C
          C
          C      SUBSCRIPTED VARIABLES---
          C
          C      IDATA = DATA POINT NUMBER.
          C      DEPTH = DEPTH OF DATA POINT--FEET.
          C      RXO = FLUSHED ZONE RESISTIVITY--RROXIMITY LOG READING--OHM-METERS.
          C      RO = DEEP INDUCTION RESISTIVITY--OHM-METERS.
          C      F = APPARENT FORMATION RESISTIVITY FACTOR.
          C      TDS = TOTAL DISSOLVED SOLIDS CONCENTRATION--PPM.
          C      CL = CHLORIDE CONCENTRATION--PPM.
          C      SO4 = SULFATE CONCENTRATION--PPM.
          C      HCO3 = BICARBONATE ION CONCENTRATION--PPM.
          C      RW = WATER RESISTIVITY--OHM-METERS.
          C      PRO = POROSITY INDEX CALCULATED FROM F = A/POR**AM.
          C      SPCOND = SPECIFIC CONDUCTANCE OF WATER--MICROMHOS/CM.
          C      RXOC = TEMPERATURE CORRECTED FLUSHED ZONE RESISTIVITY--OHM-METERS.
          C           TEMPERATURE CORRECTIONS ARE TO 77 C.
          C      ROC = TEMPERATURE CORRECTED DEEP INDUCTION RESISTIVITY--OHM-METERS
          C      ABC = DATA POINT DEPTH RESCALED TO 2 INCHES/100 FEET.
          C      SP = DEFLECTION OF SP CURVE FROM LEFT EDGE OF TRACK I--INCHES.
          C      TDSP = TDS RESCALED FOR PLOT--INCHES.
          C      CLP = CHLORIDE RESCALED FOR PLOT--INCHES.
          C      PORP = POROSITY INDEX RESCALLED FOR PLOT--INCHES.
          C      SO4P = SO4 RESCALED FOR PLOT--INCHES.
          C      X = ABSCISSA POSITION OF FPN--INCHES.
          C      FPN = DEPTH LABEL--A FLOATING POINT NUMBER.
          C      ******************************************************************
          C
          C
          C      ******************************************************************
          C      SUBPROGRAMS CALLED--
          C
          C           CLOCK
          C           IBCOM#
          C           SETMSG
          C           PLOT
          C           NUMBER
          C           FRXPR#
          C      ******************************************************************
          C
          C
          C
 0001                CALL CLOCK(T1)
 0002                DIMENSION IDATA(447),DEPTH(447),RXO(447),RO(447),F(447),TDS(447),
                    *CL(447),SO4(447),HCO3(447),RW(447),POR(447),SPCOND(447),RXOC(447),
                    *ROC(447),ABC(447),SP(447),TDSP(447),CLP(447),PORP(447),WORK(1000),
                    *X(9),FPN(9),ORD(450),LAB1(24),LAB2(44),LAB3(16)
          C
          C      PARAMETRIC DATA.
```

```
            N = 447
            RMF = 8.15
      C     (RMF ABOVE CORRECTED TO 77 F)
            AM = 1.5
            AVTEMP = 72.
            TD = 1330.
            BHT = 85.
            ROCL = 5.1
      C
      C     READ DATA POINT NUMBER, DEPTH, PROXIMITY LOG, INDUCTION LOG, SP
      C     FROM DATA CARDS.
            READ(5,1)(IDATA(K),DEPTH(K),RXO(K),RO(K),SP(K), K = 1,N)
          1 FORMAT(I3,F5.0,2F4.1,8X,F4.2)
      C
      C     WRITE PROBLEM IDENTIFICATION AND SOME PARAMETRIC DATA.
            WRITE(6,2)
          2 FORMAT('9',41X,'CITY OF EL PASO PUBLIC SERVICE BOARD',//50X,'WATER
           * WELL #3 OFFSET',////10X,'RMF = 10.8 @ 58 F',/12X,'M = 1.5',////)
      C
      C     LABEL LINE PRINTER OUTPUT.
            WRITE(6,999)
        999 FORMAT(   4X,'DATA',3X,'DEPTH',4X,'RXO',6X,'RO',5X,'F',5X,'POR',6X
           *,'RW',4X,'SPCOND',4X,'TDS',5X,'CL',6X,'SO4',4X,'HCO3',4X,'REMARKS'
           *)
      C
      C     DETERMINE TEMPERATURE GRADIENT.
            GRAD = (BHT-AVTEMP)/TD
      C
      C     PRIMARY DO LOOP.
            DO 200 K = 1,N
      C
      C     APPLY TEMPERATURE CORRECTIONS TO RXO, RO.
      C           TEMPERATURE CORRECTIONS ARE TO 77 F.
            RXOC(K) = RXO(K)*(AVTEMP + GRAD*DEPTH(K))/77.
            ROC(K) = RO(K)*(AVTEMP + GRAD*DEPTH(K))/77.
      C
      C     DETERMINE APPARENT FORMATION RESISTIVITY FACTOR.
        701 F(K) = RXOC(K)/RMF
      C
      C     CALCULATE WATER RESISTIVITY.
            RW(K)=ROC(K)/F(K)
      C
      C     CALCULATE TOTAL DISSOLVED SOLIDS.
            TDS(K) = 6350./RW(K)**0.95534
      C
      C     CALCULATE SPECIFIC CONDUCTANCE.
            SPCOND(K) = 10000.0/RW(K)
      C
      C     SELECT PROPER INTERPRETATION CONTROL EQUATIONS.
            IF(SPCOND(K).LE.1000.)GO TO 40
            IF(SPCOND(K).LT.1850..AND.SPCOND(K).GT.1000.)GO TO 50
            IF(SPCOND(K).GE.1850.)GO TO 60
         40 SO4(K) = 0.125*SPCOND(K)
            HCO3(K) = 0.08125*SPCOND(K) + 130.
            CL(K) = 13752./RW(K)**1.936
            GO TO 705
         50 SO4(K) = 0.05*SPCOND(K)
            HCO3(K) = 0.0375*SPCOND(K) + 100.
            CL(K) = 13752./RW(K)**1.936
            GO TO 705

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         60 SO4(K) = 0.05*SPCOND(K)
            HCO3(K) = 0.0375*SPCOND(K) + 100.
            CL(K) = 3250./RW(K)**1.073
      C
      C     DETERMINE POROSITY INDEX.
        705 POR(K) = 30.0/(F(K)**(1.0/AM))
      C
      C     CLAY IDENTIFICATION POROSITY INDEX = 65%.
            IF(POR(K).GT.65.)POR(K) = 65.
      C
      C     RESCALE SP, DEPTH, TDS, CL, POR FOR PLOT.
            SP(K) = SP(K)*0.25
            ABC(K) = (DEPTH(K) - 100.)*0.02
            TDSP(K) = (8.25 - (1.25E-03)*TDS(K))
            CLP(K) = (8.25 - (1.25E-03)*CL(K))
            PORP(K) = (5.75 - (2.5E-02)*POR(K))
      C
      C     TEST FOR CLAY.
            IF(RO(K).LE.ROCL)GO TO 110
      C
      C     IF NO CLAY, TEST AND CLASSIFY WATER QUALITY.
            IF(TDS(K).GE.1000.)GO TO 10
            IF(CL(K).GE.250.)GO TO 10
            IF(TDS(K).LE.880..AND.TDS(K).GE.500.)GO TO 20
            IF(TDS(K).LT.500.)GO TO 30
         10 WRITE(6,11)IDATA(K),DEPTH(K),RXO(K),RO(K),F(K),POR(K),RW(K),SPCOND
           *(K),TDS(K),CL(K),SO4(K),HCO3(K)
         11 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,4(3X,F5
           *.0),3X,'NACCEPT')
            GO TO 200
         20 WRITE(6,21)IDATA(K),DEPTH(K),RXO(K),RO(K),F(K),POR(K),RW(K),SPCOND
           *(K),TDS(K),CL(K),SO4(K),HCO3(K)
         21 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,4(3X,F5
           *.0),3X,'PACCEPT')
            GO TO 200
         30 WRITE(6,31)IDATA(K),DEPTH(K),RXO(K),RO(K),F(K),POR(K),RW(K),SPCOND
           *(K),TDS(K),CL(K),SO4(K),HCO3(K)
         31 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,4(3X,F5
           *.0),6X,'GOOD-SCREEN')
            GO TO 200
        110 WRITE(6,111)IDATA(K),DEPTH(K),RXO(K),RO(K),F(K),POR(K),RW(K),SPCON
           *D(K),TDS(K),CL(K),SO4(K),HCO3(K)
        111 FORMAT(4X,I4,3X,F5.0,2(3X,F5.1),3X,F3.1,2(3X,F5.1),3X,F6.1,4(3X,F5
           *.0),3X,'NACCEPT-CLAY')
            GO TO 200
        200 CONTINUE
      C
      C     WRITE COLUMN IDENTIFICATION.
            WRITE(6,999)
      C
      C     DETERMINE PROGRAM EXECUTION TIME.
            CALL CLOCK(T2)
            TIME = T1-T2
            WRITE(6,610)TIME
        610 FORMAT(////40X,'PROGRAM TIME IN SECONDS = ',E14.7)
      C
      C     IDENTIFY PROGRAMMER.
            WRITE(6,9999)
       9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'8
           *0X 31 CAMPUS STA.',/30X,'SOCORRO, N. M.   87801')
```

```
              C
              C
              C
              C      PLOT RESULTS IN LOG (GRAPHIC) FORM.
              C
              C      TDS, CL, TRACKS II AND III, 4000 - 0 PPM.
              C
              C      POR, TRACK II, 100 - 0 %.
              C
              C      SP, TRACK I, 20 MILLIVOLTS PER LOG DIVISION.
0070                 CALL SETMSG(13,'BRIMHALL PLOT')
0071                 CALL PLOT(0.,0.,3)
0072                 CALL PLOT(0.,-50.,-3)
0073                 CALL PLOT(30.,1.4,-3)
              C
              C      ESTABLISH LOG GRID.
              C
              C      LOG GRID SCALE IS 2 INCHES PER 100 FEET.
0074                 CALL PLOT(0.,8.25,2)
0075                 CALL PLOT(18.,8.25,2)
0076                 CALL PLOT(18.,3.25,2)
0077                 CALL PLOT(0.,3.25,2)
0078                 CALL PLOT(0.,2.5,3)
0079                 CALL PLOT(18.,2.5,2)
0080                 CALL PLOT(18.,0.,2)
0081                 CALL PLOT(0.,0.,2)
0082                 CALL PLOT(0.,5.75,3)
0083                 CALL PLOT(18.,5.75,2)
0084                 CALL PLOT(1.0,2.5,3)
0085                 CALL PLOT(1.,0.,2)
0086                 CALL PLOT(2.,0.,3)
0087                 CALL PLOT(2.,2.5,2)
0088                 CALL PLOT(3.,2.5,3)
0089                 CALL PLOT(3.,0.,2)
0090                 CALL PLOT(4.,0.,3)
0091                 CALL PLOT(4.,2.5,2)
0092                 CALL PLOT(5.,2.5,3)
0093                 CALL PLOT(5.,0.,2)
0094                 CALL PLOT(6.,0.,3)
0095                 CALL PLOT(6.0,2.5,2)
0096                 CALL PLOT(7.,2.5,3)
0097                 CALL PLOT(7.,0.,2)
0098                 CALL PLOT(8.,0.,3)
0099                 CALL PLOT(8.,2.5,2)
0100                 CALL PLOT(9.,2.5,3)
0101                 CALL PLOT(9.,0.,2)
0102                 CALL PLOT(10.,0.,3)
0103                 CALL PLOT(10.,2.5,2)
0104                 CALL PLOT(11.,2.5,3)
0105                 CALL PLOT(11.,0.,2)
0106                 CALL PLOT(12.,0.,3)
0107                 CALL PLOT(12.,2.5,2)
0108                 CALL PLOT(13.,2.5,3)
0109                 CALL PLOT(13.,0.,2)
0110                 CALL PLOT(14.,0.,3)
0111                 CALL PLOT(14.,2.5,2)
0112                 CALL PLOT(15.,2.5,3)
0113                 CALL PLOT(15.,0.,2)
0114                 CALL PLOT(16.,0.,3)
0115                 CALL PLOT(16.,2.5,2)
```

```
0116                 CALL PLOT(17.,2.5,3)
0117                 CALL PLOT(17.,0.,2)
0118                 CALL PLOT(18.,0.,3)
0119                 CALL PLOT(18.,2.5,2)
0120                 CALL PLOT(18.,3.25,3)
0121                 CALL PLOT(18.,8.25,2)
0122                 CALL PLOT(17.,8.25,3)
0123                 CALL PLOT(17.,3.25,2)
0124                 CALL PLOT(16.,3.25,3)
0125                 CALL PLOT(16.,8.25,2)
0126                 CALL PLOT(15.,8.25,3)
0127                 CALL PLOT(15.,3.25,2)
0128                 CALL PLOT(14.,3.25,3)
0129                 CALL PLOT(14.,8.25,2)
0130                 CALL PLOT(13.,8.25,3)
0131                 CALL PLOT(13.,3.25,2)
0132                 CALL PLOT(12.,3.25,3)
0133                 CALL PLOT(12.,8.25,2)
0134                 CALL PLOT(11.,8.25,3)
0135                 CALL PLOT(11.,3.25,2)
0136                 CALL PLOT(10.,3.25,3)
0137                 CALL PLOT(10.,8.25,2)
0138                 CALL PLOT(9.,8.25,3)
0139                 CALL PLOT(9.,3.25,2)
0140                 CALL PLOT(8.,3.25,3)
0141                 CALL PLOT(8.,8.25,2)
0142                 CALL PLOT(7.,8.25,3)
0143                 CALL PLOT(7.,3.25,2)
0144                 CALL PLOT(6.,3.25,3)
0145                 CALL PLOT(6.,8.25,2)
0146                 CALL PLOT(5.,8.25,3)
0147                 CALL PLOT(5.,3.25,2)
0148                 CALL PLOT(4.,3.25,3)
0149                 CALL PLOT (4.,8.25,2)
0150                 CALL PLOT(3.,8.25,3)
0151                 CALL PLOT(3.,3.25,2)
0152                 CALL PLOT(2.,3.25,3)
0153                 CALL PLOT(2.,8.25,2)
0154                 CALL PLOT(1.,8.25,3)
0155                 CALL PLOT(1.,3.25,2)
              C
              C
              C      DEPTH LABEL
0156                 Y = 2.85
0157                 HEIGHT = 0.07
0158                 THETA = 0.
0159                 NN = -1
0160                 N = 9
0161                 READ(5,800)(X(I),FPN(I), I = 1,N)
0162             800 FORMAT(F5.2,F5.0)
0163                 DO 801 I = 1,N
0164                 CALL NUMBER(X(I),Y,HEIGHT,FPN(I),THETA,NN)
0165             801 CONTINUE
              C
              C
              C
              C      LINE GENERATION
0166                 N = 446
              C
              C         POROSITY INDEX LINE PLOT
```

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FORTRAN IV    MODEL 44  PS         VERSION 3   LEVEL 1   DATE  69121       NEW MEXICO TECH    PAGE  0007

                C
 0167                 CALL PLOT(ABC(1),PORP(1),3)
 0168                 DO 1002 , K = 2,N
 0169                 CALL PLOT(ABC(K),PORP(K),2)
 0170            1002 CONTINUE
                C
                C        SP LINE PLOT
                C
 0171                 CALL PLOT(ABC(1),SP(1),3)
 0172                 DO 1001  K = 2,N
 0173                 CALL PLOT(ABC(K),SP(K),2)
 0174            1001 CONTINUE
                C
                C        TDS LINE PLOT
                C
 0175                 CALL PLOT(ABC(1),TDSP(1),3)
 0176                 DO 1003  K = 2,N
 0177                 CALL PLOT(ABC(K),TDSP(K),2)
 0178            1003 CONTINUE
                C
                C     CHLORIDES LINE PLOT
                C
 0179                 CALL PLOT(ABC(1),CLP(1),3)
 0180                 DO 1004  K = 2,N
 0181                 CALL PLOT(ABC(K),CLP(K),2)
 0182            1004 CONTINUE
                C
                C     FILE MARK.
 0183                 CALL PLOT(25.0,0.0,999)
 0184                 STOP
 0185                 END

                                          SCALAR MAP
SYMBOL     LOCATION      SYMBOL    LOCATION    SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION
T1         00017C        N         000180      RMF       000184        AM        000188        AVTEMP    00018C
TD         000190        BHT       000194      ROCL      000198        K         00019C        GRAD      0001A0
T2         0001A4        TIME      0001A8      Y         0001AC        HEIGHT    0001B0        THETA     0001B4
NN         0001B8        I         0001BC

                                          ARRAY MAP
SYMBOL     LOCATION      SYMBOL    LOCATION    SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION
IDATA      0001C0        DEPTH     0008BC      RXO       000FB8        RO        001684        F         001D80
TDS        0024AC        CL        002BA8      SO4       0032A4        HCO3      0039A0        RW        00409C
POR        004798        SPCOND    004E94      RXOC      005590        ROC       005C8C        ABC       006388
SP         006A84        TDSP      007180      CLP       00787C        PORP      007F78        WORK      008674
X          009614        FPN       009638      ORD       00965C        LAB1      009D64        LAB2      009DC4
LAB3       009E74

                                          SUBPROGRAMS CALLED
SYMBOL     LOCATION      SYMBOL    LOCATION    SYMBOL    LOCATION      SYMBOL    LOCATION      SYMBOL    LOCATION
CLOCK      009EB4        IBCOM#    009EB8      SETMSG    009EBC        PLOT      009EC0        NUMBER    009EC4
FRXPR#     009EC8

                                          LABEL MAP
LABEL      LOCATION      LABEL     LOCATION    LABEL     LOCATION      LABEL     LOCATION      LABEL     LOCATION
    1      00A468            2     00A49C        999     00A528          701     00A5F6           40     00A698
   50      00A6F6           60     00A754        705     00A7AC           10     00A902           11     00A99C
   20      00A9E0           21     00AA74         30     00AAB8           31     00A84C          110     00AB94


FORTRAN IV    MODEL 44  PS         VERSION 3   LEVEL 1   DATE  69121       NEW MEXICO TECH    PAGE  0008

  111      00AC28          200     00AC74        610     00ACDC         9999     00AD20          800     00B168
  801      00B1AC         1002     00B22A       1001     00B2A4         1003     00B312         1004     00B388

  TOTAL MEMORY REQUIREMENTS 00B4F8 BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
// EXEC LNKEDT(MAP)
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CITY OF EL PASO PUBLIC SERVICE BOARD

WATER WELL #3 OFFSET

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RMF = 10.8 @ 58 F
  M = 1.5

DATA  DEPTH   RXO    RO    F    POR   RW   SPCOND    TDS     CL    SO4   HCO3  REMARKS
   1   108.  20.0   8.0  2.3   17.1  3.3   3067.5  2053.   915.   153.  215.  NACCEPT
   2   110.  11.5   6.0  1.3   24.7  4.3   2351.7  1593.   688.   118.  188.  NACCEPT
   3   112.   8.5   6.4  1.0   30.2  6.1   1629.6  1122.   410.    81.  161.  NACCEPT
   4   114.  11.5   9.0  1.3   24.7  6.4   1567.8  1081.   381.    78.  159.  NACCEPT
   5   116.  12.5   7.5  1.5   23.3  4.9   2045.0  1394.   592.   102.  177.  NACCEPT
   6   118.   7.6   4.7  0.9   32.5  5.0   1984.1  1354.   573.    99.  174.  NACCEPT-CLAY
   7   120.   7.5   5.0  0.9   32.8  5.4   1840.5  1260.   519.    92.  169.  NACCEPT-CLAY
   8   122.  12.4   7.6  1.4   23.5  5.0   2001.9  1366.   579.   100.  175.  NACCEPT
   9   124.  13.2  10.1  1.5   22.5  6.2   1603.6  1105.   398.    80.  160.  NACCEPT
  10   126.  13.0  12.0  1.5   22.7  7.5   1329.2   924.   276.    66.  150.  NACCEPT
  11   128.  20.9  12.5  2.4   16.6  4.9   2051.5  1398.   594.   103.  177.  NACCEPT
  12   130.  28.0  12.4  3.3   13.6  3.6   2770.6  1863.   820.   139.  204.  NACCEPT
  13   132.  33.0  10.1  3.9   12.2  2.5   4009.0  2652.  1219.   200.  250.  NACCEPT
  14   134.  26.0   9.2  3.0   14.3  2.9   3467.6  2309.  1043.   173.  230.  NACCEPT
  15   136.  25.0   8.9  2.9   14.7  2.9   3446.6  2295.  1036.   172.  229.  NACCEPT
  16   138.  26.0   8.6  3.0   14.3  2.7   3709.5  2462.  1121.   185.  239.  NACCEPT
  17   140.  25.5   8.2  3.0   14.5  2.6   3815.7  2529.  1156.   191.  243.  NACCEPT
  18   142.  19.3   8.0  2.3   17.4  3.4   2960.1  1985.   880.   148.  211.  NACCEPT
  19   144.  20.3   8.0  2.4   16.9  3.2   3113.5  2083.   929.   156.  217.  NACCEPT
  20   146.  22.7   8.2  2.7   15.6  2.9   3396.7  2263.  1020.   170.  227.  NACCEPT
  21   148.  15.0   7.1  1.8   20.6  3.9   2592.2  1748.   763.   130.  197.  NACCEPT
  22   150.  20.5   5.0  2.4   16.7  2.0   5030.7  3294.  1555.   252.  289.  NACCEPT-CLAY
  23   152.   5.5   4.2  0.6   40.2  6.2   1606.8  1107.   399.    80.  160.  NACCEPT-CLAY
  24   154.   6.5   4.2  0.8   36.0  5.3   1898.9  1299.   547.    95.  171.  NACCEPT-CLAY
  25   156.   6.2   4.3  0.7   37.1  5.7   1769.2  1214.   481.    88.  166.  NACCEPT-CLAY
  26   158.   5.8   5.4  0.7   38.8  7.6   1317.9   916.   272.    66.  149.  NACCEPT
  27   160.  20.1   9.1  2.4   16.9  3.7   2710.2  1824.   801.   136.  202.  NACCEPT
  28   162.  21.5   9.5  2.5   16.2  3.6   2776.9  1867.   822.   139.  204.  NACCEPT
  29   164.  21.5   9.1  2.5   16.2  3.4   2898.9  1945.   861.   145.  209.  NACCEPT
  30   166.  22.0   8.5  2.6   15.9  3.1   3175.7  2123.   949.   159.  219.  NACCEPT
  31   168.  13.5   8.8  1.6   22.1  5.3   1882.3  1288.   542.    94.  171.  NACCEPT
  32   170.  22.0  10.0  2.6   15.9  3.7   2699.4  1817.   797.   135.  201.  NACCEPT
  33   172.  21.9  10.2  2.6   16.0  3.8   2634.4  1776.   777.   132.  199.  NACCEPT
  34   174.  23.0  10.2  2.7   15.5  3.6   2766.8  1861.   819.   138.  204.  NACCEPT
  35   176.  20.4   9.8  2.4   16.8  3.9   2554.1  1724.   751.   128.  196.  NACCEPT
  36   178.  24.0   9.3  2.8   15.0  3.2   3166.4  2117.   946.   158.  219.  NACCEPT
  37   180.  30.1   9.4  3.5   12.9  2.5   3929.0  2601.  1193.   196.  247.  NACCEPT
  38   182.  22.7   9.4  2.7   15.6  3.4   2963.1  1987.   881.   148.  211.  NACCEPT
  39   184.  22.0   8.0  2.6   15.9  3.0   3374.2  2249.  1013.   169.  227.  NACCEPT
  40   186.  19.8   7.2  2.3   17.1  3.0   3374.2  2249.  1013.   169.  227.  NACCEPT
  41   188.  19.8   7.1  2.3   17.1  2.9   3421.8  2279.  1028.   171.  228.  NACCEPT
  42   190.  20.0   6.8  2.4   17.0  2.8   3608.8  2398.  1089.   180.  235.  NACCEPT
  43   192.  12.0   5.0  1.4   23.8  3.4   2944.8  1975.   875.   147.  210.  NACCEPT-CLAY
  44   194.   7.4   5.7  0.9   32.9  6.3   1592.9  1098.   392.    80.  160.  NACCEPT
  45   196.  17.5   6.1  2.1   18.5  2.8   3520.1  2342.  1060.   176.  232.  NACCEPT
  46   198.  18.0  10.2  2.1   18.2  4.6   2165.3  1472.   629.   108.  181.  NACCEPT
  47   200.  20.2   9.5  2.4   16.8  3.8   2609.0  1759.   769.   130.  198.  NACCEPT
  48   202.  23.0   8.5  2.7   15.4  3.0   3320.1  2215.   996.   166.  225.  NACCEPT
  49   204.  20.5   8.1  2.4   16.7  3.2   3105.4  2078.   927.   155.  216.  NACCEPT
  50   206.   9.0   9.1  1.1   28.8  8.2   1213.5   847.   232.    61.  146.  PACCEPT
  51   208.  20.8   9.7  2.5   16.5  3.8   2631.1  1773.   776.   132.  199.  NACCEPT
  52   210.  16.0   9.4  1.9   19.6  4.8   2088.5  1422.   605.   104.  178.  NACCEPT
  53   212.  19.0   9.7  2.2   17.5  4.2   2403.4  1626.   704.   120.  190.  NACCEPT
  54   214.  20.1  10.0  2.4   16.9  4.1   2466.3  1667.   724.   123.  192.  NACCEPT
  55   216.  21.5  10.0  2.5   16.1  3.8   2638.0  1778.   778.   132.  199.  NACCEPT
  56   218.  18.0   9.9  2.1   18.1  4.5   2230.9  1515.   650.   112.  184.  NACCEPT
  57   220.  19.7  10.0  2.3   17.1  4.1   2417.2  1635.   708.   121.  191.  NACCEPT
  58   222.  21.0  10.0  2.5   16.4  3.9   2576.7  1738.   758.   129.  197.  NACCEPT
  59   224.  20.0   9.8  2.4   16.9  4.0   2504.1  1692.   736.   125.  194.  NACCEPT
  60   226.  19.8   9.8  2.3   17.0  4.0   2479.0  1675.   728.   124.  193.  NACCEPT
  61   228.  21.8   8.5  2.6   16.0  3.2   3146.9  2104.   940.   157.  218.  NACCEPT
  62   230.  15.0   4.8  1.8   20.5  2.6   3834.4  2541.  1162.   192.  244.  NACCEPT-CLAY
  63   232.   7.0   2.9  0.8   34.0  3.4   2961.7  1986.   881.   148.  211.  NACCEPT-CLAY
  64   234.   3.6   2.9  0.4   53.0  6.6   1523.2  1052.   360.    76.  157.  NACCEPT-CLAY
  65   236.   9.5   4.0  1.1   27.7  3.4   2914.1  1955.   866.   146.  209.  NACCEPT-CLAY
  66   238.  12.2   5.5  1.4   23.5  3.7   2721.7  1832.   804.   136.  202.  NACCEPT
  67   240.  19.0   5.7  2.3   17.5  2.4   4090.0  2703.  1245.   204.  253.  NACCEPT
  68   242.   8.7   5.6  1.0   29.4  5.2   1906.2  1303.   549.    95.  171.  NACCEPT
  69   244.  13.2   6.1  1.6   22.3  3.8   2655.1  1789.   783.   133.  200.  NACCEPT
  70   246.  18.3   7.9  2.2   17.9  3.5   2842.3  1909.   843.   142.  207.  NACCEPT
  71   248.  19.0   6.6  2.3   17.5  2.8   3532.3  2350.  1064.   177.  232.  NACCEPT
  72   250.  17.8   4.4  2.1   18.2  2.0   4963.7  3252.  1533.   248.  286.  NACCEPT-CLAY
  73   252.   7.5   4.6  0.9   32.4  5.0   2000.5  1365.   578.   100.  175.  NACCEPT-CLAY
  74   254.  12.0   6.9  1.4   23.7  4.7   2133.9  1452.   620.   107.  180.  NACCEPT
  75   256.  19.6   8.1  2.3   17.1  3.4   2969.0  1990.   883.   148.  211.  NACCEPT
  76   258.  19.9   6.6  2.4   16.9  2.7   3699.6  2456.  1118.   185.  239.  NACCEPT
  77   260.  17.0   5.1  2.0   18.8  2.4   4090.0  2703.  1245.   204.  253.  NACCEPT-CLAY
  78   262.   8.0   4.5  1.0   31.0  4.6   2181.3  1483.   634.   109.  182.  NACCEPT-CLAY
  79   264.  13.3   4.4  1.6   22.1  2.7   3708.9  2462.  1121.   185.  239.  NACCEPT-CLAY
  80   266.  11.6   4.0  1.4   24.2  2.8   3558.3  2366.  1072.   178.  233.  NACCEPT-CLAY
  81   268.  11.6   3.2  1.4   24.2  2.2   4447.9  2928.  1363.   222.  267.  NACCEPT-CLAY
  82   270.   5.1   3.4  0.6   41.9  5.4   1840.5  1260.   519.    92.  169.  NACCEPT-CLAY
  83   272.  10.0   3.7  1.2   26.7  3.0   3316.2  2212.   994.   166.  224.  NACCEPT-CLAY
  84   274.  11.0   3.9  1.3   25.1  2.9   3460.8  2304.  1041.   173.  230.  NACCEPT-CLAY
  85   276.   6.2   3.6  0.7   36.7  4.7   2113.2  1438.   613.   106.  179.  NACCEPT-CLAY
  86   278.   5.5   4.2  0.7   39.8  6.2   1606.8  1107.   399.    80.  160.  NACCEPT-CLAY
  87   280.  11.0   5.2  1.3   25.1  3.9   2595.6  1751.   764.   130.  197.  NACCEPT
  88   282.  10.5   6.0  1.3   25.8  4.7   2147.2  1460.   624.   107.  181.  NACCEPT
  89   284.   9.9   5.7  1.2   26.9  4.7   2131.1  1450.   619.   107.  180.  NACCEPT
  90   286.  11.0   5.5  1.3   25.0  4.1   2454.0  1659.   720.   123.  192.  NACCEPT
  91   288.  16.0   5.1  1.9   19.5  2.6   3849.4  2551.  1167.   192.  244.  NACCEPT-CLAY
  92   290.  14.8   4.1  1.8   20.5  2.3   4429.1  2917.  1356.   221.  266.  NACCEPT-CLAY
  93   292.  15.0   3.7  1.8   20.4  2.0   4974.3  3259.  1536.   249.  287.  NACCEPT-CLAY
  94   294.  11.1   3.7  1.3   24.9  2.7   3681.0  2444.  1112.   184.  238.  NACCEPT-CLAY
  95   296.  14.6   3.8  1.7   20.7  2.1   4714.2  3096.  1450.   236.  277.  NACCEPT-CLAY
  96   298.  18.3   3.6  2.2   17.8  1.6   6237.2  4045.  1958.   312.  334.  NACCEPT-CLAY
  97   300.  10.8   3.5  1.3   25.3  2.6   3786.2  2511.  1146.   189.  242.  NACCEPT-CLAY
  98   302.   6.1   4.0  0.7   37.1  5.3   1871.2  1281.   538.    94.  170.  NACCEPT-CLAY
  99   304.   9.2   4.3  1.1   28.2  3.8   2625.2  1770.   774.   131.  198.  NACCEPT-CLAY
 100   306.   7.6   3.1  0.9   32.0  3.3   3008.1  2015.   896.   150.  213.  NACCEPT-CLAY
 101   308.   4.4   3.1  0.5   46.0  5.7   1741.5  1196.   466.    87.  165.  NACCEPT-CLAY
 102   310.   4.4   3.6  0.5   46.0  6.7   1499.7  1036.   349.    75.  156.  NACCEPT-CLAY
 103   312.   8.2   4.7  1.0   30.4  4.7   2140.7  1456.   622.   107.  180.  NACCEPT-CLAY
 104   314.  21.0   5.4  2.5   16.2  2.1   4771.6  3132.  1469.   239.  279.  NACCEPT
 105   316.  20.6   4.6  2.5   16.4  1.8   5494.8  3584.  1709.   275.  306.  NACCEPT-CLAY
 106   318.  21.8   4.4  2.6   15.8  1.6   6079.2  3947.  1905.   304.  328.  NACCEPT-CLAY
 107   320.  22.0   4.5  2.6   15.7  1.7   5998.6  3897.  1878.   300.  325.  NACCEPT-CLAY
 108   322.  17.0   4.6  2.0   18.7  2.2   4534.5  2983.  1391.   227.  270.  NACCEPT-CLAY
 109   324.  19.7   4.4  2.4   16.9  1.8   5493.6  3583.  1709.   275.  306.  NACCEPT-CLAY
 110   326.  18.0   3.7  2.2   18.0  1.7   5969.2  3879.  1868.   298.  324.  NACCEPT-CLAY
 111   328.  16.0   3.1  1.9   19.4  1.6   6332.9  4104.  1991.   317.  337.  NACCEPT-CLAY
 112   330.   5.8   2.6  0.7   38.2  3.7   2737.1  1842.   809.   137.  203.  NACCEPT-CLAY
 113   332.   4.0   2.8  0.5   49.0  5.7   1752.8  1203.   472.    88.  166.  NACCEPT-CLAY
 114   334.   8.0   3.2  1.0   30.8  3.3   3067.5  2053.   915.   153.  215.  NACCEPT-CLAY
 115   336.  18.0   3.8  2.2   18.0  1.7   5812.1  3781.  1816.   291.  318.  NACCEPT-CLAY
 116   338.  14.6   3.8  1.8   20.6  2.1   4714.2  3096.  1450.   236.  277.  NACCEPT-CLAY
 117   340.  18.3   4.0  2.2   17.8  1.8   5613.5  3658.  1749.   281.  311.  NACCEPT-CLAY
 118   342.  18.0   3.5  2.2   17.9  1.6   6310.3  4090.  1983.   316.  337.  NACCEPT-CLAY
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```
120   346.   4.1   2.8   0.5  48.1   5.6  1796.7  1232.   495.   90.  167.  NACCEPT-CLAY
121   348.   4.9   3.0   0.6  42.7   5.0  2004.1  1367.   579.  100.  175.  NACCEPT-CLAY
122   350.   3.8   3.4   0.5  50.6   7.3  1371.3   952.   294.   69.  151.  NACCEPT-CLAY
123   352.   5.1   4.6   0.6  41.6   7.4  1360.4   944.   289.   68.  151.  NACCEPT-CLAY
124   354.   8.3   5.8   1.0  30.0   5.7  1755.9  1205.   474.   88.  166.  NACCEPT
125   356.   8.6   6.2   1.0  29.3   5.9  1702.0  1170.   446.   85.  164.  NACCEPT
126   358.  10.1   5.9   1.2  26.3   4.8  2100.4  1430.   609.  105.  179.  NACCEPT
127   360.   6.8   6.1   0.8  34.3   7.3  1367.8   949.   292.   68.  151.  NACCEPT
128   362.  10.1   6.6   1.2  26.3   5.3  1877.7  1285.   540.   94.  170.  NACCEPT
129   364.   9.4   6.3   1.1  27.6   5.5  1830.8  1254.   514.   92.  169.  NACCEPT
130   366.  10.3   5.3   1.2  26.0   4.2  2384.5  1614.   698.  119.  189.  NACCEPT
131   368.  10.7   4.7   1.3  25.3   3.6  2793.4  1878.   827.  140.  205.  NACCEPT-CLAY
132   370.   9.5   4.2   1.1  27.4   3.6  2775.3  1866.   821.  139.  204.  NACCEPT-CLAY
133   372.  17.9   4.0   2.2  18.0   1.8  5490.8  3581.  1708.  275.  306.  NACCEPT-CLAY
134   374.  18.0   3.7   2.2  17.9   1.7  5969.2  3879.  1868.  298.  324.  NACCEPT-CLAY
135   376.  11.3   3.4   1.4  24.4   2.5  4078.0  2695.  1241.  204.  253.  NACCEPT-CLAY
136   378.   5.4   3.3   0.7  39.9   5.0  2007.8  1370.   580.  100.  175.  NACCEPT-CLAY
137   380.  14.3   3.5   1.7  20.9   2.0  5013.1  3283.  1549.  251.  288.  NACCEPT-CLAY
138   382.  15.0   3.6   1.8  20.2   2.0  5112.5  3345.  1582.  256.  292.  NACCEPT-CLAY
139   384.  15.5   3.8   1.9  19.8   2.0  5004.8  3278.  1546.  250.  288.  NACCEPT-CLAY
140   386.  16.2   3.8   2.0  19.2   1.9  5230.9  3419.  1621.  262.  296.  NACCEPT-CLAY
141   388.  15.0   3.5   1.8  20.2   1.9  5258.5  3436.  1631.  263.  297.  NACCEPT-CLAY
142   390.  12.1   2.9   1.5  23.3   2.0  5119.5  3350.  1584.  256.  292.  NACCEPT-CLAY
143   392.   3.7   3.1   0.4  51.3   6.8  1464.5  1013.   334.   73.  155.  NACCEPT-CLAY
144   394.   5.4   3.9   0.7  39.9   5.9  1698.9  1168.   445.   85.  164.  NACCEPT-CLAY
145   396.   9.0   4.1   1.1  28.4   3.7  2693.4  1814.   795.  135.  201.  NACCEPT-CLAY
146   398.   4.8   3.4   0.6  43.1   5.8  1732.2  1190.   462.   87.  165.  NACCEPT-CLAY
147   400.   4.2   3.1   0.5  47.1   6.0  1662.4  1144.   426.   83.  162.  NACCEPT-CLAY
148   402.   4.1   2.9   0.5  47.9   5.8  1734.7  1191.   463.   87.  165.  NACCEPT-CLAY
149   404.   3.8   3.1   0.5  50.4   6.6  1504.1  1039.   351.   75.  156.  NACCEPT-CLAY
150   406.   4.3   3.9   0.5  46.4   7.4  1352.8   939.   286.   68.  151.  NACCEPT-CLAY
151   408.  10.0   5.2   1.2  26.4   4.2  2359.6  1598.   690.  118.  188.  NACCEPT
152   410.  18.6   5.7   2.3  17.5   2.5  4003.9  2649.  1217.  200.  250.  NACCEPT
153   412.  21.0   6.3   2.5  16.1   2.4  4090.0  2703.  1245.  204.  253.  NACCEPT
154   414.  20.8   5.5   2.5  16.2   2.2  4640.3  3049.  1426.  232.  274.  NACCEPT
155   416.  21.6   4.6   2.6  15.8   1.7  5761.5  3750.  1799.  288.  316.  NACCEPT-CLAY
156   418.   5.5   4.0   0.7  39.3   5.9  1687.1  1160.   439.   84.  163.  NACCEPT-CLAY
157   420.   5.4   3.9   0.7  39.8   5.9  1698.9  1168.   445.   85.  164.  NACCEPT-CLAY
158   422.   4.6   3.6   0.6  44.3   6.4  1567.8  1081.   381.   78.  159.  NACCEPT-CLAY
159   424.   4.6   3.6   0.6  44.3   6.4  1567.8  1081.   381.   78.  159.  NACCEPT-CLAY
160   426.   8.1   6.1   1.0  30.3   6.1  1629.3  1122.   410.   81.  161.  NACCEPT
161   428.  16.0   9.8   1.9  19.3   5.0  2003.3  1367.   579.  100.  175.  NACCEPT
162   430.  15.0  10.0   1.8  20.1   5.4  1840.5  1260.   519.   92.  169.  NACCEPT
163   432.  19.5  10.1   2.4  16.9   4.2  2368.9  1604.   693.  118.  189.  NACCEPT
164   434.  19.4   9.0   2.4  16.9   3.8  2644.9  1782.   780.  132.  199.  NACCEPT
165   436.  17.6   7.4   2.1  18.1   3.4  2918.3  1958.   867.  146.  209.  NACCEPT
166   438.  19.7   5.0   2.4  16.8   2.1  4834.4  3171.  1490.  242.  281.  NACCEPT-CLAY
167   440.   7.0   4.5   0.9  33.4   5.2  1908.7  1305.   550.   95.  172.  NACCEPT-CLAY
168   442.  12.0   5.3   1.5  23.3   3.6  2778.1  1868.   822.  139.  204.  NACCEPT
169   444.  17.0   7.3   2.1  18.5   3.5  2857.4  1919.   847.  143.  207.  NACCEPT
170   446.  20.0   7.5   2.4  16.6   3.1  3272.0  2184.   980.  164.  223.  NACCEPT
171   448.  20.3   7.5   2.5  16.4   3.0  3321.1  2215.   996.  166.  225.  NACCEPT
172   450.  20.1   7.4   2.4  16.5   3.0  3332.8  2223.  1000.  167.  225.  NACCEPT
173   452.  14.0   7.4   1.7  21.0   4.3  2321.3  1573.   678.  116.  187.  NACCEPT
174   454.  24.0   7.5   2.9  14.7   2.5  3926.4  2600.  1192.  196.  247.  NACCEPT
175   456.  13.8   7.2   1.7  21.2   4.3  2351.7  1593.   688.  118.  188.  NACCEPT
176   458.  22.5   5.3   2.7  15.3   1.9  5208.9  3405.  1614.  260.  295.  NACCEPT
177   460.   6.0   4.0   0.7  37.0   5.4  1840.5  1260.   519.   92.  169.  NACCEPT-CLAY
178   462.   5.8   3.6   0.7  37.8   5.1  1976.8  1350.   571.   99.  174.  NACCEPT-CLAY
179   464.   5.7   3.5   0.7  38.2   5.0  1998.2  1364.   577.  100.  175.  NACCEPT-CLAY
180   466.   4.3   3.2   0.5  46.1   6.1  1648.8  1135.   420.   82.  162.  NACCEPT-CLAY
181   468.   4.2   3.2   0.5  46.8   6.2  1610.4  1110.   401.   81.  160.  NACCEPT-CLAY
182   470.   4.1   3.3   0.5  47.6   6.6  1524.4  1053.   360.   76.  157.  NACCEPT-CLAY
183   472.   4.5   3.9   0.5  44.7   7.1  1415.8   981.   312.   71.  153.  NACCEPT-CLAY
184   474.   5.5   6.0   0.7  39.1   8.9  1124.7   787.   200.   56.  142.  PACCEPT
185   476.  20.1  15.0   2.5  16.5   6.1  1644.2  1132.   417.   82.  162.  NACCEPT
186   478.  25.3  28.0   3.1  14.1   9.0  1108.7   777.   195.   55.  142.  PACCEPT
187   480.  27.6  30.1   3.4  13.3   8.9  1125.1   788.   200.   56.  142.  PACCEPT
188   482.  27.6  31.0   3.4  13.3   9.2  1092.4   766.   189.   55.  141.  PACCEPT
189   484.  26.5  33.0   3.2  13.7  10.1   985.3   694.   155.  123.  210.  PACCEPT
190   486.  28.0  36.0   3.4  13.2  10.5   954.3   673.   146.  119.  208.  PACCEPT
191   488.  29.1  29.0   3.6  12.9   8.1  1231.2   858.   238.   62.  146.  PACCEPT
192   490.  26.5  15.0   3.2  13.7   4.6  2167.7  1474.   630.  108.  181.  NACCEPT
193   492.  11.4  11.0   1.4  24.0   7.9  1271.6   885.   254.   64.  148.  NACCEPT
194   494.  12.3  13.0   1.5  22.8   8.6  1160.9   812.   213.   58.  144.  PACCEPT
195   496.  16.7  24.0   2.0  18.6  11.7   853.8   605.   117.  107.  199.  PACCEPT
196   498.  26.5  37.0   3.2  13.7  11.4   878.8   622.   124.  110.  201.  PACCEPT
197   500.  34.6  42.0   4.2  11.5   9.9  1010.8   711.   163.   51.  138.  PACCEPT
198   502.  34.8  39.0   4.3  11.4   9.1  1094.9   767.   190.   55.  141.  PACCEPT
199   504.  32.0  36.0   3.9  12.1   9.2  1090.7   765.   189.   55.  141.  PACCEPT
200   506.  26.5  28.0   3.2  13.7   8.6  1161.3   812.   213.   58.  144.  PACCEPT
201   508.  22.3  22.0   2.7  15.3   8.0  1243.7   867.   243.   62.  147.  PACCEPT
202   510.  14.6  20.2   1.8  20.3  11.3   886.8   627.   126.  111.  202.  PACCEPT
203   512.  27.0  20.0   3.3  13.5   6.0  1656.4  1140.   423.   83.  162.  NACCEPT
204   514.  17.5  17.0   2.1  18.0   7.9  1263.1   880.   250.   63.  147.  NACCEPT
205   516.  26.3  16.0   3.2  13.7   5.0  2016.9  1376.   583.  101.  176.  NACCEPT
206   518.  24.2  14.5   3.0  14.5   4.9  2047.8  1396.   593.  102.  177.  NACCEPT
207   520.  25.0  13.0   3.1  14.2   4.2  2359.6  1598.   690.  118.  188.  NACCEPT
208   522.  16.4  12.0   2.0  18.8   6.0  1676.9  1153.   434.   84.  163.  NACCEPT
209   524.  26.5  10.0   3.3  13.7   3.1  3251.5  2171.   974.  163.  222.  NACCEPT
210   526.  24.5   5.8   3.0  14.4   1.9  5183.0  3389.  1606.  259.  294.  NACCEPT
211   528.   6.0   4.4   0.7  36.7   6.0  1673.2  1151.   432.   84.  163.  NACCEPT-CLAY
212   530.   5.4   3.9   0.7  39.4   5.9  1698.9  1168.   445.   85.  164.  NACCEPT-CLAY
213   532.   6.7   3.5   0.8  34.1   4.3  2348.8  1591.   687.  117.  188.  NACCEPT-CLAY
214   534.   4.3   3.6   0.5  45.9   6.8  1465.6  1014.   334.   73.  155.  NACCEPT-CLAY
215   536.   9.0   6.8   1.1  28.0   6.2  1624.0  1118.   407.   81.  161.  NACCEPT
216   538.  20.5  14.5   2.5  16.2   5.8  1734.7  1191.   463.   87.  165.  NACCEPT
217   540.  26.5  16.8   3.3  13.6   5.2  1935.4  1323.   558.   97.  173.  NACCEPT
218   542.  23.0  12.0   2.8  15.0   4.3  2351.7  1593.   688.  118.  188.  NACCEPT
219   544.  16.5   6.9   2.0  18.7   3.4  2934.1  1968.   872.  147.  210.  NACCEPT
220   546.   6.4   5.4   0.8  35.1   6.9  1454.2  1006.   329.   73.  155.  NACCEPT
221   548.   6.7   5.6   0.8  35.9   7.4  1358.5   943.   288.   68.  151.  NACCEPT
222   550.  10.1   6.8   1.2  25.9   5.5  1822.4  1249.   509.   91.  168.  NACCEPT
223   552.   9.7   7.8   1.2  26.6   6.6  1525.9  1054.   361.   76.  157.  NACCEPT
224   554.   6.0   5.5   0.7  36.7   7.5  1338.5   930.   280.   67.  150.  NACCEPT
225   556.   8.1   4.6   1.0  30.0   4.6  2160.6  1469.   628.  108.  181.  NACCEPT-CLAY
226   558.   4.6   5.3   0.6  43.8   9.4  1064.9   747.   180.   53.  140.  PACCEPT
227   560.   9.1  10.8   1.1  27.8   9.7  1033.9   727.   170.   52.  139.  PACCEPT
228   562.  20.3  19.5   2.5  16.3   7.8  1277.3   889.   256.   64.  148.  NACCEPT
229   564.  25.0  24.0   3.1  14.1   7.8  1278.1   890.   256.   64.  148.  NACCEPT
230   566.  24.3  25.5   3.0  14.4   8.6  1169.3   817.   216.   58.  144.  PACCEPT
231   568.  30.2  26.5   3.7  12.5   7.2  1398.3   969.   305.   70.  152.  NACCEPT
232   570.  30.1  25.0   3.7  12.5   6.8  1477.3  1022.   339.   74.  155.  NACCEPT
233   572.  30.1  13.0   3.7  12.5   3.5  2841.0  1908.   842.  142.  207.  NACCEPT
234   574.  29.0   8.1   3.6  12.8   2.3  4392.9  2894.  1344.  220.  265.  NACCEPT
235   576.   9.3   6.7   1.2  27.3   5.9  1703.1  1170.   447.   85.  164.  NACCEPT
236   578.   8.3   8.6   1.0  29.5   8.4  1184.2   827.   221.   59.  144.  PACCEPT
237   580.  20.7  15.0   2.6  16.0   5.9  1693.3  1164.   442.   85.  163.  NACCEPT
238   582.  21.7  24.0   2.7  15.5   9.0  1109.4   777.   195.   55.  142.  PACCEPT
239   584.  25.2  18.0   3.1  14.0   5.8  1717.8  1180.   454.   86.  164.  NACCEPT
240   586.  15.8  14.0   2.0  19.2   7.2  1384.7   960.   299.   69.  152.  NACCEPT
241   588.  12.0   8.2   1.5  23.0   5.6  1795.6  1231.   495.   90.  167.  NACCEPT
242   590.  13.2   5.7   1.6  21.6   3.5  2841.5  1909.   842.  142.  207.  NACCEPT
243   592.   5.0   6.6   0.6  41.3  10.8   929.5   656.   138.  116.  206.  PACCEPT
244   594.  13.0  12.0   1.6  21.8   7.5  1329.2   924.   276.   66.  150.  NACCEPT
245   596.  17.0  17.5   2.1  18.2   8.4  1191.9   832.   224.   60.  145.  PACCEPT
246   598.  16.8  18.0   2.1  18.4   8.7  1145.2   801.   207.   57.  143.  PACCEPT
247   600.  20.2  19.5   2.5  16.3   7.9  1271.0   885.   254.   64.  148.  NACCEPT
248   602.  18.0  21.5   2.2  17.6   9.7  1027.2   722.   168.   51.  139.  PACCEPT
249   604.  21.5  25.0   2.7  15.6   9.5  1055.2   741.   177.   53.  140.  PACCEPT
                                 12.5   6.4  1566.4  1081.   380.   78.  159.  NACCEPT
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252	610.	19.2	21.0	2.4	16.8	8.9	1121.8	785.	199.	58.	142.	[illegible]
253	612.	23.0	24.0	2.9	14.9	8.5	1175.9	822.	218.	59.	144.	PACCEPT
254	614.	25.0	23.0	3.1	14.1	7.5	1333.7	927.	278.	67.	150.	NACCEPT
255	616.	29.8	18.0	3.7	12.5	4.9	2031.4	1385.	588.	102.	176.	NACCEPT
256	618.	13.8	18.0	1.7	20.9	10.6	940.7	664.	142.	118.	206.	PACCEPT
257	620.	23.6	13.5	2.9	14.6	4.7	2145.0	1459.	623.	107.	180.	NACCEPT
258	622.	27.0	8.1	3.4	13.4	2.4	4090.0	2703.	1245.	204.	253.	NACCEPT
259	624.	8.8	6.0	1.1	28.2	5.6	1799.6	1234.	497.	90.	167.	NACCEPT
260	626.	8.7	7.3	1.1	28.4	6.8	1462.3	1012.	333.	73.	155.	NACCEPT
261	628.	7.9	8.8	1.0	30.3	9.1	1101.5	772.	192.	55.	141.	PACCEPT
262	630.	14.4	15.5	1.8	20.3	8.8	1139.9	798.	205.	57.	143.	PACCEPT
263	632.	27.8	23.0	3.5	13.1	6.7	1483.1	1026.	342.	74.	156.	NACCEPT
264	634.	32.0	28.5	4.0	11.9	7.3	1377.7	956.	296.	69.	152.	NACCEPT
265	636.	33.0	29.0	4.1	11.7	7.2	1396.2	968.	304.	70.	152.	NACCEPT
266	638.	33.0	30.5	4.1	11.7	7.5	1327.6	923.	276.	66.	150.	NACCEPT
267	640.	28.0	30.5	3.5	13.0	8.9	1126.4	789.	201.	56.	142.	PACCEPT
268	642.	30.5	32.0	3.8	12.3	8.6	1169.5	817.	216.	58.	144.	PACCEPT
269	644.	30.6	31.0	3.8	12.3	8.3	1211.2	845.	231.	61.	145.	PACCEPT
270	646.	32.1	30.3	4.0	11.9	7.7	1299.9	904.	265.	65.	149.	NACCEPT
271	648.	27.9	25.0	3.5	13.1	7.3	1369.3	950.	293.	68.	151.	NACCEPT
272	650.	29.0	18.0	3.6	12.7	5.1	1976.8	1350.	571.	99.	174.	NACCEPT
273	652.	7.2	16.1	0.9	32.2	18.2	548.7	397.	50.	69.	175.	GOOD-SCREEN
274	654.	19.8	17.0	2.5	16.4	7.0	1429.1	990.	318.	71.	154.	NACCEPT
275	656.	20.0	18.0	2.5	16.3	7.3	1363.3	946.	290.	68.	151.	NACCEPT
276	658.	22.0	20.0	2.7	15.3	7.4	1349.7	937.	285.	67.	151.	NACCEPT
277	660.	27.5	22.1	3.4	13.2	6.5	1526.8	1054.	362.	76.	157.	NACCEPT
278	662.	23.0	25.0	2.9	14.8	8.9	1128.8	790.	201.	56.	142.	PACCEPT
279	664.	25.5	23.0	3.2	13.8	7.4	1360.4	944.	289.	68.	151.	NACCEPT
280	666.	27.0	19.0	3.4	13.3	5.7	1743.6	1197.	468.	87.	165.	NACCEPT
281	668.	14.5	18.0	1.8	20.2	10.1	988.4	696.	156.	124.	210.	PACCEPT
282	670.	21.5	24.5	2.7	15.5	9.3	1076.7	755.	184.	54.	140.	PACCEPT
283	672.	25.5	26.0	3.2	13.8	8.3	1203.4	840.	228.	60.	145.	PACCEPT
284	674.	26.5	28.0	3.3	13.5	8.6	1161.3	812.	213.	58.	144.	PACCEPT
285	676.	29.0	29.5	3.6	12.7	8.3	1206.2	842.	229.	60.	145.	PACCEPT
286	678.	27.5	29.0	3.4	13.2	8.6	1163.5	813.	214.	58.	144.	PACCEPT
287	680.	30.0	29.5	3.8	12.4	8.0	1247.8	870.	245.	62.	147.	PACCEPT
288	682.	27.5	33.0	3.4	13.1	9.8	1022.5	719.	166.	51.	138.	PACCEPT
289	684.	32.0	34.5	4.0	11.9	8.8	1138.1	796.	205.	57.	143.	PACCEPT
290	686.	23.0	22.5	2.9	14.8	8.0	1254.3	874.	247.	63.	147.	PACCEPT
291	688.	30.0	14.0	3.8	12.4	3.8	2629.3	1772.	775.	131.	199.	NACCEPT
292	690.	9.0	13.0	1.1	27.7	11.8	849.5	602.	116.	106.	199.	PACCEPT
293	692.	25.0	22.0	3.1	14.0	7.2	1394.3	967.	303.	70.	152.	NACCEPT
294	694.	26.0	30.0	3.3	13.6	9.4	1063.4	746.	179.	53.	140.	PACCEPT
295	696.	32.5	29.5	4.1	11.7	7.4	1351.8	939.	286.	68.	151.	NACCEPT
296	698.	32.0	28.0	4.0	11.9	7.1	1402.3	972.	307.	70.	153.	NACCEPT
297	700.	31.0	27.0	3.9	12.1	7.1	1408.8	976.	309.	70.	153.	NACCEPT
298	702.	29.0	24.0	3.6	12.7	6.7	1482.6	1025.	342.	74.	156.	NACCEPT
299	704.	31.0	23.0	3.9	12.1	6.0	1653.8	1138.	422.	83.	162.	NACCEPT
300	706.	24.0	21.0	3.0	14.4	7.1	1402.3	972.	307.	70.	153.	NACCEPT
301	708.	26.0	18.0	3.3	13.6	5.6	1772.3	1216.	483.	89.	166.	NACCEPT
302	710.	19.0	7.9	2.4	16.8	3.4	2951.0	1979.	877.	148.	211.	NACCEPT
303	712.	8.8	4.5	1.1	28.0	4.2	2399.5	1624.	703.	120.	190.	NACCEPT-CLAY
304	714.	4.2	4.8	0.5	45.9	9.3	1073.6	753.	183.	54.	140.	NACCEPT-CLAY
305	716.	11.0	8.5	1.4	24.1	6.3	1587.9	1095.	390.	79.	160.	NACCEPT
306	718.	20.1	9.8	2.5	16.2	4.0	2516.6	1700.	740.	126.	194.	NACCEPT
307	720.	9.0	11.0	1.1	27.6	10.0	1003.9	706.	161.	50.	138.	PACCEPT
308	722.	20.0	15.0	2.5	16.2	6.1	1636.0	1126.	413.	82.	161.	NACCEPT
309	724.	20.5	19.0	2.6	15.9	7.6	1323.9	920.	274.	66.	150.	NACCEPT
310	726.	35.0	19.6	4.4	11.2	4.6	2191.1	1489.	637.	110.	182.	NACCEPT
311	728.	23.7	24.0	3.0	14.5	8.3	1211.7	845.	231.	61.	145.	PACCEPT
312	730.	23.5	9.5	3.0	14.5	3.3	3035.2	2033.	904.	152.	214.	NACCEPT
313	732.	6.0	5.1	0.8	36.1	6.9	1443.5	999.	324.	72.	154.	NACCEPT-CLAY
314	734.	9.0	3.9	1.1	27.6	3.5	2831.5	1902.	839.	142.	206.	NACCEPT-CLAY
315	736.	7.4	5.2	0.9	31.4	5.7	1746.1	1199.	469.	87.	165.	NACCEPT
316	738.	20.0	8.2	2.5	16.2	3.3	2992.7	2006.	891.	150.	212.	NACCEPT
317	740.	27.0	19.0	3.4	13.2	5.7	1743.6	1197.	468.	87.	165.	NACCEPT
318	742.	26.0	19.0	3.3	13.6	6.0	1679.0	1155.	435.	84.	163.	NACCEPT
319	744.	25.0	17.5	3.2	13.9	5.7	1752.8	1203.	472.	88.	166.	NACCEPT
320	746.	20.2	15.0	2.6	16.1	6.1	1652.4	1137.	421.	83.	162.	NACCEPT
321	748.	20.0	15.0	2.5	16.2	6.1	1636.0	1126.	413.	82.	161.	NACCEPT
322	750.	23.5	13.0	3.0	14.5	4.5	2218.0	1506.	646.	111.	183.	NACCEPT
323	752.	15.0	10.0	1.9	19.6	5.4	1840.5	1260.	519.	92.	169.	NACCEPT
324	754.	11.1	10.0	1.4	23.9	7.3	1362.0	945.	290.	68.	151.	NACCEPT
325	756.	14.6	14.0	1.8	19.9	7.8	1279.6	891.	257.	64.	148.	NACCEPT
326	758.	12.0	18.5	1.5	22.7	12.6	795.9	566.	102.	99.	195.	PACCEPT
327	760.	27.0	14.0	3.4	13.2	4.2	2366.3	1603.	692.	118.	189.	NACCEPT
328	762.	24.5	7.0	3.1	14.1	2.3	4294.5	2832.	1312.	215.	261.	NACCEPT
329	764.	5.3	5.0	0.7	39.1	7.7	1300.6	905.	265.	65.	149.	NACCEPT-CLAY
330	766.	6.2	5.8	0.8	35.2	7.6	1311.6	912.	269.	66.	149.	NACCEPT
331	768.	11.1	10.0	1.4	23.9	7.3	1362.0	945.	290.	68.	151.	NACCEPT
332	770.	18.0	14.0	2.3	17.3	6.3	1577.6	1088.	385.	79.	159.	NACCEPT
333	772.	24.1	15.2	3.1	14.2	5.1	1945.4	1329.	561.	97.	173.	NACCEPT
334	774.	21.5	15.0	2.7	15.4	5.7	1758.7	1207.	475.	88.	166.	NACCEPT
335	776.	26.5	14.5	3.4	13.4	4.5	2242.4	1522.	653.	112.	184.	NACCEPT
336	778.	20.0	14.3	2.5	16.1	5.8	1716.1	1179.	453.	86.	164.	NACCEPT
337	780.	24.3	14.0	3.1	14.2	4.7	2129.7	1449.	618.	106.	180.	NACCEPT
338	782.	23.0	13.5	2.9	14.7	4.8	2090.4	1424.	606.	105.	178.	NACCEPT
339	784.	17.5	13.0	2.2	17.6	6.1	1651.7	1137.	421.	83.	162.	NACCEPT
340	786.	23.0	13.0	2.9	14.7	4.6	2170.8	1476.	631.	109.	181.	NACCEPT
341	788.	21.0	12.5	2.7	15.6	4.9	2061.3	1405.	597.	103.	177.	NACCEPT
342	790.	16.0	12.0	2.0	18.7	6.1	1636.0	1126.	413.	82.	161.	NACCEPT
343	792.	14.0	12.5	1.8	20.4	7.3	1374.2	954.	295.	69.	152.	NACCEPT
344	794.	19.0	11.0	2.4	16.7	4.7	2119.4	1442.	615.	106.	179.	NACCEPT
345	796.	23.0	9.5	2.9	14.7	3.4	2970.6	1991.	884.	149.	211.	NACCEPT
346	798.	18.0	8.4	2.3	17.3	3.8	2629.3	1772.	775.	131.	199.	NACCEPT
347	800.	21.5	6.2	2.7	15.3	2.4	4254.9	2807.	1299.	213.	260.	NACCEPT
348	802.	5.8	5.7	0.7	36.7	8.0	1248.5	870.	245.	62.	147.	PACCEPT
349	804.	14.0	7.8	1.8	20.4	4.5	2202.3	1496.	641.	110.	183.	NACCEPT
350	806.	20.0	12.0	2.5	16.1	4.9	2045.0	1394.	592.	102.	177.	NACCEPT
351	808.	23.0	13.0	2.9	14.7	4.6	2170.8	1476.	631.	109.	181.	NACCEPT
352	810.	24.0	13.0	3.1	14.2	4.4	2265.2	1537.	661.	113.	185.	NACCEPT
353	812.	23.0	13.0	2.9	14.7	4.6	2170.8	1476.	631.	109.	181.	NACCEPT
354	814.	26.1	14.0	3.3	13.5	4.4	2287.5	1551.	668.	114.	186.	NACCEPT
355	816.	23.0	14.0	2.9	14.6	5.0	2015.8	1375.	583.	101.	176.	NACCEPT
356	818.	21.6	12.0	2.8	15.3	4.5	2208.6	1500.	643.	110.	183.	NACCEPT
357	820.	21.5	4.6	2.7	15.3	1.7	5734.9	3733.	1790.	287.	315.	NACCEPT-CLAY
358	822.	5.6	3.1	0.7	37.5	4.5	2216.5	1505.	645.	111.	183.	NACCEPT-CLAY
359	824.	4.4	3.7	0.6	44.1	6.9	1459.1	1010.	331.	73.	155.	NACCEPT-CLAY
360	826.	15.0	9.0	1.9	19.5	4.9	2045.0	1394.	592.	102.	177.	NACCEPT
361	828.	20.0	6.0	2.6	16.1	2.4	4090.0	2703.	1245.	204.	253.	NACCEPT
362	830.	13.0	4.4	1.7	21.4	2.8	3625.2	2409.	1094.	181.	236.	NACCEPT-CLAY
363	832.	12.0	5.0	1.5	22.6	3.4	2944.8	1975.	875.	147.	210.	NACCEPT-CLAY
364	834.	19.6	10.0	2.5	16.3	4.2	2404.9	1627.	704.	120.	190.	NACCEPT
365	836.	19.5	9.8	2.5	16.3	4.1	2441.5	1651.	716.	122.	192.	NACCEPT
366	838.	13.0	9.9	1.7	21.4	6.2	1611.2	1110.	401.	81.	160.	NACCEPT
367	840.	22.0	10.3	2.8	15.1	3.8	2620.8	1767.	772.	131.	198.	NACCEPT
368	842.	23.0	10.3	2.9	14.6	3.6	2739.9	1843.	810.	137.	203.	NACCEPT
369	844.	20.0	9.8	2.6	16.0	4.0	2504.1	1692.	736.	125.	194.	NACCEPT
370	846.	15.8	7.5	2.0	18.8	3.9	2584.9	1744.	761.	129.	197.	NACCEPT
371	848.	15.0	4.4	1.9	19.4	2.4	4182.9	2762.	1276.	209.	257.	NACCEPT-CLAY
372	850.	11.0	3.6	1.4	23.9	2.7	3749.1	2487.	1134.	187.	241.	NACCEPT-CLAY
373	852.	4.3	4.1	0.6	44.7	7.8	1286.8	896.	260.	64.	148.	NACCEPT-CLAY
374	854.	10.2	4.8	1.3	25.1	3.8	2607.4	1758.	768.	130.	198.	NACCEPT-CLAY
375	856.	10.0	5.7	1.3	25.4	4.6	2152.6	1464.	625.	108.	181.	NACCEPT
376	858.	20.0	10.0	2.6	16.0	4.1	2454.0	1659.	720.	123.	192.	NACCEPT
377	860.	18.1	11.0	2.3	17.1	5.0	2019.0	1377.	584.	101.	176.	NACCEPT
378	862.	23.0	10.5	2.9	14.6	3.7	2687.7	1810.	794.	134.	201.	NACCEPT
379	864.	20.0	10.7	2.6	16.0	4.4	2293.4	1555.	669.	115.	186.	NACCEPT
380	866.	26.0	11.5	3.3	13.4	3.6	2774.1	1865.	821.	139.	204.	NACCEPT
381	868.	28.0	11.5	3.6	12.8	3.3	2987.5	2002.	889.	149.	212.	NACCEPT
382	870.	20.9	11.0	2.7	15.5	4.3	2331.3	1580.	681.	117.	187.	NACCEPT
383	872.	20.6	11.0	2.6	15.7	4.4	2297.8	1558.	671.	115.	186.	NACCEPT

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 384    874.   21.5    9.0  2.8   15.2   3.4  2931.2  1966.   871.  147.  210.  NACCEPT
 385    876.   20.3    7.3  2.6   15.8   2.9  3412.0  2273.  1025.  171.  228.  NACCEPT
 386    878.   12.6    6.1  1.6   21.8   3.9  2534.4  1711.   745.  127.  195.  NACCEPT
 387    880.   11.1    5.9  1.4   23.7   4.3  2308.4  1565.   674.  115.  187.  NACCEPT
 388    882.   10.3    6.6  1.3   24.9   5.2  1914.9  1309.   552.   96.  172.  NACCEPT
 389    884.   16.8    8.3  2.2   18.0   4.0  2483.6  1678.   729.  124.  193.  NACCEPT
 390    886.   21.0    4.7  2.7   15.5   1.8  5482.3  3576.  1705.  274.  306.  NACCEPT-CLAY
 391    888.    5.0    3.6  0.6   40.3   5.9  1704.2  1171.   447.   85.  164.  NACCEPT-CLAY
 392    890.   12.0    4.4  1.5   22.5   3.0  3346.3  2231.   004.  167.  225.  NACCEPT-CLAY
 393    892.   10.0    7.0  1.3   25.4   5.7  1752.8  1203.   472.   88.  166.  NACCEPT
 394    894.   16.0    4.5  2.1   18.5   2.3  4362.6  2875.  1335.  218.  264.  NACCEPT-CLAY
 395    896.    3.5    3.4  0.5   51.1   7.9  1263.1   880.   250.   63.  147.  NACCEPT-CLAY
 396    898.    5.5    3.3  0.7   37.8   4.9  2045.0  1394.   592.  102.  177.  NACCEPT-CLAY
 397    900.    8.5    4.6  1.1   28.2   4.4  2267.3  1538.   661.  113.  185.  NACCEPT-CLAY
 398    902.   11.2    6.2  1.4   23.5   4.5  2216.5  1505.   645.  111.  183.  NACCEPT
 399    904.   12.5    7.2  1.6   21.8   4.7  2130.2  1449.   618.  107.  180.  NACCEPT
 400    906.   14.0    7.2  1.8   20.2   4.2  2385.8  1615.   698.  119.  189.  NACCEPT
 401    908.   11.0    5.8  1.4   23.8   4.3  2327.1  1577.   680.  116.  187.  NACCEPT
 402    910.    8.1    3.4  1.0   29.1   3.4  2923.1  1961.   868.  146.  210.  NACCEPT-CLAY
 403    912.    4.0    2.7  0.5   46.6   5.5  1817.8  1246.   507.   91.  168.  NACCEPT-CLAY
 404    914.    5.0    2.8  0.6   40.2   4.6  2191.1  1489.   637.  110.  182.  NACCEPT-CLAY
 405    916.    5.4    4.4  0.7   38.2   6.6  1505.9  1041.   352.   75.  156.  NACCEPT-CLAY
 406    918.   14.6    6.0  1.9   19.7   3.3  2985.7  2001.   888.  149.  212.  NACCEPT
 407    920.   18.3    7.7  2.4   16.9   3.4  2916.1  1956.   866.  146.  209.  NACCEPT
 408    922.   18.0    7.5  2.3   17.1   3.4  2944.8  1975.   875.  147.  210.  NACCEPT
 409    924.   18.5    7.6  2.4   16.8   3.3  2986.8  2002.   889.  149.  212.  NACCEPT
 410    926.   19.8    7.9  2.6   16.0   3.3  3075.2  2058.   917.  154.  215.  NACCEPT
 411    928.   18.0    7.7  2.3   17.1   3.5  2868.3  1926.   851.  143.  208.  NACCEPT
 412    930.   15.2    7.7  2.0   19.1   4.1  2422.1  1639.   710.  121.  191.  NACCEPT
 413    932.   19.3    7.4  2.5   16.3   3.1  3200.1  2138.   957.  160.  220.  NACCEPT
 414    934.   20.0    7.0  2.6   15.9   2.9  3505.7  2333.  1055.  175.  231.  NACCEPT
 415    936.   17.0    6.6  2.2   17.7   3.2  3160.4  2113.   944.  158.  219.  NACCEPT
 416    938.   18.0    7.1  2.3   17.1   3.2  3110.7  2081.   928.  156.  217.  NACCEPT
 417    940.   15.0    7.2  1.9   19.3   3.9  2556.2  1725.   752.  128.  196.  NACCEPT
 418    942.   15.1    6.2  2.0   19.2   3.3  2988.3  2003.   889.  149.  212.  NACCEPT
 419    944.    8.5    5.5  1.1   28.1   5.3  1896.3  1297.   546.   95.  171.  NACCEPT
 420    946.   10.0    5.7  1.3   25.3   4.6  2152.6  1464.   625.  108.  181.  NACCEPT
 421    948.   11.7    5.5  1.5   22.7   3.8  2610.2  1760.   769.  131.  198.  NACCEPT
 422    950.    8.1    4.0  1.0   29.1   4.0  2484.7  1679.   729.  124.  193.  NACCEPT-CLAY
 423    952.    4.0    2.8  0.5   46.5   5.7  1752.8  1203.   472.   88.  166.  NACCEPT-CLAY
 424    954.    3.7    2.9  0.5   49.0   6.4  1565.5  1080.   379.   78.  159.  NACCEPT-CLAY
 425    956.    7.0    3.9  0.9   32.0   4.5  2202.3  1496.   641.  110.  183.  NACCEPT-CLAY
 426    958.   10.9    5.9  1.4   23.8   4.4  2266.8  1538.   661.  113.  185.  NACCEPT
 427    960.   17.0    6.5  2.2   17.7   3.1  3209.1  2144.   960.  160.  220.  NACCEPT
 428    962.   19.3    6.9  2.5   16.3   2.9  3432.0  2286.  1032.  172.  229.  NACCEPT
 429    964.   19.3    7.3  2.5   16.3   3.1  3244.0  2166.   971.  162.  222.  NACCEPT
 430    966.   21.0    7.4  2.7   15.4   2.9  3482.0  2318.  1048.  174.  231.  NACCEPT
 431    968.   17.5    7.5  2.3   17.4   3.5  2863.0  1922.   849.  143.  207.  NACCEPT
 432    970.   19.5    7.5  2.5   16.1   3.1  3190.2  2132.   954.  160.  220.  NACCEPT
 433    972.   20.0    7.3  2.6   15.9   3.0  3361.6  2241.  1009.  168.  226.  NACCEPT
 434    974.   18.0    7.0  2.3   17.0   3.2  3155.1  2109.   943.  158.  218.  NACCEPT
 435    976.   11.0    5.8  1.4   23.6   4.3  2327.1  1577.   680.  116.  187.  NACCEPT
 436    978.   14.8    4.1  1.9   19.4   2.3  4429.1  2917.  1356.  221.  266.  NACCEPT-CLAY
 437    980.    6.1    3.1  0.8   35.0   4.1  2414.4  1634.   707.  121.  191.  NACCEPT-CLAY
 438    982.    4.5    2.5  0.6   42.9   4.5  2208.6  1500.   643.  110.  183.  NACCEPT-CLAY
 439    984.    3.8    2.4  0.5   48.0   5.1  1942.7  1327.   560.   97.  173.  NACCEPT-CLAY
 440    986.    3.7    2.6  0.5   48.8   5.7  1746.1  1199.   469.   87.  165.  NACCEPT-CLAY
 441    988.    6.0    3.3  0.8   35.4   4.5  2230.9  1515.   650.  112.  184.  NACCEPT-CLAY
 442    990.    8.4    4.6  1.1   28.3   4.5  2240.6  1521.   653.  112.  184.  NACCEPT-CLAY
 443    992.   12.0    5.8  1.6   22.3   3.9  2538.6  1714.   746.  127.  195.  NACCEPT
 444    994.   16.0    6.5  2.1   18.4   3.3  3020.3  2023.   899.  151.  213.  NACCEPT
 445    996.   17.0    6.5  2.2   17.7   3.1  3209.1  2144.   960.  160.  220.  NACCEPT
 446    998.   14.0    5.9  1.8   20.1   3.4  2911.5  1954.   865.  146.  209.  NACCEPT
 447   1000.   15.0    5.5  2.0   19.2   3.0  3346.3  2231.  1004.  167.  225.  NACCEPT
DATA   DEPTH   RXO     RO    F    POR    RW   SPCOND   TDS     CL    SO4   HC03  REMARKS


                         PROGRAM TIME IN SECONDS =  0.1922168E 03


            PROGRAM BY----

                 RONALD M. BRIMHALL
                 BOX 31 CAMPUS STA.
                 SOCORRO, N. M.    87801

/&
JOB TIME SUMMARY...COMPILE 0125S   ASSEMBLE 0000S   LNKEDT 0043S   UTILS 0000S   USER 0268S        TOTAL TIME  007M 16S
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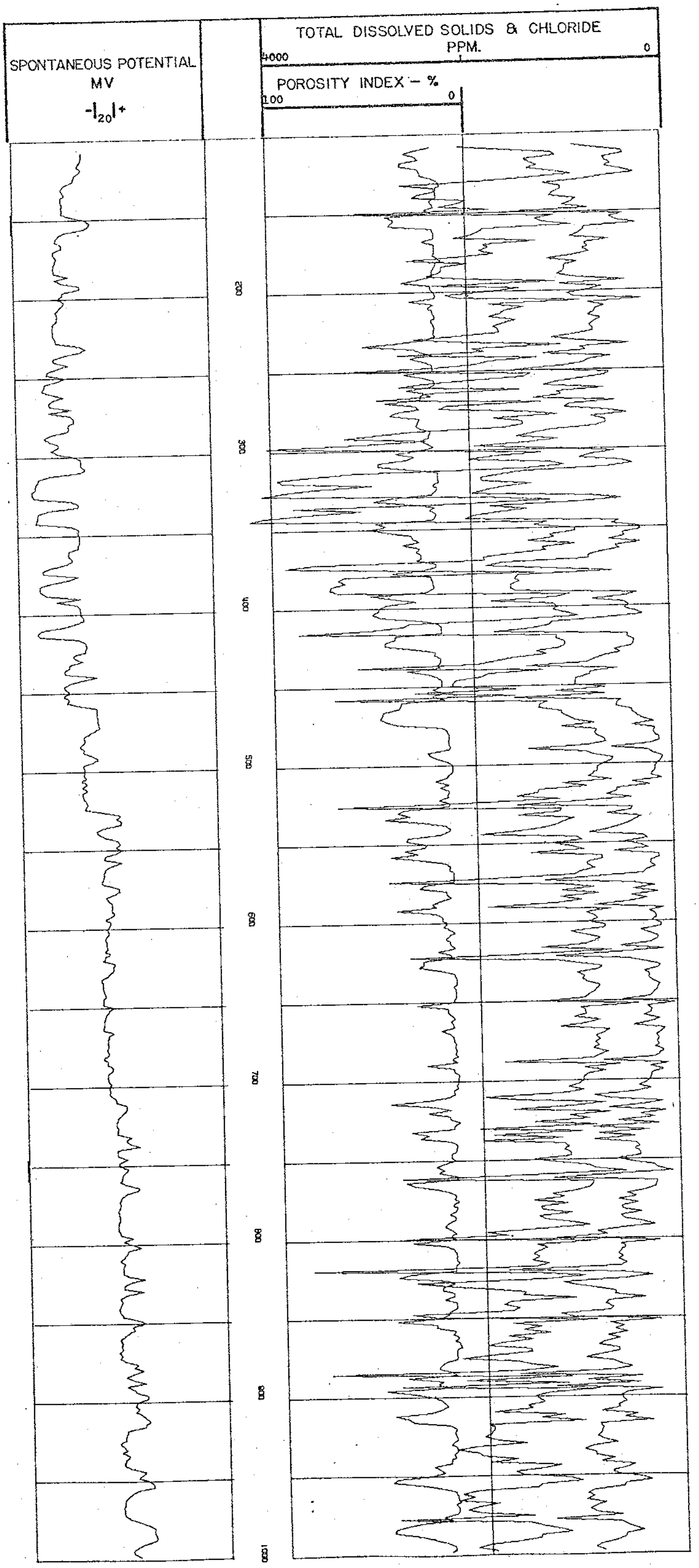
COMPANY CITY OF EL PASO PUBLIC SERVICE BOARD

WELL WATER WELL #3 OFFSET

LOCATION 901 CHELSEA STREET

COUNTY EL PASO STATE TEXAS



Secondary Programs

Secondary programs compare the results of the F-Method of water well resistivity log interpretation with the results of the FF-Method when both methods are applied to the same interpretation problem.

Two secondary programs are presented; each based on the resistivity logging program selected: FVSFF1 for the City of El Paso Water Well #3 Offset, and FVSFF2 for the City of Belen Water Well #4 and the USGS Test Well #B-5. Comparisons are made on the basis of TDS concentrations only.

Graphs prepared by a coordinate plotter illustrate the comparison of TDS concentrations as determined by both the F-Method (TDSF) and the FF-Method (TDSFF). TDSFF is plotted as ordinate and TDSF is plotted as abscissa. The companion graph compares the field formation resistivity factor with variations of the apparent formation resistivity factor for each aquifer unit. Field formation resistivity factor is plotted as ordinate and the apparent formation resistivity factor (designated "aquifer-unit formation resistivity factor") is plotted as abscissa. On each graph are lines representing a one-to-one correlation and +20% of both the ordinate and abscissa values for relative accuracy determinations. The data points are distinguished as belonging to predominantly clay bearing beds by (X) or as being gravel and sand beds by (+).

FVSFF1--City of El Paso Water Well #3 Offset

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FORTRAN IV    MODEL 44  PS        VERSION 3  LEVEL 1   DATE  69118      NEW MEXICO TECH    PAGE  0001
          C            014P,10,858,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
          C       RONALD M. BRIMHALL
          C       COMPARISON OF WATER QUALITY DETERMINATIONS FROM 'AQUIFER UNIT F'
          C       AND 'FIELD FORMATION RESISTIVITY FACTOR F(F)'
          C       ******************************************************************
          C       CITY OF EL PASO WATER WELL #3 OFFSET---HUECO BOLSON 'V' WELL
          C       ******************************************************************
          C
          C
          C
          C       RESISTIVITY LOG INTERPRETATION PROGRAM FVSFF1---
          C
          C
          C       ******************************************************************
          C       PURPOSE OF FVSFF1---
          C
          C       FVSFF1 COMPARES TOTAL DISSOLVED SOLIDS DETERMINATIONS COMPUTED
          C       BY THE F-METHOD AND THE FF-METHOD (BRIMHALL, 1969).  THIS COM-
          C       PARISON IS FOR EVALUATING ONE METHOD AGAINST THE OTHER.  THE RE-
          C       SULTS ARE PRESENTED IN TABLE FORM--COLUMNS LISTING DATA POINT
          C       NUMBER, DEPTH, F, POROSITY INDEX, SPECIFIC CONDUCTANCE AND RESIS-
          C       TIVITY OF WATER, REMARKS STATING THE ACCEPTABILITY OF WATER, AND
          C       THE ARITHMETIC DIFFERENCE BETWEEN VALUES OF TDSF AND TDSFF EX-
          C       PRESSED AS DIFFER(TDS) = TDSF-TDSFF--THE PLOT TDSF VS TDSFF ILLUS-
          C       TRATES DIFFERENCES GRAPHICALLY  THE PLOT F VS FF SHOWS THE VARIA-
          C       TION OF THE APPARENT FORMATION RESISTIVITY FACTOR FROM MINIMUM TO
          C       MAXIMUM VALUE.  CLAY BEARING BEDS ARE DISTINGUISHED FROM SANDS
          C       AND GRAVELS ON THE PLOTS.  FVSFF1 IS APPLICABLE TO ANY GEOGRAPHIC
          C       AREA BUT IS LIMITED TO WATER WELLS WHICH HAVE BEEN LOGGED BY A
          C       MACRORESISTIVITY DEVICE AND A PROXIMITY LOG.
          C       ******************************************************************
          C
          C
          C
          C       ******************************************************************
          C       REFERENCES---
          C
          C       BRIMHALL, R. M., DIGITAL ANALYSIS OF BOREHOLE-MEASURED AQUIFER
          C       RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER OF
          C       SCIENCE THESIS, N. MEX. INST. MIN. AND TECH., SOCORRO, JUNE 1969.
          C
          C       CALIFORNIA COMPUTER PRODUCTS, PROGRAMMING FOR CALCOMP DIGITAL
          C       INCREMENTAL PLOTTERS, ANAHIEM, 1966.
          C
          C       TODD, D. K., GROUND WATER HYDROLOGY, WILEY, NEW YORK, 1959.
          C       ******************************************************************
          C
          C
          C
          C       ******************************************************************
          C       NOMENCLATURE---
          C
          C       SCALAR QUANTITIES--
          C       T1 = INITIAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
          C       I = SUBSCRIPT FOR ABSCISSA OF FPN.
          C       K = INTEGER SUBSCRIPT OR REPEAT CYCLE IN CALL SCALE--K=1.
          C       RMF = MUD FILTRATE RESISTIVITY--OHM-METERS.
          C       AM = CEMENTATION EXPONENT IN F = A/POR**AM.
          C       PHIC = EMPIRICAL POROSITY INDEX ABOVE WHICH THE AQUIFER UNIT IS
          C       CLASSIFIED CLAY ON THE COORDINATE PLOTS--%.
          C       AVTEMP = AVERAGE SURFACE TEMPERATURE FOR CALCULATING GRAD.
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FORTRAN IV    MODEL 44  PS        VERSION 3  LEVEL 1   DATE  69118'     NEW MEXICO TECH    PAGE  0002
          C       TD = TOTAL DEPTH OF WELL FOR CALCULATING GRAD.
          C       BHT = BOTTOM HOLE TEMPERATURE FOR CALCULATING GRAD.
          C       N = NUMBER OF DATA POINTS AND DO 200 ITERATIONS.
          C       GRAD = TEMPERATURE GRADIENT OF AQUIFER.
          C       T2 = FINAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
          C       TIME = PROGRAM EXECUTION TIME--SECONDS.
          C       J = INTEGER SUBSCRIPT, OR DO INDEX, OR SYMBOL CONTROL IN CALL
          C       LINE.
          C       TEMP = TEMPORARY STORAGE LOCATION.
          C       SW = MAXIMUM LENGTH OF LINE REPRESENTING ABSCISSA.
          C       SH = MAXIMUM LENGTH OF LINE REPRESENTING ORDINATE.
          C       DIV = NUMBER OF DIVISIONS PER FOOT OF ABSCISSA AND ORDINATE.
          C       XO = ABSCISSA COORDINATE OF THE STARTING POINT OF ORDINATE AXIS.
          C       YO = ORDINATE COORDINATE OF THE STARTING POINT OF ORDINATE AXIS.
          C       NCO = NUMBER OF CHARACTERS IN THE ORDINATE AXIS TITLE IN CALL AXIS.
          C       THETA = ANGLE OF THE ORDINATE AND ABSCISSA AXIS--DEGREES.
          C       XA = ABSCISSA COORDINATE OF THE STARTING POINT OF ABSCISSA AXIS.
          C       YA = ORDINATE COORDINATE OF THE STARTING POINT OF ABSCISSA AXIS.
          C       NCA = NUMBER OF CHARACTERS IN THE ABSCISSA AXIS TITLE IN CALL AXIS.
          C       X = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
          C       CALL SYMBOL.
          C       HEIGHT = HEIGHT OF CHARACTERS TO BE DRAWN BY CALL SYMBOL.
          C       IS = INITIAL VALUE OF DO INDEX IN READ NONNUMERIC DATA.
          C       IE = TERMINAL VALUE OF DO INDEX IN READ NONNUMERIC DATA.
          C
          C
          C       SUBSCRIPTED VARIABLES--
          C       IDATA = DATA POINT NUMBER.
          C       RXO = PROXIMITY LOG RESISTIVITY--OHM-METERS.
          C       RO = DEEP INDUCTION RESISTIVITY--OHM-METERS.
          C       JDEPTH = DATA POINT DEPTH----FEET.
          C       F = APPARENT FORMATION RESISTIVITY FACTOR USED IN F-METHOD.
          C       FF = FIELD FORMATION RESISTIVITY FACTOR USED IN FF-METHOD.
          C       TDSF = TOTAL DISSOLVED SOLIDS CONCENTRATIONS DETERMINED BY THE FF-
          C       METHOD--PPM.
          C       TDSFF = TOTAL DISSOLVED SOLIDS CONCENTRATIONS DETERMINED BY THE
          C       FF-METHOD--PPM.
          C       RWF = WATER RESISTIVITY DETERMINED BY THE F-METHOD--OHM-METERS.
          C       RWFF = WATER RESISTIVITY DETERMINED BY THE FF-METHOD--OHM-METERS.
          C       SPCONF = WATER SPECIFIC CONDUCTANCE DETERMINED BY THE F-METHOD--
          C       MICROMHOS PER CENTIMETER.
          C       SPCOFF = WATER SPECIFIC CONDUCTANCE DETERMINED BY THE FF-METHOD--
          C       MICROMHOS PER CENTIMETER.
          C       ERROR = NAME OF DIFFER(TDS) = TDSF-TDSFF.
          C       PORF = POROSITY INDEX DETERMINED BY THE F-METHOD--%.
          C       PORFF = POROSITY INDEX DETERMINED BY THE FF-METHOD--%.
          C       ORD = NAME OF THE ARRAY TO BE PLOTTED AS ORDINATE--TDSFF AND FF.
          C       LAB1 = NAME OF ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT
          C       PLOT TDSF VS TDSFF.
          C       LAB2 = NAME OF ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT
          C       PLOT TDSFF VS TDSFF.
          C       ABS = NAME OF THE ARRAY TO BE PLOTTED AS ABSCISSA--TDSF AND F.
          C       Y = ORDINATE COORDINATE OF THE LOWER LEFT CORNER OF THE FIRST
          C       SYMBOL IN CALL SYMBOL.
          C       NS = NUMBER OF CHARACTERS IN LABEL AT CALL SYMBOL.
          C       RXOC = PROXIMITY LOG RESISTIVITY CORRECTED FOR TEMPERATURE.
          C       ROC = TEMPERATURE CORRECTED DEEP INDUCTION RESISTIVITY--OHM-METERS
          C       LAB3 = NAME OF ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT
          C       PLOT F VS FF.
          C       LAB4 = NAME OF ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT
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FORTRAN IV     MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118       NEW MEXICO TECH     PAGE  0003

              C      PLOT F VS FF.
              C      X2 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      Y2 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      X3 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      Y3 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      X4 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      Y4 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      X5 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      Y5 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      X6 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      Y6 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
              C      CALL SYMBOL--TO LEGEND PLOT.
              C      NS2 = NUMBER OF CHARACTERS IN THE LABEL.
              C      NS3 = NUMBER OF CHARACTERS IN THE LABEL.
              C      NS4 = NUMBER OF CHARACTERS IN THE LABEL.
              C      NS5 = NUMBER OF CHARACTERS IN THE LABEL.
              C      NS6 = NUMBER OF CHARACTERS IN THE LABEL.
              C      PORF1 = SECONDARY STORAGE ARRAY OF PORF FOR SORTING IN PREPARATION
              C      TO PLOT.
              C      JDEPTH1 = SECONDARY STORAGE ARRAY OF JDEPTH FOR SORTING IN PREPA-
              C      RATION TO PLOT.
              C      BCD = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
              C      NS(1), ETC.
              C      BCE = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
              C      NS2(1), ETC.
              C      BCF = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
              C      NS3(1), ETC.
              C      BCG = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
              C      NS4(1), ETC.
              C      BCH = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
              C      NS5(1), ETC.
              C      BCI = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
              C      NS6(1), ETC.
              C      *****************************************************************
              C
              C
              C
              C      *****************************************************************
              C      SUBROUTINES CALLED--NEW MEXICO TECH COMPUTER.
              C      CLOCK
              C      IBCOM#
              C      SETMSG
              C      PLOT
              C      SCALE
              C      AXIS
              C      SYMBOL
              C      FRXPR#
              C      *****************************************************************
              C
              C
              C
              C

FORTRAN IV     MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118       NEW MEXICO TECH     PAGE  0004

 0001                CALL CLOCK(T1)
 0002                DIMENSIONIDATA(500),RXO(500),RO(500),JDEPTH(500),F(502),TDSF(502),
                    *TDSFF(502),RWF(500),SPCONF(500),SPCOFF(500),ERROR(500),PORF(500),O
                    *RD(502),LAB1(24),LAB2(32),ABS(502),Y(3),NS(3),FF(502),PORFF(500),R
                    *WFF(500),RXOC(500),ROC(500),LAB3(48),LAB4(48),X2(2),Y2(2),X3(1),Y3
                    *(1),X4(2),Y4(2),NS2(2),NS3(1),NS4(2),X5(2),Y5(2),NS5(2),X6(1),Y6(1
                    *),NS6(1),PORF1(500),JDEPT1(500)
 0003                 INTEGER BCD(15),BCE(8),BCF(2),BCG(20)
                    *,BCH(3)
                    *,BCI(10)
              C
              C      READ ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT PLOT TDSF
              C      VS TDSFF.
 0004                READ(5,1001)(LAB1(I),I=1,4)
 0005          1001  FORMAT(4A4)
              C
              C      READ ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT PLOT TDSF
              C      VS TDSFF.
 0006                READ(5,1002)(LAB2(I),I = 1,3)
 0007          1002  FORMAT(3A4)
              C
              C      READ ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT PLOT F VS
              C      FF.
 0008                READ(5,1003)(LAB3(I),I = 1,10)
 0009          1003  FORMAT(10A4)
              C
              C      READ ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT PLOT F VS
              C      FF.
 0010                READ(5,1004)(LAB4(I),I = 1,12)
 0011          1004  FORMAT(12A4)
              C
              C      PARAMETRIC DATA.
 0012                PHIC = 27.0
 0013                RMF = 8.15
              C      (RMF ABOVE CORRECTED TO 77 F)
 0014                AVTEMP = 72.
 0015                BHT = 85.
 0016                AM = 1.5
 0017                    N = 400
 0018                TD = 1330.
              C
              C      READ RESISTIVITY DATA FROM CARDS.
 0019                READ(5,1)(IDATA(K),JDEPTH(K),RXO(K),RO(K), K = 1,N)
 0020              1 FORMAT(I3,I4,1X,2F4.1)
              C
              C      IDENTIFY PROBLEM AND WRITE SOME PARAMETRIC DATA.
 0021                WRITE(6,2)
 0022              2 FORMAT('9',//39X,'CITY OF EL PASO, EL PASO CO., TEXAS',/47X,'WATER
                    *WELL #3 OFFSET',///3X,'AQUIFER -F- & FIELD -F- COMPARISON',////3X,
                    *'FIELD FORMATION RES. FACTOR = 2.4',/30X,'RMF = 10.8 OHM-M @ 59 F'
                    *,/32X,'M = 1.50 FOR PORF(K) CALCULATIONS')
              C
              C      LABEL COLUMNS FOR LINE PRINTER RESULTS.
 0023                WRITE(6,300)
 0024            300 FORMAT(  /3X,'DATA',4X,'DEPTH',2X,'*',2X,'F(K)',3X,'PORF(K)',3X,'S
                    *PCONF',3X,'TDSF',4X,'REMARKS',2X,'*',2X,'PORFF',3X,'SPCOFF',3X,'TD
                    *SFF',4X,'REMARKS',7X,'DIFFER(TDS)')
 0025                    N = 400
              C
              C      LIST FF IN N LOCATIONS.
```

```
                  DO 8888  K = 1,N
 8888             FF(K) = 2.4
C
C      DETERMINE TEMPERATURE GRADIENT.
   702 GRAD = (BHT-AVTEMP)/TD
C
C      PRIMARY DO LOOP.
       DO 200 K = 1,N
C
C      APPLY TEMPERATURE CORRECTIONS.
   704 RXOC(K) = RXO(K)*(AVTEMP + GRAD*JDEPTH(K))/77.
   705 ROC(K) = RO(K)*(AVTEMP + GRAD*JDEPTH(K))/77.
C
C      DETERMINE RW, SPCOND, TDS BY F-METHOD.
   701 F(K) = RXOC(K)/RMF
   706 RWF(K) = ROC(K)/F(K)
   707 SPCONF(K) = 10000.00/RWF(K)
C
C      DETERMINE RW, SPCOND, TDS BY FF-METHOD.
   708 RWFF(K) = ROC(K)/FF(K)
       SPCOFF(K) = 10000.00/RWFF(K)
       TDSF(K) = 6350./RWF(K)**0.95534
       TDSFF(K) = 6350./RWFF(K)**0.95534
C
C      DETERMINE POROSITY INDEX BASED ON FF.
       PORFF(K) = 30.0/(FF(K)**(1.0/AM))
C
C      DETERMINE POROSITY INDEX.
   801 PORF(K) = 30.0/(F(K)**(1.0/AM))
C
C      DETERMINE DIFFERENCE IN TDS VALUES.
       ERROR(K) = TDSF(K) - TDSFF(K)
C
C      CLASSIFY EACH TDSF-TDSFF SET BY WATER QUALITY.
C
C      U. S. PUBLIC HEALTH STANDARDS(TODD, 1959)--
C            NACCEPT = TDS.GT.1000 PPM.
C            PACCEPT = 500 PPM. .LT. TDS .LT. 1000 PPM.
C             GOOD = TDS .LT. 500 PPM.
        IF(TDSF(K).GE.1000..AND.TDSFF(K).GE.1000.)GO TO 10
        IF(TDSF(K).GE.1000.0.AND.TDSFF(K).GE.500.0.AND.TDSFF(K).LE.1000.0)
       *GO TO 30
        IF(TDSF(K).LE.1000.0.AND.TDSF(K).GE.500.0.AND.TDSFF(K).GE.1000.0)
       *GO TO 40
        IF(TDSF(K).GE.500.0.AND.TDSF(K).LE.1000.0.AND.TDSFF(K).GE.500.0.AN
       %D.TDSFF(K).LE.1000.0)GO TO 50
        IF(TDSF(K).LE.500..AND.TDSFF(K).GE.1000.)GO TO 60
        IF(TDSF(K).LE.500.0.AND.TDSFF(K).LE.500.0)GO TO 20
        IF(TDSF(K).GE.1000..AND.TDSFF(K).LE.500.)GO TO 70
        IF(TDSF(K).LT.500.0.AND.TDSFF(K).GE.500.0.AND.TDSFF(K).LT.1000.0)
       *GO TO 80
        IF(TDSF(K).GE.500.0.AND.TDSF(K).LT.1000.0.AND.TDSFF(K).LT.500.0)GO
       *TO 90
    10 WRITE(6,3)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF(
       *K),SPCOFF(K),TDSFF(K),ERROR(K)
     3 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X, F6.0,3X,'NAC
       *CEPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'NACCEPT',7X,E11.4)
        GO TO 200
    20 WRITE(6,21)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
       *(K),SPCOFF(K),TDSFF(K),ERROR(K)
```

```
    21 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,6X,'GOOD
       *',2X,'*',2X,F5.2,2(3X,F6.0),6X,'GOOD',7X,E11.4)
        GO TO 200
    30 WRITE(6,31)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
       *(K),SPCOFF(K),TDSFF(K),ERROR(K)
    31 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'NACC
       *EPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'PACCEPT',7X,E11.4)
        GO TO 200
    40 WRITE(6,41)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
       *(K),SPCOFF(K),TDSFF(K),ERROR(K)
    41 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'PACC
       *EPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'NACCEPT',7X,E11.4)
        GO TO 200
    50 WRITE(6,51)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
       *(K),SPCOFF(K),TDSFF(K),ERROR(K)
    51 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'PACC
       *EPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'PACCEPT',7X,E11.4)
        GO TO 200
    60 WRITE(6,61)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
       *(K),SPCOFF(K),TDSFF(K),ERROR(K)
    61 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,6X,'GOOD
       *',2X,'*',2X,F5.2,2(3X,F6.0),3X,'NACCEPT',7X,E11.4)
        GO TO 200
    70 WRITE(6,71)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
       *(K),SPCOFF(K),TDSFF(K),ERROR(K)
    71 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'NACC
       MEPT',2X,'*',2X,F5.2,2(3X,F6.0),6X,'GOOD',7X,E11.4)
        GO TO 200
    80 WRITE(6,81)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
       *(K),SPCOFF(K),TDSFF(K),ERROR(K)
    81 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,6X,'GOOD
       *',2X,'*',2X,F5.2,2(3X,F6.0),3X,'PACCEPT',7X,E11.4)
        GO TO 200
    90 WRITE(6,91)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
       *(K),SPCOFF(K),TDSFF(K),ERROR(K)
    91 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'PACC
       *EPT',2X,'*',2X,F5.2,2(3X,F6.0),6X,'GOOD',7X,E11.4)
   200 CONTINUE
C
C      LABEL COLUMNS AT LINE PRINTER.
       WRITE(6,300)
           N = 400
C
C      DETERMINE PROGRAM TIME.
       CALL CLOCK(T2)
       TIME = T1 - T2
       WRITE(6,102)TIME
   102 FORMAT(////40X,'PROGRAM TIME IN SECONDS = ',E14.7)
C
C      IDENTIFY PROGRAMMER.
       WRITE(6,9999)
  9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'B
      *OX 31 CAMPUS STA.',/30X,'SOCORRO, N. M.   87801')
C
C      RESCALE TDSF AND TDSFF FOR PLOT.
       DO 201 K = 1,N
   802 TDSF(K) = TDSF(K)*1.0E-03
   803 TDSFF(K) = TDSFF(K)*1.0E-03
   201 CONTINUE
           N = 400
```

```
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      C
      C      DUPLICATE PORF AND JDEPTH IN PREPARATION TO SORT.
             DO 12 I = 1,N
          12 PORF1(I) = PORF(I)
      C
      C
      C      SORT TDSF, TDSFF, PORF, JDEPTH IN ASCENDING ORDER.
      C       ##########  SORT  ##########
                 N = 400
             DO 14 I = 1,N
             DO 14 J = I,N
                       IF(TDSF(I).LE.TDSF(J))GO TO 14
                  TEMP = TDSF(I)
                  TDSF(I) = TDSF(J)
                  TDSF(J) = TEMP
                  TEMP = TDSFF(I)
                  TDSFF(I) = TDSFF(J)
                  TDSFF(J) = TEMP
                 TEMP = PORF(I)
                 PORF(I) = PORF(J)
                 PORF(J) = TEMP
          14 CONTINUE
      C
      C
      C      SORT F, FF, PORF1, JDEPTH1, IN ASCENDING ORDER.
      C      ##########  SORT  ##########
             DO 11 I = 1,N
             DO 11 J = I,N
                  IF(F(I).LE.F(J))GO TO 11
                  TEMP = F(I)
                  F(I) = F(J)
                  F(J) = TEMP
                 TEMP = FF(I)
                 FF(I) = FF(J)
                FF(J) = TEMP
                   TEMP = PORF1(I)
                   PORF1(I) = PORF1(J)
                   PORF1(J) = TEMP
          11 CONTINUE
                 N = 400
      C
      C
      C      ***************  PLOT DATA  ***************
      C
             CALL SETMSG(32,'R. BRIMHALL - COORD PLOT EL PASO')
      C
      C      SET PEN AT FULL RIGHT.
             CALL PLOT(0.,-1.5,-3)
      C
      C      SET NEW CENTER OF COORDINATES.
             CALL PLOT(10.,1.5,-3)
      C
      C      ++++++++++++++++++++  PLOT TDSF VS TDSFF  +++++++++++++++
      C
      C
      C      PLOT ONE-TO-ONE LINE AND RELATIVE ACCURACY LINES.
             CALL PLOT(5.,5.,2)
             CALL PLOT(3.59,4.32,3)
             CALL PLOT(0.,0.,2)
             CALL PLOT(4.32,3.59,2)
```

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      C
      C      SET SCALE OF COORDINATES WITH CALL SCALE.
             SW = 8.
             SH = 8.
                 N = 400
             DIV = 10.
             CALL SCALE(TDSF(1),SW,N,1,DIV)
                 N = 400
             CALL SCALE(TDSFF(1),SH,N,1,DIV)
                 N = 400
      C
      C      PLOT AND LABEL COORDINATE AXIS WITH CALL AXIS.
             ORD(N+1) = 0.0
             ABS(N+1) = 0.0
             ORD(N+2) = 1000.0
             ABS(N+2) = 1000.0
             XO = 0.
             YO = 0.
             NCO = 13
             THETA = 90.
             CALL AXIS(XO,YO,LAB1,NCO,SH,THETA,ORD(N+1),ORD(N+2),DIV)
             XA = 0.
             YA = 0.
             NCA = -12
             THETA = 0.
             CALL AXIS(XA,YA,LAB2,NCA,SW,THETA,ABS(N+1),ABS(N+2),DIV)
                 N = 400
      C
      C      PLOT TDSF AND TDSFF AND DISTINGUISH CLAY FROM SAND AND GRAVELS.
                  DO   11111  I = 1,N
                          IF(PORF(I).GT.PHIC)GO TO 11115
      11117      CALL SYMBOL(TDSF(I),TDSFF(I),0.10,3,0.,-1)
                          GO TO 11111
      11115      CALL SYMBOL(TDSF(I),TDSFF(I),0.14,4,0.,-1)
      11111      CONTINUE
      C
      C      LABEL PLOT ''F VS FF COMPARISON'' AND IDENTIFY WELL.
             X = 5.25
             HEIGHT = 0.15
             THETA = 0.
             N = 3
             DO 500 I = 1,N
             IS = 5*(I-1)+1
             IE = IS + 4
         500 READ(5,2001)Y(I),(BCD(J),J = IS,IE),NS(I)
        2001 FORMAT(F4.2,5A4,I2)
        3001           CALL SYMBOL(X,Y(1),HEIGHT,BCD(1),THETA,NS(1))
        3002           CALL SYMBOL(X,Y(2),HEIGHT,BCD(6),THETA,NS(2))
        3003           CALL SYMBOL(X,Y(3),HEIGHT,BCD(11),THETA,NS(3))
               N = 2
      C
      C      READ LEGEND ALPHABETIC DATA AND WRITE LEGEND WITH CALL SYMBOL.
             DO 502 I = 1,N
             IS = 4*(I-1)+1
             IE = IS + 3
         502 READ(5,2002)X2(I),Y2(I),(BCF(J),J = IS,IE),NS2(I)
        2002 FORMAT(2F5.2,4A4,I2)
             HEIGHT = 0.10
             CALL SYMBOL(X2(1),Y2(1),HEIGHT,BCF(1),THETA,NS2(1))
             CALL SYMBOL(X2(2),Y2(2),HEIGHT,BCF(5),THETA,NS2(2))
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FORTRAN IV     MODEL 44  PS        VERSION 3   LEVEL 1   DATE  69118        NEW MEXICO TECH     PAGE  0009

 0178          .503 READ(5,2003)X3(1),Y3(1),(BCF(J),J = 1,2),NS3(1)
 0179          2003 FORMAT(2F5.2,2A4,I2)
 0180               HEIGHT = 0.14
 0181               CALL SYMBOL(X3(1),Y3(1),HEIGHT,BCF(1),THETA,NS3(1))
 0182               N = 2
 0183               DO 504 I = 1,N
 0184               IS = 10*(I-1) + 1
 0185               IE = IS + 9
 0186           504 READ(5,2004)X4(I),Y4(I),(BCG(J),J = IS,IE),NS4(I)
 0187          2004 FORMAT(2F5.2,10A4,I2)
 0188               HEIGHT = 0.10
 0189               CALL SYMBOL(X4(1),Y4(1),HEIGHT,BCG(1),THETA,NS4(1))
 0190               CALL SYMBOL(X4(2),Y4(2),HEIGHT,BCG(11),THETA,NS4(2))
               C
               C
               C                      PLOT F VS FF
               C
               C
               C     SET NEW COORDINATE AXIS FOR F VS FF PLOT.
 0191          30031 CALL PLOT(18.,0.,-3)
               C
               C     PLOT ONE-TO-ONE LINE AND RELATIVE ACCURACY LINES.
 0192          30041 CALL PLOT(5.,5.,2)
 0193                CALL PLOT(3.2,3.84,3)
 0194                CALL PLOT(0.,0.,2)
 0195                CALL PLOT(3.84,3.2,2)
 0196                    N = 400
               C
               C     SET SCALE OF COURDINATES WITH CALL SCALE.
 0197           3006 CALL SCALE(F(1),SW,N,1,DIV)
 0198                    N = 400
               C
               C     PLOT AND LABEL COORDIATE AXIS WITH CALL AXIS.
 0199           3008 ORD(N+2) = 1.
 0200           3009 ABS(N+2) = 1.
 0201           3010 NCO = 38
 0202           3011 THETA = 90.
 0203           3012 CALL AXIS(XO,YO,LAB3,NCO,SH,THETA,ORD(N+1),ORD(N+2),DIV)
 0204           3013 NCA = -47
 0205           3014 THETA = 0.
 0206           3015 CALL AXIS(XA,YA,LAB4,NCA,SW,THETA,ABS(N+1),ABS(N+2),DIV)
 0207                    N = 400
               C
               C     PLOT F VS FF AND DISTINGUISH CLAY FROM SAND AND GRAVEL.
 0208                      DO 22221  I = 1,N
 0209                         IF(PORF1(I).GT.PHIC)GO TO 22226
 0210          22227        CALL SYMBOL(F(I),FF(I),0.10,3,0.,-1)
 0211                            GO TO 22221
 0212          22226      CALL SYMBOL(F(I),FF(I),0.14,4,0.,-1)
 0213          22221     CONTINUE
               C
               C     LABEL PLOT ''F VS FF COMPARISON'' AND IDENTIFY WELL.
 0214                X = 5.25
 0215                HEIGHT = 0.15
 0216                THETA = 0.
 0217                          CALL SYMBOL(X,Y(1),HEIGHT,BCD(1),THETA,NS(1))
 0218                          CALL SYMBOL(X,Y(2),HEIGHT,BCD(6),THETA,NS(2))
 0219                          CALL SYMBOL(X,Y(3),HEIGHT,BCD(11),THETA,NS(3))
 0220                    N = 2
               C


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               C     READ LEGEND ALPHABETIC DATA AND WRITE LEGEND WITH CALL SYMBOL.
 0221                   DO 512 I = 1,N
 0222                   IS = 3*(I-1) + 1
 0223                   IE = IS + 2
 0224            512       READ(5,2012)X5(I),Y5(I),(BCH(J),J = IS,IE),NS5(I)
 0225           2012    FORMAT(2F5.2,3A4,I2)
 0226                   HEIGHT = 0.10
 0227                   CALL SYMBOL(X5(1),Y5(1),HEIGHT,BCH(1),THETA,NS5(1))
 0228                   CALL SYMBOL(X5(2),Y5(2),HEIGHT,BCH(4),THETA,NS5(2))
 0229                HEIGHT = 0.14
 0230                CALL SYMBOL(X3(1),Y3(1),HEIGHT,BCF(1),THETA,NS3(1))
 0231                HEIGHT = 0.10
 0232                CALL SYMBOL(X4(1),Y4(1),HEIGHT,BCG(1),THETA,NS4(1))
 0233            505 READ(5,2005)X6(1),Y6(1),(BCI(J), J = 1,10),NS6(1)
 0234           2005 FORMAT(2F5.2,10A4,I2)
 0235                CALL SYMBOL(X6(1),Y6(1),HEIGHT,BCI(1),THETA,NS6(1))
               C
               C     FILE MARK.
 0236                CALL PLOT(14.,0.,999)
 0237                STOP
 0238                END

                                          SCALAR MAP
 SYMBOL     LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION
 T1         000228       I         00022C       PHIC      000230       RMF       000234       AVTEMP    000238
 BHT        00023C       AM        000240       N         000244       TD        000248       K         00024C
 GRAD       000250       T2        000254       TIME      000258       J         00025C       TEMP      000260
 SW         000264       SH        000268       DIV       00026C       XO        000270       YO        000274
 NCO        000278       THETA     00027C       XA        000280       YA        000284       NCA       000288
 X          00028C       HEIGHT    000290       IS        000294       IE        000298

                                          ARRAY MAP
 SYMBOL     LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION
 IDATA      00029C       RXO       000A6C       RO        00123C       JDEPTH    001A0C       F         0021DC
 TDSF       002984       TDSFF     00318C       RWF       003964       SPCONF    004134       SPCOFF    004904
 ERROR      0050D4       PORF      0058A4       ORD       006074       LAB1      00684C       LAB2      0068AC
 ABS        00692C       Y         007104       NS        007110       FF        00711C       PORFF     0078F4
 RWFF       0080C4       RXOC      008894       ROC       009064       LAB3      009834       LAB4      0098F4
 X2         0099B4       Y2        0099BC       X3        0099C4       Y3        0099C8       X4        0099CC
 Y4         0099D4       NS2       0099DC       NS3       0099E4       NS4       0099E8       X5        0099F0
 Y5         0099F8       NS5       009A00       X6        009A08       Y6        009A0C       NS6       009A10
 PORF1      009A14       JDEPT1    00A1E4       BCD       00A9B4       BCE       00A9F0       BCF       00AA10
 BCG        00AA18       BCH       00AA68       BCI       00AA74

                                     SUBPROGRAMS CALLED
 SYMBOL     LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION
 CLOCK      00AA9C       IBCOM#    00AAA0       SETMSG    00AAA4       PLOT      00AAA8       SCALE     00AAAC
 AXIS       00AAB0       SYMBOL    00AAB4       FRXPR#    00AAB8

                                          LABEL MAP
 LABEL      LOCATION     LABEL     LOCATION     LABEL     LOCATION     LABEL     LOCATION     LABEL     LOCATION
   1001     00AEB8         1002    00AF14         1003    00AF70         1004    00AFCC            1    00807C
      2     0080AC          300    0081A4         8888    00823E          702    008268          704    008280
    705     0082C4          701    0082FC          706    00830C          707    00831C          708    008330
    801     0083E0           10    008676            3    008708           20    008764           21    0087F0
     30     008848           31    0088D4           40    008930           41    00898C           50    008A18
     51     008AA4           60    008B00           61    008B8C           70    008BE8           71    008C74
     80     008CD0           81    008D5C           90    008DB8           91    008E44          200    008E9A
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   102     00BF08          9999    00BF4C           802     00BFBE         803     00BFDE          201     00BFEA
    12     00C00C            14    00C0D0            11     00C17A       11117     00C34A        11115     00C372
 11111     00C3A4           500    00C408          2001     00C492        3001     00C4A4         3002     00C4CA
  3003     00C4F0           502    00C54C          2002     00C5DE         503     00C658         2003     00C6C0
   504     00C742          2004    00C7D6         30031     00C850       30041     00C85A         3006     00C88A
  3008     00C8B0          3009    00C8C4          3010     00C8D0        3011     00C8D8         3012     00C8E0
  3013     00C906          3014    00C912          3015     00C91A       22227     00C966        22226     00C992
 22221     00C9C0           512    00CA9E          2012     00CB32         505     00CC18         2005     00CC80

  TOTAL MEMORY REQUIREMENTS 00CD00 BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
// EXEC LNKEDT(MAP)
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 69/118                                       58628    LINKAGE EDIT

                                                                                  CREATED
LIST        PHASE   FVSFF,*                                                       CREATED
LIST        INCLUDE FVSFF,L
LIST   AUTOLINK     CLOCK
LIST   AUTOLINK     IBCOM#
LIST   AUTOLINK     PLOT
LIST    REP  000560 0010000,0000    PLOTAPE   22 DEC 68     W/O SENSW.
LIST   AUTOLINK     SCALE
LIST   AUTOLINK     AXIS
LIST   AUTOLINK     SYMBOL
LIST   AUTOLINK     FRXPR#
LIST   AUTOLINK     RC8ORG#
LIST   AUTOLINK     USEROPT
LIST   AUTOLINK     UNITAB#
LIST   AUTOLINK     ALOG
LIST   AUTOLINK     FRXPI#
LIST   AUTOLINK     NUMBER
LIST   AUTOLINK     COS
LIST   AUTOLINK     SQRT
LIST   AUTOLINK     EXP                                                           CREATED
LIST        ENTRY
```

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                              CITY OF EL PASO, EL PASO CO., TEXAS
                                    WATERWELL #3 OFFSET

AQUIFER -F- & FIELD -F- COMPARISON

FIELD FORMATION RES. FACTOR = 2.4
                          RMF = 10.8 OHM-M @ 59 F
                            M = 1.50 FOR PORF(K) CALCULATIONS

DATA   DEPTH  *  F(K)  PORF(K)  SPCONF   TDSF'  REMARKS  *  PORFF  SPCOFF  TDSFF  REMARKS   DIFFER(TDS)
  1     108   *  2.3    17.1    3067.   2053.   NACCEPT  *  16.74  3162.   2114.  NACCEPT   -0.6039E 02
  2     110   *  1.3    24.7    2352.   1593.   NACCEPT  *  16.74  4215.   2782.  NACCEPT   -0.1189E 04
  3     112   *  1.0    30.2    1630.   1122.   NACCEPT  *  16.74  3950.   2615.  NACCEPT   -0.1493E 04
  4     114   *  1.3    24.7    1568.   1081.   NACCEPT  *  16.74  2808.   1887.  NACCEPT   -0.8059E 03
  5     116   *  1.5    23.3    2045.   1394.   NACCEPT  *  16.74  3369.   2246.  NACCEPT   -0.8520E 03
  6     118   *  0.9    32.5    1984.   1354.   NACCEPT  *  16.74  5375.   3509.  NACCEPT   -0.2155E 04
  7     120   *  0.9    32.8    1840.   1260.   NACCEPT  *  16.74  5051.   3307.  NACCEPT   -0.2046E 04
  8     122   *  1.4    23.5    2002.   1366.   NACCEPT  *  16.74  3322.   2216.  NACCEPT   -0.8501E 03
  9     124   *  1.5    22.5    1604.   1105.   NACCEPT  *  16.74  2499.   1688.  NACCEPT   -0.5833E 03
 10     126   *  1.5    22.7    1329.    924.   PACCEPT  *  16.74  2103.   1432.  NACCEPT   -0.5080E 03
 11     128   *  2.4    16.6    2052.   1398.   NACCEPT  *  16.74  2018.   1377.  NACCEPT    0.2167E 02
 12     130   *  3.3    13.6    2771.   1863.   NACCEPT  *  16.74  2034.   1387.  NACCEPT    0.4764E 03
 13     132   *  3.9    12.2    4009.   2652.   NACCEPT  *  16.74  2497.   1687.  NACCEPT    0.9651E 03
 14     134   *  3.0    14.3    3468.   2309.   NACCEPT  *  16.74  2740.   1843.  NACCEPT    0.4651E 03
 15     136   *  2.9    14.7    3447.   2295.   NACCEPT  *  16.74  2832.   1902.  NACCEPT    0.3929E 03
 16     138   *  3.0    14.3    3710.   2462.   NACCEPT  *  16.74  2930.   1965.  NACCEPT    0.4971E 03
 17     140   *  3.0    14.5    3816.   2529.   NACCEPT  *  16.74  3072.   2056.  NACCEPT    0.4734E 03
 18     142   *  2.3    17.4    2960.   1985.   NACCEPT  *  16.74  3148.   2105.  NACCEPT   -0.1200E 03
 19     144   *  2.4    16.9    3113.   2083.   NACCEPT  *  16.74  3147.   2104.  NACCEPT   -0.2129E 02
 20     146   *  2.7    15.6    3397.   2263.   NACCEPT  *  16.74  3069.   2055.  NACCEPT    0.2089E 03
 21     148   *  1.8    20.6    2592.   1748.   NACCEPT  *  16.74  3544.   2357.  NACCEPT   -0.6087E 03
 22     150   *  2.4    16.7    5031.   3294.   NACCEPT  *  16.74  5031.   3294.  NACCEPT   -0.1370E 00
 23     152   *  0.6    40.2    1607.   1107.   NACCEPT  *  16.74  5988.   3890.  NACCEPT   -0.2783E 04
 24     154   *  0.8    36.0    1899.   1299.   NACCEPT  *  16.74  5986.   3889.  NACCEPT   -0.2591E 04
 25     156   *  0.7    37.1    1769.   1214.   NACCEPT  *  16.74  5845.   3802.  NACCEPT   -0.2588E 04
 26     158   *  0.7    38.8    1318.    916.   PACCEPT  *  16.74  4653.   3058.  NACCEPT   -0.2141E 04
 27     160   *  2.4    16.9    2710.   1824.   NACCEPT  *  16.74  2761.   1857.  NACCEPT   -0.3238E 02
 28     162   *  2.5    16.2    2777.   1867.   NACCEPT  *  16.74  2644.   1781.  NACCEPT    0.8570E 02
 29     164   *  2.5    16.2    2899.   1945.   NACCEPT  *  16.74  2759.   1856.  NACCEPT    0.8977E 02
 30     166   *  2.6    15.9    3176.   2123.   NACCEPT  *  16.74  2953.   1980.  NACCEPT    0.1424E 03
 31     168   *  1.6    22.1    1882.   1288.   NACCEPT  *  16.74  2852.   1915.  NACCEPT   -0.6273E 03
 32     170   *  2.6    15.9    2699.   1817.   NACCEPT  *  16.74  2509.   1695.  NACCEPT    0.1228E 03
 33     172   *  2.6    16.0    2634.   1776.   NACCEPT  *  16.74  2459.   1662.  NACCEPT    0.1132E 03
 34     174   *  2.7    15.5    2767.   1861.   NACCEPT  *  16.74  2458.   1662.  NACCEPT    0.1987E 03
 35     176   *  2.4    16.8    2554.   1724.   NACCEPT  *  16.74  2558.   1726.  NACCEPT   -0.2440E 01
 36     178   *  2.8    15.0    3166.   2117.   NACCEPT  *  16.74  2695.   1814.  NACCEPT    0.3023E 03
 37     180   *  3.5    12.9    3929.   2601.   NACCEPT  *  16.74  2665.   1795.  NACCEPT    0.8057E 03
 38     182   *  2.7    15.6    2963.   1987.   NACCEPT  *  16.74  2665.   1795.  NACCEPT    0.1916E 03
 39     184   *  2.6    15.9    3374.   2249.   NACCEPT  *  16.74  3130.   2093.  NACCEPT    0.1557E 03
 40     186   *  2.3    17.1    3374.   2249.   NACCEPT  *  16.74  3477.   2315.  NACCEPT   -0.6541E 02
 41     188   *  2.3    17.1    3422.   2279.   NACCEPT  *  16.74  3525.   2345.  NACCEPT   -0.6570E 02
 42     190   *  2.4    17.0    3609.   2398.   NACCEPT  *  16.74  3680.   2443.  NACCEPT   -0.4493E 02
 43     192   *  1.4    23.8    2945.   1975.   NACCEPT  *  16.74  5003.   3277.  NACCEPT   -0.1302E 04
 44     194   *  0.9    32.9    1593.   1098.   NACCEPT  *  16.74  4387.   2890.  NACCEPT   -0.1792E 04
 45     196   *  2.1    18.5    3520.   2342.   NACCEPT  *  16.74  4099.   2708.  NACCEPT   -0.3664E 03
 46     198   *  2.1    18.2    2165.   1472.   NACCEPT  *  16.74  2450.   1657.  NACCEPT   -0.1847E 03
 47     200   *  2.4    16.8    2609.   1759.   NACCEPT  *  16.74  2630.   1773.  NACCEPT   -0.1376E 02
 48     202   *  2.7    15.4    3320.   2215.   NACCEPT  *  16.74  2939.   1971.  NACCEPT    0.2435E 03
 49     204   *  2.4    16.7    3105.   2078.   NACCEPT  *  16.74  3083.   2064.  NACCEPT    0.1408E 02
 50     206   *  1.1    28.8    1214.    847.   PACCEPT  *  16.74  2744.   1846.  NACCEPT   -0.9992E 03
 51     208   *  2.5    16.5    2631.   1773.   NACCEPT  *  16.74  2573.   1736.  NACCEPT    0.3717E 02
 52     210   *  1.9    19.6    2089.   1422.   NACCEPT  *  16.74  2655.   1789.  NACCEPT   -0.3664E 03
 53     212   *  2.2    17.5    2403.   1626.   NACCEPT  *  16.74  2572.   1735.  NACCEPT   -0.1089E 03
 54     214   *  2.4    16.9    2466.   1667.   NACCEPT  *  16.74  2494.   1685.  NACCEPT   -0.1805E 02
 55     216   *  2.5    16.1    2638.   1778.   NACCEPT  *  16.74  2494.   1685.  NACCEPT    0.9314E 02
 56     218   *  2.1    18.1    2231.   1515.   NACCEPT  *  16.74  2518.   1701.  NACCEPT   -0.1858E 03
 57     220   *  2.3    17.1    2417.   1635.   NACCEPT  *  16.74  2492.   1684.  NACCEPT   -0.4848E 02
 58     222   *  2.5    16.4    2577.   1738.   NACCEPT  *  16.74  2492.   1683.  NACCEPT    0.5490E 02
 59     224   *  2.4    16.9    2504.   1692.   NACCEPT  *  16.74  2542.   1716.  NACCEPT   -0.2431E 02
 60     226   *  2.3    17.0    2479.   1675.   NACCEPT  *  16.74  2541.   1715.  NACCEPT   -0.4005E 02
 61     228   *  2.6    16.0    3147.   2104.   NACCEPT  *  16.74  2929.   1965.  NACCEPT    0.1394E 03
 62     230   *  1.8    20.5    3834.   2541.   NACCEPT  *  16.74  5185.   3391.  NACCEPT   -0.8494E 03
 63     232   *  0.8    34.0    2962.   1986.   NACCEPT  *  16.74  8580.   5486.  NACCEPT   -0.3500E 04
 64     234   *  0.4    53.0    1523.   1052.   NACCEPT  *  16.74  8578.   5485.  NACCEPT   -0.4433E 04
 65     236   *  1.1    27.7    2914.   1955.   NACCEPT  *  16.74  6217.   4033.  NACCEPT   -0.2078E 04
 66     238   *  1.4    23.5    2722.   1832.   NACCEPT  *  16.74  4521.   2974.  NACCEPT   -0.1142E 04
 67     240   *  2.3    17.5    4090.   2703.   NACCEPT  *  16.74  4361.   2874.  NACCEPT   -0.1708E 03
 68     242   *  1.0    29.4    1906.   1303.   NACCEPT  *  16.74  4438.   2922.  NACCEPT   -0.1619E 04
 69     244   *  1.6    22.3    2655.   1789.   NACCEPT  *  16.74  4073.   2692.  NACCEPT   -0.9032E 03
 70     246   *  2.2    17.9    2842.   1909.   NACCEPT  *  16.74  3144.   2102.  NACCEPT   -0.1931E 03
 71     248   *  2.3    17.5    3532.   2350.   NACCEPT  *  16.74  3762.   2496.  NACCEPT   -0.1459E 03
 72     250   *  2.1    18.2    4964.   3252.   NACCEPT  *  16.74  5642.   3675.  NACCEPT   -0.4232E 03
 73     252   *  0.9    32.4    2001.   1365.   NACCEPT  *  16.74  5395.   3522.  NACCEPT   -0.2157E 04
 74     254   *  1.4    23.7    2134.   1452.   NACCEPT  *  16.74  3596.   2390.  NACCEPT   -0.9383E 03
 75     256   *  2.3    17.1    2969.   1990.   NACCEPT  *  16.74  3062.   2050.  NACCEPT   -0.5970E 02
 76     258   *  2.4    16.9    3700.   2456.   NACCEPT  *  16.74  3757.   2492.  NACCEPT   -0.3659E 02
 77     260   *  2.0    18.8    4090.   2703.   NACCEPT  *  16.74  4861.   3188.  NACCEPT   -0.4849E 03
 78     262   *  1.0    31.0    2181.   1483.   NACCEPT  *  16.74  5508.   3592.  NACCEPT   -0.2109E 04
 79     264   *  1.6    22.1    3709.   2462.   NACCEPT  *  16.74  5632.   3669.  NACCEPT   -0.1207E 04
 80     266   *  1.4    24.2    3558.   2366.   NACCEPT  *  16.74  6193.   4018.  NACCEPT   -0.1651E 04
 81     268   *  1.4    24.2    4448.   2928.   NACCEPT  *  16.74  7739.   4971.  NACCEPT   -0.2043E 04
 82     270   *  0.6    41.9    1840.   1260.   NACCEPT  *  16.74  7282.   4690.  NACCEPT   -0.3430E 04
 83     272   *  1.2    26.7    3316.   2212.   NACCEPT  *  16.74  6690.   4325.  NACCEPT   -0.2113E 04
 84     274   *  1.3    25.1    3461.   2304.   NACCEPT  *  16.74  6345.   4112.  NACCEPT   -0.1808E 04
 85     276   *  0.7    36.7    2113.   1438.   NACCEPT  *  16.74  6872.   4438.  NACCEPT   -0.2999E 04
 86     278   *  0.7    39.8    1607.   1107.   NACCEPT  *  16.74  5889.   3829.  NACCEPT   -0.2722E 04
 87     280   *  1.3    25.1    2596.   1751.   NACCEPT  *  16.74  4755.   3121.  NACCEPT   -0.1371E 04
 88     282   *  1.3    25.8    2147.   1460.   NACCEPT  *  16.74  4120.   2722.  NACCEPT   -0.1261E 04
 89     284   *  1.2    26.9    2131.   1450.   NACCEPT  *  16.74  4336.   2858.  NACCEPT   -0.1408E 04
 90     286   *  1.3    25.0    2454.   1659.   NACCEPT  *  16.74  4492.   2956.  NACCEPT   -0.1297E 04
 91     288   *  1.9    19.5    3849.   2551.   NACCEPT  *  16.74  4843.   3177.  NACCEPT   -0.6259E 03
 92     290   *  1.8    20.5    4429.   2917.   NACCEPT  *  16.74  6023.   3912.  NACCEPT   -0.9955E 03
 93     292   *  1.8    20.4    4974.   3259.   NACCEPT  *  16.74  6672.   4314.  NACCEPT   -0.1056E 04
 94     294   *  1.3    24.9    3681.   2444.   NACCEPT  *  16.74  6671.   4313.  NACCEPT   -0.1869E 04
 95     296   *  1.7    20.7    4714.   3096.   NACCEPT  *  16.74  6493.   4204.  NACCEPT   -0.1108E 04
 96     298   *  2.2    17.8    6237.   4045.   NACCEPT  *  16.74  6852.   4425.  NACCEPT   -0.3803E 03
 97     300   *  1.3    25.3    3786.   2511.   NACCEPT  *  16.74  7046.   4545.  NACCEPT   -0.2034E 04
 98     302   *  0.7    37.1    1871.   1281.   NACCEPT  *  16.74  6164.   4000.  NACCEPT   -0.2719E 04
 99     304   *  1.1    28.2    2625.   1770.   NACCEPT  *  16.74  5732.   3732.  NACCEPT   -0.1962E 04
100     306   *  0.9    32.0    3008.   2015.   NACCEPT  *  16.74  7949.   5100.  NACCEPT   -0.3084E 04
101     308   *  0.5    46.0    1742.   1196.   NACCEPT  *  16.74  7947.   5099.  NACCEPT   -0.3903E 04
102     310   *  0.5    46.0    1500.   1036.   NACCEPT  *  16.74  6842.   4419.  NACCEPT   -0.3382E 04
103     312   *  1.0    30.4    2141.   1456.   NACCEPT  *  16.74  5239.   3424.  NACCEPT   -0.1968E 04
104     314   *  2.5    16.2    4772.   3132.   NACCEPT  *  16.74  4559.   2998.  NACCEPT    0.1336E 03
105     316   *  2.5    16.4    5495.   3584.   NACCEPT  *  16.74  5350.   3494.  NACCEPT    0.9015E 02
106     318   *  2.6    15.8    6079.   3947.   NACCEPT  *  16.74  5592.   3644.  NACCEPT    0.3028E 03
107     320   *  2.6    15.7    5999.   3897.   NACCEPT  *  16.74  5466.   3566.  NACCEPT    0.3311E 03
108     322   *  2.0    18.7    4535.   2983.   NACCEPT  *  16.74  5346.   3491.  NACCEPT   -0.5081E 03
109     324   *  2.4    16.9    5494.   3583.   NACCEPT  *  16.74  5588.   3642.  NACCEPT   -0.5854E 02
110     326   *  2.2    18.0    5969.   3879.   NACCEPT  *  16.74  6643.   4296.  NACCEPT   -0.4173E 03
111     328   *  1.9    19.4    6333.   4104.   NACCEPT  *  16.74  7927.   5086.  NACCEPT   -0.9816E 03
112     330   *  0.7    38.2    2737.   1842.   NACCEPT  *  16.74  9449.   6015.  NACCEPT   -0.4173E 04
113     332   *  0.5    49.0    1753.   1203.   NACCEPT  *  16.74  8771.   5603.  NACCEPT   -0.4399E 04
114     334   *  1.0    30.8    3067.   2053.   NACCEPT  *  16.74  7673.   4930.  NACCEPT   -0.2877E 04
115     336   *  2.2    18.0    5812.   3781.   NACCEPT  *  16.74  6460.   4183.  NACCEPT   -0.4016E 03
116     338   *  1.8    20.6    4714.   3096.   NACCEPT  *  16.74  6458.   4182.  NACCEPT   -0.1086E 04
117     340   *  2.2    17.8    5613.   3658.   NACCEPT  *  16.74  6134.   3981.  NACCEPT   -0.3231E 03
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119   344  *  1.9  19.4   6544.  4235.  NACCEPT  *  16.74  8174.  5237.  NACCEPT  -0.1002E 04
120   346  *  0.5  48.1   1797.  1232.  NACCEPT  *  16.74  8755.  5593.  NACCEPT  -0.4361E 04
121   348  *  0.6  42.7   2004.  1367.  NACCEPT  *  16.74  8170.  5235.  NACCEPT  -0.3867E 04
122   350  *  0.5  50.6   1371.   952.  PACCEPT  *  16.74  7207.  4644.  NACCEPT  -0.3692E 04
123   352  *  0.6  41.6   1360.   944.  PACCEPT  *  16.74  5325.  3478.  NACCEPT  -0.2534E 04
124   354  *  1.0  30.0   1756.  1205.  NACCEPT  *  16.74  4222.  2786.  NACCEPT  -0.1581E 04
125   356  *  1.0  29.3   1702.  1170.  NACCEPT  *  16.74  3949.  2614.  NACCEPT  -0.1444E 04
126   358  *  1.2  26.3   2100.  1430.  NACCEPT  *  16.74  4149.  2740.  NACCEPT  -0.1310E 04
127   360  *  0.8  34.3   1368.   949.  PACCEPT  *  16.74  4012.  2653.  NACCEPT  -0.1704E 04
128   362  *  1.2  26.3   1878.  1285.  NACCEPT  *  16.74  3707.  2460.  NACCEPT  -0.1176E 04
129   364  *  1.1  27.6   1831.  1254.  NACCEPT  *  16.74  3882.  2572.  NACCEPT  -0.1318E 04
130   366  *  1.2  26.0   2385.  1614.  NACCEPT  *  16.74  4614.  3033.  NACCEPT  -0.1418E 04
131   368  *  1.3  25.3   2793.  1878.  NACCEPT  *  16.74  5201.  3401.  NACCEPT  -0.1523E 04
132   370  *  1.1  27.4   2775.  1866.  NACCEPT  *  16.74  5819.  3785.  NACCEPT  -0.1919E 04
133   372  *  2.2  18.0   5491.  3581.  NACCEPT  *  16.74  6108.  3965.  NACCEPT  -0.3838E 03
134   374  *  2.2  17.9   5969.  3879.  NACCEPT  *  16.74  6602.  4271.  NACCEPT  -0.3918E 03
135   376  *  1.4  24.4   4078.  2695.  NACCEPT  *  16.74  7182.  4629.  NACCEPT  -0.1933E 04
136   378  *  0.7  39.9   2008.  1370.  NACCEPT  *  16.74  7398.  4761.  NACCEPT  -0.3392E 04
137   380  *  1.7  20.9   5013.  3283.  NACCEPT  *  16.74  6974.  4500.  NACCEPT  -0.1217E 04
138   382  *  1.8  20.2   5112.  3345.  NACCEPT  *  16.74  6778.  4380.  NACCEPT  -0.1034E 04
139   384  *  1.9  19.8   5005.  3278.  NACCEPT  *  16.74  6420.  4158.  NACCEPT  -0.8802E 03
140   386  *  2.0  19.2   5231.  3419.  NACCEPT  *  16.74  6418.  4157.  NACCEPT  -0.7379E 03
141   388  *  1.8  20.2   5259.  3436.  NACCEPT  *  16.74  6966.  4496.  NACCEPT  -0.1059E 04
142   390  *  1.5  23.3   5120.  3350.  NACCEPT  *  16.74  8406.  5379.  NACCEPT  -0.2030E 04
143   392  *  0.4  51.3   1464.  1013.  NACCEPT  *  16.74  7861.  5046.  NACCEPT  -0.4033E 04
144   394  *  0.7  39.9   1699.  1168.  NACCEPT  *  16.74  6247.  4051.  NACCEPT  -0.2883E 04
145   396  *  1.1  28.4   2693.  1814.  NACCEPT  *  16.74  5941.  3861.  NACCEPT  -0.2048E 04
146   398  *  0.6  43.1   1732.  1190.  NACCEPT  *  16.74  7162.  4616.  NACCEPT  -0.3427E 04
147   400  *  0.5  47.1   1662.  1144.  NACCEPT  *  16.74  7853.  5041.  NACCEPT  -0.3897E 04
148   402  *  0.5  47.9   1735.  1191.  NACCEPT  *  16.74  8393.  5371.  NACCEPT  -0.4180E 04
149   404  *  0.5  50.4   1504.  1039.  NACCEPT  *  16.74  7849.  5038.  NACCEPT  -0.3999E 04
150   406  *  0.5  46.4   1353.   939.  PACCEPT  *  16.74  6237.  4045.  NACCEPT  -0.3106E 04
151   408  *  1.2  26.4   2360.  1598.  NACCEPT  *  16.74  4677.  3072.  NACCEPT  -0.1474E 04
152   410  *  2.3  17.5   4004.  2649.  NACCEPT  *  16.74  4266.  2814.  NACCEPT  -0.1651E 03
153   412  *  2.5  16.1   4090.  2703.  NACCEPT  *  16.74  3858.  2556.  NACCEPT   0.1465E 03
154   414  *  2.5  16.2   4640.  3049.  NACCEPT  *  16.74  4418.  2910.  NACCEPT   0.1395E 03
155   416  *  2.6  15.8   5762.  3750.  NACCEPT  *  16.74  5281.  3451.  NACCEPT   0.2991E 03
156   418  *  0.7  39.3   1687.  1160.  NACCEPT  *  16.74  6072.  3943.  NACCEPT  -0.2783E 04
157   420  *  0.7  39.8   1699.  1168.  NACCEPT  *  16.74  6226.  4038.  NACCEPT  -0.2871E 04
158   422  *  0.6  44.3   1568.  1081.  NACCEPT  *  16.74  6743.  4358.  NACCEPT  -0.3277E 04
159   424  *  0.6  44.3   1568.  1081.  NACCEPT  *  16.74  6742.  4357.  NACCEPT  -0.3275E 04
160   426  *  1.0  30.3   1629.  1122.  NACCEPT  *  16.74  3978.  2632.  NACCEPT  -0.1510E 04
161   428  *  1.9  19.3   2003.  1367.  NACCEPT  *  16.74  2475.  1673.  NACCEPT  -0.3061E 03
162   430  *  1.8  20.1   1840.  1260.  NACCEPT  *  16.74  2425.  1641.  NACCEPT  -0.3800E 03
163   432  *  2.4  16.9   2369.  1604.  NACCEPT  *  16.74  2400.  1625.  NACCEPT  -0.2039E 02
164   434  *  2.4  16.9   2645.  1782.  NACCEPT  *  16.74  2693.  1813.  NACCEPT  -0.3110E 02
165   436  *  2.1  18.1   2918.  1958.  NACCEPT  *  16.74  3275.  2186.  NACCEPT  -0.2278E 03
166   438  *  2.4  16.8   4834.  3171.  NACCEPT  *  16.74  4845.  3178.  NACCEPT  -0.6818E 01
167   440  *  0.9  33.4   1909.  1305.  NACCEPT  *  16.74  5382.  3514.  NACCEPT  -0.2209E 04
168   442  *  1.5  23.3   2778.  1868.  NACCEPT  *  16.74  4569.  3004.  NACCEPT  -0.1136E 04
169   444  *  2.1  18.5   2857.  1919.  NACCEPT  *  16.74  3316.  2212.  NACCEPT  -0.2933E 03
170   446  *  2.4  16.6   3272.  2184.  NACCEPT  *  16.74  3227.  2155.  NACCEPT   0.2879E 02
171   448  *  2.5  16.4   3321.  2215.  NACCEPT  *  16.74  3226.  2155.  NACCEPT   0.6061E 02
172   450  *  2.4  16.5   3333.  2223.  NACCEPT  *  16.74  3269.  2182.  NACCEPT   0.4080E 02
173   452  *  1.7  21.0   2321.  1573.  NACCEPT  *  16.74  3268.  2181.  NACCEPT  -0.6080E 03
174   454  *  2.9  14.7   3926.  2600.  NACCEPT  *  16.74  3224.  2153.  NACCEPT   0.4464E 03
175   456  *  1.7  21.2   2352.  1593.  NACCEPT  *  16.74  3357.  2238.  NACCEPT  -0.6451E 03
176   458  *  2.7  15.3   5209.  3405.  NACCEPT  *  16.74  4559.  2999.  NACCEPT   0.4069E 03
177   460  *  0.7  37.0   1840.  1260.  NACCEPT  *  16.74  6040.  3922.  NACCEPT  -0.2662E 04
178   462  *  0.7  37.8   1977.  1350.  NACCEPT  *  16.74  6709.  4337.  NACCEPT  -0.2987E 04
179   464  *  0.7  38.2   1998.  1364.  NACCEPT  *  16.74  6899.  4454.  NACCEPT  -0.3090E 04
180   466  *  0.5  46.1   1649.  1135.  NACCEPT  *  16.74  7544.  4851.  NACCEPT  -0.3716E 04
181   468  *  0.5  46.8   1610.  1110.  NACCEPT  *  16.74  7542.  4850.  NACCEPT  -0.3740E 04
182   470  *  0.5  47.6   1524.  1053.  NACCEPT  *  16.74  7311.  4708.  NACCEPT  -0.3655E 04
183   472  *  0.5  44.7   1416.   981.  PACCEPT  *  16.74  6185.  4013.  NACCEPT  -0.3032E 04
184   474  *  0.7  39.1   1125.   787.  PACCEPT  *  16.74  4019.  2658.  NACCEPT  -0.1871E 04
185   476  *  2.5  16.5   1644.  1132.  NACCEPT  *  16.74  1607.  1107.  NACCEPT   0.2429E 02
186   478  *  3.1  14.1   1109.   777.  PACCEPT  *  16.74   861.   610.  PACCEPT   0.1668E 03
187   480  *  3.4  13.3   1125.   788.  PACCEPT  *  16.74   801.   569.  PACCEPT   0.2186E 03
188   482  *  3.4  13.3   1092.   766.  PACCEPT  *  16.74   777.   553.  PACCEPT   0.2127E 03
189   484  *  3.2  13.7    985.   694.  PACCEPT  *  16.74   730.   521.  PACCEPT   0.1730E 03
190   486  *  3.4  13.2    954.   673.  PACCEPT  *  16.74   669.   479.     GOOD   0.1938E 03
191   488  *  3.6  12.9   1231.   858.  PACCEPT  *  16.74   830.   589.  PACCEPT   0.2694E 03
192   490  *  3.2  13.7   2168.  1474.  NACCEPT  *  16.74  1604.  1106.  NACCEPT   0.3682E 03
193   492  *  1.4  24.0   1272.   885.  PACCEPT  *  16.74  2187.  1486.  NACCEPT  -0.6011E 03
194   494  *  1.5  22.8   1161.   812.  PACCEPT  *  16.74  1850.  1267.  NACCEPT  -0.4553E 03
195   496  *  2.0  18.6    854.   605.  PACCEPT  *  16.74  1002.   705.  PACCEPT  -0.9998E 02
196   498  *  3.2  13.7    879.   622.  PACCEPT  *  16.74   650.   466.     GOOD   0.1559E 03
197   500  *  4.2  11.5   1011.   711.  PACCEPT  *  16.74   572.   413.     GOOD   0.2981E 03
198   502  *  4.3  11.4   1095.   767.  PACCEPT  *  16.74   616.   443.     GOOD   0.3243E 03
199   504  *  3.9  12.1   1091.   765.  PACCEPT  *  16.74   667.   478.     GOOD   0.2864E 03
200   506  *  3.2  13.7   1161.   812.  PACCEPT  *  16.74   858.   608.  PACCEPT   0.2040E 03
201   508  *  2.7  15.3   1244.   867.  PACCEPT  *  16.74  1091.   765.  PACCEPT   0.1017E 03
202   510  *  1.8  20.3    887.   627.  PACCEPT  *  16.74  1188.   830.  PACCEPT  -0.2024E 03
203   512  *  3.3  13.5   1656.  1140.  NACCEPT  *  16.74  1200.   838.  PACCEPT   0.3021E 03
204   514  *  2.1  18.0   1263.   880.  PACCEPT  *  16.74  1411.   978.  PACCEPT  -0.9839E 02
205   516  *  3.2  13.7   2017.  1376.  NACCEPT  *  16.74  1499.  1036.  NACCEPT   0.3395E 03
206   518  *  3.0  14.5   2048.  1396.  NACCEPT  *  16.74  1654.  1138.  NACCEPT   0.2577E 03
207   520  *  3.1  14.2   2360.  1598.  NACCEPT  *  16.74  1844.  1263.  NACCEPT   0.3353E 03
208   522  *  2.0  18.8   1677.  1153.  NACCEPT  *  16.74  1997.  1363.  NACCEPT  -0.2097E 03
209   524  *  3.3  13.7   3252.  2171.  NACCEPT  *  16.74  2396.  1622.  NACCEPT   0.5491E 03
210   526  *  3.0  14.4   5183.  3389.  NACCEPT  *  16.74  4130.  2728.  NACCEPT   0.6608E 03
211   528  *  0.7  36.7   1673.  1151.  NACCEPT  *  16.74  5443.  3552.  NACCEPT  -0.2401E 04
212   530  *  0.7  39.4   1699.  1168.  NACCEPT  *  16.74  6139.  3984.  NACCEPT  -0.2817E 04
213   532  *  0.8  34.1   2349.  1591.  NACCEPT  *  16.74  6839.  4417.  NACCEPT  -0.2826E 04
214   534  *  0.5  45.9   1466.  1014.  NACCEPT  *  16.74  6648.  4299.  NACCEPT  -0.3285E 04
215   536  *  1.1  28.0   1624.  1118.  NACCEPT  *  16.74  3518.  2341.  NACCEPT  -0.1223E 04
216   538  *  2.5  16.2   1735.  1191.  NACCEPT  *  16.74  1650.  1135.  NACCEPT   0.5588E 02
217   540  *  3.3  13.6   1935.  1323.  NACCEPT  *  16.74  1423.   986.  PACCEPT   0.3364E 03
218   542  *  2.8  15.0   2352.  1593.  NACCEPT  *  16.74  1992.  1360.  NACCEPT   0.2335E 03
219   544  *  2.0  18.7   2934.  1968.  NACCEPT  *  16.74  3464.  2306.  NACCEPT  -0.3382E 03
220   546  *  0.8  35.1   1454.  1006.  NACCEPT  *  16.74  4425.  2914.  NACCEPT  -0.1908E 04
221   548  *  0.8  35.9   1358.   943.  PACCEPT  *  16.74  4266.  2814.  NACCEPT  -0.1871E 04
222   550  *  1.2  25.9   1822.  1249.  NACCEPT  *  16.74  3512.  2337.  NACCEPT  -0.1088E 04
223   552  *  1.2  26.6   1526.  1054.  NACCEPT  *  16.74  3061.  2049.  NACCEPT  -0.9956E 03
224   554  *  0.7  36.7   1339.   930.  PACCEPT  *  16.74  4340.  2861.  NACCEPT  -0.1931E 04
225   556  *  1.0  30.0   2161.  1469.  NACCEPT  *  16.74  5188.  3392.  NACCEPT  -0.1923E 04
226   558  *  0.6  43.8   1065.   747.  PACCEPT  *  16.74  4502.  2962.  NACCEPT  -0.2215E 04
227   560  *  1.1  27.8   1034.   727.  PACCEPT  *  16.74  2209.  1500.  NACCEPT  -0.7738E 03
228   562  *  2.5  16.3   1277.   889.  PACCEPT  *  16.74  1223.   853.  PACCEPT   0.3621E 02
229   564  *  3.1  14.1   1278.   890.  PACCEPT  *  16.74   993.   699.  PACCEPT   0.1904E 03
230   566  *  3.0  14.4   1169.   817.  PACCEPT  *  16.74   935.   660.  PACCEPT   0.1573E 03
231   568  *  3.7  12.5   1398.   969.  PACCEPT  *  16.74   899.   636.  PACCEPT   0.3336E 03
232   570  *  3.7  12.5   1477.  1022.  NACCEPT  *  16.74   953.   672.  PACCEPT   0.3496E 03
233   572  *  3.7  12.5   2841.  1908.  NACCEPT  *  16.74  1832.  1255.  NACCEPT   0.6533E 03
234   574  *  3.6  12.8   4393.  2894.  NACCEPT  *  16.74  2940.  1972.  NACCEPT   0.9223E 03
235   576  *  1.2  27.3   1703.  1170.  NACCEPT  *  16.74  3553.  2363.  NACCEPT  -0.1192E 04
236   578  *  1.0  29.5   1184.   827.  PACCEPT  *  16.74  2767.  1861.  NACCEPT  -0.1034E 04
237   580  *  2.6  16.0   1693.  1164.  NACCEPT  *  16.74  1586.  1094.  NACCEPT   0.7040E 02
238   582  *  2.7  15.5   1109.   777.  PACCEPT  *  16.74   991.   698.  PACCEPT   0.7935E 02
239   584  *  3.1  14.0   1718.  1180.  NACCEPT  *  16.74  1321.   918.  PACCEPT   0.2618E 03
240   586  *  2.0  19.2   1385.   960.  PACCEPT  *  16.74  1698.  1167.  NACCEPT  -0.2068E 03
241   588  *  1.5  23.0   1796.  1231.  NACCEPT  *  16.74  2899.  1945.  NACCEPT  -0.7142E 03
242   590  *  1.6  21.6   2841.  1909.  NACCEPT  *  16.74  4169.  2753.  NACCEPT  -0.8442E 03
243   592  *  0.6  41.3    930.   656.  PACCEPT  *  16.74  3600.  2392.  NACCEPT  -0.1736E 04
244   594  *  1.6  21.8   1329.   924.  PACCEPT  *  16.74  1979.  1351.  NACCEPT  -0.4275E 03
245   596  *  2.1  18.2   1192.   832.  PACCEPT  *  16.74  1357.   942.  PACCEPT  -0.1097E 03
246   598  *  2.1  18.4   1145.   801.  PACCEPT  *  16.74  1319.   917.  PACCEPT  -0.1157E 03
247   600  *  2.5  16.3   1271.   885.  PACCEPT  *  16.74  1217.   849.  PACCEPT   0.3591E 02
248   602  *  2.2  17.6   1027.   722.  PACCEPT  *  16.74  1104.   773.  PACCEPT  -0.5119E 02
249   604  *  2.7  15.6   1055.   741.  PACCEPT  *  16.74   949.   669.  PACCEPT   0.7150E 02
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250   606  *  3.7   12.5   1566.  1081.   NACCEPT  *  16.74   1009.   710.   PACCEPT     0.3106E 03
251   608  *  2.8   15.1   1353.   939.   PACCEPT  *  16.74   1157.   809.   PACCEPT     0.1305E 03
252   610  *  2.4   16.8   1122.   785.   PACCEPT  *  16.74   1129.   790.   PACCEPT    -0.4633E 01
253   612  *  2.9   14.9   1176.   822.   PACCEPT  *  16.74    987.   695.   PACCEPT     0.1263E 03
254   614  *  3.1   14.1   1334.   927.   PACCEPT  *  16.74   1030.   724.   PACCEPT     0.2026E 03
255   616  *  3.7   12.5   2031.  1385.   NACCEPT  *  16.74   1316.   915.   PACCEPT     0.4703E 03
256   618  *  1.7   20.9    941.   664.   PACCEPT  *  16.74   1316.   915.   PACCEPT    -0.2507E 03
257   620  *  2.9   14.6   2145.  1459.   NACCEPT  *  16.74   1754.  1204.   NACCEPT     0.2554E 03
258   622  *  3.4   13.4   4090.  2703.   NACCEPT  *  16.74   2922.  1960.   NACCEPT     0.7427E 03
259   624  *  1.1   28.2   1800.  1234.   NACCEPT  *  16.74   3944.  2611.   NACCEPT    -0.1377E 04
260   626  *  1.1   28.4   1462.  1012.   NACCEPT  *  16.74   3241.  2164.   NACCEPT    -0.1152E 04
261   628  *  1.0   30.3   1102.   772.   PACCEPT  *  16.74   2688.  1810.   NACCEPT    -0.1038E 04
262   630  *  1.8   20.3   1140.   798.   PACCEPT  *  16.74   1525.  1054.   NACCEPT    -0.2559E 03
263   632  *  3.5   13.1   1483.  1026.   NACCEPT  *  16.74   1028.   722.   PACCEPT     0.3031E 03
264   634  *  4.0   11.9   1378.   956.   PACCEPT  *  16.74    829.   588.   PACCEPT     0.3673E 03
265   636  *  4.1   11.7   1396.   968.   PACCEPT  *  16.74    815.   579.   PACCEPT     0.3894E 03
266   638  *  4.1   11.7   1328.   923.   PACCEPT  *  16.74    774.   551.   PACCEPT     0.3713E 03
267   640  *  3.5   13.0   1126.   789.   PACCEPT  *  16.74    774.   551.   PACCEPT     0.2374E 03
268   642  *  3.8   12.3   1169.   817.   PACCEPT  *  16.74    738.   526.   PACCEPT     0.2910E 03
269   644  *  3.8   12.3   1211.   845.   PACCEPT  *  16.74    761.   542.   PACCEPT     0.3027E 03
270   646  *  4.0   11.9   1300.   904.   PACCEPT  *  16.74    779.   554.   PACCEPT     0.3499E 03
271   648  *  3.5   13.1   1369.   950.   PACCEPT  *  16.74    944.   666.   PACCEPT     0.2844E 03
272   650  *  3.6   12.7   1977.  1350.   NACCEPT  *  16.74   1310.   911.   PACCEPT     0.4384E 03
273   652  *  0.9   32.2    549.  -397.      GOOD  *  16.74   1465.  1013.   NACCEPT    -0.6166E 03
274   654  *  2.5   16.4   1429.   990.   PACCEPT  *  16.74   1387.   962.   PACCEPT     0.2807E 02
275   656  *  2.5   16.3   1363.   946.   PACCEPT  *  16.74   1309.   910.   PACCEPT     0.3584E 02
276   658  *  2.7   15.3   1350.   937.   PACCEPT  *  16.74   1178.   823.   PACCEPT     0.1142E 03
277   660  *  3.4   13.2   1527.  1054.   NACCEPT  *  16.74   1066.   748.   PACCEPT     0.3064E 03
278   662  *  2.9   14.8   1129.   790.   PACCEPT  *  16.74    942.   665.   PACCEPT     0.1254E 03
279   664  *  3.2   13.8   1360.   944.   PACCEPT  *  16.74   1024.   720.   PACCEPT     0.2246E 03
280   666  *  3.4   13.3   1744.  1197.   NACCEPT  *  16.74   1239.   864.   PACCEPT     0.3334E 03
281   668  *  1.8   20.2    988.   696.   PACCEPT  *  16.74   1307.   909.   PACCEPT    -0.2132E 03
282   670  *  2.7   15.5   1077.   755.   PACCEPT  *  16.74    960.   677.   PACCEPT     0.7825E 02
283   672  *  3.2   13.8   1203.   840.   PACCEPT  *  16.74    905.   640.   PACCEPT     0.2004E 03
284   674  *  3.3   13.5   1161.   812.   PACCEPT  *  16.74    840.   596.   PACCEPT     0.2162E 03
285   676  *  3.6   12.7   1206.   842.   PACCEPT  *  16.74    797.   567.   PACCEPT     0.2752E 03
286   678  *  3.4   13.2   1164.   813.   PACCEPT  *  16.74    810.   576.   PACCEPT     0.2376E 03
287   680  *  3.8   12.4   1248.   870.   PACCEPT  *  16.74    797.   566.   PACCEPT     0.3032E 03
288   682  *  3.4   13.1   1022.   719.   PACCEPT  *  16.74    712.   509.   PACCEPT     0.2102E 03
289   684  *  4.0   11.9   1138.   796.   PACCEPT  *  16.74    681.   487.      GOOD     0.3089E 03
290   686  *  2.9   14.8   1254.   874.   PACCEPT  *  16.74   1044.   733.   PACCEPT     0.1408E 03
291   688  *  3.8   12.4   2629.  1772.   NACCEPT  *  16.74   1677.  1153.   NACCEPT     0.6191E 03
292   690  *  1.1   27.7    849.   602.   PACCEPT  *  16.74   1805.  1237.   NACCEPT    -0.6352E 03
293   692  *  3.1   14.0   1394.   967.   PACCEPT  *  16.74   1066.   748.   PACCEPT     0.2164E 03
294   694  *  3.3   13.6   1063.   746.   PACCEPT  *  16.74    782.   556.   PACCEPT     0.1900E 03
295   696  *  4.1   11.7   1352.   939.   PACCEPT  *  16.74    795.   565.   PACCEPT     0.3734E 03
296   698  *  4.0   11.9   1402.   972.   PACCEPT  *  16.74    837.   594.   PACCEPT     0.3781E 03
297   700  *  3.9   12.1   1409.   976.   PACCEPT  *  16.74    868.   615.   PACCEPT     0.3616E 03
298   702  *  3.6   12.7   1483.  1025.   NACCEPT  *  16.74    976.   688.   PACCEPT     0.3373E 03
299   704  *  3.9   12.1   1654.  1138.   NACCEPT  *  16.74   1019.   716.   PACCEPT     0.4218E 03
300   706  *  3.0   14.4   1402.   972.   PACCEPT  *  16.74   1115.   781.   PACCEPT     0.1910E 03
301   708  *  3.3   13.6   1772.  1216.   NACCEPT  *  16.74   1301.   905.   PACCEPT     0.3110E 03
302   710  *  2.4   16.8   2951.  1979.   NACCEPT  *  16.74   2963.  1987.   NACCEPT    -0.7894E 01
303   712  *  1.1   28.0   2399.  1624.   NACCEPT  *  16.74   5201.  3400.   NACCEPT    -0.1777E 04
304   714  *  0.5   45.9   1074.   753.   PACCEPT  *  16.74   4875.  3196.   NACCEPT    -0.2443E 04
305   716  *  1.4   24.1   1588.  1095.   NACCEPT  *  16.74   2752.  1851.   NACCEPT    -0.7566E 03
306   718  *  2.5   16.2   2517.  1700.   NACCEPT  *  16.74   2386.  1616.   NACCEPT     0.8407E 02
307   720  *  1.1   27.6   1004.   706.   PACCEPT  *  16.74   2126.  1446.   NACCEPT    -0.7400E 03
308   722  *  2.5   16.2   1636.  1126.   NACCEPT  *  16.74   1558.  1075.   NACCEPT     0.5111E 02
309   724  *  2.6   15.9   1324.   920.   PACCEPT  *  16.74   1230.   858.   PACCEPT     0.6243E 02
310   726  *  4.4   11.2   2191.  1489.   NACCEPT  *  16.74   1192.   832.   PACCEPT     0.6566E 03
311   728  *  3.0   14.5   1212.   845.   PACCEPT  *  16.74    973.   686.   PACCEPT     0.1597E 03
312   730  *  3.0   14.5   3035.  2033.   NACCEPT  *  16.74   2458.  1662.   NACCEPT     0.3709E 03
313   732  *  0.8   36.1   1444.   999.   PACCEPT  *  16.74   4578.  3010.   NACCEPT    -0.2011E 04
314   734  *  1.1   27.6   2832.  1902.   NACCEPT  *  16.74   5985.  3889.   NACCEPT    -0.1986E 04
315   736  *  0.9   31.4   1746.  1199.   NACCEPT  *  16.74   4488.  2953.   NACCEPT    -0.1755E 04
316   738  *  2.5   16.2   2993.  2006.   NACCEPT  *  16.74   2845.  1911.   NACCEPT     0.9462E 02
317   740  *  3.4   13.2   1744.  1197.   NACCEPT  *  16.74   1228.   856.   PACCEPT     0.3410E 03
318   742  *  3.3   13.6   1679.  1155.   NACCEPT  *  16.74   1227.   856.   PACCEPT     0.2988E 03
319   744  *  3.2   13.9   1753.  1203.   NACCEPT  *  16.74   1332.   926.   PACCEPT     0.2775E 03
320   746  *  2.6   16.1   1652.  1137.   NACCEPT  *  16.74   1554.  1072.   NACCEPT     0.6491E 02
321   748  *  2.5   16.2   1636.  1126.   NACCEPT  *  16.74   1553.  1072.   NACCEPT     0.5440E 02
322   750  *  3.0   14.5   2218.  1506.   NACCEPT  *  16.74   1792.  1229.   NACCEPT     0.2778E 03
323   752  *  1.9   19.6   1840.  1260.   NACCEPT  *  16.74   2329.  1578.   NACCEPT    -0.3178E 03
324   754  *  1.4   23.9   1362.   945.   PACCEPT  *  16.74   2328.  1578.   NACCEPT    -0.6325E 03
325   756  *  1.8   19.9   1280.   891.   PACCEPT  *  16.74   1663.  1144.   NACCEPT    -0.2532E 03
326   758  *  1.5   22.7    796.   566.   PACCEPT  *  16.74   1258.   876.   PACCEPT    -0.3104E 03
327   760  *  3.4   13.2   2366.  1603.   NACCEPT  *  16.74   1662.  1143.   NACCEPT     0.4592E 03
328   762  *  3.1   14.1   4294.  2832.   NACCEPT  *  16.74   3323.  2216.   NACCEPT     0.6154E 03
329   764  *  0.7   39.1   1301.   905.   PACCEPT  *  16.74   4651.  3056.   NACCEPT    -0.2151E 04
330   766  *  0.8   35.2   1312.   912.   PACCEPT  *  16.74   4008.  2651.   NACCEPT    -0.1739E 04
331   768  *  1.4   23.9   1362.   945.   PACCEPT  *  16.74   2324.  1575.   NACCEPT    -0.6300E 03
332   770  *  2.3   17.3   1578.  1088.   NACCEPT  *  16.74   1660.  1142.   NACCEPT    -0.5413E 02
333   772  *  3.1   14.2   1945.  1329.   NACCEPT  *  16.74   1528.  1055.   NACCEPT     0.2736E 03
334   774  *  2.7   15.4   1759.  1207.   NACCEPT  *  16.74   1548.  1069.   NACCEPT     0.1382E 03
335   776  *  3.4   13.4   2242.  1522.   NACCEPT  *  16.74   1601.  1104.   NACCEPT     0.4187E 03
336   778  *  2.5   16.1   1716.  1179.   NACCEPT  *  16.74   1623.  1118.   NACCEPT     0.6089E 02
337   780  *  3.1   14.2   2130.  1449.   NACCEPT  *  16.74   1658.  1141.   NACCEPT     0.3084E 03
338   782  *  2.9   14.7   2090.  1424.   NACCEPT  *  16.74   1719.  1181.   NACCEPT     0.2428E 03
339   784  *  2.2   17.6   1652.  1137.   NACCEPT  *  16.74   1784.  1224.   NACCEPT    -0.8710E 02
340   786  *  2.9   14.7   2171.  1476.   NACCEPT  *  16.74   1784.  1223.   NACCEPT     0.2523E 03
341   788  *  2.7   15.6   2061.  1405.   NACCEPT  *  16.74   1855.  1270.   NACCEPT     0.1347E 03
342   790  *  2.0   18.7   1636.  1126.   NACCEPT  *  16.74   1932.  1320.   NACCEPT    -0.1938E 03
343   792  *  1.8   20.4   1374.   954.   PACCEPT  *  16.74   1854.  1269.   NACCEPT    -0.3158E 03
344   794  *  2.4   16.7   2119.  1442.   NACCEPT  *  16.74   2106.  1434.   NACCEPT     0.8488E 01
345   796  *  2.9   14.7   2971.  1991.   NACCEPT  *  16.74   2438.  1649.   NACCEPT     0.3424E 03
346   798  *  2.3   17.3   2629.  1772.   NACCEPT  *  16.74   2757.  1854.   NACCEPT    -0.8209E 02
347   800  *  2.7   15.3   4255.  2807.   NACCEPT  *  16.74   3734.  2478.   NACCEPT     0.3291E 03
348   802  *  0.7   36.7   1249.   870.   PACCEPT  *  16.74   4061.  2685.   NACCEPT    -0.1814E 04
349   804  *  1.8   20.4   2202.  1496.   NACCEPT  *  16.74   2967.  1989.   NACCEPT    -0.4927E 03
350   806  *  2.5   16.1   2045.  1394.   NACCEPT  *  16.74   1928.  1318.   NACCEPT     0.7633E 02
351   808  *  2.9   14.7   2171.  1476.   NACCEPT  *  16.74   1779.  1220.   NACCEPT     0.2555E 03
352   810  *  3.1   14.2   2265.  1537.   NACCEPT  *  16.74   1779.  1220.   NACCEPT     0.3170E 03
353   812  *  2.9   14.7   2171.  1476.   NACCEPT  *  16.74   1778.  1220.   NACCEPT     0.2560E 03
354   814  *  3.3   13.5   2287.  1551.   NACCEPT  *  16.74   1651.  1136.   NACCEPT     0.4153E 03
355   816  *  2.9   14.6   2016.  1375.   NACCEPT  *  16.74   1650.  1136.   NACCEPT     0.2391E 03
356   818  *  2.8   15.3   2209.  1500.   NACCEPT  *  16.74   1925.  1316.   NACCEPT     0.1845E 03
357   820  *  2.7   15.3   5735.  3733.   NACCEPT  *  16.74   5021.  3288.   NACCEPT     0.4454E 03
358   822  *  0.7   37.5   2217.  1505.   NACCEPT  *  16.74   7448.  4792.   NACCEPT    -0.3287E 04
359   824  *  0.6   44.1   1459.  1010.   NACCEPT  *  16.74   6239.  4046.   NACCEPT    -0.3036E 04
360   826  *  1.9   19.5   2045.  1394.   NACCEPT  *  16.74   2564.  1730.   NACCEPT    -0.3364E 03
361   828  *  2.6   16.1   4090.  2703.   NACCEPT  *  16.74   3846.  2548.   NACCEPT     0.1545E 03
362   830  *  1.7   21.4   3625.  2409.   NACCEPT  *  16.74   5243.  3426.   NACCEPT    -0.1018E 04
363   832  *  1.5   22.6   2945.  1975.   NACCEPT  *  16.74   4612.  3032.   NACCEPT    -0.1057E 04
364   834  *  2.5   16.3   2405.  1627.   NACCEPT  *  16.74   2306.  1563.   NACCEPT     0.6425E 02
365   836  *  2.5   16.3   2441.  1651.   NACCEPT  *  16.74   2352.  1593.   NACCEPT     0.5778E 02
366   838  *  1.7   21.4   1611.  1110.   NACCEPT  *  16.74   2328.  1578.   NACCEPT    -0.4675E 03
367   840  *  2.8   15.1   2621.  1767.   NACCEPT  *  16.74   2237.  1519.   NACCEPT     0.2481E 03
368   842  *  2.9   14.6   2740.  1843.   NACCEPT  *  16.74   2236.  1518.   NACCEPT     0.3251E 03
369   844  *  2.6   16.0   2504.  1692.   NACCEPT  *  16.74   2350.  1592.   NACCEPT     0.9969E 02
370   846  *  2.0   18.8   2585.  1744.   NACCEPT  *  16.74   3070.  2055.   NACCEPT    -0.3112E 03
371   848  *  1.9   19.4   4183.  2762.   NACCEPT  *  16.74   5231.  3419.   NACCEPT    -0.6577E 03
372   850  *  1.4   23.9   3749.  2487.   NACCEPT  *  16.74   6392.  4141.   NACCEPT    -0.1654E 04
373   852  *  0.6   44.7   1287.   896.   PACCEPT  *  16.74   5611.  3656.   NACCEPT    -0.2761E 04
374   854  *  1.3   25.1   2607.  1758.   NACCEPT  *  16.74   4792.  3144.   NACCEPT    -0.1386E 04
375   856  *  1.3   25.4   2153.  1464.   NACCEPT  *  16.74   4034.  2668.   NACCEPT    -0.1204E 04
376   858  *  2.6   16.0   2454.  1659.   NACCEPT  *  16.74   2299.  1559.   NACCEPT     0.1003E 03
377   860  *  2.3   17.1   2019.  1377.   NACCEPT  *  16.74   2089.  1423.   NACCEPT    -0.4586E 02
378   862  *  2.9   14.6   2688.  1810.   NACCEPT  *  16.74   2188.  1487.   NACCEPT     0.3227E 03
379   864  *  2.6   16.0   2293.  1555.   NACCEPT  *  16.74   2147.  1460.   NACCEPT     0.9506E 02
380   866  *  3.3   13.4   2774.  1865.   NACCEPT  *  16.74   1997.  1363.   NACCEPT     0.5026E 03
381   868  *  3.6   12.8   2887.  2002.   NACCEPT  *
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 382     870  *   2.7    15.5     2331.   1580.   NACCEPT  *  16.74   2087.   1421.   NACCEPT      0.1586E 03
 383     872  *   2.6    15.7     2298.   1558.   NACCEPT  *  16.74   2086.   1421.   NACCEPT      0.1373E 03
 384     874  *   2.8    15.2     2931.   1966.   NACCEPT  *  16.74   2549.   1721.   NACCEPT      0.2454E 03
 385     876  *   2.6    15.8     3412.   2273.   NACCEPT  *  16.74   3142.   2101.   NACCEPT      0.1720E 03
 386     878  *   1.6    21.8     2534.   1711.   NACCEPT  *  16.74   3760.   2494.   NACCEPT     -0.7828E 03
 387     880  *   1.4    23.7     2308.   1565.   NACCEPT  *  16.74   3886.   2574.   NACCEPT     -0.1009E 04
 388     882  *   1.3    24.9     1915.   1309.   NACCEPT  *  16.74   3473.   2312.   NACCEPT     -0.1003E 04
 389     884  *   2.2    18.0     2484.   1678.   NACCEPT  *  16.74   2761.   1857.   NACCEPT     -0.1787E 03
 390     886  *   2.7    15.5     5482.   3576.   NACCEPT  *  16.74   4875.   3196.   NACCEPT      0.3796E 03
 391     888  *   0.6    40.3     1704.   1171.   NACCEPT  *  16.74   6363.   4123.   NACCEPT     -0.2952E 04
 392     890  *   1.5    22.5     3346.   2231.   NACCEPT  *  16.74   5205.   3403.   NACCEPT     -0.1171E 04
 393     892  *   1.3    25.4     1753.   1203.   NACCEPT  *  16.74   3271.   2183.   NACCEPT     -0.9801E 03
 394     894  *   2.1    18.5     4363.   2875.   NACCEPT  *  16.74   5086.   3329.   NACCEPT     -0.4540E 03
 395     896  *   0.5    51.1     1263.    880.   PACCEPT  *  16.74   6730.   4350.   NACCEPT     -0.3470E 04
 396     898  *   0.7    37.8     2045.   1394.   NACCEPT  *  16.74   6933.   4475.   NACCEPT     -0.3081E 04
 397     900  *   1.1    28.2     2267.   1538.   NACCEPT  *  16.74   4972.   3257.   NACCEPT     -0.1719E 04
 398     902  *   1.4    23.5     2217.   1505.   NACCEPT  *  16.74   3688.   2449.   NACCEPT     -0.9432E 03
 399     904  *   1.6    21.8     2130.   1449.   NACCEPT  *  16.74   3175.   2122.   NACCEPT     -0.6728E 03
 400     906  *   1.8    20.2     2386.   1615.   NACCEPT  *  16.74   3174.   2122.   NACCEPT     -0.5066E 03

DATA    DEPTH  *  F(K)  PORF(K)   SPCONF   TDSF    REMARKS  *  PORFF   SPCOFF   TDSFF   REMARKS      DIFFER(TDS)


                              PROGRAM TIME IN SECONDS =  0.1712500E 03


                   PROGRAM BY----

                        RONALD M. BRIMHALL
                        BOX 31 CAMPUS STA.
                        SOCORRO, N. M.   87801
/&
JOB TIME SUMMARY...COMPILE 0174S   ASSEMBLE 0000S   LNKEDT 0053S   UTILS 0000S   USER 0363S      TOTAL TIME  009M 50S
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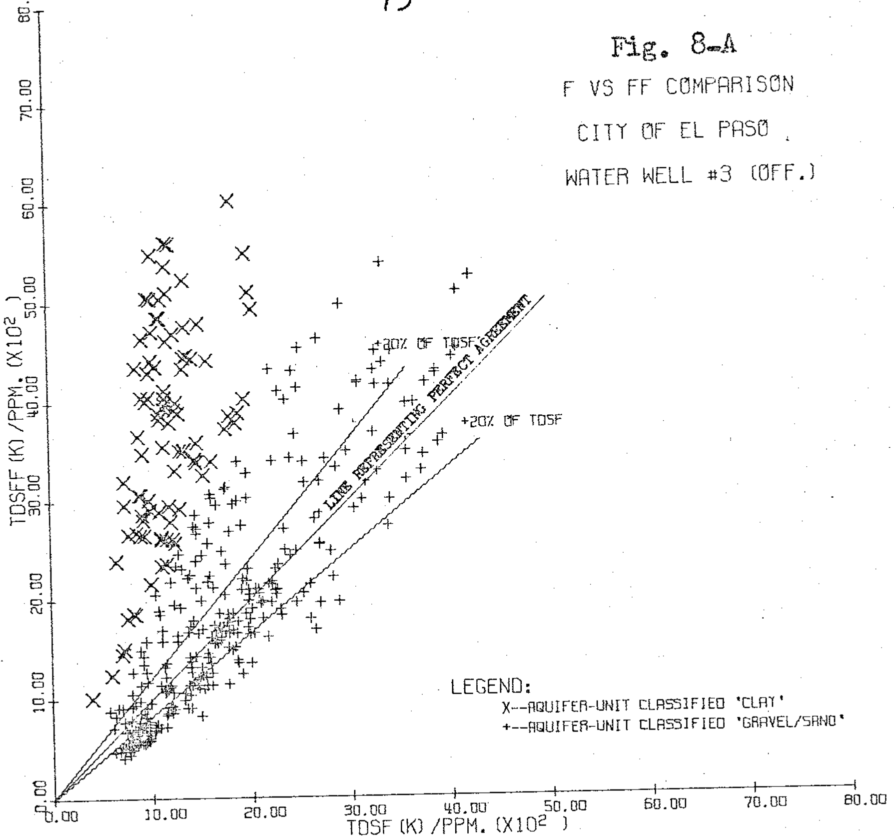

Fig. 8-A

F VS FF COMPARISON

CITY OF EL PASO

WATER WELL #3 (OFF.)

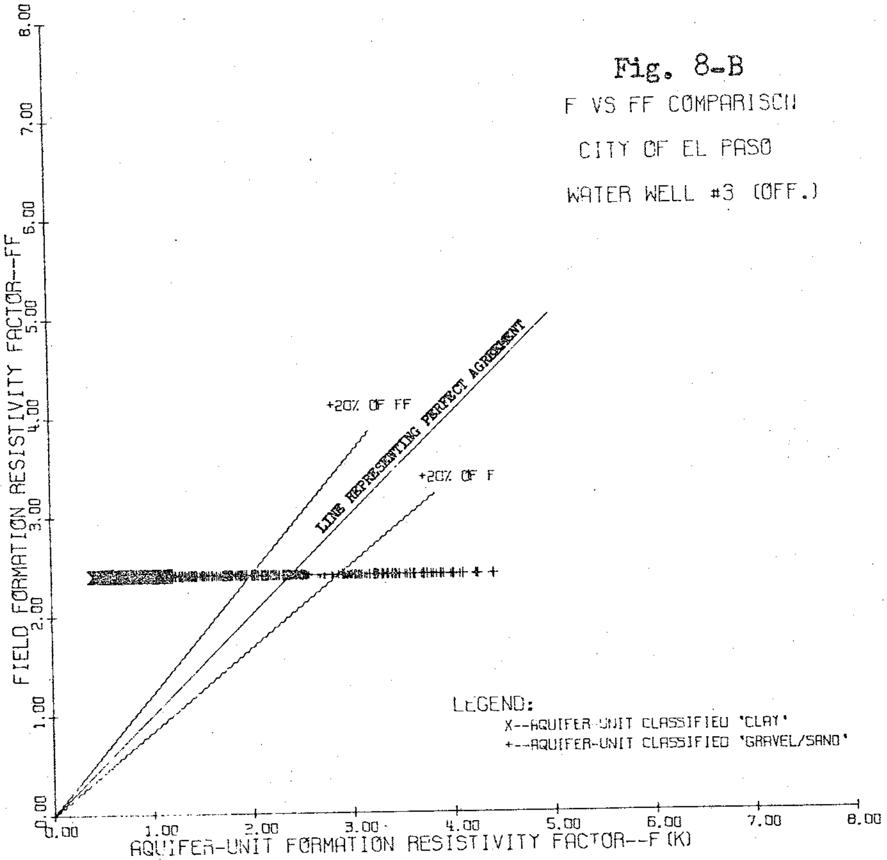

Fig. 8-B

F VS FF COMPARISON

CITY OF EL PASO

WATER WELL #3 (OFF.)

the F and FF-Methods: City

FVSFF2--City of Belen Water Well #4

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FORTRAN IV    MODEL 44  PS       VERSION 3   LEVEL 1   DATE  69118      NEW MEXICO TECH     PAGE  0001
                 014P,10,858,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
           C      RONALD M. BRIMHALL
           C      ------------------------------------------------------------------
           C      COMPARISON OF WATER QUALITY DETERMINATIONS FROM 'AQUIFER UNIT F'
           C      AND 'FIELD FORMATION RESISTIVITY FACTOR F(F)'
           C      ******************************************************************
           C      CITY OF BELEN--WATER WELL #4   PLOTS
           C      RESISTIVITY LOG INTERPRETATION PROGRAM FVSFF2---
           C
           C
           C
           C      ******************************************************************
           C      PURPOSE OF FVSFF2---
           C
           C      FVSFFZ COMPARES TOTAL DISSOLVED SOLIDS DETERMINATIONS COMPUTED
           C      BY THE F-METHOD AND THE FF-METHOD (BRIMHALL, 1969).  THIS COM-
           C      PARISON IS FOR EVALUATING ONE METHOD AGAINST THE OTHER.  THE RE-
           C      SULTS ARE PRESENTED IN TABLE FORM--COLUMNS LISTING DATA POINT
           C      NUMBER, DEPTH, F, POROSITY INDEX, SPECIFIC CONDUCTANCE AND RESIS-
           C      TIVITY OF WATER, REMARKS STATING THE ACCEPTABILITY OF WATER, AND
           C      THE ARITHMETIC DIFFERENCE BETWEEN VALUES OF TDSF AND TDSFF EX-
           C      PRESSED AS DIFFER(TDS) = TDSF-TDSFF--THE PLOT TDSF VS TDSFF ILLUS-
           C      TRATES DIFFERENCES GRAPHICALLY  THE PLOT F VS FF SHOWS THE VARIA-
           C      TION OF THE APPARENT FORMATION RESISTIVITY FACTOR FROM MINIMUM TO
           C      MAXIMUM VALUE.  CLAY BEARING BEDS ARE DISTINGUISHED FROM SANDS
           C      AND GRAVELS ON THE PLOTS.  FVSFF2 IS APPLICABLE TO ANY GEOGRAPHIC
           C      AREA BUT IS LIMITED TO WATER WELLS WHICH HAVE BEEN LOGGED BY A
           C      MACRORESISTIVITY DEVICE AND A MICROLOG.
           C
           C
           C
           C      ******************************************************************
           C      REFERENCES---
           C
           C      BRIMHALL, R. M., DIGITAL ANALYSIS   OF BOREHOLE-MEASURED AQUIFER
           C      RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER OF
           C      SCIENCE THESIS, N. MEX. INST. MIN. AND TECH., SOCORRO, JUNE 1969.
           C
           C      CALIFORNIA COMPUTER PRODUCTS, PROGRAMMING FOR CALCOMP DIGITAL
           C      INCREMENTAL PLOTTERS, ANAHIEM, 1966.
           C
           C      TODD, D. K., GROUND WATER HYDROLOGY, WILEY, NEW YORK, 1959.
           C      ******************************************************************
           C
           C
           C
           C      ******************************************************************
           C      NOMENCLATURE---
           C
           C      SCALAR QUANTITIES--
           C      T1 = INITIAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
           C      I = SUBSCRIPT FOR ABSCISSA OF FPN.
           C      K = INTEGER SUBSCRIPT OR REPEAT CYCLE IN CALL SCALE--K=1.
           C      RMF = MUD FILTRATE RESISTIVITY--OHM-METERS.
           C      RMC = MUD CAKE RESISTIVITY--OHM-METERS.
           C      AM = CEMENTATION EXPONENT IN F = A/POR**AM.
           C      PHIC = EMPIRICAL POROSITY INDEX ABOVE WHICH THE AQUIFER UNIT IS
           C      CLASSIFIED CLAY ON THE COORDINATE PLOTS--%.
           C      AVTEMP = AVERAGE SURFACE TEMPERATURE FOR CALCULATING GRAD.
           C      TD = TOTAL DEPTH OF WELL FOR CALCULATING GRAD.
           C      BHT = BOTTOM HOLE TEMPERATURE FOR CALCULATING GRAD.
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           C      N = NUMBER OF DATA POINTS AND DO 200 ITERATIONS.
           C      A = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
           C      B = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
           C      C = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
           C      D = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
           C      E = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
           C      Q = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
           C      G = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
           C      GRAD = TEMPERATURE GRADIENT OF AQUIFER.
           C      T2 = FINAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
           C      TIME = PROGRAM EXECUTION TIME--SECONDS.
           C      J = INTEGER SUBSCRIPT, OR DO INDEX, OR SYMBOL CONTROL IN CALL
           C      LINE.
           C      TEMP = TEMPORARY STORAGE LOCATION.
           C      SW = MAXIMUM LENGTH OF LINE REPRESENTING ABSCISSA.
           C      SH = MAXIMUM LENGTH OF LINE REPRESENTING ORDINATE.
           C      DIV = NUMBER OF DIVISIONS PER FOOT OF ABSCISSA AND ORDINATE.
           C      XO = ABSCISSA COORDINATE OF THE STARTING POINT OF ORDINATE AXIS.
           C      YO = ORDINATE COORDINATE OF THE STARTING POINT OF ORDINATE AXIS.
           C      NCO = NUMBER OF CHARACTERS IN THE ORDINATE AXIS TITLE IN CALL AXIS.
           C      THETA = ANGLE OF THE ORDINATE AND ABSCISSA AXIS--DEGREES.
           C      XA = ABSCISSA COORDINATE OF THE STARTING POINT OF ABSCISSA AXIS.
           C      YA = ORDINATE COORDINATE OF THE STARTING POINT OF ABSCISSA AXIS.
           C      NCA = NUMBER OF CHARACTERS IN THE ABSCISSA AXIS TITLE IN CALL AXIS.
           C      X = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
           C      CALL SYMBOL.
           C      HEIGHT = HEIGHT OF CHARACTERS TO BE DRAWN BY CALL SYMBOL.
           C      IS = INITIAL VALUE OF DO INDEX IN READ NONNUMERIC DATA.
           C      IE = TERMINAL VALUE OF DO INDEX IN READ NONNUMERIC DATA.
           C
           C
           C
           C      SUBSCRIPTED VARIABLES--
           C      IDATA = DATA POINT NUMBER.
           C      RMN = MICRONORMAL RESISTIVITY READ FROM MICROLOG--OHM-METERS.
           C      RO = DEEP INDUCTION RESISTIVITY--OHM-METERS.
           C      JDEPTH = DATA PUINT DEPTH----FEET.
           C      F = APPARENT FORMATION RESISTIVITY FACTOR USED IN F-METHOD.
           C      FF = FIELD FORMATION RESISTIVITY FACTOR USED IN FF-METHOD.
           C      TDSF = TOTAL DISSOLVED SOLIDS CONCENTRATIONS DETERMINED BY THE FF-
           C      METHOD--PPM.
           C      TDSFF = TOTAL DISSOLVED SOLIDS CONCENTRATIONS DETERMINED BY THE
           C      FF-METHOD--PPM.
           C      RWF = WATER RESISTIVITY DETERMINED BY THE F-METHOD--OHM-METERS.
           C      RWFF = WATER RESISTIVITY DETERMINED BY THE FF-METHOD--OHM-METERS.
           C      SPCONF = WATER SPECIFIC CONDUCTANCE DETERMINED BY THE F-METHOD--
           C      MICROMHOS PER CENTIMETER.
           C      SPCOFF = WATER SPECIFIC CONDUCTANCE DETERMINED BY THE FF-METHOD--
           C      MICROMHOS PER CENTIMETER.
           C      ERROR = NAME OF DIFFER(TDS) = TDSF-TDSFF.
           C      PORF = POROSITY INDEX DETERMINED BY THE F-METHOD--%.
           C      PORFF = POROSITY INDEX DETERMINED BY THE FF-METHOD--%.
           C      ORD = NAME OF THE ARRAY TO BE PLOTTED AS ORDINATE--TDSFF AND FF.
           C      LAB1 = NAME OF ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT
           C      PLOT TDSF VS TDSFF.
           C      LAB2 = NAME OF ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT
           C      PLOT TDSFF VS TDSFF.
           C      ABS = NAME OF THE ARRAY TO BE PLOTTED AS ABSCISSA--TDSF AND F.
           C      Y = ORDINATE COORDINATE OF THE LOWER LEFT CORNER OF THE FIRST
           C      SYMBOL IN CALL SYMBOL.
           C      NS = NUMBER OF CHARACTERS IN LABEL AT CALL SYMBOL.
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                 C      RXOC = MICRONORMAL RESISTIVITY CORRECTED FOR TEMPERATURE AND
                 C             MUDCAKE--OHM/METERS.
                 C      ROC = TEMPERATURE CORRECTED DEEP INDUCTION RESISTIVITY--OHM-METERS
                 C      LAB3 = NAME OF ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT
                 C      PLOT F VS FF.
                 C      LAB4 = NAME OF ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT
                 C      PLOT F VS FF.
                 C      X2 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      Y2 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      X3 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      Y3 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      X4 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      Y4 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      X5 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      Y5 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      X6 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      Y6 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                 C      CALL SYMBOL--TO LEGEND PLOT.
                 C      NS2 = NUMBER OF CHARACTERS IN THE LABEL.
                 C      NS3 = NUMBER OF CHARACTERS IN THE LABEL.
                 C      NS4 = NUMBER OF CHARACTERS IN THE LABEL.
                 C      NS5 = NUMBER OF CHARACTERS IN THE LABEL.
                 C      NS6 = NUMBER OF CHARACTERS IN THE LABEL.
                 C      PORF1 = SECONDARY STORAGE ARRAY OF PORF FOR SORTING IN PREPARATION
                 C      TO PLOT.
                 C      JDEPTH1 = SECONDARY STORAGE ARRAY OF JDEPTH FOR SORTING IN PREPA-
                 C      RATION TO PLOT.
                 C      RXO1 = MICRONORMAL RESISTIVITY CORRECTED FOR MUD CAKE--OHM-METERS.
                 C      W = RATIO RMN/RMC--A PARAMETER IN MUD CAKE CORRECTIONS.
                 C      BCD = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                 C      NS(1), ETC.
                 C      BCE = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                 C      NS2(1), ETC.
                 C      BCF = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                 C      NS3(1), ETC.
                 C      BCG = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                 C      NS4(1), ETC.
                 C      BCH = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                 C      NS5(1), ETC.
                 C      BCI = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                 C      NS6(1), ETC.
                 C      *****************************************************************
                 C
                 C
                 C
                 C      *****************************************************************
                 C      SUBROUTINES CALLED--NEW MEXICO TECH COMPUTER.
                 C      CLOCK
                 C      IBCOM#
                 C      SETMSG
                 C      PLOT


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                 C      SCALE
                 C      AXIS
                 C      SYMBOL
                 C      FRXPR#
                 C      *****************************************************************
                 C
 0001                   CALL CLOCK(T1)
 0002                   DIMENSIONIDATA(500),RXO(500),RO(500),JDEPTH(500),F(502),TDSF(502),
                       *TDSFF(502),RWF(500),SPCONF(500),SPCOFF(500),ERROR(500),PORF(500),O
                       *RD(502),LAB1(24),LAB2(32),ABS(502),Y(3),NS(3),FF(502),PORFF(500),R
                       *WFF(500),RXOC(500),ROC(500),LAB3(48),LAB4(48),X2(2),Y2(2),X3(1),Y3
                       *(1),X4(2),Y4(2),NS2(2),NS3(1),NS4(2),X5(2),Y5(2),NS5(2),X6(1),Y6(1
                       *),NS6(1),PORF1(500),JDEPT1(500)
                       *,RXO1(500),W(500)
 0003                    INTEGER BCD(15),BCE(8),BCF(2),BCG(20)
                       *,BCH(3)
                       *,BCI(10)
                 C
                 C      READ ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT PLOT TDSF
                 C      VS TDSFF.
 0004                   READ(5,1001)(LAB1(I),I=1,4)
 0005              1001 FORMAT(4A4)
                 C
                 C      READ ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT PLOT TDSF
                 C      VS TDSFF.
 0006                   READ(5,1002)(LAB2(I),I = 1,3)
 0007              1002 FORMAT(3A4)
                 C
                 C      READ ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT PLOT F VS
                 C      FF.
 0008                   READ(5,1003)(LAB3(I),I = 1,10)
 0009              1003 FORMAT(10A4)
                 C      READ ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT PLOT F VS
                 C      FF.
 0010                   READ(5,1004)(LAB4(I),I = 1,12)
 0011              1004 FORMAT(12A4)
                 C
                 C      PARAMETRIC DATA.
 0012                   AVTEMP = 72.
 0013                   TD =  607.
 0014                   BHT = 80.
 0015                   PHIC = 24.
 0016                   AM = 1.5
 0017                   RMF = 9.66
 0018                   RMC = 14.0
 0019                   N = 291
                 C
                 C      READ RESISTIVITY DATA FROM CARDS.
 0020                   READ(5,1)(IDATA(K),JDEPTH(K),RXO(K),RO(K), K = 1,N)
 0021                 1 FORMAT(2I4,1X,F4.1,F5.1)
                 C
                 C      IDENTIFY PROBLEM AND WRITE SOME PARAMETRIC DATA.
 0022                   WRITE(6,2)
 0023                 2 FORMAT('9',/40X,'VALENCIA COUNTY NEW MEXICO WATER WELL',/46X,'(CIT
                       *Y OF BELEN WATER WELL #4)',/41X,'AQUIFER -F- AND FIELD -F- COMPARI
                       *SON',///3X,'FIELD FORMATION RES. FACTOR-FF = 2.4',/30X,'RMF = 10.8
                       * @ 69 F',/32X,'M = 0.88 FOR PORF(K) CALCULATIONS')
                 C
                 C      LABEL COLUMNS FOR LINE PRINTER RESULTS.
 0024                   WRITE(6,300)
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0025            300 FORMAT(/  3X,'DATA',4X,'DEPTH',2X,'*',2X,'F(K)',3X,'PORF(K)',3X,'S
                   *PCONF',3X,'TDSF',4X,'REMARKS',2X,'*',2X,'PORFF',3X,'SPCOFF',3X,'TD
                   *SFF',4X,'REMARKS',7X,'DIFFER(TDS)')
               C
               C      LIST FF IN N LOCATIONS.
0026                            DO 8888  K = 1,N
0027             8888           FF(K) = 2.42
               C
               C      CONSTANTS FOR MUD CAKE THICKNESS OF 1/8 INCHES
               C      ...............................................................
0028                  A = -0.3299839E-04
0029                  B = +0.1307268E-01
0030                  C = -0.2115985E+00
0031                  D = 0.1284551E+01
0032                  E = -0.3342364E+01
0033                  Q = +0.5336034E+01
0034                  G = -0.1959661E+01
               C
               C      DETERMINE TEMPERATURE GRADIENT.
0035              702 GRAD = (BHT-AVTEMP)/TD
               C
               C      PRIMARY DO LOOP.
0036                  DO 200 K = 1,N
               C
               C      APPLY MUD CAKE CORRECTIONS.
               C      MUDCAKE CORRECTION FOR TMC = 1/8 INCH ASSUMED
               C       ADAPTED FROM SCHLUMBERGER 'LOG INTERPRETATION CHARTS', 1968, P34.
0037                  W(K) = RXO(K)/RMC
0038                  RXO1(K) = (A*W(K)**6+B*W(K)**5+C*W(K)**4+D*W(K)**3+E*W(K)**2+Q*W(K
                     *)+G)*RMC
               C
               C      MAKE ALL DATA POINTS CALCULABLE.
0039                  IF(RXO1(K).LE.0.0)GO TO 611
               C
               C      APPLY TEMPERATURE CORRECTIONS.
0040              700 ROC(K) = RO(K)*(AVTEMP + GRAD*JDEPTH(K))/77.
0041                  RXOC(K) = RXO1(K)*(AVTEMP + GRAD*JDEPTH(K))/77.
0042                  GO TO 701
0043              611 RXO1(K) = RXO(K)
0044                  GO TO 700
               C
               C      DETERMINE RW, SPCOND, TDS BY F-METHOD.
0045              701 F(K) = RXOC(K)/RMF
0046              706 RWF(K) = ROC(K)/F(K)
0047              707 SPCONF(K) = 10000.00/RWF(K)
0048              710 TDSF(K) = 6400./RWF(K)
               C
               C      DETERMINE RW, SPCOND, TDS BY FF-METHOD.
0049              708 RWFF(K) = ROC(K)/FF(K)
0050              709 SPCOFF(K) = 10000.00/RWFF(K)
0051              711 TDSFF(K) = 6400./RWFF(K)
               C
               C      DETERMINE DIFFERENCE IN TDS VALUES.
0052              714 ERROR(K) = TDSF(K) - TDSFF(K)
               C
               C      DETERMINE POROSITY INDEX.
0053              713 PORF(K) = 30.0/(F(K)**(1.0/AM))
               C
               C      DETERMINE POROSITY INDEX BASED ON FF.
0054              712 PORFF(K) = 30.0/(FF(K)**(1.0/AM))


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               C
               C      CLASSIFY EACH TDSF-TDSFF SET BY WATER QUALITY.
               C
               C      U. S. PUBLIC HEALTH STANDARDS(TODD, 1959)--
               C           NACCEPT = TDS.GT.1000 PPM.
               C           PACCEPT = 500 PPM. .LT. TDS .LT. 1000 PPM.
               C            GOOD = TDS .LT. 500 PPM.
0055                  IF(TDSF(K).GE.1000..AND.TDSFF(K).GE.1000.)GO TO 10
0056                  IF(TDSF(K).GE.1000.0.AND.TDSFF(K).GE.500.0.AND.TDSFF(K).LE.1000.0)
                     *GO TO 30
0057                  IF(TDSF(K).LE.1000.0.AND.TDSF(K).GE.500.0.AND.TDSFF(K).GE.1000.0)
                     *GO TO 40
0058                  IF(TDSF(K).GE.500.0.AND.TDSF(K).LE.1000.0.AND.TDSFF(K).GE.500.0.AN
                     %D.TDSFF(K).LE.1000.0)GO TO 50
0059                  IF(TDSF(K).LE.500..AND.TDSFF(K).GE.1000.)GO TO 60
0060                  IF(TDSF(K).LE.500.0.AND.TDSFF(K).LE.500.0)GO TO 20
0061                  IF(TDSF(K).GE.1000..AND.TDSFF(K).LE.500.)GO TO 70
0062                  IF(TDSF(K).LT.500.0.AND.TDSFF(K).GE.500.0.AND.TDSFF(K).LT.1000.0)
                     *GO TO 80
0063                  IF(TDSF(K).GE.500.0.AND.TDSF(K).LT.1000.0.AND.TDSFF(K).LT.500.0)GO
                     *TO 90
0064               10 WRITE(6,3)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF(
                     *K),SPCOFF(K),TDSFF(K),ERROR(K)
0065                3 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X, F6.0,3X,'NAC
                     *CEPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'NACCEPT',7X,E11.4)
0066                  GO TO 200
0067               20 WRITE(6,21)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                     *(K),SPCOFF(K),TDSFF(K),ERROR(K)
0068               21 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,6X,'GOOD
                     *',2X,'*',2X,F5.2,2(3X,F6.0),6X,'GOOD',7X,E11.4)
0069                  GO TO 200
0070               30 WRITE(6,31)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                     *(K),SPCOFF(K),TDSFF(K),ERROR(K)
0071               31 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'NACC
                     *EPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'PACCEPT',7X,E11.4)
0072                  GO TO 200
0073               40 WRITE(6,41)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                     *(K),SPCOFF(K),TDSFF(K),ERROR(K)
0074               41 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'PACC
                     *EPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'NACCEPT',7X,E11.4)
0075                  GO TO 200
0076               50 WRITE(6,51)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                     *(K),SPCOFF(K),TDSFF(K),ERROR(K)
0077               51 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'PACC
                     *EPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'PACCEPT',7X,E11.4)
0078                  GO TO 200
0079               60 WRITE(6,61)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                     *(K),SPCOFF(K),TDSFF(K),ERROR(K)
0080               61 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,6X,'GOOD
                     *',2X,'*',2X,F5.2,2(3X,F6.0),3X,'NACCEPT',7X,E11.4)
0081                  GO TO 200
0082               70 WRITE(6,71)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                     *(K),SPCOFF(K),TDSFF(K),ERROR(K)
0083               71 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'NACC
                     *EPT',2X,'*',2X,F5.2,2(3X,F6.0),6X,'GOOD',7X,E11.4)
0084                  GO TO 200
0085               80 WRITE(6,81)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                     *(K),SPCOFF(K),TDSFF(K),ERROR(K)
0086               81 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,6X,'GOOD
                     *',2X,'*',2X,F5.2,2(3X,F6.0),3X,'PACCEPT',7X,E11.4)
```

```
      GO TO 200
   90 WRITE(6,91)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
     *(K),SPCOFF(K),TUSFF(K),ERROR(K)
   91 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'PACC
     *EPT',2X,'*',2X,F5.2,2(3X,F6.0),6X,'GOOD',7X,E11.4)
      N = 291
  200 CONTINUE
C
C     LABEL COLUMNS AT LINE PRINTER.
      WRITE(6,300)
      CALL CLOCK(T2)
      TIME = T1 - T2
      WRITE(6,102)TIME
  102 FORMAT(////40X,'PROGRAM TIME IN SECONDS = ',E14.7)
C
C     IDENTIFY PROGRAMMER.
      WRITE(6,9999)
 9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'B
     *OX 31 CAMPUS STA.',/30X,'SOCORRO, N. M.   87801')
C
C     RESCALE TDSF AND TDSFF FOR PLOT.
      DO 201 K = 1,N
      TDSF(K) = TDSF(K)*2.0E-03
      TDSFF(K) = TDSFF(K)*2.0E-03
  201 CONTINUE
C
C     DUPLICATE PORF AND JDEPTH IN PREPARATION TO SORT.
      DO 12 I = 1,N
   12 PORF1(I) = PORF(I)
C
C
C     SORT TDSF, TDSFF, PORF, JDEPTH IN ASCENDING ORDER.
C      ###########  SURT  ###########
      N = 291
      DO 110 I = 1,N
      DO 110 J = 1,N
      IF(TDSF(I).LE.TDSF(J))GO TO 110
            TEMP = TDSF(I)
            TDSF(I) = TDSF(J)
            TDSF(J) = TEMP
            TEMP = TDSFF(I)
            TDSFF(I) = TDSFF(J)
            TDSFF(J) = TEMP
           TEMP = PORF(I)
           PORF(I) = PURF(J)
           PORF(J) = TEMP
  110 CONTINUE
C
C
C     SORT F, FF, PORF1, JDEPTH1, IN ASCENDING ORDER.
C     ###########  SORT  ###########
      DO 11 I = 1,N
      DO 11 J = 1,N
            IF(F(I).LE.F(J))GO TO 11
            TEMP = F(I)
            F(I) = F(J)
            F(J) = TEMP
           TEMP = FF(I)
            FF(I) = FF(J)
           FF(J) = TEMP
```

```
            TEMP = PORF1(I)
            PORF1(I) = PORF1(J)
            PORF1(J) = TEMP
   11 CONTINUE
         N = 291
C
C
C     ***************  PLOT DATA  ***************
C
      CALL SETMSG(28,'R. BRIMHALL COORD-PLOT BELEN')
C
C     SET PEN AT FULL RIGHT.
      CALL PLOT(0.,-1.5,-3)
C
C     SET NEW CENTER UF COORDINATES.
      CALL PLOT(10.,1.5,-3)
C
C     ++++++++++++++++++++  PLOT TDSF VS TDSFF  +++++++++++++++
C
C     PLOT ONE-TO-ONE LINE AND RELATIVE ACCURACY LINES.
      CALL PLOT(5.,5.,2)
      CALL PLOT(3.59,4.45,3)
      CALL PLOT(0.,0.,2)
      CALL PLOT(4.45,3.60,2)
C
C     SET SCALE OF COORDINATES WITH CALL SCALE.
      SW = 8.
      SH = 8.
      N = 291
      DIV = 10.
      CALL SCALE(TDSF(1),SW,N,1,DIV)
 6044 N = 291
      CALL SCALE(TDSFF(1),SH,N,1,DIV)
      N = 291
C
C     PLOT AND LABEL COORDINATE AXIS WITH CALL AXIS.
      ORD(N+1) = 0.0
      ABS(N+1) = 0.0
      ORD(N+2) = 500.
      ABS(N+2) = 500.
      XO = 0.
      YO = 0.
      NCO = 13
      THETA = 90.
      CALL AXIS(XO,YO,LAB1,NCO,SH,THETA,ORD(N+1),ORD(N+2),DIV)
      XA = 0.
      YA = 0.
      NCA = -12
      THETA = 0.
      CALL AXIS(XA,YA,LAB2,NCA,SW,THETA,ABS(N+1),ABS(N+2),DIV)
      N = 291
C
C     PLOT TDSF AND TUSFF AND DISTINGUISH CLAY FROM SAND AND GRAVELS.
            DO   11111  I = 1,N
                  IF(PORF(I).GT.PHIC)GO TO 11115
11117     CALL SYMBOL(TDSF(I),TDSFF(I),0.10,3,0.,-1)
                  GO TO 11111
11115     CALL SYMBOL(TDSF(I),TDSFF(I),0.14,4,0.,-1)
11111     CONTINUE
C
```

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              C      LABEL PLOT ''F VS FF COMPARISON'' AND IDENTIFY WELL.
                     X = 5.25
                     HEIGHT = 0.15
                     THETA = 0.
                     N = 3
                     DO 500 I = 1,N
                     IS = 5*(I-1)+1
                     IE = IS + 4
                 500 READ(5,2001)Y(I),(BCD(J),J = IS,IE),NS(I)
                2001 FORMAT(F4.2,5A4,I2)
                3001            CALL SYMBOL(X,Y(1),HEIGHT,BCD(1),THETA,NS(1))
                3002            CALL SYMBOL(X,Y(2),HEIGHT,BCD(6),THETA,NS(2))
                3003            CALL SYMBOL(X,Y(3),HEIGHT,BCD(11),THETA,NS(3))
                        N = 2
              C
              C      READ LEGEND ALPHABETIC DATA AND WRITE LEGEND WITH CALL SYMBOL.
                     DO 502 I = 1,N
                     IS = 4*(I-1)+1
                     IE = IS + 3
                 502 READ(5,2002)X2(I),Y2(I),(BCE(J),J = IS,IE),NS2(I)
                2002 FORMAT(2F5.2,4A4,I2)
                     HEIGHT = 0.10
                     CALL SYMBOL(X2(1),Y2(1),HEIGHT,BCE(1),THETA,NS2(1))
                     CALL SYMBOL(X2(2),Y2(2),HEIGHT,BCE(5),THETA,NS2(2))
                 503 READ(5,2003)X3(1),Y3(1),(BCF(J),J = 1,2),NS3(1)
                2003 FORMAT(2F5.2,2A4,I2)
                     HEIGHT = 0.14
                     CALL SYMBOL(X3(1),Y3(1),HEIGHT,BCF(1),THETA,NS3(1))
                     N = 2
                     DO 504 I = 1,N
                     IS = 10*(I-1) + 1
                     IE = IS + 9
                 504 READ(5,2004)X4(I),Y4(I),(BCG(J),J = IS,IE),NS4(I)
                2004 FORMAT(2F5.2,10A4,I2)
                     HEIGHT = 0.10
                     CALL SYMBOL(X4(1),Y4(1),HEIGHT,BCG(1),THETA,NS4(1))
                     CALL SYMBOL(X4(2),Y4(2),HEIGHT,BCG(11),THETA,NS4(2))
              C
              C
              C                       PLOT F VS FF
              C
              C
              C
              C      SET NEW COORDINATE AXIS FOR F VS FF PLOT.
              30031 CALL PLOT(18.,0.,-3)
              C
              C      PLOT ONE-TO-ONE LINE AND RELATIVE ACCURACY LINES.
              30041 CALL PLOT(5.,5.,2)
                    CALL PLOT(3.2,3.84,3)
                    CALL PLOT(0.,0.,2)
                    CALL PLOT(3.84,3.2,2)
              C
              C      SET SCALE OF COORDINATES WITH CALL SCALE.
               3005 N = 291
               3006 CALL SCALE(F(1),SW,N,1,DIV)
                    N = 291
               3007 CALL SCALE(FF(1),SH,N,1,DIV)
               3033 N = 291
              C
              C      PLOT AND LABEL COORDIATE AXIS WITH CALL AXIS.
               3008 ORD(N+2) = 1.

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               3009 ABS(N+2) = 1.
               3010 NCO = 38
               3011 THETA = 90.
               3012 CALL AXIS(XO,YO,LAB3,NCO,SH,THETA,ORD(N+1),ORD(N+2),DIV)
               3013 NCA = -47
               3014 THETA = 0.
               3015 CALL AXIS(XA,YA,LAB4,NCA,SW,THETA,ABS(N+1),ABS(N+2),DIV)
                    N = 291
              C
              C      PLOT F VS FF AND DISTINGUISH CLAY FROM SAND AND GRAVEL.
                             DO 22221  I = 1,N
                                 IF(PORFI(I).GT.PHIC)GO TO 22226
              22227           CALL SYMBOL(F(I),FF(I),0.10,3,0.,-1)
                                   GO TO 22221
              22226         CALL SYMBOL(F(I),FF(I),0.14,4,0.,-1)
              22221        CONTINUE
              C
              C      LABEL PLOT ''F VS FF COMPARISON'' AND IDENTIFY WELL.
                     X = 5.25
                     HEIGHT = 0.15
                     THETA = 0.
                               CALL SYMBOL(X,Y(1),HEIGHT,BCD(1),THETA,NS(1))
                               CALL SYMBOL(X,Y(2),HEIGHT,BCD(6),THETA,NS(2))
                               CALL SYMBOL(X,Y(3),HEIGHT,BCD(11),THETA,NS(3))
                        N = 2
              C
              C      READ LEGEND ALPHABETIC DATA AND WRITE LEGEND WITH CALL SYMBOL.
                        DO 512 I = 1,N
                        IS = 3*(I-1) + 1
                        IE = IS + 2
                 512       READ(5,2012)X5(I),Y5(I),(BCH(J),J = IS,IE),NS5(I)
                2012    FORMAT(2F5.2,3A4,I2)
                        HEIGHT = 0.10
                        CALL SYMBOL(X5(1),Y5(1),HEIGHT,BCH(1),THETA,NS5(1))
                        CALL SYMBOL(X5(2),Y5(2),HEIGHT,BCH(4),THETA,NS5(2))
                     HEIGHT = 0.14
                     CALL SYMBOL(X3(1),Y3(1),HEIGHT,BCF(1),THETA,NS3(1))
                     HEIGHT = 0.10
                     CALL SYMBOL(X4(1),Y4(1),HEIGHT,BCG(1),THETA,NS4(1))
                 505 READ(5,2005)X6(1),Y6(1),(BCI(J), J = 1,10),NS6(1)
                2005 FORMAT(2F5.2,10A4,I2)
                     CALL SYMBOL(X6(1),Y6(1),HEIGHT,BCI(1),THETA,NS6(1))
              C
              C      FILE MARK.
                     CALL PLOT(14.0,0.0,999)
                     STOP
                     END
```

```
                                          SCALAR MAP
SYMBOL     LOCATION       SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION
TI         00023C         I          000240       AVTEMP     000244       TD         000248       BHT        00024C
PHIC       000250         AM         000254       RMF        000258       RMC        00025C       N          000260
K          000264         A          000268       B          00026C       C          000270       D          000274
E          000278         O          00027C       G          000280       GRAD       000284       TZ         000288
TIME       00028C         J          000290       TEMP       000294       SW         000298       SH         00029C
DIV        0002A0         XO         0002A4       YO         0002A8       NCO        0002AC       THETA      0002B0
XA         0002B4         YA         0002B8       NCA        0002BC       X          0002C0       HEIGHT     0002C4
IS         0002C8         IE         0002CC
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                                            ARRAY MAP
SYMBOL      LOCATION       SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION
IDATA       0002D0         RXO        000AA0       RO         001270       JDEPTH     001A40       F          002210
TDSF        0029E8         TDSFF      0031C0       RWF        003998       SPCONF     004168       SPCOFF     004938
ERROR       005108         PORF       0058D8       ORD        0060A8       LAB1       006880       LAB2       0068E0
ABS         006960         Y          007138       NS         007144       FF         007150       PORFF      007928
RWFF        0080F8         RXOC       0088C8       ROC        009098       LAB3       009868       LAB4       009928
X2          0099E8         Y2         0099F0       X3         0099F8       Y3         0099FC       X4         009A00
Y4          009A08         NS2        009A10       NS3        009A18       NS4        009A1C       X5         009A24
Y5          009A2C         NS5        009A34       X6         009A3C       Y6         009A40       NS6        009A44
PORF1       009A48         JDEPT1     00A218       RXO1       00A9E8       W          00B1B8       BCD        00B988
BCE         00B9C4         BCF        00B9E4       BCG        00B9EC       BCH        00BA3C       BCI        00BA48
                                          SUBPROGRAMS CALLED
SYMBOL      LOCATION       SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION     SYMBOL     LOCATION
CLOCK       00BA70         IBCOM#     00BA74       SETMSG     00BA78       PLOT       00BA7C       SCALE      00BA80
AXIS        00BA84         SYMBOL     00BA88       FRXPR#     00BA8C
                                            LABEL MAP
LABEL       LOCATION       LABEL      LOCATION     LABEL      LOCATION     LABEL      LOCATION     LABEL      LOCATION
  1001      00BE90           1002     00BEEC         1003     00BF48         1004     00BFA4            1     00C05C
     2      00C08C            300     00C18C         8888     00C21E          702     00C280          700     00C324
   611      00C3AA            701     00C3C4          706     00C3E0          707     00C3FC          710     00C40C
   708      00C41C            709     00C434          711     00C448          714     00C458          713     00C464
   712      00C49C             10     00C71E            3     00C780           20     00C80C           21     00C898
    30      00C8F0             31     00C97C           40     00C9D8           41     00CA64           50     00CAC0
    51      00CB4C             60     00CBA8           61     00CC34           70     00CC90           71     00CD1C
    80      00CD78             81     00CE04           90     00CE60           91     00CEEC          200     00CF4E
   102      00CFB4           9999     00CFF8          201     000096           12     00D0B0          110     00D178
    11      00D222           6044     00D2D2        11117     00D3F2        11115     00D41A        11111     00D44C
   500      00D4B0           2001     00D53E         3001     000550         3002     00D576         3003     00D59C
   502      0005F8           2002     00D68A          503     00D704         2003     00D76C          504     00D7EE
  2004      00D882          30031     00D8FC        30041     00D906         3005     00D92E         3006     00D936
  3007      00D95C           3033     00D972         3008     00D97A         3009     00D98E         3010     00D996
  3011      00D99E           3012     00D9A6         3013     00D9CC         3014     00D9D8         3015     00D9E0
 22227      00DA30          22226     00DA5C        22221     00DA8A          512     00DB68         2012     00DBFA
   505      00DCE0           2005     00DD48

   TOTAL MEMORY REQUIREMENTS 00DEB4 BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
// EXEC LNKEDT(MAP)
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 69/118                                        58624    LINKAGE EDIT

                                                                                  CREATED
LIST        PHASE    FVSFF,*                                                      CREATED
LIST        INCLUDE  FVSFF,L
LIST    AUTOLINK     CLOCK
LIST    AUTOLINK     IBCOM#
LIST    AUTOLINK     PLOT
LIST     REP  000560 0010000,0000    PLOTAPE   22 DEC 68     W/O SENSW
LIST    AUTOLINK     SCALE
LIST    AUTOLINK     AXIS
LIST    AUTOLINK     SYMBOL
LIST    AUTOLINK     FRXPR#
LIST    AUTOLINK     RCBORG#
LIST    AUTOLINK     USEROPT
LIST    AUTOLINK     UNITAB#
LIST    AUTOLINK     ALOG
LIST    AUTOLINK     FRXPI#
LIST    AUTOLINK     NUMBER
LIST    AUTOLINK     COS
LIST    AUTOLINK     SQRT
LIST    AUTOLINK     EXP                                                          CREATED
LIST         ENTRY
```

```
                         VALENCIA COUNTY NEW MEXICO WATER WELL
                             (CITY OF BELEN WATER WELL #4)
                         AQUIFER -F- AND FIELD -F- COMPARISON

FIELD FORMATION RES. FACTOR-FF = 2.4
                           RMF = 10.8 @ 69 F
                             M = 0.88 FOR PORF(K) CALCULATIONS

DATA  DEPTH  *  F(K)  PORF(K)  SPCONF   TDSF   REMARKS  *  PORFF  SPCOFF  TDSFF  REMARKS    DIFFER(TDS)
  1     20   *  3.0    14.4     469.    300.     GOOD   *  16.64   379.   243.     GOOD     0.5767E 02
  2     22   *  2.9    14.7     519.    332.     GOOD   *  16.64   430.   275.     GOOD     0.5722E 02
  3     24   *  2.3    17.3     973.    623.  PACCEPT   *  16.64  1031.   660.  PACCEPT    -0.3668E 02
  4     26   *  2.4    16.6    1846.   1182.  NACCEPT   *  16.64  1840.  1178.  NACCEPT     0.4007E 01
  5     28   *  0.8    35.9     662.    424.     GOOD   *  16.64  2093.  1340.  NACCEPT    -0.9160E 03
  6     30   *  0.8    35.8     543.    348.     GOOD   *  16.64  1716.  1098.  NACCEPT    -0.7507E 03
  7     32   *  0.3    67.8     120.     77.     GOOD   *  16.64   990.   633.  PACCEPT    -0.5563E 03
  8     34   *  4.3    11.4     992.    635.  PACCEPT   *  16.64   559.   358.     GOOD     0.2773E 03
  9     36   *  4.3    11.4    2685.   1719.  NACCEPT   *  16.64  1512.   968.  PACCEPT     0.7506E 03
 10     38   *  0.8    35.8    1072.    686.  PACCEPT   *  16.64  3382.  2164.  NACCEPT    -0.1478E 04
 11     40   *  2.1    18.0    2962.   1895.  NACCEPT   *  16.64  3337.  2135.  NACCEPT    -0.2400E 03
 12     42   *  0.3    67.7     522.    334.     GOOD   *  16.64  4281.  2740.  NACCEPT    -0.2406E 04
 13     44   *  0.3    67.7     391.    250.     GOOD   *  16.64  3209.  2054.  NACCEPT    -0.1803E 04
 14     46   *  1.5    22.6     706.    452.     GOOD   *  16.64  1116.   714.  PACCEPT    -0.2625E 03
 15     48   *  3.3    13.5     688.    440.     GOOD   *  16.64   503.   322.     GOOD     0.1183E 03
 16     50   *  4.0    12.0     645.    413.     GOOD   *  16.64   395.   253.     GOOD     0.1602E 03
 17     52   *  4.0    12.0     635.    407.     GOOD   *  16.64   388.   249.     GOOD     0.1579E 03
 18     54   *  4.0    12.0     645.    413.     GOOD   *  16.64   394.   252.     GOOD     0.1604E 03
 19     56   *  4.0    12.0     518.    331.     GOOD   *  16.64   316.   202.     GOOD     0.1288E 03
 20     58   *  6.4     8.7     583.    373.     GOOD   *  16.64   221.   141.     GOOD     0.2316E 03
 21     60   *  6.4     8.7     845.    541.  PACCEPT   *  16.64   320.   205.     GOOD     0.3359E 03
 22     62   *  4.3    11.3    2536.   1623.  NACCEPT   *  16.64  1422.   910.  PACCEPT     0.7132E 03
 23     64   *  1.7    21.1    1322.    846.  PACCEPT   *  16.64  1881.  1204.  NACCEPT    -0.3580E 03
 24     66   *  0.6    42.8     319.    204.     GOOD   *  16.64  1311.   839.  PACCEPT    -0.6354E 03
 25     68   *  3.8    12.3    1606.   1028.  NACCEPT   *  16.64  1022.   654.  PACCEPT     0.3731E 03
 26     70   *  4.3    11.3    4962.   3176.  NACCEPT   *  16.64  2778.  1778.  NACCEPT     0.1398E 04
 27     72   *  0.5    48.2     557.    356.     GOOD   *  16.64  2747.  1758.  NACCEPT    -0.1402E 04
 28     74   *  0.8    35.7     558.    357.     GOOD   *  16.64  1749.  1119.  NACCEPT    -0.7623E 03
 29     76   *  1.4    24.4    1134.    726.  PACCEPT   *  16.64  2010.  1286.  NACCEPT    -0.5608E 03
 30     78   *  0.0    ****      20.     13.     GOOD   *  16.64  1748.  1119.  NACCEPT    -0.1105E 04
 31     80   *  3.0    14.6     779.    498.     GOOD   *  16.64   638.   408.     GOOD     0.9015E 02
 32     82   *  4.3    11.3     456.    292.     GOOD   *  16.64   255.   163.     GOOD     0.1290E 03
 33     84   *  4.2    11.6     663.    424.     GOOD   *  16.64   386.   247.     GOOD     0.1772E 03
 34     86   *  2.5    16.5     663.    424.     GOOD   *  16.64   653.   418.     GOOD     0.6009E 01
 35     88   *  2.5    16.5     699.    447.     GOOD   *  16.64   688.   441.     GOOD     0.6492E 01
 36     90   *  3.7    12.7     768.    492.     GOOD   *  16.64   509.   326.     GOOD     0.1657E 03
 37     92   *  3.7    12.7     768.    492.     GOOD   *  16.64   509.   326.     GOOD     0.1658E 03
 38     94   *  3.8    12.3    1029.    659.  PACCEPT   *  16.64   652.   418.     GOOD     0.2412E 03
 39     96   *  4.0    11.9    1048.    671.  PACCEPT   *  16.64   636.   407.     GOOD     0.2638E 03
 40     98   *  3.0    14.3     580.    371.     GOOD   *  16.64   462.   296.     GOOD     0.7551E 02
 41    100   *  3.9    12.1     526.    337.     GOOD   *  16.64   326.   209.     GOOD     0.1281E 03
 42    102   *  4.9    10.4     689.    441.     GOOD   *  16.64   339.   217.     GOOD     0.2241E 03
 43    104   *  4.7    10.7     827.    529.  PACCEPT   *  16.64   423.   271.     GOOD     0.2582E 03
 44    106   *  4.2    11.5     959.    614.  PACCEPT   *  16.64   552.   353.     GOOD     0.2608E 03
 45    108   *  3.3    13.4     702.    449.     GOOD   *  16.64   508.   325.     GOOD     0.1242E 03
 46    110   *  4.0    11.9     559.    358.     GOOD   *  16.64   338.   216.     GOOD     0.1412E 03
 47    112   *  6.0     9.1    1185.    758.  PACCEPT   *  16.64   479.   306.     GOOD     0.4519E 03
 48    114   *  4.0    11.9    1270.    813.  PACCEPT   *  16.64   768.   492.     GOOD     0.3213E 03
 49    116   *  1.6    22.4     492.    315.     GOOD   *  16.64   768.   491.     GOOD    -0.1767E 03
 50    118   *  3.0    14.3     840.    537.  PACCEPT   *  16.64   667.   427.     GOOD     0.1108E 03
 51     12   *  2.8    14.9    1125.    720.  PACCEPT   *  16.64   956.   612.  PACCEPT     0.1079E 03
 52    122   *  2.2    17.8     912.    584.  PACCEPT   *  16.64  1013.   648.  PACCEPT    -0.6427E 02
 53    124   *  2.5    16.4     738.    473.     GOOD   *  16.64   723.   463.     GOOD     0.9865E 01
 54    126   *  4.4    11.2     895.    573.  PACCEPT   *  16.64   496.   317.     GOOD     0.2554E 03
 55    128   *  4.0    11.9    1048.    671.  PACCEPT   *  16.64   632.   405.     GOOD     0.2661E 03
 56    130   *  4.2    11.5    1152.    737.  PACCEPT   *  16.64   665.   426.     GOOD     0.3112E 03
 57    132   *  3.4    13.2    1329.    851.  PACCEPT   *  16.64   936.   599.  PACCEPT     0.2519E 03
 58    134   *  3.7    12.6    2400.   1536.  NACCEPT   *  16.64  1579.  1010.  NACCEPT     0.5258E 03
 59    136   *  0.5    44.7     459.    294.     GOOD   *  16.64  2020.  1293.  NACCEPT    -0.9991E 03
 60    138   *  0.8    35.4     599.    383.     GOOD   *  16.64  1856.  1188.  NACCEPT    -0.8046E 03
 61    140   *  0.8    35.4     474.    303.     GOOD   *  16.64  1467.   939.  PACCEPT    -0.6359E 03
 62    142   *  2.3    17.0     973.    623.  PACCEPT   *  16.64  1009.   646.  PACCEPT    -0.2279E 02
 63    144   *  2.3    17.3     818.    524.  PACCEPT   *  16.64   870.   556.  PACCEPT    -0.3289E 02
 64    146   *  2.9    14.7    1012.    648.  PACCEPT   *  16.64   840.   538.  PACCEPT     0.1103E 03
 65    148   *  3.2    13.8    2462.   1576.  NACCEPT   *  16.64  1853.  1186.  NACCEPT     0.3898E 03
 66    150   *  3.4    13.3    1189.    761.  PACCEPT   *  16.64   854.   546.  PACCEPT     0.2146E 03
 67    152   *  4.6    10.9    3173.   2031.  NACCEPT   *  16.64  1679.  1074.  NACCEPT     0.9565E 03
 68    154   *  0.8    35.3     668.    427.     GOOD   *  16.64  2063.  1320.  NACCEPT    -0.8932E 03
 69    156   *  1.9    19.6    1309.    838.  PACCEPT   *  16.64  1677.  1074.  NACCEPT    -0.2357E 03
 70    158   *  1.9    19.6    1155.    739.  PACCEPT   *  16.64  1480.   947.  PACCEPT    -0.2076E 03
 71    160   *  2.5    16.3    1557.    996.  PACCEPT   *  16.64  1515.   969.  PACCEPT     0.2705E 02
 72    162   *  1.7    20.8    1145.    733.  PACCEPT   *  16.64  1601.  1025.  NACCEPT    -0.2920E 03
 73    164   *  1.0    30.0     472.    302.     GOOD   *  16.64  1142.   731.  PACCEPT    -0.4291E 03
 74    166   *  2.5    16.3    2840.   1818.  NACCEPT   *  16.64  2760.  1766.  NACCEPT     0.5122E 02
 75    168   *  3.2    13.7    2790.   1786.  NACCEPT   *  16.64  2092.  1339.  NACCEPT     0.4465E 03
 76    170   *  0.8    35.2     885.    567.  PACCEPT   *  16.64  2728.  1746.  NACCEPT    -0.1179E 04
 77    172   *  0.6    41.0     675.    432.     GOOD   *  16.64  2614.  1673.  NACCEPT    -0.1241E 04
 78    174   *  1.7    20.8    1372.    878.  PACCEPT   *  16.64  1915.  1225.  NACCEPT    -0.3473E 03
 79    176   *  3.4    13.3    1299.    832.  PACCEPT   *  16.64   929.   594.  PACCEPT     0.2372E 03
 80    178   *  3.1    14.2    1064.    681.  PACCEPT   *  16.64   835.   535.  PACCEPT     0.1461E 03
 81    180   *  2.9    14.9     925.    592.  PACCEPT   *  16.64   783.   501.  PACCEPT     0.9117E 02
 82    182   *  3.7    12.5    1164.    745.  PACCEPT   *  16.64   759.   486.     GOOD     0.2591E 03
 83    184   *  2.2    17.7     912.    584.  PACCEPT   *  16.64  1001.   641.  PACCEPT    -0.5715E 02
 84    186   *  2.2    17.7    1900.   1216.  NACCEPT   *  16.64  2086.  1335.  NACCEPT    -0.1186E 03
 85    188   *  1.6    22.2    1866.   1194.  NACCEPT   *  16.64  2876.  1841.  NACCEPT    -0.6464E 03
 86    190   *  0.5    47.6     507.    325.     GOOD   *  16.64  2452.  1569.  NACCEPT    -0.1245E 04
 87    192   *  1.9    19.6     786.    503.  PACCEPT   *  16.64  1000.   640.  PACCEPT    -0.1373E 03
 88    194   *  2.9    14.6    1125.    720.  PACCEPT   *  16.64   926.   592.  PACCEPT     0.1276E 03
 89    196   *  1.5    23.1     786.    503.  PACCEPT   *  16.64  1281.   820.  PACCEPT    -0.3169E 03
 90    198   *  2.1    18.1    2118.   1356.  NACCEPT   *  16.64  2401.  1537.  NACCEPT    -0.1813E 03
 91    200   *  0.8    35.1     740.    474.     GOOD   *  16.64  2270.  1453.  NACCEPT    -0.9787E 03
 92    202   *  2.8    15.1    1110.    710.  PACCEPT   *  16.64   960.   614.  PACCEPT     0.9596E 02
 93    204   *  5.2    10.0    1494.    956.  PACCEPT   *  16.64   693.   444.     GOOD     0.5126E 03
 94    206   *  3.7    12.5    1280.    819.  PACCEPT   *  16.64   831.   532.  PACCEPT     0.2873E 03
 95    208   *  3.1    14.1    1182.    756.  PACCEPT   *  16.64   923.   591.  PACCEPT     0.1655E 03
 96    210   *  3.4    13.3    1169.    748.  PACCEPT   *  16.64   831.   532.  PACCEPT     0.2167E 03
 97    212   *  2.5    16.2     862.    551.  PACCEPT   *  16.64   830.   531.  PACCEPT     0.1988E 02
 98    214   *  3.1    14.1    1277.    817.  PACCEPT   *  16.64   996.   638.  PACCEPT     0.1794E 03
 99    216   *  2.1    18.5     966.    618.  PACCEPT   *  16.64  1132.   724.  PACCEPT    -0.1063E 03
100    218   *  2.8    15.1    1312.    839.  PACCEPT   *  16.64  1131.   724.  PACCEPT     0.1155E 03
101    220   *  2.7    15.6    2104.   1346.  NACCEPT   *  16.64  1914.  1225.  NACCEPT     0.1216E 03
102    222   *  0.8    35.0     857.    549.  PACCEPT   *  16.64  2618.  1675.  NACCEPT    -0.1127E 04
103    224   *  1.0    29.8    1038.    664.  PACCEPT   *  16.64  2486.  1591.  NACCEPT    -0.9271E 03
104    226   *  0.1    ****     122.     78.     GOOD   *  16.64  2589.  1657.  NACCEPT    -0.1579E 04
105    228   *  1.9    19.5    2046.   1309.  NACCEPT   *  16.64  2588.  1656.  NACCEPT    -0.3470E 03
106    230   *  0.3    66.2     326.    209.     GOOD   *  16.64  2587.  1656.  NACCEPT    -0.1447E 04
107    232   *  1.4    23.9    1231.    788.  PACCEPT   *  16.64  2122.  1358.  NACCEPT    -0.5704E 03
108    234   *  1.2    26.4    1233.    789.  PACCEPT   *  16.64  2457.  1573.  NACCEPT    -0.7835E 03
109    236   *  1.6    22.1    1784.   1142.  NACCEPT   *  16.64  2726.  1745.  NACCEPT    -0.6032E 03
110    238   *  0.6    42.9     688.    440.     GOOD   *  16.64  2851.  1824.  NACCEPT    -0.1384E 04
111    240   *  0.7    38.8     633.    405.     GOOD   *  16.64  2254.  1442.  NACCEPT    -0.1037E 04
112    242   *  1.4    23.9     960.    614.  PACCEPT   *  16.64  1652.  1057.  NACCEPT    -0.4431E 03
113    244   *  2.2    17.6    1303.    834.  PACCEPT   *  16.64  1416.   906.  PACCEPT    -0.7202E 02
114    246   *  2.2    18.0    2203.   1410.  NACCEPT   *  16.64  2477.  1585.  NACCEPT    -0.1751E 03
115    248   *  0.6    41.8     654.    418.     GOOD   *  16.64  2606.  1668.  NACCEPT    -0.1249E 04
116    250   *  2.2    17.6    1869.   1196.  NACCEPT   *  16.64  2029.  1298.  NACCEPT    -0.1019E 03
117    252   *  2.0    19.2    1664.   1065.  NACCEPT   *  16.64  2062.  1319.  NACCEPT    -0.2547E 03
118    254   *  1.6    22.0    1956.   1252.  NACCEPT   *  16.64  2980.  1907.  NACCEPT    -0.6553E 03
119    256   *  0.6    41.8     683.    437.     GOOD   *  16.64  2717.  1739.  NACCEPT    -0.1302E 04
120    258   *  1.6    22.0    1411.    903.  PACCEPT   *  16.64  2149.  1375.  NACCEPT    -0.4720E 03
121    260   *  1.9    19.4    1964.   1257.  NACCEPT   *  16.64  2470.  1581.  NACCEPT    [illegible]
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122   262 *  0.6   41.8    776.   497.     GOOD * 16.64  3087.  1976.  NACCEPT   -0.1479E 04
123   264 *  0.0   ****     35.    23.     GOOD * 16.64  2939.  1881.  NACCEPT   -0.1858E 04
124   266 *  0.7   39.6    811.   519.  PACCEPT * 16.64  2973.  1903.  NACCEPT   -0.1384E 04
125   268 *  0.3   65.9    326.   209.     GOOD * 16.64  2570.  1645.  NACCEPT   -0.1436E 04
126   270 *  0.9   31.9    987.   632.  PACCEPT * 16.64  2624.  1679.  NACCEPT   -0.1047E 04
127   272 *  0.7   39.2    887.   568.  PACCEPT * 16.64  3202.  2049.  NACCEPT   -0.1481E 04
128   274 *  0.6   44.0    660.   422.     GOOD * 16.64  2833.  1813.  NACCEPT   -0.1391E 04
129   276 *  1.4   23.8   1516.   970.  PACCEPT * 16.64  2593.  1660.  NACCEPT   -0.6897E 03
130   278 *  1.2   26.2   1557.   996.  PACCEPT * 16.64  3078.  1970.  NACCEPT   -0.9740E 03
131   280 *  0.0   ****     40.    25.     GOOD * 16.64  3283.  2101.  NACCEPT   -0.2075E 04
132   282 *  0.6   41.7    540.   346.     GOOD * 16.64  2140.  1370.  NACCEPT   -0.1024E 04
133   284 *  3.0   14.5   1266.   810.  PACCEPT * 16.64  1025.   656.  PACCEPT    0.1540E 03
134   286 *  2.8   15.0    962.   616.  PACCEPT * 16.64   820.   525.  PACCEPT    0.9094E 02
135   288 *  3.0   14.5    868.   555.  PACCEPT * 16.64   702.   450.     GOOD    0.1059E 03
136   290 *  3.6   12.7    918.   588.  PACCEPT * 16.64   614.   393.     GOOD    0.1943E 03
137   292 *  4.5   11.0   1141.   730.  PACCEPT * 16.64   614.   393.     GOOD    0.3373E 03
138   294 *  4.1   11.7   1397.   894.  PACCEPT * 16.64   819.   524.  PACCEPT    0.3704E 03
139   296 *  3.3   13.5   1240.   794.  PACCEPT * 16.64   909.   582.  PACCEPT    0.2117E 03
140   298 *  2.5   16.1    923.   591.  PACCEPT * 16.64   876.   561.  PACCEPT    0.2980E 02
141   300 *  4.0   12.0   1147.   734.  PACCEPT * 16.64   701.   449.     GOOD    0.2853E 03
142   302 *  3.1   14.0    939.   601.  PACCEPT * 16.64   721.   482.     GOOD    0.1391E 03
143   304 *  2.8   14.9    849.   543.  PACCEPT * 16.64   721.   461.     GOOD    0.8169E 02
144   306 *  4.1   11.6   1906.  1220.  NACCEPT * 16.64  1114.   713.  PACCEPT    0.5066E 03
145   308 *  2.9   14.9   2623.  1679.  NACCEPT * 16.64  2227.  1425.  NACCEPT    0.2535E 03
146   310 *  0.6   44.0    703.   450.     GOOD * 16.64  3024.  1935.  NACCEPT   -0.1485E 04
147   312 *  0.6   41.5    722.   462.     GOOD * 16.64  2847.  1822.  NACCEPT   -0.1360E 04
148   314 *  0.0   ****     35.    22.     GOOD * 16.64  2879.  1843.  NACCEPT   -0.1820E 04
149   316 *  0.6   41.5    518.   331.     GOOD * 16.64  2039.  1305.  NACCEPT   -0.9736E 03
150   318 *  3.2   13.9   1140.   729.  PACCEPT * 16.64   873.   559.  PACCEPT    0.1704E 03
151   320 *  4.1   11.6   1823.  1166.  NACCEPT * 16.64  1063.   680.  PACCEPT    0.4862E 03
152   322 *  1.8   20.4   1039.   665.  PACCEPT * 16.64  1413.   904.  PACCEPT   -0.2392E 03
153   324 *  1.9   19.3   1393.   891.  PACCEPT * 16.64  1733.  1109.  NACCEPT   -0.2176E 03
154   326 *  2.0   18.7   1049.   671.  PACCEPT * 16.64  1252.   802.  PACCEPT   -0.1305E 03
155   328 *  2.3   17.4    970.   621.  PACCEPT * 16.64  1039.   665.  PACCEPT   -0.4385E 02
156   330 *  2.3   17.4    950.   608.  PACCEPT * 16.64  1017.   651.  PACCEPT   -0.4271E 02
157   332 *  3.1   14.1   1946.  1246.  NACCEPT * 16.64  1525.   976.  PACCEPT    0.2697E 03
158   334 *  1.0   29.4    741.   474.     GOOD * 16.64  1742.  1115.  NACCEPT   -0.6407E 03
159   336 *  1.3   25.5   1053.   674.  PACCEPT * 16.64  1998.  1279.  NACCEPT   -0.6048E 03
160   338 *  0.3   65.4    275.   176.     GOOD * 16.64  2138.  1368.  NACCEPT   -0.1193E 04
161   340 *  0.3   65.4    261.   167.     GOOD * 16.64  2030.  1299.  NACCEPT   -0.1132E 04
162   342 *  1.5   22.7   1207.   772.  PACCEPT * 16.64  1918.  1227.  NACCEPT   -0.4550E 03
163   344 *  1.4   23.6   1241.   794.  PACCEPT * 16.64  2099.  1343.  NACCEPT   -0.5489E 03
164   346 *  0.8   34.5    503.   322.     GOOD * 16.64  1502.   962.  PACCEPT   -0.6398E 03
165   348 *  3.0   14.4   1012.   648.  PACCEPT * 16.64   811.   519.  PACCEPT    0.1289E 03
166   350 *  4.7   10.6   1322.   846.  PACCEPT * 16.64   676.   432.     GOOD    0.4138E 03
167   352 *  5.1   10.1   3229.  2067.  NACCEPT * 16.64  1520.   973.  PACCEPT    0.1094E 04
168   354 *  2.6   16.0   2585.  1654.  NACCEPT * 16.64  2431.  1556.  NACCEPT    0.9856E 02
169   356 *  0.0   ****     29.    18.     GOOD * 16.64  2359.  1510.  NACCEPT   -0.1491E 04
170   358 *  0.8   34.5    905.   579.  PACCEPT * 16.64  2699.  1727.  NACCEPT   -0.1148E 04
171   360 *  1.2   26.0   1557.   996.  PACCEPT * 16.64  3035.  1942.  NACCEPT   -0.9462E 03
172   362 *  0.5   46.6    493.   315.     GOOD * 16.64  2312.  1479.  NACCEPT   -0.1164E 04
173   364 *  2.3   17.3    845.   541.  PACCEPT * 16.64   899.   575.  PACCEPT   -0.3459E 02
174   366 *  4.1   11.7   1177.   753.  PACCEPT * 16.64   693.   444.     GOOD    0.3099E 03
175   368 *  4.2   11.6   1149.   735.  PACCEPT * 16.64   664.   425.     GOOD    0.3099E 03
176   370 *  4.6   10.9   1602.  1025.  NACCEPT * 16.64   850.   544.  PACCEPT    0.4808E 03
177   372 *  3.3   13.4   2093.  1339.  NACCEPT * 16.64  1514.   969.  PACCEPT    0.3700E 03
178   374 *  0.8   34.4    479.   307.     GOOD * 16.64  1425.   912.  PACCEPT   -0.6053E 03
179   376 *  4.0   11.9   1384.   886.  PACCEPT * 16.64   835.   534.  PACCEPT    0.3514E 03
180   378 *  3.5   13.0   1032.   660.  PACCEPT * 16.64   712.   456.     GOOD    0.2047E 03
181   380 *  3.5   13.0   1132.   724.  PACCEPT * 16.64   781.   500.     GOOD    0.2247E 03
182   382 *  4.2   11.5   2096.  1341.  NACCEPT * 16.64  1209.   774.  PACCEPT    0.5674E 03
183   384 *  2.6   15.9   1412.   904.  PACCEPT * 16.64  1321.   846.  PACCEPT    0.5822E 02
184   386 *  2.6   15.9   1124.   719.  PACCEPT * 16.64  1051.   673.  PACCEPT    0.4655E 02
185   388 *  2.6   15.9   1353.   866.  PACCEPT * 16.64  1265.   810.  PACCEPT    0.5634E 02
186   390 *  1.8   20.3   1015.   650.  PACCEPT * 16.64  1365.   873.  PACCEPT   -0.2236E 03
187   392 *  2.7   15.3   1140.   729.  PACCEPT * 16.64  1006.   644.  PACCEPT    0.8537E 02
188   394 *  2.1   18.1    924.   591.  PACCEPT * 16.64  1050.   672.  PACCEPT   -0.8058E 02
189   396 *  3.4   13.4   2093.  1339.  NACCEPT * 16.64  1508.   965.  PACCEPT    0.3740E 03
190   398 *  0.8   34.3    673.   431.     GOOD * 16.64  1994.  1276.  NACCEPT   -0.8451E 03
191   400 *  0.7   37.2    621.   397.     GOOD * 16.64  2079.  1330.  NACCEPT   -0.9330E 03
192   402 *  1.0   29.2    943.   604.  PACCEPT * 16.64  2192.  1403.  NACCEPT   -0.7989E 03
193   404 *  0.6   43.3    624.   399.     GOOD * 16.64  2619.  1676.  NACCEPT   -0.1277E 04
194   406 *  0.8   34.3    814.   521.  PACCEPT * 16.64  2409.  1542.  NACCEPT   -0.1021E 04
195   408 *  0.5   46.4    323.   207.     GOOD * 16.64  1505.   963.  PACCEPT   -0.7562E 03
196   410 *  4.0   11.8    956.   612.  PACCEPT * 16.64   573.   367.     GOOD    0.2448E 03
197   412 *  4.4   11.2    951.   609.  PACCEPT * 16.64   523.   335.     GOOD    0.2740E 03
198   414 *  3.4   13.4    698.   446.     GOOD * 16.64   501.   321.     GOOD    0.1256E 03
199   416 *  4.2   11.5    932.   596.  PACCEPT * 16.64   534.   342.     GOOD    0.2542E 03
200   418 *  1.8   20.2    428.   274.     GOOD * 16.64   572.   366.     GOOD   -0.9247E 02
201   420 *  5.9    9.2   1871.  1197.  NACCEPT * 16.64   773.   495.     GOOD    0.7027E 03
202   422 *  2.5   16.5    936.   599.  PACCEPT * 16.64   924.   591.  PACCEPT    0.7625E 01
203   424 *  2.5   16.5   1375.   880.  PACCEPT * 16.64  1357.   868.  PACCEPT    0.1149E 02
204   426 *  0.8   34.2    479.   307.     GOOD * 16.64  1412.   904.  PACCEPT   -0.5972E 03
205   428 *  2.0   19.0    786.   503.  PACCEPT * 16.64   960.   614.  PACCEPT   -0.1117E 03
206   430 *  2.3   17.2   1629.  1042.  NACCEPT * 16.64  1714.  1097.  NACCEPT   -0.5428E 02
207   432 *  1.6   21.6   1845.  1181.  NACCEPT * 16.64  2725.  1744.  NACCEPT   -0.5638E 03
208   434 *  0.4   53.7    394.   252.     GOOD * 16.64  2283.  1461.  NACCEPT   -0.1209E 04
209   436 *  1.8   20.2    719.   460.     GOOD * 16.64   959.   614.  PACCEPT   -0.1535E 03
210   438 *  1.8   20.2    691.   442.     GOOD * 16.64   922.   590.  PACCEPT   -0.1474E 03
211   440 *  2.1   18.4   1374.   879.  PACCEPT * 16.64  1597.  1022.  NACCEPT   -0.1427E 03
212   442 *  2.9   14.7   2554.  1634.  NACCEPT * 16.64  2119.  1356.  NACCEPT    0.2782E 03
213   444 *  0.3   64.6    261.   167.     GOOD * 16.64  1995.  1277.  NACCEPT   -0.1110E 04
214   446 *  1.3   25.7    593.   380.     GOOD * 16.64  1139.   729.  PACCEPT   -0.3497E 03
215   448 *  2.6   15.8   1124.   719.  PACCEPT * 16.64  1040.   666.  PACCEPT    0.5361E 02
216   450 *  2.6   15.8   1175.   752.  PACCEPT * 16.64  1087.   696.  PACCEPT    0.5628E 02
217   452 *  2.2   17.7    944.   604.  PACCEPT * 16.64  1039.   665.  PACCEPT   -0.6085E 02
218   454 *  1.3   25.2    535.   343.     GOOD * 16.64   996.   637.  PACCEPT   -0.2945E 03
219   456 *  2.2   18.0    885.   566.  PACCEPT * 16.64   995.   637.  PACCEPT   -0.7048E 02
220   458 *  2.8   15.2   1052.   673.  PACCEPT * 16.64   918.   588.  PACCEPT    0.8543E 02
221   460 *  5.0   10.2   1600.  1024.  NACCEPT * 16.64   770.   493.     GOOD    0.5312E 03
222   462 *  2.6   15.8   1034.   662.  PACCEPT * 16.64   955.   611.  PACCEPT    0.5077E 02
223   464 *  2.6   15.8    923.   591.  PACCEPT * 16.64   852.   545.  PACCEPT    0.4551E 02
224   466 *  2.6   15.8    680.   435.     GOOD * 16.64   628.   402.     GOOD    0.3367E 02
225   468 *  4.1   11.8    933.   597.  PACCEPT * 16.64   554.   355.     GOOD    0.2426E 03
226   470 *  3.4   13.3    761.   487.     GOOD * 16.64   542.   347.     GOOD    0.1404E 03
227   472 *  5.2    9.9   1099.   703.  PACCEPT * 16.64   507.   324.     GOOD    0.3791E 03
228   474 *  4.3   11.4   1022.   654.  PACCEPT * 16.64   581.   372.     GOOD    0.2826E 03
229   476 *  3.1   14.1    980.   627.  PACCEPT * 16.64   768.   491.     GOOD    0.1356E 03
230   478 *  3.6   12.8   1132.   724.  PACCEPT * 16.64   768.   491.     GOOD    0.2329E 03
231   480 *  5.0   10.2   1503.   962.  PACCEPT * 16.64   721.   461.     GOOD    0.5006E 03
232   482 *  3.2   13.7    778.   498.     GOOD * 16.64   580.   371.     GOOD    0.1269E 03
233   484 *  4.1   11.7   2007.  1284.  NACCEPT * 16.64  1189.   761.  PACCEPT    0.5236E 03
234   486 *  3.6   12.8   3341.  2138.  NACCEPT * 16.64  2263.  1449.  NACCEPT    0.6897E 03
235   488 *  0.6   40.7   1035.   663.  PACCEPT * 16.64  3960.  2534.  NACCEPT   -0.1872E 04
236   490 *  0.6   40.7   1129.   723.  PACCEPT * 16.64  4318.  2764.  NACCEPT   -0.2041E 04
237   492 *  0.4   57.2    532.   341.     GOOD * 16.64  3392.  2171.  NACCEPT   -0.1830E 04
238   494 *  0.8   34.0    582.   372.     GOOD * 16.64  1695.  1085.  NACCEPT   -0.7127E 03
239   496 *  1.7   21.4    854.   547.  PACCEPT * 16.64  1249.   799.  PACCEPT   -0.2524E 03
240   498 *  2.2   17.9    924.   591.  PACCEPT * 16.64  1031.   660.  PACCEPT   -0.6886E 02
241   500 *  2.3   17.1    877.   561.  PACCEPT * 16.64   912.   584.  PACCEPT   -0.2230E 02
242   502 *  2.2   17.9    850.   544.  PACCEPT * 16.64   948.   607.  PACCEPT   -0.6294E 02
243   504 *  2.9   14.6   2061.  1319.  NACCEPT * 16.64  1692.  1083.  NACCEPT    0.2360E 03
244   506 *  2.6   15.7   3446.  2205.  NACCEPT * 16.64  3158.  2021.  NACCEPT    0.1842E 03
245   508 *  0.7   38.5    948.   607.  PACCEPT * 16.64  3335.  2134.  NACCEPT   -0.1528E 04
246   510 *  0.3   64.1    337.   215.     GOOD * 16.64  2545.  1629.  NACCEPT   -0.1413E 04
247   512 *  1.5   23.2   1108.   709.  PACCEPT * 16.64  1820.  1165.  NACCEPT   -0.4561E 03
248   514 *  1.3   25.5    830.   531.  PACCEPT * 16.64  1577.  1009.  NACCEPT   -0.4780E 03
249   516 *  2.6   15.7   1034.   662.  PACCEPT * 16.64   946.   605.  PACCEPT    0.5628E 02
250   518 *  2.6   15.7   1428.   914.  PACCEPT * 16.64  1306.   836.  PACCEPT    0.7802E 02
251   520 *  2.2   17.9   1328.   850.  PACCEPT * 16.64  1477.   945.  PACCEPT   -0.9550E 02
252   522 *  1.8   20.0   1872.  1198.  NACCEPT * 16.64  2461.  1575.  NACCEPT   -0.3767E 03
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 254     526  *  0.4   52.2    772.   494.     GOOD  *  16.64   4292.   2747.   NACCEPT    -0.2253E 04
 255     528  *  0.4   59.2    503.   322.     GOOD  *  16.64   3371.   2158.   NACCEPT    -0.1836E 04
 256     530  *  1.1   28.8   1729.  1107.  NACCEPT  *  16.64   3932.   2516.   NACCEPT    -0.1410E 04
 257     532  *  0.5   45.7   1294.   828.  PACCEPT  *  16.64   5896.   3773.   NACCEPT    -0.2945E 04
 258     534  *  0.4   59.1    838.   536.  PACCEPT  *  16.64   5613.   3593.   NACCEPT    -0.3056E 04
 259     536  *  0.5   45.7    739.   473.     GOOD  *  16.64   3367.   2155.   NACCEPT    -0.1682E 04
 260     538  *  1.3   25.5   1083.   693.  PACCEPT  *  16.64   2049.   1311.   NACCEPT    -0.6182E 03
 261     540  *  1.3   25.5   1132.   725.  PACCEPT  *  16.64   2141.   1370.   NACCEPT    -0.6458E 03
 262     542  *  1.1   28.7   1482.   949.  PACCEPT  *  16.64   3364.   2153.   NACCEPT    -0.1204E 04
 263     544  *  0.4   56.9    643.   411.     GOOD  *  16.64   4058.   2597.   NACCEPT    -0.2186E 04
 264     546  *  0.7   38.3   1103.   706.  PACCEPT  *  16.64   3857.   2469.   NACCEPT    -0.1763E 04
 266     550  *  0.4   52.1    943.   604.  PACCEPT  *  16.64   5225.   3344.   NACCEPT    -0.2740E 04
 265     548  *  0.4   52.1    598.   383.     GOOD  *  16.64   3313.   2120.   NACCEPT    -0.1738E 04
 267     552  *  0.4   56.8    828.   530.  PACCEPT  *  16.64   5223.   3343.   NACCEPT    -0.2813E 04
 268     554  *  0.4   53.0    637.   408.     GOOD  *  16.64   3615.   2314.   NACCEPT    -0.1906E 04
 269     556  *  0.6   40.4    565.   361.     GOOD  *  16.64   2135.   1367.   NACCEPT    -0.1005E 04
 270     558  *  1.1   28.7   1092.   699.  PACCEPT  *  16.64   2472.   1582.   NACCEPT    -0.8830E 03
 271     560  *  1.1   28.7   1647.  1054.  NACCEPT  *  16.64   3726.   2385.   NACCEPT    -0.1331E 04
 272     562  *  0.0   ****     56.    36.     GOOD  *  16.64   4428.   2834.   NACCEPT    -0.2798E 04
 273     564  *  0.5   45.6   1035.   663.  PACCEPT  *  16.64   4692.   3003.   NACCEPT    -0.2340E 04
 274     566  *  0.4   52.9    812.   520.  PACCEPT  *  16.64   4598.   2943.   NACCEPT    -0.2423E 04
 275     568  *  0.6   40.3    986.   631.  PACCEPT  *  16.64   3721.   2382.   NACCEPT    -0.1751E 04
 276     570  *  0.5   45.6    624.   399.     GOOD  *  16.64   2824.   1807.   NACCEPT    -0.1408E 04
 277     572  *  0.6   42.5    463.   296.     GOOD  *  16.64   1889.   1209.   NACCEPT    -0.9130E 03
 278     574  *  1.1   28.6    720.   461.     GOOD  *  16.64   1626.   1041.   NACCEPT    -0.5798E 03
 279     576  *  1.3   25.4    773.   495.     GOOD  *  16.64   1454.    931.   PACCEPT    -0.4357E 03
 280     578  *  1.5   23.0    873.   558.  PACCEPT  *  16.64   1418.    908.   PACCEPT    -0.3493E 03
 281     580  *  2.0   19.1   1460.   934.  PACCEPT  *  16.64   1800.   1152.   NACCEPT    -0.2174E 03
 282     582  *  0.6   42.5    478.   306.     GOOD  *  16.64   1949.   1247.   NACCEPT    -0.9414E 03
 283     584  *  1.1   28.6    648.   415.     GOOD  *  16.64   1461.    935.   PACCEPT    -0.5202E 03
 284     586  *  2.2   17.7   1118.   716.  PACCEPT  *  16.64   1230.    787.   PACCEPT    -0.7173E 02
 285     588  *  1.8   20.5   1426.   913.  PACCEPT  *  16.64   1947.   1246.   NACCEPT    -0.3335E 03
 286     590  *  0.8   33.6   1116.   714.  PACCEPT  *  16.64   3200.   2048.   NACCEPT    -0.1334E 04
 287     592  *  0.6   40.2    986.   631.  PACCEPT  *  16.64   3706.   2372.   NACCEPT    -0.1741E 04
 288     594  *  0.0   ****     33.    21.     GOOD  *  16.64   2594.   1660.   NACCEPT    -0.1639E 04
 289     596  *  1.5   23.0   1028.   658.  PACCEPT  *  16.64   1667.   1067.   NACCEPT    -0.4085E 03
 290     598  *  1.9   19.8    966.   618.  PACCEPT  *  16.64   1254.    803.   PACCEPT    -0.1842E 03
 291     600  *  2.5   16.4   1250.   800.  PACCEPT  *  16.64   1221.    781.   PACCEPT     0.1872E 02

 DATA   DEPTH *  F(K)  PORF(K) SPCONF  TDSF   REMARKS *  PORFF  SPCOFF   TDSFF   REMARKS    DIFFER(TDS)


                              PROGRAM TIME IN SECONDS =  0.1249023E 03


                      PROGRAM BY----

                         RONALD M. BRIMHALL
                         BOX 31 CAMPUS STA.
                         SOCORRO, N. M.    87801

/&                                                                           TOTAL TIME  007M 50S
JOB TIME SUMMARY...COMPILE 0182S   ASSEMBLE 0000S   LNKEDT 0052S   UTILS 0000S   USER 0236S
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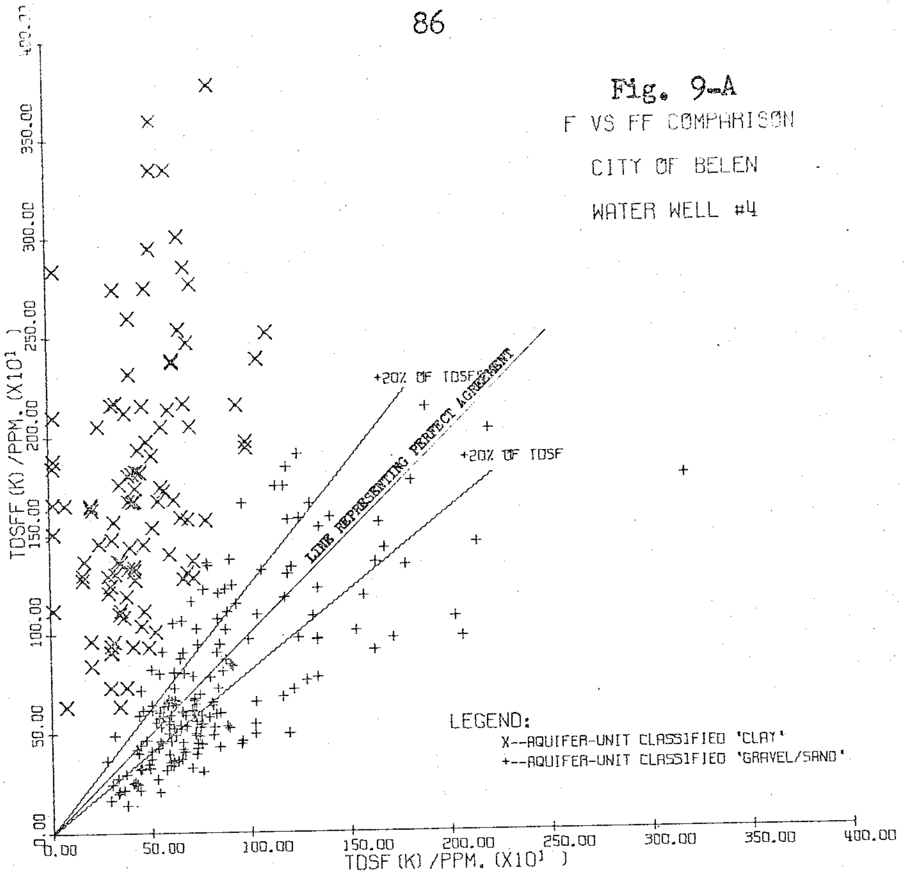

Fig. 9-A

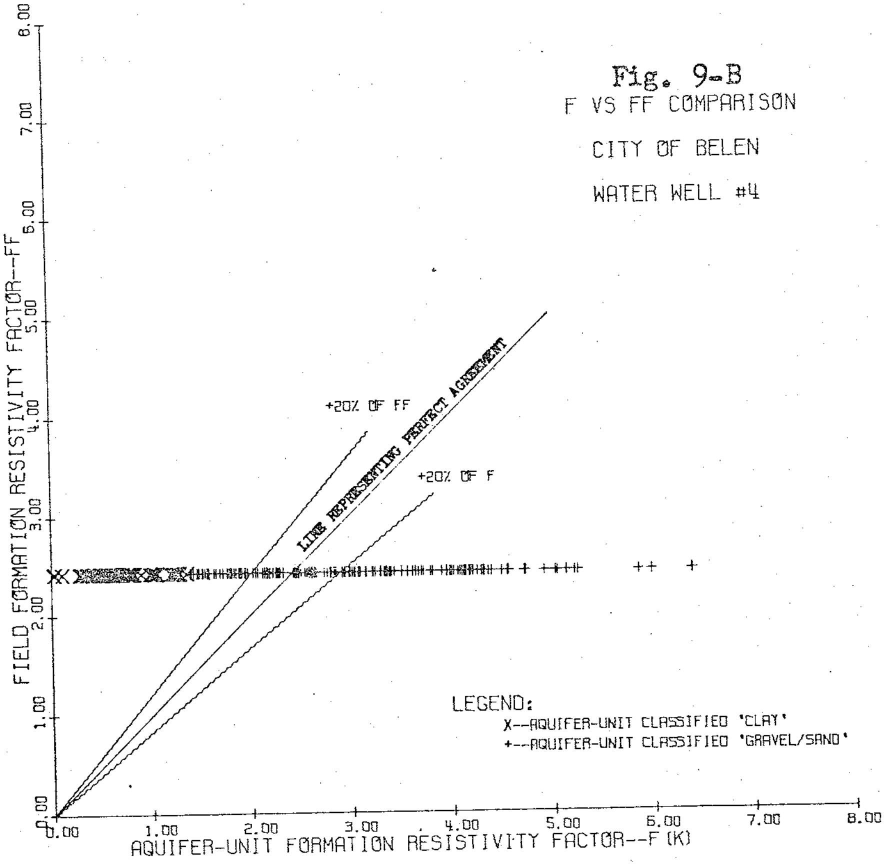

Fig. 9-B

Fig. 9 Comparison of the F- and FF-Methods: City

FVSFF2--USGS Test Well #B-5

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FORTRAN IV    MODEL 44  PS      VERSION 3   LEVEL 1   DATE  69118      NEW MEXICO TECH     PAGE  0001
            C            014P,10,858,BRIMHALL(A,P,L)  DET WAT QUAL FR RES LOGS
            C                 RONALD M. BRIMHALL
            C      ----------------------------------------------------------------
            C      COMPARISON OF WATER QUALITY DETERMINATIONS FROM 'AQUIFER UNIT F'
            C      AND 'FIELD FORMATION RESISTIVITY FACTOR F(F)'
            C      ----------------------------------------------------------------
            C      SOCORRO COUNTY NEW MEXICO WATER WELL    (USGS TEST WELL #8-5)
            C
            C
            C
            C      ********************  COORD PLOTS (TDSF VS TDSFF & F VS FF *******
            C
            C      RESISTIVITY LOG INTERPRETATION PROGRAM FVSFF2---
            C
            C
            C      *****************************************************************
            C      PURPOSE OF FVSFF2---
            C
            C      FVSFF2 COMPARES TOTAL DISSOLVED SOLIDS DETERMINATIONS COMPUTED
            C      BY THE F-METHOD AND THE FF-METHOD (BRIMHALL, 1969).  THIS COM-
            C      PARISON IS FOR EVALUATING ONE METHOD AGAINST THE OTHER.  THE RE-
            C      SULTS ARE PRESENTED IN TABLE FORM--COLUMNS LISTING DATA POINT
            C      NUMBER, DEPTH, F, POROSITY INDEX, SPECIFIC CONDUCTANCE AND RESIS-
            C      TIVITY OF WATER, REMARKS STATING THE ACCEPTABILITY OF WATER, AND
            C      THE ARITHMETIC DIFFERENCE BETWEEN VALUES OF TDSF AND TDSFF EX-
            C      PRESSED AS DIFFER(TDS) = TDSF-TDSFF--THE PLOT TDSF VS TDSFF ILLUS-
            C      TRATES DIFFERENCES GRAPHICALLY  THE PLOT F VS FF SHOWS THE VARIA-
            C      TION OF THE APPARENT FORMATION RESISTIVITY FACTOR FROM MINIMUM TO
            C      MAXIMUM VALUE.  CLAY BEARING BEDS ARE DISTINGUISHED FROM SANDS
            C      AND GRAVELS ON THE PLOTS.  FVSFF2 IS APPLICABLE TO ANY GEOGRAPHIC
            C      AREA BUT IS LIMITED TO WATER WELLS WHICH HAVE BEEN LOGGED BY A
            C      MACRORESISTIVITY DEVICE AND A MICROLOG.
            C      *****************************************************************
            C
            C
            C      *****************************************************************
            C      REFERENCES---
            C
            C      BRIMHALL, R. M., DIGITAL ANALYSIS  OF BOREHOLE-MEASURED AQUIFER
            C      RESISTIVITY TO DETERMINE WATER QUALITY, UNPUBLISHED MASTER OF
            C      SCIENCE THESIS, N. MEX. INST. MIN. AND TECH., SOCORRO, JUNE 1969.
            C
            C      CALIFORNIA COMPUTER PRODUCTS, PROGRAMMING FOR CALCOMP DIGITAL
            C      INCREMENTAL PLOTTERS, ANAHIEM, 1966.
            C
            C      TODD, D. K., GROUND WATER HYDROLOGY, WILEY, NEW YORK, 1959.
            C      *****************************************************************
            C
            C
            C
            C      *****************************************************************
            C      NOMENCLATURE---
            C
            C      SCALAR QUANTITIES--
            C      T1 = INITIAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
            C      I = SUBSCRIPT FOR ABSCISSA OF FPN.
            C      K = INTEGER SUBSCRIPT OR REPEAT CYCLE IN CALL SCALE--K=1.
            C      RMF = MUD FILTRATE RESISTIVITY--OHM-METERS.
            C      RMC = MUD CAKE RESISTIVITY--OHM-METERS.
            C      AM = CEMENTATION EXPONENT IN F = A/POR**AM.
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FORTRAN IV    MODEL 44  PS      VERSION 3   LEVEL 1   DATE  69118      NEW MEXICO TECH     PAGE  0002
            C      PHIC = EMPIRICAL POROSITY INDEX ABOVE WHICH THE AQUIFER UNIT IS
            C      CLASSIFIED CLAY ON THE COORDINATE PLOTS--%.
            C      AVTEMP = AVERAGE SURFACE TEMPERATURE FOR CALCULATING GRAD.
            C      TD = TOTAL DEPTH OF WELL FOR CALCULATING GRAD.
            C      BHT = BOTTOM HOLE TEMPERATURE FOR CALCULATING GRAD.
            C      N = NUMBER OF DATA POINTS AND DO 200 ITERATIONS.
            C      A = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
            C      B = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
            C      C = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
            C      D = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
            C      E = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
            C      Q = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
            C      G = COEFFICIENT IN MUD CAKE CORRECTION EQUATION--TMC = 1/8 INCH.
            C      GRAD = TEMPERATURE GRADIENT OF AQUIFER.
            C      T2 = FINAL TIME-VALUE FOR CALCULATING EXECUTION TIME.
            C      TIME = PROGRAM EXECUTION TIME--SECONDS.
            C      J = INTEGER SUBSCRIPT, OR DO INDEX, OR SYMBOL CONTROL IN CALL
            C      LINE.
            C      TEMP = TEMPORARY STORAGE LOCATION.
            C      SW = MAXIMUM LENGTH OF LINE REPRESENTING ABSCISSA.
            C      SH = MAXIMUM LENGTH OF LINE REPRESENTING ORDINATE.
            C      DIV = NUMBER OF DIVISIONS PER FOOT OF ABSCISSA AND ORDINATE.
            C      XO = ABSCISSA COORDINATE OF THE STARTING POINT OF ORDINATE AXIS.
            C      YO = ORDINATE COORDINATE OF THE STARTING POINT OF ORDINATE AXIS.
            C      NCO = NUMBER OF CHARACTERS IN THE ORDINATE AXIS TITLE IN CALL AXIS.
            C      THETA = ANGLE OF THE ORDINATE AND ABSCISSA AXIS--DEGREES.
            C      XA = ABSCISSA COORDINATE OF THE STARTING POINT OF ABSCISSA AXIS.
            C      YA = ORDINATE COORDINATE OF THE STARTING POINT OF ABSCISSA AXIS.
            C      NCA = NUMBER OF CHARACTERS IN THE ABSCISSA AXIS TITLE IN CALL AXIS.
            C      X = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
            C      CALL SYMBOL.
            C      HEIGHT = HEIGHT OF CHARACTERS TO BE DRAWN BY CALL SYMBOL.
            C      IS = INITIAL VALUE OF DO INDEX IN READ NONNUMERIC DATA.
            C      IE = TERMINAL VALUE OF DO INDEX IN READ NONNUMERIC DATA.
            C
            C
            C      SUBSCRIPTED VARIABLES--
            C      IDATA = DATA POINT NUMBER.
            C      RMN = MICRONORMAL RESISTIVITY READ FROM MICROLOG--OHM-METERS.
            C      RO = DEEP INDUCTION RESISTIVITY--OHM-METERS.
            C      JDEPTH = DATA POINT DEPTH----FEET.
            C      F = APPARENT FORMATION RESISTIVITY FACTOR USED IN F-METHOD.
            C      FF = FIELD FORMATION RESISTIVITY FACTOR USED IN FF-METHOD.
            C      TDSF = TOTAL DISSOLVED SOLIDS CONCENTRATIONS DETERMINED BY THE FF-
            C      METHOD--PPM.
            C      TDSFF = TOTAL DISSOLVED SOLIDS CONCENTRATIONS DETERMINED BY THE
            C      FF-METHOD--PPM.
            C      RWF = WATER RESISTIVITY DETERMINED BY THE F-METHOD--OHM-METERS.
            C      RWFF = WATER RESISTIVITY DETERMINED BY THE FF-METHOD--OHM-METERS.
            C      SPCONF = WATER SPECIFIC CONDUCTANCE DETERMINED BY THE F-METHOD--
            C      MICROMHOS PER CENTIMETER.
            C      SPCOFF = WATER SPECIFIC CONDUCTANCE DETERMINED BY THE FF-METHOD--
            C      MICROMHOS PER CENTIMETER.
            C      ERROR = NAME OF DIFFER(TDS) = TDSF-TDSFF.
            C      PORF = POROSITY INDEX DETERMINED BY THE F-METHOD--%.
            C      PORFF = POROSITY INDEX DETERMINED BY THE FF-METHOD--%.
            C      ORD = NAME OF THE ARRAY TO BE PLOTTED AS ORDINATE--TDSFF AND FF.
            C      LAB1 = NAME OF ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT
            C      PLOT TDSF VS TDSFF.
            C      LAB2 = NAME OF ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT
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                C      PLOT TDSFF VS TDSFF.
                C      ABS = NAME OF THE ARRAY TO BE PLOTTED AS ABSCISSA--TDSF AND F.
                C      Y = ORDINATE COORDINATE OF THE LOWER LEFT CORNER OF THE FIRST
                C      SYMBOL IN CALL SYMBOL.
                C      NS = NUMBER OF CHARACTERS IN LABEL AT CALL SYMBOL.
                C      RXOC = MICRONORMAL RESISTIVITY CORRECTED FOR TEMPERATURE AND
                C             MUDCAKE--OHM/METERS.
                C      ROC = TEMPERATURE CORRECTED DEEP INDUCTION RESISTIVITY--OHM-METERS
                C      LAB3 = NAME OF ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT
                C      PLOT F VS FF.
                C      LAB4 = NAME OF ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT
                C      PLOT F VS FF.
                C      X2 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      Y2 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      X3 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      Y3 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      X4 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      Y4 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      X5 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      Y5 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      X6 = ABSCISSA COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      Y6 = ORDINATE COORDINATE OF LOWER LEFT CORNER OF FIRST SYMBOL IN
                C      CALL SYMBOL--TO LEGEND PLOT.
                C      NS2 = NUMBER OF CHARACTERS IN THE LABEL.
                C      NS3 = NUMBER OF CHARACTERS IN THE LABEL.
                C      NS4 = NUMBER OF CHARACTERS IN THE LABEL.
                C      NS5 = NUMBER OF CHARACTERS IN THE LABEL.
                C      NS6 = NUMBER OF CHARACTERS IN THE LABEL.
                C      PORF1 = SECONDARY STORAGE ARRAY OF PORF FOR SORTING IN PREPARATION
                C      TO PLOT.
                C      JDEPTH1 = SECONDARY STORAGE ARRAY OF JDEPTH FOR SORTING IN PREPA-
                C      RATION TO PLOT.
                C      RXO1 = MICRONORMAL RESISTIVITY CORRECTED FOR MUD CAKE--OHM-METERS.
                C      W = RATIO RMN/RMC--A PARAMETER IN MUD CAKE CORRECTIONS.
                C      BCD = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                C      NS(1), ETC.
                C      BCE = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                C      NS2(1), ETC.
                C      BCF = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                C      NS3(1), ETC.
                C      BCG = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                C      NS4(1), ETC.
                C      BCH = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                C      NS5(1), ETC.
                C      BCI = LOCATION OF ALPHABETIC ARRAY TO LEGEND PLOTS, CORRESPONDS TO
                C      NS6(1), ETC.
                C      ****************************************************************
                C
                C
                C
                C      ****************************************************************
                C
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                C      SUBROUTINES CALLED--NEW MEXICO TECH COMPUTER.
                C      CLOCK
                C      IBCOM#
                C      SETMSG
                C      PLOT
                C      SCALE
                C      AXIS
                C      SYMBOL
                C      FRXPR#
                C      ****************************************************************
                C
                C
                C
                       CALL CLOCK(T1)
 0001                  DIMENSIONIDATA(291),RXO(291),RO(291),JDEPTH(291),F(293),TDSF(293),
 0002                 *TDSFF(293),RMF(291),SPCONF(291),SPCOFF(291),ERROR(291),PORF(291),
                      *ORD(294),LAB1(24),LAB2(32)
                      *,ABS(294),Y(3),NS(3)
                      *,FF(293),
                      *PORFF(291),RMFF(291),RXOC(291),ROC(291)
                      *,LAB3(48),LAB4(48)
                      *,X2(2),Y2(2),X3(1),Y3(1),X4(2),Y4(2)
                      *,NS2(2),NS3(1),NS4(2)
                      *,X5(2),Y5(2)
                      *,NS5(2)
                      *,X6(1),Y6(1),NS6(1)
                      *,PORF1(291),JDEPT1(291)
                      *,RXO1(500),W(500)
                         INTEGER BCD(15),BCE(8),BCF(2),BCG(20)
 0003                 *,BCH(3)
                      *,BCI(10)
                C
                C      READ ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT PLOT TDSF
                C      VS TDSFF.
                       READ(5,1001)(LAB1(I),I=1,4)
 0004             1001 FORMAT(4A4)
 0005           C
                C      READ ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT PLOT TDSF
                C      VS TDSFF.
                       READ(5,1002)(LAB2(I),I = 1,3)
 0006             1002 FORMAT(3A4)
 0007           C
                C      READ ALPHABETIC ARRAY TO LABEL ORDINATE IN CALL AXIS AT PLOT F VS
                C      FF.
                       READ(5,1003)(LAB3(I),I = 1,10)
 0008             1003 FORMAT(10A4)
 0009           C      READ ALPHABETIC ARRAY TO LABEL ABSCISSA IN CALL AXIS AT PLOT F VS
                C      FF.
                       READ(5,1004)(LAB4(I),I = 1,12)
 0010             1004 FORMAT(12A4)
 0011           C
                C      PARAMETRIC DATA.
                          RMF = 5.9
 0012                  RMC = 6.0
 0013                  AM = 1.5
 0014                  PHIC = 36.0
 0015                  AVTEMP = 72.
 0016                  TD = 510.
 0017                  BHT = 84.
 0018                  N = 222
 0019           C
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                  C      READ RESISTIVITY DATA FROM CARDS.
 0020                    READ(5,1)(IDATA(K),JDEPTH(K),RXO(K),RO(K), K = 1,N)
 0021                  1 FORMAT(2I4,2F5.1)
                  C
                  C      IDENTIFY PROBLEM AND WRITE SOME PARAMETRIC DATA.
 0022                    WRITE(6,2)
 0023                  2 FORMAT('9',40X,'SOCORRO COUNTY NEW MEXICO WATER WELL',/49X,'(USGS
                        *TEST WELL #8-5)',/41X,'AQUIFER -F- & FIELD -F- COMPARISON',///3X,'
                        *FIELD FORMATION RES. FACTOR-FF = 2.5',/29X,'SLOPE = 0.791',/30X,'R
                        *MF = 5.4 OHM-M @ AQUIFER TEMP.',/32X,'M = 0.6 FOR PORF(K) CALCULAT
                        *IONS')
                  C
                  C      LABEL COLUMNS FOR LINE PRINTER RESULTS.
 0024                    WRITE(6,300)
 0025                300 FORMAT(/  3X,'DATA',4X,'DEPTH',2X,'*',2X,'F(K)',3X,'PORF(K)',3X,'S
                        *PCONF',3X,'TDSF',4X,'REMARKS',2X,'*',2X,'PORFF',3X,'SPCOFF',3X,'TD
                        *SFF',4X,'REMARKS',7X,'DIFFER(TDS)')
                  C
                  C      LIST FF IN N LOCATIONS.
 0026                             DO 8888  K = 1,N
 0027              8888           FF(K) = 2.51
                  C
                  C      .................................................................
                  C      CONSTANTS FOR MUD CAKE THICKNESS OF 1/8 INCHES
 0028                    A = -0.3299839E-04
 0029                    B = +0.1307268E-01
 0030                    C = -0.2115985E+00
 0031                    D = 0.1284551E+01
 0032                    E = -0.3342364E+01
 0033                    O = +0.5336034E+01
 0034                    G = -0.1959661E+01
                  C
                  C      DETERMINE TEMPERATURE GRADIENT.
 0035                700 GRAD = (BHT-AVTEMP)/TD
                  C
                  C      PRIMARY DO LOOP.
 0036                    DO 200 K = 1,222
 0037                    N = 222
                  C
                  C      APPLY MUD CAKE CORRECTIONS.
                  C      MUDCAKE CORRECTION FOR TMC = 1/8 INCH ASSUMED
                  C       ADAPTED FROM SCHLUMBERGER 'LOG INTERPRETATION CHARTS', 1968, P34.
 0038                    W(K) = RXO(K)/RMC
 0039                    RXOI(K) = (A*W(K)**6+B*W(K)**5+C*W(K)**4+D*W(K)**3+E*W(K)**2+Q*W(K
                        *)+G)*RMC
                  C
                  C
                  C      MAKE ALL DATA POINTS CALCULABLE.
 0040                    IF(RXOI(K).LE.0.0)GO TO 611
                  C
                  C      APPLY TEMPERATURE CORRECTIONS.
 0041                702 ROC(K) = RO(K)*(AVTEMP + GRAD*JDEPTH(K))/77.
 0042                703 RXOC(K) = RXOI(K)*(AVTEMP + GRAD*JDEPTH(K))/77.
 0043                    GO TO 701
 0044                611 RXOI(K) = RXO(K)
 0045                    GO TO 702
                  C
                  C      DETERMINE RW, SPCOND, TDS BY F-METHOD.
 0046                701 F(K) = RXOC(K)/RMF
 0047                704 RWF(K) = ROC(K)/F(K)


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 0048                705 SPCONF(K) = 10000.00/RWF(K)
 0049                706 TDSF(K) = 0.705*SPCONF(K)
                  C
                  C      DETERMINE POROSITY INDEX.
 0050                707 PORF(K) = 50.00/(F(K)**(1.0/AM))
                  C
                  C      DETERMINE RW, SPCOND, TDS BY FF-METHOD.
 0051                708 RWFF(K) = ROC(K)/FF(K)
 0052                709 SPCOFF(K) = 10000.00/RWFF(K)
 0053                710 TDSFF(K) = 0.705*SPCOFF(K)
                  C
                  C      DETERMINE POROSITY INDEX BASED ON FF.
 0054                711 PORFF(K) = 50.0/(FF(K)**(1.0/AM))
                  C
                  C      DETERMINE DIFFERENCE IN TDS VALUES.
 0055                712 ERROR(K) = TDSF(K) - TDSFF(K)
                  C
                  C      CLASSIFY EACH TDSF-TDSFF SET BY WATER QUALITY.
                  C
                  C
                  C      U. S. PUBLIC HEALTH STANDARDS(TODD, 1959)--
                  C           NACCEPT = TDS.GT.1000 PPM.
                  C           PACCEPT = 500 PPM. .LT. TDS .LT. 1000 PPM.
                  C            GOOD = TDS .LT. 500 PPM.
                  C
 0056                    IF(TDSF(K).GE.1000..AND.TDSFF(K).GE.1000.)GO TO 10
 0057                    IF(TDSF(K).GE.1000.0.AND.TDSFF(K).GE.500.0.AND.TDSFF(K).LE.1000.0)
                        *GO TO 30
 0058                    IF(TDSF(K).LE.1000.0.AND.TDSF(K).GE.500.0.AND.TDSFF(K).GE.1000.0)
                        *GO TO 40
 0059                    IF(TDSF(K).GE.500.0.AND.TDSF(K).LE.1000.0.AND.TDSFF(K).GE.500.0.AN
                        *D.TDSFF(K).LE.1000.0)GO TO 50
 0060                    IF(TDSF(K).LE.500..AND.TDSFF(K).GE.1000.)GO TO 60
 0061                    IF(TDSF(K).LE.500.0.AND.TDSFF(K).LE.500.0)GO TO 20
 0062                    IF(TDSF(K).GE.1000..AND.TDSFF(K).LE.500.)GO TO 70
 0063                    IF(TDSF(K).LT.500.0.AND.TDSFF(K).GE.500.0.AND.TDSFF(K).LT.1000.0)
                        *GO TO 80
 0064                    IF(TDSF(K).GE.500.0.AND.TDSF(K).LT.1000.0.AND.TDSFF(K).LT.500.0)GO
                        *TO 90
 0065                 10 WRITE(6,3)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF(
                        *K),SPCOFF(K),TDSFF(K),ERROR(K)
 0066                  3 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X, F6.0,3X,'NAC
                        *CEPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'NACCEPT',7X,E11.4)
 0067                    GO TO 200
 0068                 20 WRITE(6,21)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                        *(K),SPCOFF(K),TDSFF(K),ERROR(K)
 0069                 21 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,6X,'GOOD
                        *',2X,'*',2X,F5.2,2(3X,F6.0),6X,'GOOD',7X,E11.4)
 0070                    GO TO 200
 0071                 30 WRITE(6,31)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                        *(K),SPCOFF(K),TDSFF(K),ERROR(K)
 0072                 31 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'NACC
                        *EPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'PACCEPT',7X,E11.4)
 0073                    GO TO 200
 0074                 40 WRITE(6,41)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                        *(K),SPCOFF(K),TDSFF(K),ERROR(K)
 0075                 41 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'PACC
                        *EPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'NACCEPT',7X,E11.4)
 0076                    GO TO 200
 0077                 50 WRITE(6,51)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
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                  *(K),SPCOFF(K),TDSFF(K),ERROR(K)
 0078           51 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'PACC
                  *EPT',2X,'*',2X,F5.2,2(3X,F6.0),3X,'PACCEPT',7X,E11.4)
 0079              GO TO 200
 0080           60 WRITE(6,61)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                  *(K),SPCOFF(K),TDSFF(K),ERROR(K)
 0081           61 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,6X,'GOOD
                  *',2X,'*',2X,F5.2,2(3X,F6.0),3X,'NACCEPT',7X,E11.4)
 0082              GO TO 200
 0083           70 WRITE(6,71)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                  *(K),SPCOFF(K),TDSFF(K),ERROR(K)
 0084           71 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'NACC
                  *EPT',2X,'*',2X,F5.2,2(3X,F6.0),6X,'GOOD',7X,E11.4)
 0085              GO TO 200
 0086           80 WRITE(6,81)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONE(K),TDSF(K),PORFF
                  *(K),SPCOFF(K),TDSFF(K),ERROR(K)
 0087           81 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,6X,'GOOD
                  *',2X,'*',2X,F5.2,2(3X,F6.0),3X,'PACCEPT',7X,E11.4)
 0088              GO TO 200
 0089           90 WRITE(6,91)IDATA(K),JDEPTH(K),F(K),PORF(K),SPCONF(K),TDSF(K),PORFF
                  *(K),SPCOFF(K),TDSFF(K),ERROR(K)
 0090           91 FORMAT(3X,I4,5X,I4,2X,'*',3X,F3.1,4X,F4.1,5X,F6.0,2X,F6.0,3X,'PACC
                  *EPT',2X,'*',2X,F5.2,2(3X,F6.0),6X,'GOOD',7X,E11.4)
 0091          200 CONTINUE
              C
              C       LABEL COLUMNS AT LINE PRINTER.
 0092                 WRITE(6,300)
              C
              C       DETERMINE PROGRAM EXECUTION TIME.
 0093                 CALL CLOCK(T2)
 0094                 TIME = T1-T2
 0095                 WRITE(6,102)TIME
 0096          102 FORMAT(////35X, 'PROGRAM TIME IN SECONDS = ',E14.7)
              C
              C       IDENTIFY PROGRAMMER.
 0097                 WRITE(6,9999)
 0098         9999 FORMAT(////25X,'PROGRAM BY----',//30X,'RONALD M. BRIMHALL',/30X,'B
                  *OX 31 CAMPUS STA.',/30X,'SOCORRO, N. M.   87801')
              C
              C       RESCALE TDSF AND TDSFF FOR PLOT.
 0099                 DO 201 K = 1,N
 0100                 TDSF(K) = TDSF(K)*1.25E-03
 0101                 TDSFF(K) = TDSFF(K)*1.25E-03
 0102          201 CONTINUE
              C
              C       DUPLICATE PORF AND JDEPTH IN PREPARATION TO SORT.
 0103                 DO 12 I = 1,N
 0104           12 PORF1(I) = PORF(I)
 0105                 DO 13 I = 1,N
 0106           13 JDEPT1(I) = JDEPTH(I)
              C
              C
              C       SORT TDSF, TDSFF, PORF, JDEPTH IN ASCENDING ORDER.
              C        ##########  SORT  ##########
 0107                 N = 222
 0108                 DO 110 I = 1,N
 0109                 DO 110 J = 1,N
 0110                 IF(TDSF(I).LE.TDSF(J))GO TO 110
 0111                       TEMP = TDSF(I)
 0112                       TDSF(I) = TDSF(J)

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 0113                       TDSF(J) = TEMP
 0114                       TEMP = TDSFF(I)
 0115                       TDSFF(I) = TDSFF(J)
 0116                       TDSFF(J) = TEMP
 0117                      TEMP = PORF(I)
 0118                      PORF(I) = PORF(J)
 0119                      PORF(J) = TEMP
 0120                      TEMP = JDEPTH(I)
 0121                      JDEPTH(I) = JDEPTH(J)
 0122                      JDEPTH(J) = TEMP
 0123          110 CONTINUE
              C
              C
              C       SORT F, FF, PORF1, JDEPTH1, IN ASCENDING ORDER.
              C       ##########  SORT  ##########
 0124                 DO 11 I = 1,N
 0125                 DO 11 J = 1,N
 0126                     IF(F(I).LE.F(J))GO TO 11
 0127                     TEMP = F(I)
 0128                     F(I) = F(J)
 0129                     F(J) = TEMP
 0130                    TEMP = FF(I)
 0131                    FF(I) = FF(J)
 0132                   FF(J) = TEMP
 0133                      TEMP = PORF1(I)
 0134                      PORF1(I) = PORF1(J)
 0135                      PORF1(J) = TEMP
 0136                      TEMP = JDEPT1(I)
 0137                      JDEPT1(I) = JDEPT1(J)
 0138                      JDEPT1(J) = TEMP
 0139           11 CONTINUE
 0140                        N = 222
              C
              C
              C       ***************  PLOT DATA  ***************
              C
 0141                  CALL SETMSG(27,'R. BRIMHALL CO-PO USGS #B-5')
              C
              C       SET PEN AT FULL RIGHT.
 0142                 CALL PLOT(0.,-1.5,-3)
              C
              C       SET NEW CENTER OF COORDINATES.
 0143                 CALL PLOT(10.,1.5,-3)
              C
              C       +++++++++++++++++++  PLOT TDSF VS TDSFF  ++++++++++++++
              C
              C       PLOT ONE-TO-ONE LINE AND RELATIVE ACCURACY LINES.
 0144                 CALL PLOT(5.,5.,2)
 0145                 CALL PLOT(3.69,4.40,3)
 0146                 CALL PLOT(0.,0.,2)
 0147                 CALL PLOT(4.60,3.89,2)
              C
              C       SET SCALE OF COORDINATES WITH CALL SCALE.
 0148                 SW = 8.
 0149                 SH = 8.
 0150                       N = 222
 0151                 DIV = 10.
 0152                 CALL SCALE(TDSF(1),SW,N,1,DIV)
 0153         6044         N = 222
 0154                 CALL SCALE(TDSFF(1),SH,N,1,DIV)
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           N =.222
C
C     PLOT AND LABEL COORDINATE AXIS WITH CALL AXIS.
      ORD(N+1) = 0.0
      ABS(N+1) = 0.0
      ORD(N+2) = 800.0
      ABS(N+2) = 800.0
      XO = 0.
      YO = 0.
      NCO = 13
      THETA = 90.
      CALL AXIS(XO,YO,LAB1,NCO,SH,THETA,ORD(N+1),ORD(N+2),DIV)
      XA = 0.
      YA = 0.
      NCA = -12
      THETA = 0.
      CALL AXIS(XA,YA,LAB2,NCA,SW,THETA,ABS(N+1),ABS(N+2),DIV)
          N = 222
C
C     PLOT TDSF AND TDSFF AND DISTINGUISH CLAY FROM SAND AND GRAVELS.
           DO   11111  I = 1,N
C
C     FOR USGS TEST WELL #B-5 AND FOR DEPTHS LESS THAN 60 FEET, THE LI-
C     THOLOGY IS SAND AND GRAVEL EVEN THOUGH THE POROSITY INDEX IS GREA-
C     TER THAN 36%.
               IF(JDEPTH(I).LT.60)GO TO 11117
                   IF(PORF(I).GT.PHIC)GO TO 11115
11117     CALL SYMBOL(TDSF(I),TDSFF(I),0.10,3,0.,-1)
                   GO TO 11111
11115     CALL SYMBOL(TDSF(I),TDSFF(I),0.14,4,0.,-1)
11111     CONTINUE
C
C     LABEL PLOT ''F VS FF COMPARISON'' AND IDENTIFY WELL.
      X = 5.25
      HEIGHT = 0.15
      THETA = 0.
      N = 3
      DO 500 I = 1,N
      IS = 5*(I-1)+1
      IE = IS + 4
  500 READ(5,2001)Y(I),(BCD(J),J = IS,IE),NS(I)
 2001 FORMAT(F4.2,5A4,I2)
 3001           CALL SYMBOL(X,Y(1),HEIGHT,BCD(1),THETA,NS(1))
 3002           CALL SYMBOL(X,Y(2),HEIGHT,BCD(6),THETA,NS(2))
 3003           CALL SYMBOL(X,Y(3),HEIGHT,BCD(11),THETA,NS(3))
         N = 2
C
C     READ LEGEND ALPHABETIC DATA AND WRITE LEGEND WITH CALL SYMBOL.
      DO 502 I = 1,N
      IS = 4*(I-1)+1
      IE = IS + 3
  502 READ(5,2002)X2(I),Y2(I),(BCE(J),J = IS,IE),NS2(I)
 2002 FORMAT(2F5.2,4A4,I2)
      HEIGHT = 0.10
      CALL SYMBOL(X2(1),Y2(1),HEIGHT,BCE(1),THETA,NS2(1))
      CALL SYMBOL(X2(2),Y2(2),HEIGHT,BCE(5),THETA,NS2(2))
  503 READ(5,2003)X3(1),Y3(1),(BCF(J),J = 1,2),NS3(1)
 2003 FORMAT(2F5.2,2A4,I2)
      HEIGHT = 0.14
      CALL SYMBOL(X3(1),Y3(1),HEIGHT,BCF(1),THETA,NS3(1))


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      N = 2
      DO 504 I = 1,N
      IS = 10*(I-1) + 1
      IE = IS + 9
  504 READ(5,2004)X4(I),Y4(I),(BCG(J),J = IS,IE),NS4(I)
 2004 FORMAT(2F5.2,10A4,I2)
      HEIGHT = 0.10
      CALL SYMBOL(X4(1),Y4(1),HEIGHT,BCG(1),THETA,NS4(1))
      CALL SYMBOL(X4(2),Y4(2),HEIGHT,BCG(11),THETA,NS4(2))
C
C
C     +++++++++++++++  PLOT F VS FF  +++++++++++++++
C
C     SET NEW COORDINATE AXIS FOR F VS FF PLOT.
30031 CALL PLOT(18.,0.,-3)
C
C     PLOT ONE-TO-ONE LINE AND RELATIVE ACCURACY LINES.
30041 CALL PLOT(5.,5.,2)
      CALL PLOT(3.2,3.84,3)
      CALL PLOT(0.,0.,2)
      CALL PLOT(3.84,3.2,2)
C
C     SET SCALE OF COORDINATES WITH CALL SCALE.
 3005       N = 222
 3006 CALL SCALE(F(1),SW,N,1,DIV)
             N = 222
 3007 CALL SCALE(FF(1),SH,N,1,DIV)
 3033               N = 222
C
C     PLOT AND LABEL COORDIATE AXIS WITH CALL AXIS.
 3008 ORD(N+2) = 1.
 3009 ABS(N+2) = 1.
 3010 NCO = 38
 3011 THETA = 90.
 3012 CALL AXIS(XO,YO,LAB3,NCO,SH,THETA,ORD(N+1),ORD(N+2),DIV)
 3013 NCA = -47
 3014 THETA = 0.
 3015 CALL AXIS(XA,YA,LAB4,NCA,SW,THETA,ABS(N+1),ABS(N+2),DIV)
             N = 222
C
C     PLOT F VS FF AND DISTINGUISH CLAY FROM SAND AND GRAVEL.
              DO 22221  I = 1,N
C
C     FOR USGS TEST WELL #B-5 AND DEPTHS LESS THAN 60 FEET, THE LIGHO-
C     LOGY IS SAND AND GRAVEL EVEN THOUGH POROSITY INDEX IS GREATER
C     THAN 36%.
               IF(JDEPTH(I).LT.60)GO TO 22227
                  IF(PORF1(I).GT.PHIC)GO TO 22226
22227          CALL SYMBOL(F(I),FF(I),0.10,3,0.,-1)
                    GO TO 22221
22226        CALL SYMBUL(F(I),FF(I),0.14,4,0.,-1)
22221       CONTINUE
C
C     LABEL PLOT ''F VS FF COMPARISON'' AND IDENTIFY WELL.
      X = 5.25
      HEIGHT = 0.15
      THETA = 0.
                CALL SYMBOL(X,Y(1),HEIGHT,BCD(1),THETA,NS(1))
                CALL SYMBOL(X,Y(2),HEIGHT,BCD(6),THETA,NS(2))
                CALL SYMBOL(X,Y(3),HEIGHT,BCD(11),THETA,NS(3))
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0244                N = 2
            C
            C     READ LEGEND ALPHABETIC DAT/ AND WRITE LEGEND WITH CALL SYMBOL.
0245                DO 512 I = 1,N
0246                IS = 3*(I-1) + 1
0247                IE = IS + 2
0248         512       READ(5,2012)X5(I),Y5(I),(BCH(J),J = IS,IE),NS5(I)
0249        2012    FORMAT(2F5.2,3A4,I2)
0250                HEIGHT = 0.10
0251                CALL SYMBOL(X5(1),Y5(1),HEIGHT,BCH(1),THETA,NS5(1))
0252                CALL SYMBOL(X5(2),Y5(2),HEIGHT,BCH(4),THETA,NS5(2))
0253              HEIGHT = 0.14
0254              CALL SYMBOL(X3(1),Y3(1),HEIGHT,BCF(1),THETA,NS3(1))
0255              HEIGHT = 0.10
0256              CALL SYMBOL(X4(1),Y4(1),HEIGHT,BCG(1),THETA,NS4(1))
0257         505 READ(5,2005)X6(1),Y6(1),(BCI(J), J = 1,10),NS6(1)
0258        2005 FORMAT(2F5.2,10A4,I2)
0259              CALL SYMBOL(X6(1),Y6(1),HEIGHT,BCI(1),THETA,NS6(1))
            C
            C     FILE MARK.
0260              CALL PLOT(14.0,0.0,999)
0261              STOP
0262              END

                                          SCALAR MAP
SYMBOL     LOCATION      SYMBOL    LOCATION    SYMBOL    LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION
T1         000244        I         000248      RMF       00024C       RMC       000250       AM        000254
PHIC       000258        AVTEMP    00025C      TD        000260       BHT       000264       N         000268
K          00026C        A         000270      B         000274       C         000278       D         00027C
E          000280        O         000284      G         000288       GRAD      00028C       T2        000290
TIME       000294        J         000298      TEMP      00029C       SW        0002A0       SH        0002A4
DIV        0002A8        XO        0002AC      YO        0002B0       NCO       0002B4       THETA     0002B8
XA         0002BC        YA        0002C0      NCA       0002C4       X         0002C8       HEIGHT    0002CC
IS         0002D0        IE        0002D4

                                          ARRAY MAP
SYMBOL     LOCATION      SYMBOL    LOCATION    SYMBOL    LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION
IDATA      0002D8        RXO       000764      RO        0008F0       JDEPTH    00107C       F         001508
TDSF       00199C        TDSFF     001E30      RWF       0022C4       SPCONF    002750       SPCOFF    0028DC
ERROR      003068        PORF      0034F4      ORD       003980       LAB1      003E18       LAB2      003E78
ABS        003EF8        Y         004390      NS        00439C       FF        0043A8       PORFF     00483C
RWFF       004CC8        RXOC      005154      ROC       0055E0       LAB3      005A6C       LAB4      00582C
X2         005BEC        Y2        005BF4      X3        005BFC       Y3        005C00       X4        005C04
Y4         005C0C        NS2       005C14      NS3       005C1C       NS4       005C20       X5        005C28
Y5         005C30        NS5       005C38      X6        005C40       Y6        005C44       NS6       005C48
PORF1      005C4C        JDEPT1    0060D8      RXO1      006564       W         006D34       BCD       007504
BCE        007540        BCF       007560      BCG       007568       BCH       007588       BCI       0075C4

                                       SUBPROGRAMS CALLED
SYMBOL     LOCATION      SYMBOL    LOCATION    SYMBOL    LOCATION     SYMBOL    LOCATION     SYMBOL    LOCATION
CLOCK      0075EC        IBCOM#    0075F0      SETMSG    0075F4       PLOT      0075F8       SCALE     0075FC
AXIS       007600        SYMBOL    007604      FRXPR#    007608

                                          LABEL MAP
LABEL      LOCATION      LABEL     LOCATION    LABEL     LOCATION     LABEL     LOCATION     LABEL     LOCATION
 1001      007A10         1002     007A68       1003     007AC8        1004     007824           1     007B0C
    2      007C08          300     007D18       8888     007DAA         700     007E0C         702     007EC0
  703      007F08          611     007F46        701     007F60         704     007F7C         705     007F94


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                                                                           709     007FEC         710     008000
  706      007FA0          707     007FAC        708     007FDC
  711      008010          712     008048         10     0082A6           3     008338          20     008394
   21      008420           30     008478         31     008504          40     008560          41     0085EC
   50      008648           51     0086D4         60     008730          61     0087BC          70     008818
   71      0088A4           80     008900         81     00898C          90     0089E8          91     008A74
  200      008ACA          102     008B30       9999     008874         201     008C0E          12     008C28
   13      008C62          110     008D72         11     008E68        6044     008F18       11117     009036
11115      009066        11111     009090        500     0090F4        2001     00917E        3001     009190
 3002      0091B6         3003     0091DC        502     009238        2002     0092CA         503     009344
 2003      0093AC          504     00942E       2004     0094C2       30031     00953C       30041     009546
 3005      00956E         3006     009576       3007     00959C        3033     0095B2        3008     0095BA
 3009      0095CA         3010     0095D2       3011     0095DA        3012     0095E2        3013     009604
 3014      00960C         3015     009614      22227     00967A       22226     0096AE       22221     0096DC
  512      0097BA         2012     00984E        505     009934        2005     00999C

   TOTAL MEMORY REQUIREMENTS 009814 BYTES

COMPILER HIGHEST SEVERITY CODE WAS  0
// EXEC LNKEDT(MAP)
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SOCORRO COUNTY NEW MEXICO WATER WELL
(USGS TEST WELL #B-5)
AQUIFER -F- & FIELD -F- COMPARISON

FIELD FORMATION RES. FACTOR-FF = 2.5
SLOPE = 0.791
RMF = 5.4 OHM-M @ AQUIFER TEMP.
M = 0.6 FOR PORF(K) CALCULATIONS

DATA	DEPTH	*	F(K)	PORF(K)	SPCONF	TDSF	REMARKS	*	PORFF	SPCOFF	TDSFF	REMARKS	DIFFER(TDS)
1	30	*	2.3	29.0	343.	241.	GOOD	*	27.07	380.	268.	GOOD	-0.2624E 02
2	32	*	2.8	25.1	298.	210.	GOOD	*	27.07	266.	187.	GOOD	0.2309E 02
3	34	*	2.0	31.0	433.	306.	GOOD	*	27.07	531.	374.	GOOD	-0.6875E 02
4	36	*	1.4	40.2	319.	225.	GOOD	*	27.07	577.	407.	GOOD	-0.1816E 03
5	38	*	1.3	41.1	283.	200.	GOOD	*	27.07	530.	374.	GOOD	-0.1742E 03
6	40	*	1.4	40.6	240.	169.	GOOD	*	27.07	442.	311.	GOOD	-0.1419E 03
7	42	*	1.4	39.2	330.	233.	GOOD	*	27.07	576.	406.	GOOD	-0.1729E 03
8	44	*	1.3	42.1	332.	234.	GOOD	*	27.07	645.	455.	GOOD	-0.2207E 03
9	46	*	1.5	38.7	396.	279.	GOOD	*	27.07	678.	478.	GOOD	-0.1986E 03
10	48	*	1.2	43.9	291.	205.	GOOD	*	27.07	601.	423.	GOOD	-0.2182E 03
11	50	*	1.6	36.7	389.	274.	GOOD	*	27.07	614.	433.	GOOD	-0.1589E 03
12	52	*	1.6	36.7	372.	262.	GOOD	*	27.07	587.	414.	GOOD	-0.1516E 03
13	54	*	1.6	36.3	395.	278.	GOOD	*	27.07	613.	432.	GOOD	-0.1543E 03
14	56	*	1.7	35.3	436.	308.	GOOD	*	27.07	649.	458.	GOOD	-0.1502E 03
15	58	*	1.8	33.7	474.	334.	GOOD	*	27.07	659.	464.	GOOD	-0.1304E 03
16	60	*	2.8	24.9	489.	345.	GOOD	*	27.07	432.	304.	GOOD	0.4062E 02
17	62	*	3.4	22.3	783.	552.	PACCEPT	*	27.07	585.	412.	GOOD	0.1398E 03
18	64	*	2.6	26.6	561.	396.	GOOD	*	27.07	548.	386.	GOOD	0.9635E 01
19	66	*	3.8	20.4	873.	615.	PACCEPT	*	27.07	571.	403.	GOOD	0.2125E 03
20	68	*	3.7	20.8	766.	540.	PACCEPT	*	27.07	515.	363.	GOOD	0.1769E 03
21	70	*	4.2	19.2	878.	619.	PACCEPT	*	27.07	525.	370.	GOOD	0.2489E 03
22	72	*	2.9	24.8	597.	421.	GOOD	*	27.07	525.	370.	GOOD	0.5097E 02
23	74	*	2.9	24.8	533.	376.	GOOD	*	27.07	468.	330.	GOOD	0.4572E 02
24	76	*	4.5	18.2	790.	557.	PACCEPT	*	27.07	437.	308.	GOOD	0.2494E 03
25	78	*	7.2	13.4	1372.	967.	PACCEPT	*	27.07	476.	336.	GOOD	0.6314E 03
26	80	*	4.0	19.7	954.	673.	PACCEPT	*	27.07	595.	419.	GOOD	0.2537E 03
27	82	*	5.3	16.4	1160.	818.	PACCEPT	*	27.07	545.	384.	GOOD	0.4341E 03
28	84	*	7.0	13.6	1494.	1053.	NACCEPT	*	27.07	533.	376.	GOOD	0.6776E 03
29	86	*	4.2	19.3	906.	639.	PACCEPT	*	27.07	544.	383.	GOOD	0.2556E 03
30	88	*	5.8	15.5	1200.	846.	PACCEPT	*	27.07	522.	368.	GOOD	0.4781E 03
31	90	*	4.6	18.2	895.	631.	PACCEPT	*	27.07	492.	347.	GOOD	0.2839E 03
32	92	*	2.6	26.5	627.	442.	GOOD	*	27.07	606.	427.	GOOD	0.1458E 02
33	94	*	2.3	28.4	485.	342.	GOOD	*	27.07	521.	367.	GOOD	-0.2543E 02
34	96	*	2.9	24.7	785.	554.	PACCEPT	*	27.07	685.	483.	GOOD	0.7077E 02
35	98	*	2.1	30.6	602.	424.	GOOD	*	27.07	723.	509.	PACCEPT	-0.8495E 02
36	100	*	3.5	21.7	740.	522.	PACCEPT	*	27.07	530.	374.	GOOD	0.1476E 03
37	102	*	2.6	26.4	539.	380.	GOOD	*	27.07	520.	366.	GOOD	0.1371E 02
38	104	*	2.3	28.3	485.	342.	GOOD	*	27.07	519.	366.	GOOD	-0.2427E 02
39	106	*	2.4	27.5	550.	388.	GOOD	*	27.07	564.	398.	GOOD	-0.9822E 01
40	108	*	2.2	29.6	504.	355.	GOOD	*	27.07	576.	406.	GOOD	-0.5081E 02
41	110	*	2.4	28.1	490.	345.	GOOD	*	27.07	518.	365.	GOOD	-0.1986E 02
42	112	*	2.5	27.1	538.	380.	GOOD	*	27.07	539.	380.	GOOD	-0.7363E 00
43	114	*	2.5	26.9	580.	409.	GOOD	*	27.07	575.	405.	GOOD	0.3753E 01
44	116	*	2.4	27.7	611.	430.	GOOD	*	27.07	631.	445.	GOOD	-0.1423E 02
45	118	*	3.0	24.3	743.	523.	PACCEPT	*	27.07	630.	444.	GOOD	0.7905E 02
46	120	*	2.6	26.3	642.	452.	GOOD	*	27.07	615.	434.	GOOD	0.1878E 02
47	122	*	3.2	23.2	777.	548.	PACCEPT	*	27.07	615.	433.	GOOD	0.1142E 03
48	124	*	3.1	23.6	792.	558.	PACCEPT	*	27.07	645.	455.	GOOD	0.1036E 03
49	126	*	1.4	40.4	345.	243.	GOOD	*	27.07	629.	443.	GOOD	-0.1998E 03
50	128	*	2.9	24.5	678.	478.	GOOD	*	27.07	586.	413.	GOOD	0.6531E 02
51	130	*	2.7	25.7	662.	467.	GOOD	*	27.07	613.	432.	GOOD	0.3436E 02
52	132	*	2.6	26.3	627.	442.	GOOD	*	27.07	598.	422.	GOOD	0.1994E 02
53	134	*	2.7	25.9	671.	473.	GOOD	*	27.07	627.	442.	GOOD	0.3087E 02
54	136	*	2.5	27.4	723.	510.	PACCEPT	*	27.07	734.	518.	PACCEPT	-0.8004E 01
55	138	*	2.4	27.9	743.	523.	PACCEPT	*	27.07	778.	549.	PACCEPT	-0.2525E 02
56	140	*	2.9	24.5	963.	679.	PACCEPT	*	27.07	828.	584.	PACCEPT	0.9489E 02
57	142	*	3.2	22.9	1136.	801.	PACCEPT	*	27.07	885.	624.	PACCEPT	0.1771E 03
58	144	*	2.8	25.0	998.	704.	PACCEPT	*	27.07	884.	623.	PACCEPT	0.8061E 02
59	146	*	3.7	20.8	1266.	893.	PACCEPT	*	27.07	854.	602.	PACCEPT	0.2907E 03
60	148	*	2.7	25.8	983.	693.	PACCEPT	*	27.07	914.	645.	PACCEPT	0.4802E 02
61	150	*	3.0	24.3	2740.	1932.	NACCEPT	*	27.07	2326.	1640.	NACCEPT	0.2918E 03
62	152	*	2.4	28.1	3068.	2163.	NACCEPT	*	27.07	3237.	2282.	NACCEPT	-0.1190E 03
63	154	*	1.6	35.9	2572.	1813.	NACCEPT	*	27.07	3932.	2772.	NACCEPT	-0.9585E 03
64	156	*	1.7	35.2	2074.	1462.	NACCEPT	*	27.07	3077.	2169.	NACCEPT	-0.7070E 03
65	158	*	4.7	17.9	3161.	2229.	NACCEPT	*	27.07	1702.	1200.	NACCEPT	0.1029E 04
66	160	*	6.3	14.6	4023.	2836.	NACCEPT	*	27.07	1594.	1124.	NACCEPT	0.1712E 04
67	162	*	2.9	24.9	2227.	1570.	NACCEPT	*	27.07	1961.	1383.	NACCEPT	0.1876E 03
68	164	*	2.0	31.4	1857.	1309.	NACCEPT	*	27.07	2316.	1633.	NACCEPT	-0.3238E 03
69	168	*	2.9	24.3	1492.	1052.	NACCEPT	*	27.07	1272.	897.	PACCEPT	0.1549E 03
70	170	*	4.7	17.9	2062.	1454.	NACCEPT	*	27.07	1106.	779.	PACCEPT	0.6741E 03
71	172	*	5.9	15.3	2500.	1762.	NACCEPT	*	27.07	1059.	747.	PACCEPT	0.1016E 04
72	174	*	3.9	20.1	1657.	1168.	NACCEPT	*	27.07	1058.	746.	PACCEPT	0.4224E 03
73	176	*	3.9	20.1	1657.	1168.	NACCEPT	*	27.07	1058.	746.	PACCEPT	0.4229E 03
74	178	*	4.3	18.8	1829.	1289.	NACCEPT	*	27.07	1057.	745.	PACCEPT	0.5442E 03
75	180	*	5.1	16.9	2239.	1578.	NACCEPT	*	27.07	1102.	777.	PACCEPT	0.8013E 03
76	182	*	5.5	16.0	2931.	2067.	NACCEPT	*	27.07	1333.	940.	PACCEPT	0.1127E 04
77	184	*	6.2	14.9	4145.	2922.	NACCEPT	*	27.07	1688.	1190.	NACCEPT	0.1732E 04
78	186	*	4.9	17.3	4495.	3169.	NACCEPT	*	27.07	2300.	1622.	NACCEPT	0.1547E 04
79	188	*	1.4	39.9	1666.	1174.	NACCEPT	*	27.07	2975.	2098.	NACCEPT	-0.9231E 03
80	190	*	2.6	26.3	4124.	2907.	NACCEPT	*	27.07	3949.	2784.	NACCEPT	0.1234E 03
81	192	*	1.7	35.6	3344.	2357.	NACCEPT	*	27.07	5052.	3561.	NACCEPT	-0.1204E 04
82	194	*	0.8	60.4	1579.	1113.	NACCEPT	*	27.07	5259.	3708.	NACCEPT	-0.2594E 04
83	196	*	0.8	57.0	1450.	1022.	NACCEPT	*	27.07	4426.	3120.	NACCEPT	-0.2098E 04
84	198	*	3.0	24.2	4591.	3237.	NACCEPT	*	27.07	3879.	2735.	NACCEPT	0.5021E 03
85	200	*	3.0	24.2	4737.	3339.	NACCEPT	*	27.07	3999.	2820.	NACCEPT	0.5198E 03
86	202	*	3.3	22.6	5400.	3807.	NACCEPT	*	27.07	4128.	2910.	NACCEPT	0.8966E 03
87	204	*	3.7	21.0	7388.	5209.	NACCEPT	*	27.07	5033.	3548.	NACCEPT	0.1660E 04
88	206	*	0.5	84.0	959.	676.	PACCEPT	*	27.07	5240.	3694.	NACCEPT	-0.3018E 04
89	208	*	5.6	15.9	9283.	6544.	NACCEPT	*	27.07	4189.	2953.	NACCEPT	0.3591E 04
90	210	*	4.0	19.9	5449.	3842.	NACCEPT	*	27.07	3441.	2426.	NACCEPT	0.1416E 04
91	212	*	2.5	26.9	3834.	2703.	NACCEPT	*	27.07	3804.	2682.	NACCEPT	0.2132E 02
92	214	*	2.4	27.7	3618.	2551.	NACCEPT	*	27.07	3745.	2640.	NACCEPT	-0.8937E 02
93	216	*	2.7	25.8	4022.	2836.	NACCEPT	*	27.07	3742.	2638.	NACCEPT	0.1974E 03
94	218	*	4.4	18.6	6753.	4761.	NACCEPT	*	27.07	3855.	2718.	NACCEPT	0.2043E 04
95	220	*	4.4	18.7	6906.	4869.	NACCEPT	*	27.07	3975.	2802.	NACCEPT	0.2066E 04
96	222	*	3.5	21.6	5421.	3822.	NACCEPT	*	27.07	3850.	2715.	NACCEPT	0.1107E 04
97	224	*	3.0	24.1	4737.	3339.	NACCEPT	*	27.07	3970.	2799.	NACCEPT	0.5404E 03
98	226	*	2.7	25.6	5043.	3555.	NACCEPT	*	27.07	4629.	3263.	NACCEPT	0.2915E 03
99	228	*	0.3	****	558.	394.	GOOD	*	27.07	5551.	3914.	NACCEPT	-0.3520E 04
100	230	*	0.5	83.6	921.	649.	PACCEPT	*	27.07	4993.	3520.	NACCEPT	-0.2871E 04
101	232	*	0.7	61.8	1291.	910.	PACCEPT	*	27.07	4456.	3141.	NACCEPT	-0.2231E 04
102	234	*	0.6	71.8	888.	626.	PACCEPT	*	27.07	3836.	2705.	NACCEPT	-0.2079E 04
103	236	*	1.2	44.9	1168.	823.	PACCEPT	*	27.07	2492.	1757.	NACCEPT	-0.9335E 03
104	238	*	4.0	19.8	1989.	1402.	NACCEPT	*	27.07	1245.	878.	PACCEPT	0.5243E 03
105	240	*	5.6	15.8	2422.	1707.	NACCEPT	*	27.07	1082.	763.	PACCEPT	0.9443E 03
106	242	*	4.8	17.6	1897.	1337.	NACCEPT	*	27.07	995.	701.	PACCEPT	0.6358E 03
107	244	*	3.5	21.9	1268.	894.	PACCEPT	*	27.07	921.	649.	PACCEPT	0.2448E 03
108	246	*	3.2	23.0	1092.	770.	PACCEPT	*	27.07	857.	604.	PACCEPT	0.1660E 03
109	248	*	3.0	23.9	995.	701.	PACCEPT	*	27.07	828.	584.	PACCEPT	0.1177E 03
110	250	*	2.5	27.5	866.	610.	PACCEPT	*	27.07	886.	625.	PACCEPT	-0.1451E 02
111	252	*	2.7	25.6	842.	594.	PACCEPT	*	27.07	775.	546.	PACCEPT	0.4733E 02
112	254	*	5.6	15.8	1547.	1091.	NACCEPT	*	27.07	688.	485.	GOOD	0.6053E 03
113	256	*	5.9	15.4	1653.	1165.	NACCEPT	*	27.07	708.	499.	GOOD	0.6661E 03
114	258	*	3.3	22.4	1029.	726.	PACCEPT	*	27.07	774.	545.	PACCEPT	0.1803E 03
115	260	*	7.9	12.6	1941.	1369.	NACCEPT	*	27.07	619.	436.	GOOD	0.9326E 03
116	262	*	5.7	15.8	1326.	935.	PACCEPT	*	27.07	589.	415.	GOOD	0.5199E 03
117	264	*	6.1	15.0	1500.	1057.	NACCEPT	*	27.07	618.	436.	GOOD	0.6220E 03
118	266	*	4.9	17.4	1196.	843.	PACCEPT	*	27.07	617.	435.	GOOD	0.4076E 03
119	268	*	6.0	15.1	1478.	1042.	NACCEPT	*	27.07	617.	435.	GOOD	0.6072E 03
120	270	*	5.7	15.7	1466.	1033.	NACCEPT	*	27.07	649.	458.	GOOD	0.5757E 03
121	272	*	3.4	22.3	823.	581.	PACCEPT	*	27.07	616.	434.	GOOD	0.1461E 03

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122    274  *  2.7   25.5    674.   475.    GOOD   *  27.07    616.   434.    GOOD       0.4075E 02
123    276  *  3.4   22.3    915.   645.  PACCEPT  *  27.07    684.   482.    GOOD       0.1629E 03
124    278  *  3.1   23.6    861.   607.  PACCEPT  *  27.07    703.   496.    GOOD       0.1115E 03
125    280  *  3.7   20.9   1007.   710.  PACCEPT  *  27.07    683.   482.    GOOD       0.2283E 03
126    282  *  3.2   22.9    932.   657.  PACCEPT  *  27.07    723.   510.  PACCEPT      0.1471E 03
127    284  *  2.8   25.4    998.   704.  PACCEPT  *  27.07    910.   641.  PACCEPT      0.6230E 02
128    286  *  2.8   25.4    962.   679.  PACCEPT  *  27.07    877.   618.  PACCEPT      0.6044E 02
129    288  *  3.1   23.8    933.   657.  PACCEPT  *  27.07    767.   541.  PACCEPT      0.1169E 03
130    290  *  2.8   25.4    793.   559.  PACCEPT  *  27.07    721.   508.  PACCEPT      0.5038E 02
131    290  *  2.8   25.4    793.   559.  PACCEPT  *  27.07    721.   508.  PACCEPT      0.5038E 02
132    292  *  2.7   25.9    768.   542.  PACCEPT  *  27.07    721.   508.  PACCEPT      0.3346E 02
133    294  *  3.4   22.2   1029.   726.  PACCEPT  *  27.07    765.   540.  PACCEPT      0.1861E 03
134    296  *  3.4   22.2   1063.   749.  PACCEPT  *  27.07    790.   557.  PACCEPT      0.1925E 03
135    298  *  5.7   15.6   1989.  1402.  NACCEPT  *  27.07    874.   616.  PACCEPT      0.7865E 03
136    300  *  4.1   19.6   1473.  1039.  NACCEPT  *  27.07    905.   638.  PACCEPT      0.4003E 03
137    302  *  4.5   18.4   1404.   989.  PACCEPT  *  27.07    788.   556.  PACCEPT      0.4338E 03
138    304  *  5.7   15.6   1797.  1267.  NACCEPT  *  27.07    788.   555.  PACCEPT      0.7114E 03
139    306  *  5.7   15.6   1857.  1309.  NACCEPT  *  27.07    813.   573.  PACCEPT      0.7354E 03
140    308  *  6.2   14.9   2000.  1410.  NACCEPT  *  27.07    813.   573.  PACCEPT      0.8369E 03
141    310  *  5.7   15.6   2652.  1870.  NACCEPT  *  27.07   1161.   818.  PACCEPT      0.1052E 04
142    312  *  2.8   25.3   1347.   950.  PACCEPT  *  27.07   1218.   859.  PACCEPT      0.9129E 02
143    314  *  3.7   20.8   1768.  1247.  NACCEPT  *  27.07   1188.   837.  PACCEPT      0.4095E 03
144    316  *  3.2   23.2   1281.   903.  PACCEPT  *  27.07   1014.   715.  PACCEPT      0.1885E 03
145    318  *  2.6   26.7   1179.   832.  PACCEPT  *  27.07   1158.   816.  PACCEPT      0.1518E 02
146    320  *  2.4   27.9   1105.   779.  PACCEPT  *  27.07   1157.   816.  PACCEPT     -0.3705E 02
147    322  *  2.6   26.2    984.   693.  PACCEPT  *  27.07    934.   659.  PACCEPT      0.3487E 02
148    324  *  4.1   19.5   1326.   935.  PACCEPT  *  27.07    809.   570.  PACCEPT      0.3644E 03
149    326  *  3.1   23.6   1105.   779.  PACCEPT  *  27.07    898.   633.  PACCEPT      0.1458E 03
150    328  *  3.3   22.7   1320.   930.  PACCEPT  *  27.07   1010.   712.  PACCEPT      0.2183E 03
151    330  *  2.5   26.9   1114.   785.  PACCEPT  *  27.07   1101.   776.  PACCEPT      0.8746E 01
152    332  *  2.6   26.7   1126.   794.  PACCEPT  *  27.07   1101.   776.  PACCEPT      0.1771E 02
153    334  *  2.4   27.8   1105.   779.  PACCEPT  *  27.07   1152.   812.  PACCEPT     -0.3369E 02
154    336  *  2.7   25.9   1175.   828.  PACCEPT  *  27.07   1099.   775.  PACCEPT      0.5313E 02
155    338  *  3.1   23.4   1507.  1062.  NACCEPT  *  27.07   1209.   852.  PACCEPT      0.2104E 03
156    340  *  2.8   25.0   1361.   960.  PACCEPT  *  27.07   1208.   852.  PACCEPT      0.1082E 03
157    342  *  2.9   24.5   1404.   990.  PACCEPT  *  27.07   1207.   851.  PACCEPT      0.1388E 03
158    344  *  5.4   16.3   2452.  1729.  NACCEPT  *  27.07   1149.   810.  PACCEPT      0.9186E 03
159    346  *  4.1   19.4   1894.  1335.  NACCEPT  *  27.07   1148.   810.  PACCEPT      0.5258E 03
160    348  *  4.2   19.2   2025.  1428.  NACCEPT  *  27.07   1205.   850.  PACCEPT      0.5784E 03
161    350  *  4.1   19.4   1657.  1168.  NACCEPT  *  27.07   1004.   708.  PACCEPT      0.4609E 03
162    352  *  4.1   19.4   1894.  1335.  NACCEPT  *  27.07   1146.   808.  PACCEPT      0.5272E 03
163    354  *  3.2   23.0   1507.  1063.  NACCEPT  *  27.07   1179.   831.  PACCEPT      0.2311E 03
164    356  *  2.8   25.1   1328.   936.  PACCEPT  *  27.07   1185.   835.  PACCEPT      0.1008E 03
165    358  *  2.8   24.9   1361.   960.  PACCEPT  *  27.07   1202.   847.  PACCEPT      0.1127E 03
166    360  *  3.1   23.4   1492.  1052.  NACCEPT  *  27.07   1201.   847.  PACCEPT      0.2053E 03
167    362  *  3.8   20.6   1898.  1338.  NACCEPT  *  27.07   1257.   886.  PACCEPT      0.4521E 03
168    364  *  3.2   23.1   1602.  1130.  NACCEPT  *  27.07   1263.   890.  PACCEPT      0.2395E 03
169    366  *  2.8   25.0   1411.   995.  PACCEPT  *  27.07   1255.   885.  PACCEPT      0.1098E 03
170    368  *  3.1   23.7   1531.  1080.  NACCEPT  *  27.07   1255.   884.  PACCEPT      0.1951E 03
171    370  *  3.3   22.6   1642.  1158.  NACCEPT  *  27.07   1254.   884.  PACCEPT      0.2737E 03
172    372  *  3.1   23.4   1658.  1169.  NACCEPT  *  27.07   1330.   937.  PACCEPT      0.2314E 03
173    374  *  2.8   25.0   1684.  1187.  NACCEPT  *  27.07   1495.  1054.  NACCEPT      0.1335E 03
174    376  *  2.9   24.8   1815.  1280.  NACCEPT  *  27.07   1594.  1124.  NACCEPT      0.1562E 03
175    378  *  2.8   25.3   1820.  1283.  NACCEPT  *  27.07   1648.  1162.  NACCEPT      0.1216E 03
176    380  *  3.1   23.6   2031.  1432.  NACCEPT  *  27.07   1658.  1169.  NACCEPT      0.2629E 03
177    382  *  2.9   24.5   1930.  1361.  NACCEPT  *  27.07   1657.  1168.  NACCEPT      0.1925E 03
178    384  *  3.2   23.2   2184.  1540.  NACCEPT  *  27.07   1728.  1218.  NACCEPT      0.3214E 03
179    386  *  3.2   23.2   2319.  1635.  NACCEPT  *  27.07   1834.  1293.  NACCEPT      0.3419E 03
180    388  *  3.0   24.3   2675.  1886.  NACCEPT  *  27.07   2269.  1600.  NACCEPT      0.2860E 03
181    390  *  1.2   44.3   1424.  1004.  NACCEPT  *  27.07   2976.  2098.  NACCEPT     -0.1094E 04
182    392  *  2.3   28.8   1806.  1273.  NACCEPT  *  27.07   1983.  1398.  NACCEPT     -0.1247E 03
183    394  *  2.6   26.7   1795.  1266.  NACCEPT  *  27.07   1762.  1242.  NACCEPT      0.2392E 02
184    396  *  2.2   29.7   1590.  1121.  NACCEPT  *  27.07   1828.  1289.  NACCEPT     -0.1678E 03
185    398  *  2.5   27.5   1718.  1211.  NACCEPT  *  27.07   1760.  1240.  NACCEPT     -0.2901E 02
186    400  *  2.6   26.5   1750.  1234.  NACCEPT  *  27.07   1696.  1195.  NACCEPT      0.3843E 02
187    402  *  2.7   25.8   1880.  1326.  NACCEPT  *  27.07   1745.  1230.  NACCEPT      0.9576E 02
188    404  *  2.8   25.4   1920.  1354.  NACCEPT  *  27.07   1744.  1229.  NACCEPT      0.1247E 03
189    406  *  2.8   25.0   1961.  1383.  NACCEPT  *  27.07   1743.  1228.  NACCEPT      0.1540E 03
190    408  *  2.6   26.3   1835.  1293.  NACCEPT  *  27.07   1754.  1237.  NACCEPT      0.5657E 02
191    410  *  2.9   24.8   2026.  1429.  NACCEPT  *  27.07   1780.  1255.  NACCEPT      0.1737E 03
192    412  *  2.6   26.6   1865.  1315.  NACCEPT  *  27.07   1820.  1283.  NACCEPT      0.3153E 02
193    414  *  2.9   24.8   2191.  1545.  NACCEPT  *  27.07   1922.  1355.  NACCEPT      0.1894E 03
194    416  *  2.8   25.3   2106.  1485.  NACCEPT  *  27.07   1906.  1344.  NACCEPT      0.1415E 03
195    418  *  3.0   23.8   2388.  1684.  NACCEPT  *  27.07   1968.  1387.  NACCEPT      0.2963E 03
196    420  *  2.8   25.1   2399.  1692.  NACCEPT  *  27.07   2146.  1513.  NACCEPT      0.1788E 03
197    422  *  2.3   28.6   2408.  1698.  NACCEPT  *  27.07   2621.  1848.  NACCEPT     -0.1502E 03
198    424  *  2.2   29.6   2223.  1567.  NACCEPT  *  27.07   2535.  1787.  NACCEPT     -0.2201E 03
199    426  *  2.6   26.6   2353.  1659.  NACCEPT  *  27.07   2288.  1613.  NACCEPT      0.4630E 02
200    428  *  2.6   26.6   2090.  1473.  NACCEPT  *  27.07   2030.  1431.  NACCEPT      0.4193E 02
201    430  *  2.6   26.5   2244.  1582.  NACCEPT  *  27.07   2179.  1536.  NACCEPT      0.4592E 02
202    432  *  2.3   28.6   2104.  1483.  NACCEPT  *  27.07   2284.  1610.  NACCEPT     -0.1266E 03
203    434  *  2.2   29.5   2047.  1443.  NACCEPT  *  27.07   2328.  1641.  NACCEPT     -0.1979E 03
204    436  *  2.3   28.4   2108.  1486.  NACCEPT  *  27.07   2259.  1593.  NACCEPT     -0.1065E 03
205    438  *  2.7   25.9   2340.  1650.  NACCEPT  *  27.07   2195.  1547.  NACCEPT      0.1023E 03
206    440  *  2.7   25.9   2340.  1650.  NACCEPT  *  27.07   2193.  1546.  NACCEPT      0.1032E 03
207    442  *  2.9   24.7   2616.  1845.  NACCEPT  *  27.07   2277.  1605.  NACCEPT      0.2392E 03
208    444  *  2.9   24.7   2778.  1959.  NACCEPT  *  27.07   2417.  1704.  NACCEPT      0.2549E 03
209    446  *  2.3   28.5   2408.  1698.  NACCEPT  *  27.07   2603.  1835.  NACCEPT     -0.1376E 03
210    448  *  2.7   26.1   2692.  1898.  NACCEPT  *  27.07   2545.  1794.  NACCEPT      0.1037E 03
211    450  *  2.9   24.6   2929.  2065.  NACCEPT  *  27.07   2544.  1793.  NACCEPT      0.2718E 03
212    455  *  3.2   23.0   3353.  2364.  NACCEPT  *  27.07   2626.  1851.  NACCEPT      0.5127E 03
213    460  *  2.9   24.6   3170.  2235.  NACCEPT  *  27.07   2745.  1935.  NACCEPT      0.2997E 03
214    465  *  2.6   26.4   2693.  1899.  NACCEPT  *  27.07   2589.  1825.  NACCEPT      0.7341E 02
215    470  *  3.4   22.2   3690.  2601.  NACCEPT  *  27.07   2738.  1930.  NACCEPT      0.6714E 03
216    475  *  4.8   17.5   4963.  3499.  NACCEPT  *  27.07   2582.  1820.  NACCEPT      0.1679E 04
217    480  *  3.9   20.1   3898.  2748.  NACCEPT  *  27.07   2495.  1759.  NACCEPT      0.9892E 03
218    485  *  3.9   20.1   3898.  2748.  NACCEPT  *  27.07   2491.  1756.  NACCEPT      0.9916E 03
219    490  *  2.0   31.5   2528.  1782.  NACCEPT  *  27.07   3170.  2235.  NACCEPT     -0.4525E 03
220    495  *  4.9   17.4   5955.  4198.  NACCEPT  *  27.07   3081.  2172.  NACCEPT      0.2027E 04
221    500  *  3.2   22.8   3979.  2805.  NACCEPT  *  27.07   3076.  2169.  NACCEPT      0.6362E 03
222    505  *  2.9   24.4   3593.  2533.  NACCEPT  *  27.07   3072.  2166.  NACCEPT      0.3674E 03

DATA  DEPTH  * F(K)  PORF(K)  SPCONF  TDSF  REMARKS  * PORFF  SPCOFF  TDSFF  REMARKS   DIFFER(TDS)


                      PROGRAM TIME IN SECONDS =  0.9575000E 02


              PROGRAM BY----

                   RONALD M. BRIMHALL
                   BOX 31 CAMPUS STA.
                   SOCORRO, N. M.   87801
/&
JOB TIME SUMMARY...COMPILE 0193S  ASSEMBLE 0000S  LNKEDT 0051S  UTILS 0000S  USER 0174S    TOTAL TIME  006M 58S
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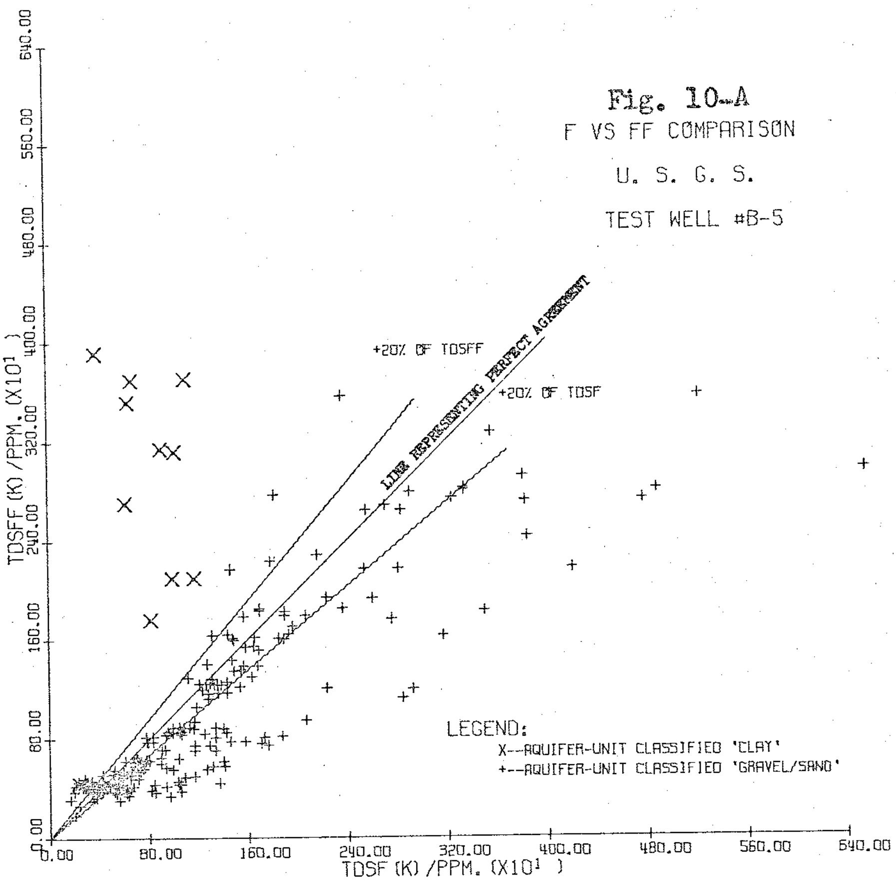

Fig. 10-A
F VS FF COMPARISON
U. S. G. S.
TEST WELL #B-5

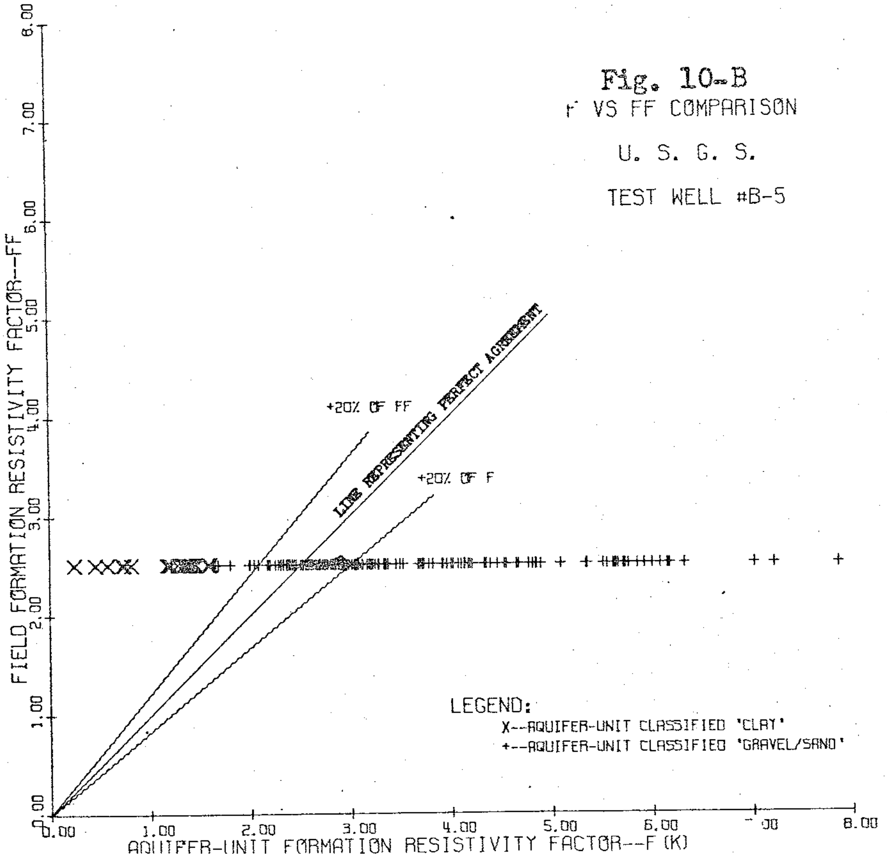

Fig. 10-B
F VS FF COMPARISON
U. S. G. S.
TEST WELL #B-5

APPENDIX A: DEFINITIONS OF TERMS AND SYMBOLS

DEFINITIONS OF TERMS AND SYMBOLS

C_w : Specific conductance of water [micromhos/cm].

F : F-Method formation resistivity factor; ratio of R_{xo}/R_{mf} $[M^oL^oT^o]$.

FF : FF-Method formation resistivity factor; the symbol used in the text and adjunctive interpretation programs for the field formation resistivity factor $[M^oL^oT^o]$.

R_m : Resistivity of drilling fluid at time well is logged [ohm-meters].

R_{mc} : Resistivity of mud cake [ohm-meters].

R_{mf} : Resistivity of invading mud filtrate [ohm-meters].

R_o : Resistivity of uncontaminated zone if 100 percent water saturated [ohm-meters].

R_t : Resistivity of uncontaminated zone under any conditions of saturation [ohm-meters].

R_{xo} : Resistivity of the flushed zone [ohm-meters].

SP : Abbreviation for spontaneous potential [millivolts].

a : An empirically determined formation constant which relates F to ϕ.

c : An empirical constant.

h : Aquifer thickness; usually in feet $[M^oL^1T^o]$.

m : Cementation exponent in $F = a/\Phi^m$ $[M^oL^oT^o]$.

n : Upper limit in a summation; a constant.

t : Temperature of an electrolyte [°F, °C, °K].

Φ : Aquifer porosity [percent or fraction].

Cl : Chloride ion concentration [ppm].

HARD : Hardness as calcium carbonate [ppm].

HCO_3 : Bicarbonate ion concentration [ppm].

SO_4 : Sulfate ion concentration [ppm].

TDS : Total dissolved solids concentration [ppm].

TDSF : Concentration of total dissolved solids determined by the F-Method [ppm].

TDSFF: Concentration of total dissolved solids determined by the FF-Method [ppm].

Chem. Conc. : Abbreviation for Chemical analysis determined concentration [ppm].

Flushed zone : That portion of the aquifer for which it is presumed all natural aquifer fluids have been displaced by invading drilling mud filtrate---a portion of the invaded zone.

Invaded zone : That portion of the aquifer in which there exists a mixture of invading mud filtrate and connate water.

Log conc. : Abbreviation for Log analysis determined concentration [ppm].

Uncontaminated zone: That portion of the aquifer in which there has been no idsplacement or contamination of native water.

GOOD-SCREEN : Designation that the water contained in a given aquifer unit is within the range of acceptability as established in water quality standards.

NACCEPT : Designation that the water contained in a given aquifer unit is not within the range of acceptability as established in water quality standards.

NACCEPT-CLAY : Designation that an aquifer unit is predominantly clay or clay bearing; the permeability is presumed very small relative to adjacent sands and gravels.

PACCEPT : Designation that the water contained in a given aquifer is between the ranges of acceptability of GOOD-SCREEN and NACCEPT.

PACCEPT/SANDY-CLAY : Designation that an aquifer unit contains water of acceptable quality but the rock matrix of the aquifer contains clay in amounts that could effect the permeability.

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APPENDIX B: ABSTRACT FROM THE THESIS

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ABSTRACT[a]

Methods of log interpretation were developed whereby quantitative values of parameters relating to water quality can be determined in order to obtain maximum use from modern macroresistivity and microresistivity logs.

Two methods of interpretation, each based on different formation resistivity factor concepts and each programmed for digital computers, are discussed and evaluated for unconsolidated alluvial deposits. The "F-Method", based on interval formation resistivity factors, gave results which compare favorably with chemical analysis of water samples; the "FF-Method", based on a generalized "field formation resistivity factor", gave results which do not compare favorably with chemical analysis. The F-Method is the preferred method for the geographic areas studied. The interpretation is aided by auxiliary computer programs.

[a] Source: Brimhall [1969].

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Brimhall, R. M., Digital Analysis of Borehole-Measured Aquifer Resistivity to Determine Water Quality, Unpublished Master of Science thesis, N. Mex. Inst. Min. and Tech., Socorro, May 1969.

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Schlumberger Technology Corp., Log Interpretation Charts Schlumberger-Doll Research Center, Ridgefield, Conn., 1968.

Note: Each program presented here contains its own reference list.