

ANALYTICAL STREAM DEPLETION MODEL

By

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Introduction

The model will compute stream depletion or accretion caused by a well pumping from or recharging an aquifer hydraulically connected to the stream. Depletion may be computed to a stream of infinite length or to a segment of the stream. Pumping may be input at a constant or variable rate. As options, impermeable (no-flow) boundaries may be simulated parallel or perpendicular to the stream. Stream depletion is solved using analytical equations described by Glover (Glover 1977) and others.

The source code is written in "BASIC" and does not contain any color or graphics commands. Output requires a printer and includes the option of graphing the depletion rate and the cumulative volume of depletion. Sample output and a listing of the code are attached. The code on floppy disks is available from the Office of the State Engineer, Colorado Division of Water Resources.

Equations Used and Their Solutions

The depletion rate for a stream of infinite length is given by the equation:

$$\frac{q}{Q} = 1 - \frac{2}{\sqrt{\pi}} \int_0^{\frac{x_1}{\sqrt{4tT/S}}} e^{-u^2} du \quad (1)$$

in which q = depletion rate
 Q = pumping rate
 T = transmissivity
 t = time since pumping began
 S = specific yield
 x_1 = distance between well and stream

The exponential integral is solved using the series:

$$(x - \frac{x^3}{3 \cdot 1!} + \frac{x^5}{5 \cdot 2!} - \frac{x^7}{7 \cdot 3!} + \frac{x^9}{9 \cdot 4!} - + \dots)$$

where $x = x_1 / \sqrt{4tT/S}$

Series terms are summed until a term with an absolute value smaller than 1×10^{-8} is reached assuring series accuracy to the 5th place to the right of the decimal. For values of x greater than 2.9, q/Q is set to zero because computed values of q/Q will be less than 0.00005.

The ratio of volume of depletion of a stream of infinite length to the volume pumped is given by the equation:

$$\frac{v}{V} = \frac{q/Q(1+2x^2)}{\sqrt{\pi}} - \frac{2xe^{-x^2}}{\sqrt{\pi}} \quad (2)$$

in which v = cumulative volume of stream depletion
 V = cumulative volume pumped

Because equation (2) contains the term q/Q , accuracy to the 5th place to the right of the decimal is expected for the computed value of v/V .

Equations (1) and (2) give the depletion for a stream of infinite length. If the user chooses to compute the depletion to a segment of a stream of infinite length, the depletion rate is given by the equation:

$$q/Q = \frac{x_1}{\pi} \int_{z_1}^{z_2} \frac{e^{-(\frac{x_1^2+z^2}{4t+s})}}{(x_1^2+z^2)} dz \quad (3)$$

in which z_1 = coordinate of one end of stream segment
 z_2 = coordinate of other end of stream segment where the origin is the intersection of the stream and a line through the well and normal to the stream.

Integration of equation (3) is accomplished using Simpson's approximation. The n in Simpson's approximation is computed by the program and computed values of q/Q are normally accurate to the fourth place to the right of the decimal.

At any time (t) the ratio of volume of stream depletion to volume pumped is given by the equation:

$$\frac{v}{V} = \frac{1}{t} \int_0^t q/Q dt \quad (4)$$

Equation (4) is solved using Simpson's approximation and the discrete values for q/Q obtained from integration of equation (3). Accuracy of the approximation is dependent upon the number of time steps chosen by the user. Greater accuracy is obtained with a larger number of time steps.

Boundaries

The user is given the choice of one of four aquifer options as follows:

1. Semi-infinite aquifer bounded only by a stream.
2. Alluvial aquifer (aquifer bounded by a stream and a parallel impermeable boundary).

3. Aquifer bounded by a stream and an impermeable boundary perpendicular to the stream.
4. Boundary effects approximated by use of an effective stream depletion factor (sdf).

Use of equations (1), (2), and (3) assumes the following aquifer and boundary idealization:

1. The aquifer is isotropic, homogeneous, of uniform thickness, and infinite except where bounded by specified boundaries.
2. The transmissivity is everywhere the same and does not change with time. Drawdown is considered negligible when compared to the aquifer thickness.
3. The water table is initially flat.
4. Water temperatures are constant.
5. Water is released instantaneously from storage.
6. The stream is straight, infinite in length, and fully penetrates the aquifer.
7. The pumping rate is constant for any pumping period.
8. The diameter of the well is negligible.
9. For aquifer option #2 (alluvial aquifer), the impermeable boundary is straight, infinite in length and parallel to the stream.
10. For aquifer option #3, the impermeable boundary is straight, normal to the stream, and infinite away from the stream.

The required boundary condition for aquifer option #1 is that zero (0) drawdown occurs along the stream. This condition is met by placing a recharge image well on the opposite side of the river and at the same distance from the river as the pumping well (Figure 1). Single application of equations (1) and (2) (equations (3) and (4) for a stream segment) give the depletion rate and volume of depletion for this simplest aquifer system.

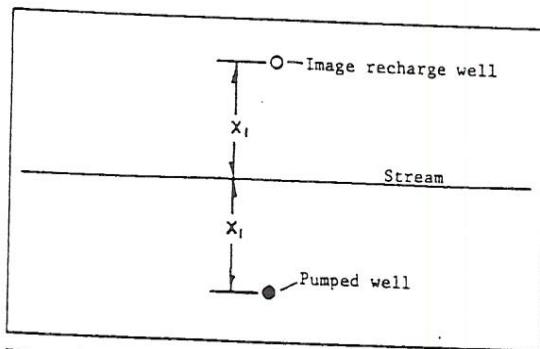
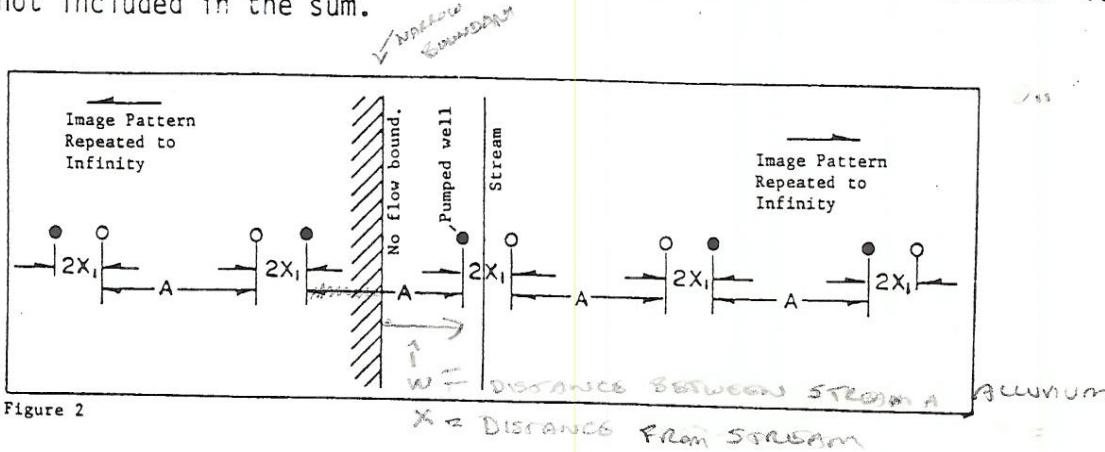
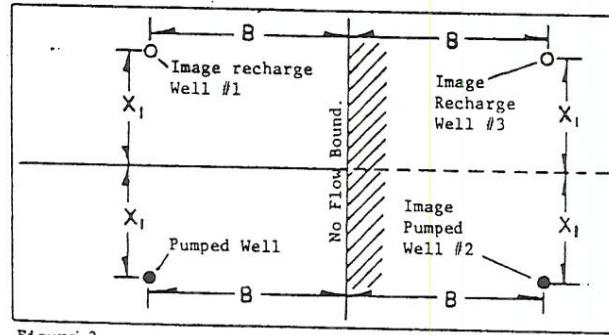


Figure 1

Aquifer option #2 requires a no-flow boundary parallel to the stream. Boundary conditions are met by placement of a repeating series of recharging and discharging image wells as shown in Figure 2. Depletion to the stream is computed by summing the depletion or accretion due to each pair of pumping and recharging wells. More distant pairs which contribute less than 0.00005 to q/Q are not included in the sum.



Aquifer option #3 requires a no-flow boundary perpendicular to the stream. Boundary conditions are met by placement of 3 image wells as shown in Figure 3. Depletion to the stream is computed by simply summing the depletion due to the pumping well and image well #1 and the depletion due to image wells #2 and #3.



Use of Jenkins' (Jenkins 1970) effective stream depletion factor (sdf) combines transmissivity, specific yield, distance between well and stream, and the effects of real boundaries into a unitized term. If aquifer option #4 is used, the sdf should have been previously determined from model studies or field measurements. Stream depletion using sdf is computed by allowing $\text{sdf} = X_1^2 S/T$ and using equations (1) and (2).

Variable Pumping Rates

The user may input pumping at a constant rate or multiple pumping periods may be input at different pumping rates. A pumping period is a period of time during which the pumping rate is constant. Superposition is used to compute the stream depletion due to pumping a well at different rates.

An example may best illustrate use of superposition to compute stream depletion from pumping at variable rates. Given a well pumping at 1000 gpm for 3 months and then resting ($Q = 0$ gpm) for the remaining 9 months of the year, the depletion one year after pumping began would be the sum of the depletion of a well pumping continuously for one year at 1000 gpm and the accretion of a well recharging the aquifer at the rate of 1000 gpm and starting at the same time that the real pumping well ceased.

User's Guide

The program is written with sufficient prompting statements for data input and detailed instructions are not necessary. A few comments concerning certain input items are as follows:

1. Units for inputting distances, transmissivity and pumping rates are feet, gpd/ft. and gpm respectively.
2. The user may select days, weeks, months, or years as the unit of time for inputting the pumping schedule. The following assumptions apply depending upon which time unit is chosen:
 - a) 1 year = 365 days
 - b) 1 month = 365/12 days
 - c) 1 week = 365/52 days
3. The length of a pumping period and the time between printouts must be input as a whole number of the time units selected.
4. If the user wishes to simulate a period of time when the well is not pumping, that period is considered as a pumping period and the well yield must be entered as zero (0).
5. The pumping rate for a recharge well must be negative.
6. Unless the user declares differently, depletion will be printed only for the end of each pumping period.

Sample Problem

The sample problem is for a well pumping 4 months out of the year for 5 years at the rate of 1000 gpm. Transmissivity, specific yield, and distance from the stream are 30,000 gpd/ft., 0.15 and 3000 feet respectively. Model output is attached.

References

Glover, R.E., 1974, Transient Ground Water Hydraulics: Water Resources Publications, P.O. Box 303, Fort Collins, CO 80522, p. 141-144.

Jenkins, C.T., 1970, Computation of Rate and Volume of Stream Depletion by
Wells: Techniques of Water Resources Investigations of the United States
Geological Survey, Book 4, Chapter D1, 17 pages.

SAMPLE OUTPUT

STREAM DEPLETION USING GLOVER TECHNIQUES

SAMPLE PROBLEM ---- INFINITE AQUIFER
VARIABLE PUMPING RATE ---- DRS
JULY 21, 1987

=====
STREAM :
:
:
3000
:
:
:
0 WELL

T= 30000 GPD/FT, S= .15
NOT DRAWN TO SCALE

PUMPING SCHEDULE TOTAL TIME SIMULATED= 60 MONTHS

PUMPING PERIOD	Q (GPM)	LENGTH (MONTHS)	CUM. TIME (MONTHS)	VOL. PUMPED THIS PERIOD (ACRE-FEET)	CUM. VOL. PUMPED (ACRE-FEET)
1	1000.000	4	4	537.588	537.588
2	0.000	8	12	0.000	537.588
3	1000.000	4	16	537.588	1075.177
4	0.000	8	24	0.000	1075.177
5	1000.000	4	28	537.588	1612.765
6	0.000	8	36	0.000	1612.765
7	1000.000	4	40	537.588	2150.353
8	0.000	8	48	0.000	2150.353
9	1000.000	4	52	537.588	2687.941
10	0.000	8	60	0.000	2687.941

SAMPLE OUTPUT (continued)

STREAM DEPLETION

TIME (MONTHS)	DEP. RATE (GPM)	VOL. OF DEP. (ACRE-FEET)	VOL. OF DEP. THIS STEP (ACRE-FEET)
1	18.6516	0.5232	0.5232
2	96.2296	7.9969	7.4737
3	174.4090	26.3152	18.3183
4	239.5108	54.2770	27.9618
5	274.1319	89.6403	35.3633
6	240.6383	124.5677	34.9274
7	199.5229	154.0826	29.5149
8	166.0633	178.5560	24.4734
9	140.1739	199.0598	20.5039
10	120.0683	216.4930	17.4331
11	104.2171	231.5233	15.0303
12	91.5094	244.6463	13.1230
13	99.8086	256.7495	12.1032
14	168.8314	274.5374	17.7879
15	239.8500	302.1168	27.5815
16	298.8887	338.4570	36.3382
17	328.3243	381.4424	42.9854
18	290.3565	423.3462	41.9037
19	245.3487	459.2758	35.9296
20	208.4776	487.6729	30.3971
21	179.5799	515.6720	25.9990
22	156.8042	538.2170	22.5450
23	138.5716	558.0226	19.8055
24	123.7287	575.6174	17.5948
25	130.1048	591.9191	16.3017
26	197.3882	613.6604	21.7413
27	266.8271	644.9697	31.3093
28	324.4267	684.8350	39.8653
29	352.5472	731.1644	46.3293
30	313.3732	776.2416	45.0773
31	267.2558	815.1894	38.9477
32	229.3618	848.4620	33.2727
33	199.5177	877.2019	28.7399
34	175.8652	902.3663	25.1643
35	156.8185	924.6790	22.3127
36	141.2175	944.6736	19.9945
37	146.8869	963.2790	18.6055
38	213.5096	987.2297	23.9507
39	282.3304	1020.6651	33.4354
40	339.3501	1062.5734	41.9083
41	366.9258	1110.8705	48.2971
42	327.2400	1157.8482	46.9776
43	280.6398	1198.6250	40.7768
44	242.2909	1233.6671	35.0421
45	212.0170	1264.1166	30.4495
46	187.9576	1290.9312	26.8146
47	168.5258	1314.8432	23.9121
48	152.5597	1336.3854	21.5422
49	157.8825	1356.4916	20.1062
50	224.1762	1381.8989	25.4073
51	292.6839	1416.7463	34.8474
52	349.4056	1460.0274	43.2811
53	376.6970	1509.6544	49.6270
54	336.7403	1557.9260	48.2716
55	289.8815	1599.9617	42.0356
56	251.2855	1636.2292	36.2675
57	220.7755	1667.8732	31.6441
58	196.4901	1695.8524	27.9792
59	176.8419	1720.8974	25.0450
60	160.6682	1743.5428	22.6454

SAMPLE OUTPUT (continued)

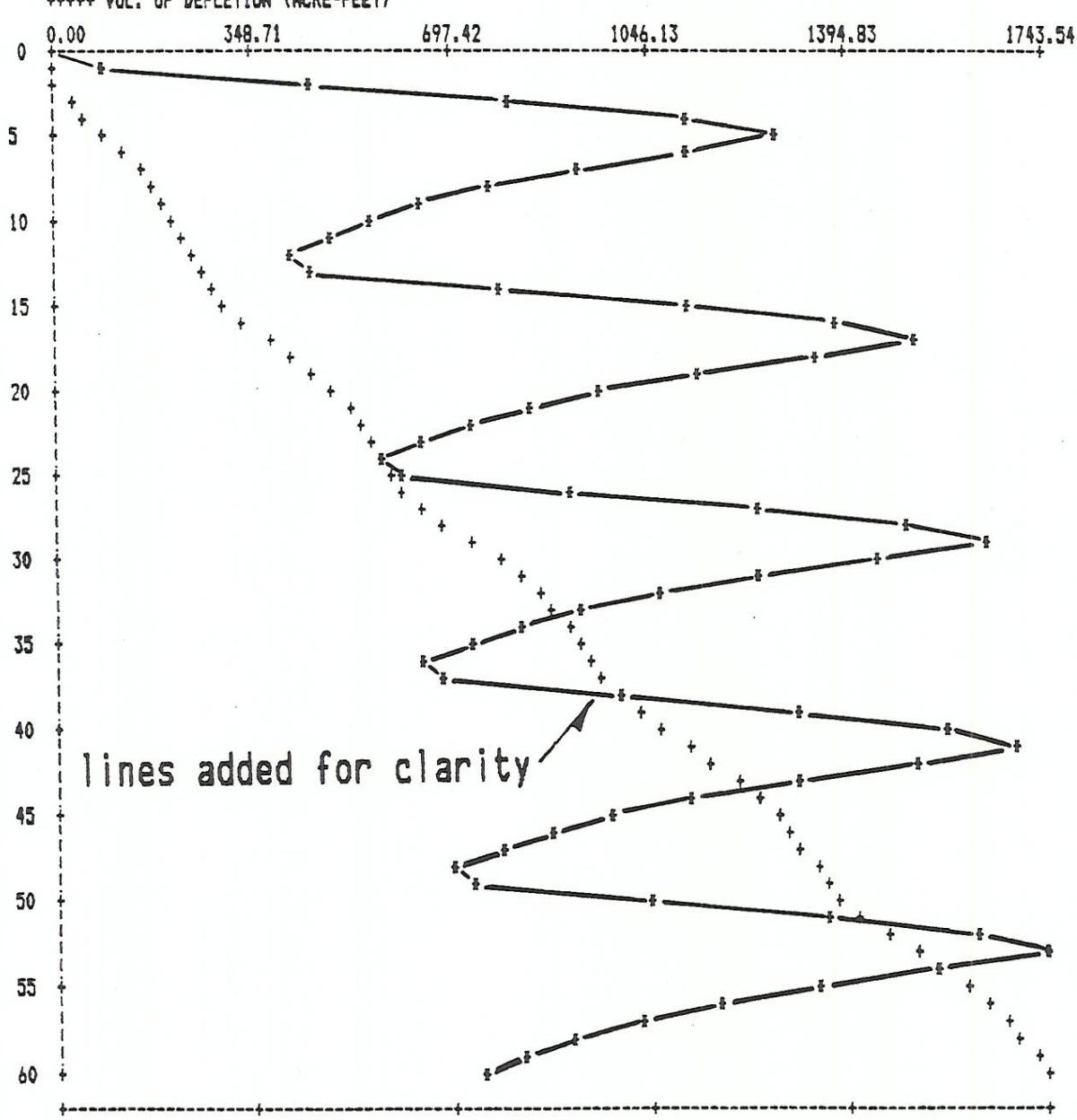
STREAM DEPLETION VS TIME (MONTHS)

***** RATE OF DEPLETION (GPM)

0.00	75.34	150.68	226.02	301.36	376.70
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***** VOL. OF DEPLETION (ACRE-FEET)

0.00	348.71	697.42	1046.13	1394.83	1743.54
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IF RATE AND VOLUME HAVE SAME COORDINATES ONLY AN (+) IS PRINTED.

PROGRAM LISTING

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10 '***** ANALYTICAL STREAM DEPLETION MODEL DRS, 5/24/84 *****
20 ***** ANALYTICAL STREAM DEPLETION MODEL DRS, 5/24/84 *****
30 *****
40 ***** SPECIFICATIONS *****
50 WIDTH "LPT1:",150
60 LPRINT CHR$(27);"E"
70 CLS
80 PRINT " ANALYTICAL STREAM DEPLETION MODEL"
90 PRINT " OFFICE OF THE STATE ENGINEER"
100 PRINT " COLORADO DIVISION OF WATER RESOURCES"
110 PRINT " Dewayne R. Schroeder"
120 PRINT " May 24, 1984"
130 FOR X=1 TO 10:PRINT:NEXT X
140 INPUT " Do you want double precision? (Y/N) "
141 IF NUT$="n" OR NUT$="N" THEN J=1000:GOTO 170 ELSE J=790
142 INPUT " Do you want double precision? (Y/N) "
143 IF NUT$="n" OR NUT$="N" THEN J=1000:GOTO 170 ELSE J=790
144 PRINT " NUT$"
145 IF NUT$="n" OR NUT$="N" THEN J=1000:GOTO 170 ELSE J=790
146 DEFDBL A,C,D,E,F,G,H,K,L,M,O,P,Q,R,S,T,U,V,W,Y,Z
147 PI=3.141592653589793:E=2.7182818284590458
148 I=200
149 DIM LS(18),LL$(18),TU$(4),DELT(I),Q(I),ZZAT(I),QQ(J),VV(J),BD(J),VD(J),VPTP(I),AVP(I),LTP(365),TP(365),H(202)
150 IF NUT$="n" OR NUT$="N" THEN J=1000:GOTO 170 ELSE J=790
151 INPUT " Do you want double precision? (Y/N) "
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198 IF NUT$="n" OR NUT$="N" THEN J=1000:GOTO 170 ELSE J=790
199 INPUT " Do you want double precision? (Y/N) "
200 INPUT "***** INPUT DATA FOR HEADING *****"
201 CLS
202 LINE INPUT "ENTER 1st HEADER (not to exceed 70 characters) "
203 ";HEAD1$"
204 IF LEN(HEAD1$)>70 THEN PRINT "HEADING TO LONG":GOTO 220
205 LINE INPUT "ENTER 2nd HEADER (not to exceed 70 characters) "
206 ";HEAD2$"
207 IF LEN(HEAD2$)>70 THEN PRINT "HEADING TO LONG":GOTO 240
208 XMO=VAL(MID$(DATE$,1,2))
209 FOR X=1 TO XMO
210 READ XMON$  

211 NEXT X
212 DTE$=XMON$+" "+MID$(DATE$,4,2)+" "+MID$(DATE$,7)
213 DATA "JAN.", "FEB.", "MARCH", "APRIL", "MAY", "JUNE", "JULY", "AUG.", "SEPT.", "OCT.", "NOV.", "DEC."
214 INPUT "***** SELECT BOUNDARIES *****"
215 CLS
216 PRINT "SELECT BOUNDARY CONDITIONS (ENTER ITEM NUMBER)"
217 PRINT " 1) INFINITE AQUIFER"
218 PRINT " 2) ALLUVIAL AQUIFER"
219 PRINT " 3) NO FLOW BOUNDARY PERPENDICULAR TO STREAM"
220 PRINT " 4) USE EFFECTIVE STREAM DEPLETION FACTOR TO APPROXIMATE EFFECT OF BOUNDARIES"
221 INPUT BI
222 IF BI=4 THEN ZZSEG$="N":GOTO 440
223 IF BI>4 GOTO 330
224 INPUT "DO YOU WANT TO COMPUTE DEPLETION FOR A SEGMENT OF STREAM (Y OR N)":ZZSEG$  

225 IF ZZSEG$="N" OR ZZSEG$="n" THEN ZZSEG$="N" ELSE ZZSEG$="Y"
```

```

440 '***** DRAW DIAGRAM ON SCREEN *****
450 FOR X=1 TO 18
460 L$(X)=""
470 LL$(X)=""
480 PRINT
490 NEXT X
500 IF ZZSEG$="N" GOTO 540
510 L$(1)=" <--(-Z) : (+Z)-->"
520 L$(2)=" <---Z1--->: <---Z2--->""
530 L$(3)=" <-----SEGMENT----->""
540 L$(4)="-----"
550 L$(5)=" STREAM"
560 L$(12)=" O WELL"
570 IF BI=4 GOTO 890
580 IF BI=2 GOTO 760
590 FOR X=6 TO 11
600 L$(X)=" ;"
610 NEXT X
620 L$(5)=" STREAM ;"
630 L$(8)=" X"
640 IF BI=1 GOTO 890
650 L$(10)=" ;<----B----->"
660 FOR X=1 TO 14
670 LL$(X)="|||||"
680 NEXT X
690 LL$(3)="//N//"
700 LL$(4)="//O//"
710 LL$(6)="//F//"
720 LL$(7)="//L//"
730 LL$(8)="//O//"
740 LL$(9)="//W//"
750 GOTO 890
760 FOR X=6 TO 11
770 L$(X)=" ; ;"
780 NEXT X
790 L$(5)=" STREAM ; ;"
800 L$(8)=" X W"
810 L$(13)=" ;"
820 L$(14)=" ;"
830 FOR X= 16 TO 18
840 L$(X)="||||||||||||||||||"
850 NEXT X
860 L$(15)="-"
870 L$(17)="||||||||NO FLOW||||||"
880 L$(12)=" O WELL ;"
890 FOR X=1 TO 18
900 PRINT L$(X);TAB(30)LL$(X)
910 NEXT X
920 PRINT
930 PRINT
940 '***** INPUT AQUIFER AND BOUNDARY PARAMETERS *****
950 IF BI=4 THEN INPUT "ENTER STREAM DEPLETION FACTOR (days) "; SDF:GOTO 1070
960 IF BI=2 THEN INPUT "W(FEET)"; W
970 IF BI=3 THEN INPUT "B(FEET)"; B
980 INPUT "TRANSMISSIVITY (GPD/FT)"; TR
990 INPUT "SPECIFIC YIELD"; S

```

```
1000 INPUT "X(FEET)"; DXX
1010 IF BI=2 AND (W-DXX)<0 THEN PRINT "X CANNOT EXCEED W":GOTO 960
1020 IF ZZSEG$="N" GOTO 1070
1030 INPUT "ENTER LEFT LIMIT (Z1, SEE DIAGRAM) OF STREAM SEGMENT. ENTER -99999 FOR NEGATIVE INFINITE FEET"; Z1
1040 INPUT "ENTER RIGHT LIMIT (Z2, SEE DIAGRAM) OF STREAM SEGMENT. ENTER 99999 FOR INFINITY (FEET)"; Z2
1050 IF BI=3 AND B<Z2 THEN PRINT "Z2 CANNOT EXCEED B":GOTO 1040
1060 IF (Z2-Z1)<0 THEN PRINT "Z1 CANNOT EXCEED Z2":GOTO 1030
1070 ***** DRAW DIAGRAM ON SCREEN WITH DIMENSIONS *****
1080 REM DRAW DIAGRAM ON SCREEN WITH DIMENSIONS
1090 FOR X=1 TO 10
1100 PRINT
1110 NEXT X
1120 IF ZZSEG$="N" GOTO 1300
1130 PRINT "Z1="; Z1;"FEET, Z2="; Z2;"FEET"
1140 IF Z1<0 GOTO 1170
1150 PRINT TAB(15) ":"<--Z1-->; TAB(30) LL$(1)
1160 GOTO 1180
1170 PRINT "<----Z1---->; TAB(30) LL$(1)
1180 IF Z2 <0 GOTO 1240
1190 IF Z2=B GOTO 1220
1200 PRINT TAB(15) ":"<----Z2---->; TAB(30) LL$(2)
1210 GOTO 1250
1220 PRINT TAB(15) ":"<----Z2---->; LL$(2)
1230 GOTO 1250
1240 PRINT "      <-Z2->; TAB(30) LL$(2)
1250 PRINT TAB(30) LL$(3)
1260 FOR X=4 TO 7
1270 PRINT L$(X); TAB(30) LL$(X)
1280 NEXT X
1290 GOTO 1330
1300 FOR X=1 TO 7
1310 PRINT L$(X); TAB(30) LL$(X)
1320 NEXT X
1330 IF BI=4 GOTO 1470
1340 IF BI=2 GOTO 1370
1350 PRINT TAB(11) DXX; ""; TAB(30) LL$(8)
1360 GOTO 1380
1370 PRINT TAB(11) DXX; ""; TAB(21) W; ""; TAB(30) LL$(8)
1380 PRINT L$(9); TAB(30) LL$(9)
1390 IF BI=3 GOTO 1420
1400 PRINT L$(10); TAB(30) LL$(10)
1410 GOTO 1430
1420 PRINT TAB(15) ":"<->; B; """; TAB(28) "->; LL$(10)
1430 FOR X=11 TO 18
1440 PRINT L$(X); TAB(30) LL$(X)
1450 NEXT X
1460 GOTO 1520
1470 FOR X=8 TO 12
1480 PRINT L$(X)
1490 NEXT X
1500 PRINT "SDF=" SDF; "DAYS"
1510 GOTO 1530
1520 PRINT "T=" TR; "GPD/FT, S="; S
1530 PRINT "NOT DRAWN TO SCALE"
```

```
1540 ***** CHANGE PARAMETERS ? *****
1550 REM TO CHANGE PARAMETER PREVIOUSLY ENTERED
1560 INPUT "DO YOU WISH TO MAKE ANY CHANGES (Y OR N)"; NUT$
1570 IF NUT$="N" OR NUT$="n" GOTO 1830
1580 PRINT "ENTER ITEM NUMBER TO BE CHANGED"
1590 PRINT " 1) BOUNDRIES
1600 PRINT " 2) TRANSMISSIVITY
1610 PRINT " 3) SPECIFIC YIELD
1620 PRINT " 4) X-DISTANCE FROM STREAM
1630 PRINT " 5) W-DISTANCE BETWEEN STREAM AND EDGE OF ALLUVIUM
1640 PRINT " 6) B-DISTANCE BETWEEN WELL AND NO FLOW BOUNDARY
1650 PRINT " 7) Z1-LEFT COORDINATE OF STREAM SEGMENT
1660 PRINT " 8) Z2-RIGHT COORDINATE OF STREAM SEGMENT
1670 INPUT CHA
1680 ON CHA GOTO 340,1690,1710,1730,1750,1770,1790,1810
1690 INPUT "T(GPD/FT)"; TR
1700 GOTO 1070
1710 INPUT "SPECIFIC YIELD"; S
1720 GOTO 1070
1730 INPUT "DISTANCE FROM STREAM (FEET)"; DXX
1740 GOTO 1070
1750 INPUT "DISTANCE BETWEEN STREAM AND EDGE OF ALLUVIUM (FEET)"; W
1760 GOTO 1070
1770 INPUT "DISTANCE BETWEEN WELL AND NO FLOW BOUNDARY (FEET)"; B
1780 GOTO 1070
1790 INPUT "LEFT COORDINATE OF STREAM SEGMENT (FEET)"; Z1
1800 GOTO 1070
1810 INPUT "RIGHT COORDINATE OF STREAM SEGMENT (FEET)"; Z2
1820 GOTO 1070
1830 REM *****
1840 REM INPUT PUMPING DATA
1850 CLS
1860 PRINT "A PUMPING PERIOD IS A PERIOD OF TIME DURING WHICH THE PUMPING RATE IS CONSTANT"
1870 TT=0
1880 PRINT
1890 INPUT "DO YOU WISH TO ENTER A CYCLIC (SEASONAL) PUMPING SCHEDULE (Y OR N)"; CS1$
1900 IF CS1$="N" OR CS1$="n" GOTO 1950
1910 INPUT "NUMBER OF CYCLES OR SEASONS TO BE SIMULATED"; NC
1920 INPUT "NUMBER OF PUMPING PERIODS PER CYCLE"; NPPC
1930 NP=NC*NPPC
1940 GOTO 1970
1950 PRINT "ENTER NUMBER OF PUMPING PERIODS"
1960 INPUT NP
1970 PRINT "ENTER NUMBER FOR TIME UNITS TO BE USED
1980 PRINT " (1) DAYS"
1990 PRINT " (2) WEEKS - A WEEK WILL = 365/52 DAYS"
2000 PRINT " (3) MONTHS - A MONTH WILL = 365/12 DAYS"
2010 PRINT " (4) YEARS - A YEAR WILL = 365 DAYS"
2020 INPUT TUI
2030 RESTORE 2050
2040 FOR X=1 TO TUI:READ TU$(X),FACT:NEXT X
2050 DATA DAYS,1,WEEKS,7.019231,MONTHS,30.41667,YEARS,365
2060 IF CS1$="Y" OR CS1$="y" THEN GOSUB 6940:GOTO 2160
2070 FOR X=1 TO NP
2080 PRINT "FOR PUMPING PERIOD #";X;"ENTER LENGTH OF PUMPING PERIOD IN ";TU$(TUI);"(LENGTH MUST BE
WHOLE NUMBER OF TIME UNITS)"
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2090 INPUT DELT(X)
2100 IF (DELT(X)-INT(DELT(X)))<>0 GOTO 2080
2110 TT=TT + DELT(X)
2120 ZZAT(X)=TT
2130 PRINT "ENTER PUMPING RATE (GPM) FOR PUMPING PERIOD #";X
2140 INPUT Q(X)
2150 NEXT X
2160 '***** PRINT PUMPING SCHEDULE ON SCREEN *****
2170 CLS
2180 LCOUNT=5
2190 PRINT TAB(15)"PUMPING SCHEDULE"
2200 PRINT "TOTAL TIME SIMULATED = ";TT;TU$(TUI)
2210 PRINT
2220 PRINT "PUMPING","Q","LENGTH","ACC. TIME"
2230 PRINT "PERIOD","GPM",TU$(TUI),TU$(TUI)
2240 FOR X=1 TO NP
2250 PRINT X, Q(X), DELT(X),ZZAT(X)
2260 LCOUNT=LCOUNT +1
2270 IF LCOUNT=20 THEN INPUT "press return to continue";NUT$:LCOUNT=0
2280 NEXT X
2290 '***** CHANGE PUMPING SCHEDULE ? *****
2300 INPUT "DO YOU WANT TO CHANGE PUMPING SCHEDULE (Y OR N)";NUT$
2310 IF NUT$="Y" OR NUT$="y" GOTO 1840
2320 REM *****
2330 '***** SELECT TIME BETWEEN PRINTOUTS *****
2340 CLS
2350 PRINT "A LARGER NUMBER OF TIME STEPS CAN BE SELECTED BY ANSWERING THE NEXT QUESTION WITH A Y
ES(Y)."
2360 INPUT "DO YOU WANT DEPLETION PRINTED OR GRAPHED FOR TIMES OTHER THAN END OF EACH PUMPING
PERIOD (Y OR N) "; PFOT$
2370 IF PFOT$="N" OR PFOT$="n" THEN GOTO 2420 ELSE PFOT$="Y"
2380 PRINT "ENTER NUMBER OF "; TU$(TUI); " BETWEEN PRINTOUTS."
2390 INPUT TBP
2400 IF (TBP-INT(TBP))>.0001 THEN PRINT "YOU MUST SELECT A WHOLE NUMBER OF ";TU$(TUI):GOTO 2380
2410 '***** SELECT GRAPH OPTION *****
2420 INPUT "DO YOU WANT DEPLETION GRAPHED (Y OR N)";GI$
2430 IF GI$="Y" OR GI$="y" THEN GI$="Y" ELSE GI$="N"
2440 '***** PRINT HEADING, DIAGRAM AND PUMPING SCHEDULE *****
2450 LPRINT
2460 LPRINT
2470 LPRINT "*****"
2480 CLS:PRINT "THINKING, PLEASE WAIT"
2490 LPRINT
2500 LPRINT "STREAM DEPLETION USING GLOVER TECHNIQUES"
2510 LPRINT
2520 TA1=(80-LEN(HEAD1$))/2:TA2=(80-LEN(HEAD2$))/2:TA3=(80-LEN(DTE$))/2
2530 LPRINT TAB(TA1);HEAD1$:LPRINT TAB(TA2);HEAD2$:LPRINT TAB(TA3);DTE$
2540 LPRINT
2550 LPRINT "*****"
2560 LPRINT
2570 LPRINT
2580 IF ZZSEG$="N" GOTO 2760
2590 LPRINT "Z1=";Z1;"FEET, Z2=";Z2;"FEET"
2600 IF Z1<0 GOTO 2630
2610 LPRINT TAB(15)";<--Z1-->"; TAB(30)LL$(1)
2620 GOTO 2640

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2630 LPRINT "<----Z1---->;TAB(30)LL$(1)
2640 IF Z2<0 GOTO 2700
2650 IF Z2=B GOTO 2680
2660 LPRINT TAB(15)"<----Z2---->;TAB(30)LL$(2)
2670 GOTO 2710
2680 LPRINT TAB(15)"<----Z2---->;LL$(2)
2690 GOTO 2710
2700 LPRINT "<-Z2->;TAB(30)LL$(2)
2710 LPRINT TAB(30)LL$(3)
2720 FOR X=4 TO 7
2730 LPRINT L$(X); TAB(30)LL$(X)
2740 NEXT X
2750 GOTO 2790
2760 FOR X=1 TO 7
2770 LPRINT L$(X); TAB(30)LL$(X)
2780 NEXT X
2790 IF BI = 4 GOTO 2930
2800 IF BI = 2 GOTO 2830
2810 LPRINT TAB(11)DXX;"'";TAB(30)LL$(8)
2820 GOTO 2840
2830 LPRINT TAB(11)DXX;"'";TAB(21)W;"'";TAB(30)LL$(8)
2840 LPRINT L$(9);TAB(30)LL$(9)
2850 IF BI = 3 GOTO 2880
2860 LPRINT L$(10); TAB(30)LL$(10)
2870 GOTO 2890
2880 LPRINT TAB(15)"<-";B;"'";TAB(28)"->;LL$(10)
2890 FOR X = 11 TO 18
2900 LPRINT L$(X); TAB(30)LL$(X)
2910 NEXT X
2920 GOTO 2980
2930 FOR X = 8 TO 12
2940 LPRINT L$(X)
2950 NEXT X
2960 LPRINT "SDF=";SDF;"DAYS"
2970 GOTO 2990
2980 LPRINT "T=";TR;"GPD/FT, S=";S
2990 LPRINT "NOT DRAWN TO SCALE"
3000 ##### GET LENGTH OF PUMP, PERIODS AND # OF TIME STEPS FOR CALC. PURPOSES #####
3010 IF PFOT$="Y" GOTO 3090
3020 MN=1000000!
3030 FOR X= 1 TO NP
3040 IF DELT(X)>MN GOTO 3060
3050 MN=DELT(X)
3060 NEXT X
3070 DELA=MN
3080 GOTO 3100
3090 DELA=TBP
3100 ADF=0
3110 FOR X=1 TO NP
3120 A=DELT(X)/DELA
3130 IF (A-INT(A))=0 GOTO 3150
3140 ADF=1
3150 NEXT X
3160 IF (TBP/DELA-INT(TBP/DELA))>0 GOTO 3180
3170 IF ADF=0 GOTO 3200
3180 DELA=DELA-1
```

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3190 GOTO 3100
3200 NPA=TT/DELA
3210 '***** PRINT PUMPING SCHEDULE AND BRANCH TO SOLVE ROUTINES *****
3220 GOSUB 6790
3230 GOSUB 6550
3240 PRINT "COMPUTATIONS BEGIN AT ";TIME$
3250 IF ZZSEG$="Y" OR ZZSEG$="y" GOTO 4240
3260 IF BI=2 GOTO 3360
3270 '***** SOLVE DEPLETION FOR OPTION 1, 3 AND 4 (ENTIRE STREAM) *****
3280 FOR X=1 TO NPA
3290 T=T+DELA
3300 IF BI=4 THEN U=(SDF/(4*FACT*T))^.5 ELSE U=DXX/((4*TR*FACT*T/(S*7.481))^.5)
3310 GOSUB 5490
3320 QQ(X)=QQ
3330 VV(X)=VV
3340 NEXT X
3350 GOTO 3600
3360 '***** SOLVE DEPLETION FOR OPTION 2 *****
3370 FOR X=1 TO NPA
3380 T=T+DELA
3390 QS=0
3400 VS=0
3410 YY=-DXX
3420 FAC=1
3430 YY=YY+2*DXX
3440 U=YY/((4*TR*FACT*T/(S*7.481))^.5)
3450 GOSUB 5490
3460 QS=QS +QQ*FAC
3470 VS=VS+VV*FAC
3480 IF QQ=0 GOTO 3570
3490 YY=YY-2*DXX+2*W
3500 U=YY/((4*TR*FACT*T/(S*7.481))^.5)
3510 GOSUB 5490
3520 QS=QS+QQ*FAC
3530 VS=VS+VV*FAC
3540 IF QQ=0 GOTO 3570
3550 FAC=FAC*(-1)
3560 GOTO 3430
3570 QQ(X)=QS
3580 VV(X)=VS
3590 NEXT X
3600 '***** USING SUPERPOSITION, GENERATE DEPLETION VALUES FOR PRINTING *****
3610 ADEL=1
3620 FOR J=1 TO NP
3630 N=0
3640 IF Q(J)=0 GOTO 3770
3650 FOR X=ADEL TO NPA
3660 N=N+1
3670 QD(X)=QD(X)+QQ(N)*Q(J)
3680 VD(X)=VD(X)+VV(N)*Q(J)*FACT*N*DELA
3690 NEXT X
3700 N=0
3710 IF NP=1 GOTO 3780
3720 FOR X=( 1+ZZAT(J)/DELA) TO NPA
3730 N=N+1
3740 QD(X)=QD(X)-QQ(N)*Q(J)

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SDF

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3750 VD(X)=VD(X)-VV(N)*Q(J)*FACT*N*DELA
3760 NEXT X
3770 ADEL=1+ZZAT(J)/DELA
3780 NEXT J
3790 '***** PRINT DEPLETION *****
3800 PRINT "COMPUTATIONS END AT ";TIMES
3810 PRINT "PLEASE WAIT FOR OUTPUT."
3820 LPRINT
3830 LPRINT
3840 LPRINT
3850 IF NP>1 GOTO 3920
3860 LPRINT TAB(34)"STREAM DEPLETION"
3870 LPRINT
3880 LPRINT "
3890 LPRINT " TIME DEP. RATE DEP. RATE VOL. OF DEP. VOL. OF DEP. VOL. OF DEP." THIS STEP"
3900 LPRINT ZZ$;" (GPM) (%)";ZZZ$;" (%)";ZZZ$;" (%)";ZZZ$;""
3910 GOTO 3970
3920 LPRINT TAB(20)"STREAM DEPLETION"
3930 LPRINT
3940 LPRINT " VOL. OF DEP."
3950 LPRINT " TIME DEP. RATE VOL. OF DEP. THIS STEP"
3960 LPRINT ZZ$;" (GPM)";ZZZ$;ZZZ$;""
3970 LPRINT
3980 IF VUNIT$="GALLONS" GOTO 4010
3990 VFAC=1440/325900!
4000 GOTO 4030
4010 VFAC=1440
4020 VDTP=0
4030 FOR X=1 TO NPA
4040 IF PFOT$="Y" GOTO 4140
4050 PFLG=0
4060 TDELA=TDELA+DELA
4070 FOR J=1 TO NP
4080 IF TDELA=ZZAT(J) GOTO 4100
4090 GOTO 4110
4100 PFLG=1
4110 NEXT J
4120 IF PFLG=1 GOTO 4160
4130 GOTO 4210
4140 IF((X*DELA/TBP)-(INT(X*DELA/TBP))=0 GOTO 4160
4150 GOTO 4210
4160 IF NP>1 GOTO 4190
4170 LPRINT USING"#####";DELA*X;;LPRINT TAB(15);;LPRINT USING"#####.####";QD(X);QD(X)*100
/8(1);VD(X)*VFAC;VD(X)+100/(8(1)*DELA*X*FACT);(VD(X)*VFAC-VDTP)
4180 GOTO 4200
4190 LPRINT USING"#####";DELA*X;;LPRINT TAB(15);;LPRINT USING"#####.####";QD(X);VD(X)*VFA
C;(VD(X)*VFAC-VDTP)
4200 VDTP=VD(X)*VFAC
4210 NEXT X
4220 IF 61$="Y" GOTO 5650
4230 END
4240 '***** SOLVE DEPLETION FOR SEGMENT OF STREAM *****
4250 IF Z1=-99999! THEN IFLG=1:Z1=0
4260 IF Z2=99999! THEN IFLG=1:Z2=0
4270 YY=DXX
4280 BL=0
```

4290 BN=0
4300 DN BI GOTO 4310,4540,5040
4310 L1=Z1
4320 L2=Z2
4330 FOR X=1 TO NPA
4340 T=T+DELA
4350 U=YY/((4*TR*FACT*T/(S#7.481))^5)
4360 IF U>2.9 GOTO 4510
4370 IF IFLG=0 GOTO 4410
4380 GOSUB 5490
4390 QQ(X)=.5*BQQ
4400 VV(X)=.5*SVV
4410 U=4*TR*T*FACT/(S#7.481)
4420 GOSUB 7130
4430 QQ(X)=QQ(X)+BQQ
4440 BN=BQQ
4450 U=4*TR*(T-DELA/2)*FACT/(S#7.481)
4460 GOSUB 7130
4470 BP=BQQ
4480 GOSUB 7300
4490 AVV=AVV+SVV
4500 VV(X)=VV(X)+AVV/T
4510 BL=BN
4520 NEXT X
4530 GOTO 3600
4540 FAC=1
4550 L1=Z1
4560 L2=Z2
4570 FOR X=1 TO NPA
4580 FAC=1
4590 BL=BN
4600 BN=0
4610 BP=0
4620 T=T+DELA
4630 YY=-DXX
4640 YY=YY+2*DXX
4650 WW=0
4660 IF IFLG=0 GOTO 4720
4670 U=YY/((4*TR*FACT*T/(S#7.481))^5)
4680 GOSUB 5490
4690 WW=WW+BQQ
4700 QQ(X)=BQQ+FAC/2+BQQ(X)
4710 VV(X)=VV(X)+SVV+FAC/2
4720 U=4*TR*T*FACT/(S#7.481)
4730 IF L1<>L2 THEN GOSUB 7130 ELSE GOTO 4810
4740 WW=WW+BQQ
4750 QQ(X)=QQ(X)+BQQ+FAC
4760 BN=BN+BQQ+FAC
4770 U=4*TR*(T-DELA/2)*FACT/(S#7.481)
4780 XYZ=U
4790 IF L1<>L2 THEN GOSUB 7130
4800 BP=BP+BQQ+FAC
4810 YY=YY-2*DXX+2*W
4820 IF IFLG=0 GOTO 4880
4830 U=YY/((4*TR*FACT*T/(S#7.481))^5)
4840 GOSUB 5490

4850 WW=WW+BQQ
4860 QQ(X)=QQ(X)+BQQ*FAC/2
4870 VV(X)=VV(X)+SVV*FAC/2
4880 U=XYZ
4890 IF L1<>L2 THEN GOSUB 7130 ELSE GOTO 4960
4900 QP=QP+BQQ*FAC
4910 U=4*TR*T*FACT/(S#7.481)
4920 IF L1<>L2 THEN GOSUB 7130
4930 WW=WW+BQQ
4940 QN=QN+BQQ*FAC
4950 QQ(X)=QQ(X)+BQQ*FAC
4960 IF ABS(WW)<.00001 GOTO 4990
4970 FAC=FAC*(-1)
4980 GOTO 4640
4990 IF L1<>L2 THEN GOSUB 7300 ELSE GOTO 5020
5000 AVV=AVV+SVV
5010 VV(X)=VV(X)+AVV/T
5020 NEXT X
5030 GOTO 3600
5040 FOR X=1 TO NPA
5050 T=T+DELA
5060 U=YY/((4*TR*T*FACT*T/(S#7.481))^5)
5070 IF U>2.9 GOTO 5460
5080 IF IFLG=0 GOTO 5260
5090 GOSUB 5490
5100 QQ(X)=BQQ
5110 VV(X)=SVV
5120 IF B=Z2 GOTO 5470
5130 L1=Z2
5140 L2=2*B-Z2
5150 U=4*TR*T*FACT/(S#7.481)
5160 GOSUB 7130
5170 QQ(X)=QQ(X)-BQQ
5180 QN=BQQ
5190 U=4*TR*(T=DELA/2)*FACT/(S#7.481)
5200 GOSUB 7130
5210 QP=BQQ
5220 GOSUB 7300
5230 AVV=AVV+SVV
5240 VV(X)=VV(X)-AVV/T
5250 GOTO 5460
5260 L1=Z1
5270 L2=Z2
5280 U=4*TR*T*FACT/(S#7.481)
5290 GOSUB 7130
5300 QQ(X)=BQQ
5310 QN=BQQ
5320 U=4*TR*(T-DELA/2)*FACT/(S#7.481)
5330 GOSUB 7130
5340 QP=BQQ
5350 L1=2*B-Z2
5360 L2=2*B-Z1
5370 GOSUB 7130
5380 QP=BQQ+QP
5390 U=4*TR*T*FACT/(S#7.481)
5400 GOSUB 7130

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5410 QN=QN+BQQ
5420 BQQ(X)=BQQ(X)+BQQ
5430 GOSUB 7300
5440 AVV=AVV+SVV
5450. VV(X)=AVV/T
5460 QL=QN
5470 NEXT X
5480 GOTO 3600
5490 '***** SUB TO EVALUATE COMPLIMENTARY ERROR FUNCTION AND 2nd REPEATED
5500 '***** INTEGRAL OF COMPLIMENTARY ERROR FUNCTION *****
5510 IF U>2.9 THEN BQQ=0:SVV=0:RETURN
5520 SUM=U
5530 M=0
5540 N=U^2
5550 TERM=U
5560 P=1
5570 M=M+1
5580 P=P+2
5590 TERM=(((-1)^M)*TERM+N*(P-2))/(P*M)
5600 SUM=SUM+TERM
5610 IF (ABS(TERM))>1E-08 GOTO 5570
5620 BQQ=1-2*SUM/(PI^.5)
5630 SVV=BQQ*(1+2*(U^2))-(2*U*E^-(U^2))/(PI^.5)
5640 RETURN
5650 '***** DRAW GRAPH *****
5660 MAXVD=-1000000!
5670 MAXQD=-1000000!
5680 MINVD=1000000!
5690 MINQD=1000000!
5700 LPRINT CHR$(15);
5710 LPRINT CHR$(27); "1";
5720 FOR X=1 TO NPA
5730 IF QD(X)>MAXQD THEN MAXQD=QD(X)
5740 IF QD(X)<MINQD THEN MINQD=QD(X)
5750 IF VD(X)>MAXVD THEN MAXVD=VD(X)
5760 IF VD(X)<MINVD THEN MINVD=VD(X)
5770 NEXT X
5780 IF MINVD>0 THEN MINVD=0
5790 IF MINQD>0 THEN MINQD=0
5800 LVD=MAXVD-MINVD
5810 LQD=MAXQD-MINQD
5820 LBP=INT(50/NPA)+1
5830 LPRINT
5840 LPRINT
5850 LPRINT
5860 LPRINT TAB(20)"STREAM DEPLETION VS TIME (";TU$(TUI);")"
5870 LPRINT
5880 LPRINT
5890 LPRINT TAB(10)**** RATE OF DEPLETION (GPM) "
5900 LPRINT
5910 FOR IZ=1 TO 6
5920 IF IZ<>1 THEN LPRINT TAB(IZ*20-19);
5930 LPRINT USING"####.##";MINQD+(IZ-1)*LQD/5;
5940 NEXT IZ
5950 LPRINT
5960 LPRINT TAB(10)"+-----+-----+-----+

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+-----+
5970 LPRINT
5980 LPRINT
5990 LPRINT TAB(10)"+*** VOL. OF DEPLETION (";VUNIT$;")"
6000 LPRINT
6010 FOR IZ=1 TO 6
6020 IF IZ>>1 THEN LPRINT TAB(IZ*20-19);
6030 LPRINT USING"#####.##";MINVD*VFAC+(IZ-1)*VFAC*LVD/5;
6040 NEXT IZ
6050 LPRINT
6060 LPRINT TAB(7)"0 +-----+
-----+
6070 FOR X=1 TO NPA
6080 QD(X)=(QD(X)-MINQD)*100/LQD+10
6090 VD(X)=(VD(X)-MINVD)*100/LVD+10
6100 IF LBP=1 GOTO 6140
6110 FOR J=1 TO (LBP-1)
6120 LPRINT TAB(10)"!"
6130 NEXT J
6140 IF CINT(VD(X))>CINT(QD(X)) GOTO 6380
6150 IF CINT(VD(X))=CINT(QD(X)) GOTO 6270
6160 IF (X/5-INT(X/5))=0 GOTO 6220
6170 IF VD(X)<10.5 GOTO 6200
6180 LPRINT TAB(10)"!";TAB(VD(X))"+";TAB(QD(X))"#
6190 GOTO 6480
6200 LPRINT TAB(10)+"";TAB(QD(X))"#
6210 GOTO 6480
6220 IF VD(X)<10.5 GOTO 6250
6230 LPRINT TAB(5)(X#DELA);TAB(10)+"";TAB(VD(X))"+";TAB(QD(X))"#
6240 GOTO 6480
6250 LPRINT TAB(5)(X#DELA);TAB(10)+"";TAB(QD(X))"#
6260 GOTO 6480
6270 IF (X/5-INT(X/5))=0 GOTO 6330
6280 IF QD(X)<10.5 GOTO 6310
6290 LPRINT TAB(10)"!";TAB(QD(X))"#
6300 GOTO 6480
6310 LPRINT TAB(10)"#
6320 GOTO 6480
6330 IF QD(X)<10.5 GOTO 6360
6340 LPRINT TAB(5)(X#DELA);TAB(10)"!";TAB(QD(X))"#
6350 GOTO 6480
6360 LPRINT TAB(5)(X#DELA);TAB(10)"#
6370 GOTO 6480
6380 IF (X/5-INT(X/5))=0 GOTO 6440
6390 IF QD(X)<10.5 GOTO 6420
6400 LPRINT TAB(10)"!";TAB(QD(X))"#";TAB(VD(X))"#
6410 GOTO 6480
6420 LPRINT TAB(10)"#";TAB(VD(X))"#
6430 GOTO 6480
6440 IF QD(X)<10.5 GOTO 6470
6450 LPRINT TAB(5)(X#DELA);TAB(10)+"";TAB(QD(X))"#";TAB(VD(X))"#
6460 GOTO 6480
6470 LPRINT TAB(5)(X#DELA);TAB(10)"#";TAB(VD(X))"#
6480 NEXT X
6490 LPRINT
6500 LPRINT TAB(10)"+-----+
-----+

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+-----+
6510 LPRINT
6520 LPRINT "IF RATE AND VOLUME HAVE SAME COORDINATES ONLY AN (*) IS PRINTED."
6530 LPRINT CHR$(27);";";
6540 END
6550 '***** SUBROUTINE FOR PRINTING PUMPING SCHEDULE *****
6560 LPRINT
6570 LPRINT
6580 LPRINT
6590 LPRINT TAB(31)"PUMPING SCHEDULE"
6600 LPRINT TAB(23)"TOTAL TIME SIMULATED=";TT;TU$(TUI)
6610 LPRINT
6620 LPRINT "
6630 LPRINT "PUMPING      Q      LENGTH      CUM. TIME      THIS PERIOD      CUM. VOL."  

6640 ZZ$=""+TU$(TUI)+"":FOR II=1 TO (14-LEN(ZZ$)):ZZ$=" "+ZZ$:NEXT II  

6650 ZZZ$=""+VUNIT$+":FOR II=1 TO (14-LEN(ZZZ$)):ZZZ$=" "+ZZZ$:NEXT II
6660 LPRINT "PERIOD      (GPM)";ZZ$;ZZ$;ZZZ$;ZZZ$  

6670 LPRINT
6680 FOR X=1 TO NP
6690 LPRINT USING"####";X;LPRINT TAB(8);
6700 LPRINT USING"#####.###";Q(X);
6710 LPRINT USING"#####.####";DELT(X);ZZAT(X);
6720 LPRINT USING"#####.###";VPTP(X);AVP(X)
6730 NEXT X
6740 LPRINT
6750 LPRINT
6760 LPRINT
6770 LPRINT
6780 RETURN
6790 '***** SUBROUTINE FOR DETERMINING VOL. PUMPED AND VOL. UNITS ****
6800 FOR X=1 TO NP
6810 VPTP(X)=Q(X)*DELT(X)*FACT#1440
6820 AVSUM=AVSUM+VPTP(X)
6830 AVP(X)=AVSUM
6840 NEXT X
6850 IF (ABS(AVSUM))>1000000! GOTO 6880
6860 VUNIT$="GALLONS"
6870 RETURN
6880 FOR X=1 TO NP
6890 VPTP(X)=VPTP(X)/325900!
6900 AVP(X)=AVP(X)/325900!
6910 NEXT X
6920 VUNIT$="ACRE-FEET"
6930 RETURN
6940 '***** SUBROUTINE TO INPUT CYCLIC PUMPING SCHEDULE *****
6950 FOR X=1 TO NPPC
6960 PRINT "FOR PUMPING PERIOD #";X;"ENTER LENGTH OF PUMPING PERIOD IN ";TU$(TUI);"(LENGTH MUST BE  

WHOLE NUMBER OF TIME UNITS)"
6970 INPUT LTP(X)
6980 PRINT "ENTER PUMPING RATE(GPM) FOR PUMPING PERIOD #";X
6990 INPUT QTP(X)
7000 NEXT X
7010 I=0
7020 TT=0
7030 FOR X=1 TO NC
7040 FOR J=1 TO NPPC

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```
7050 I=I+1
7060 DELT(I)=LTP(J)
7070 TT=TT+DELT(I)
7080 ZZAT(I)=TT
7090 Q(I)=QTP(J)
7100 NEXT J
7110 NEXT X
7120 RETURN
7130 '***** SUBROUTINE FOR q/Q (STREAM SEGMENT) *****
7140 SIMN=ABS(INT((L2-L1)/YY))+20
7150 IF SIMN<40 THEN SIMN=40
7160 IF SIMN>100 THEN SIMN=100
7170 DELX=(L2-L1)/SIMN
7180 XC=L1-DELX
7190 FOR N=1 TO (SIMN+1)
7200 XC=XC+DELX
7210 AB=(YY^2)+(XC^2)
7220 IF (AB/U)>60 THEN H(N)=0 ELSE H(N)=(E^(-(AB/U)))/AB
7230 NEXT N
7240 BQQ=H(1)+H(SIMN+1)
7250 FOR N=2 TO SIMN
7260 IF (N/2-INT(N/2))=0 THEN BQQ=BQQ+4*H(N) ELSE BQQ=BQQ+2*H(N)
7270 NEXT N
7280 IF BQQ<1E-33 THEN BQQ=0 ELSE BQQ=BQQ*DELX*YY/(3*3.1415927)
7290 RETURN
7300 '***** SUBROUTINE FOR v/V (STREAM SEGMENT) *****
7310 SVV=(QN+QL)*DELA/2+(QP-(QL+QN)/2)*DELA*2/3
7320 RETURN
```