RELIABILITY OF SUPPLEMENTAL
IRRIGATION SYSTEMS

by

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B.S., University of Kansas, 1978

A MASTER'S REPORT

submitted in partial fulfillment of
the requirements for the degree

MASTER OF SCIENCE

Department of Civil Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1981

Approved:

[Signature]
Major Professor
SUMMARY

By daily simulation, using historic weather data, a computer model evaluates reliability of a supplemental irrigation system in Riley County, Kansas. Irrigation application rate and drainage area are found to influence system reliability.
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INTRODUCTION

Rainfall in the Manhattan area peaks during May to July and then drops off for the rest of the growing season. Stress in crops and possibly reduced yields, due to poor distribution of rainfall during the growing season, occurs. This often leads farmers to consider surface and subsurface irrigation water supplies.

Due to the topography, most irrigation in Riley County is confined to the Kansas River valley. The eastern half is often steep and rocky, typical of the flint hills. A loess mantle overlies the western half, mitigating the undulation and permitting tillage in deep silty clay loams. This mixed land use pattern offers small cropland fields interspersed with pasture and hayland.

The subject of this paper is such a watershed area. The L. and M. Jahnke farm, located in west central Riley County, has a dam site with 55 acres of contributing drainage area. The area is composed of approximately 50% cropland and 50% pasture. The proposed irrigation plot is 18 acres of alfalfa.

The proposed system is evaluated using a continuous simulation hydrologic model as presented in (1). The system is composed of a storage pond and an irrigation field plot. The pond stores runoff from the drainage area. The model pond is idealized as a trapezoidal volume. The model maintains an account of direct precipitation, evaporation, exfiltration, overflows, and irrigation demands for the pond.

The model field plot soil moisture is monitored. Irrigation applications, direct precipitation, infiltration, runoff, and interception are accounted for during the simulation period.
are made whenever the soil moisture drops below a specified percentage of field capacity.

DISCUSSION

The computer model was calibrated for the Manhattan area by adjusting coefficients in the Penman equation as described in (1). Adjustments were made until 15.6 inches of net evaporation were obtained. This closely matches the average annual evaporation and rainfall as in (2) and (3).

The actual drainage area is composed of Irwin and Wymore soils as shown in (4). Both are irrigation design group 1 or 0.1 inch/hour intake family as described in (6). Pasture and terraced cropland on these soils yield nearly the same runoff. Therefore, the drainage area is considered as all pasture.

The storage pond was modeled as a trapezoidal volume with 12:1 side slopes, 125 x 125 foot bottom, and 13 foot deep. This approximates actual surface area to within 0.27 acres and actual volume to within 0.07 acre-foot. Seepage was assumed to be 0.06 inches/day.

The irrigation plot is 18 acres of alfalfa on irrigation design group 2 soil. Irrigation applications were 1.5 inches/day and 1.0 inch/day for two trial simulations.

Results of Simulation

The model was run for 29 years of historic weather events on a daily basis. The pond was considered to have failed whenever an irrigation application was attempted, but the pond was empty, making the full application rate, or a fraction thereof, unavailable.
The system was checked with a 900 acre drainage area in order to determine the reliability of the system.

Reliability is defined as:

\[
\text{Reliability} = \frac{29 \text{ years} - \text{number of years failed}}{29 \text{ years}} \times 100\%.
\]

The results are shown in Figure No. 1.

The system has a 58.6% reliability with 1 inch/day applications and 55.2% reliability with 1.5 inch/day applications. Doubling the size of the drainage area yields approximately 10% increased reliability. After about 200 acres of drainage, diminishing returns of reliability occur.

Figure No. 1 shows 1.0 inch/day and 1.5 inch/day reliability curves plotted on log-normal probability paper. Also, the 80% and 50% chance yield versus required drainage area is plotted. This was computed based on net, seasonal irrigation requirements from (5) and average annual yield values from (6).

For example, the 80% chance, net, irrigation requirement for alfalfa in Riley County is 18.2 inches. Irrigating 18 acres, the operator would need 327.6 acre-inches of water stored in a pond. The 80% chance yield from a drainage area with a CN of 82 and a II AMC is 1.1 inches. The storage pond would need 327.6 acre-inches/1.1 inches or 298 acres. The 50% chance drainage area is computed similarly.
CONCLUSION

It is seen from Figure No. 1 that the 1.0 inch/day application rate yields a more reliable system, from the standpoint of water supply, than the 1.5 inch/day rate. If the operator makes 1.0 inch/day applications, he can expect to irrigate approximately 6 out of 10 years on average, without failure of the supply. This assumes a similar hydrologic cycle for the next 29 years of record.

From a management viewpoint the 1.0 inch/day application rate is advantageous. The alfalfa plot has such a slow intake rate that light but frequent applications will be necessary. Otherwise, a reduced irrigation efficiency will occur due to excessive runoff.

The reliability based on the average annual values from (5) and (6) is 49%. One reason for this difference may be that average annual values neglect the operators ability to schedule light but frequent irrigations. This strategy may allow him to conserve his supply until it rains again.

The average annual curve shows a greater reliability than the 1.5 inch/day curve for drainage areas greater than 140 acres. This may be showing that rainfall is poorly distributed through the growing season.

The model is able to account for the poor distribution but the average annual method cannot. Smaller application rates increase the reliability of the system. As more reliability is sought with greater drainage area, the effect of poor distribution of rainfall is less able to be countered or masked by better management of application.
There were some very droughty years that were not overcome even with 900 acres of drainage. During these years the pond failed four years of 29 for an 86% reliability even though 1.0 inch/day applications were made.

RECOMMENDATIONS

Model simulation should be done using applications of, say, 0.5 inch/day and starting irrigation at 75% of field capacity. Evaluating these management techniques may yield a higher system reliability. The operator should be encouraged to try this strategy for optimizing his supplemental irrigation system.


APPENDIX A

Years of Failure, 1948-1977

1.5 inch/day application rate:

Drainage area:

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<th>55 acres</th>
<th>100 acres</th>
<th>200 acres</th>
<th>900 acres</th>
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\[
\frac{29-10}{29} \times 100\% = 65.5\% \\
\frac{29-6}{29} \times 100\% = 79.0\%
\]

| 1977     |           |           |           |

\[
\frac{29-9}{29} \times 100\% = 69.0\% \\
\frac{29-13}{29} \times 100\% = 55.2\%
\]
Years of Failure, 1948-1977

1.0 inch/day application rate:

Drainage area-

<table>
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\[
\begin{align*}
\text{1972} & \quad \frac{29-9}{29} \times 100\% = 69.0\% \\
\text{1972} & \quad \frac{29-4}{29} \times 100\% = 86.0\% \\
\text{1972} & \quad \frac{29-12}{29} \times 100\% = 58.6\% \\
\text{1972} & \quad \frac{29-6}{29} \times 100\% = 79.3\%
\end{align*}
\]
CROSS SECTION OF DAM ALONG E OF PRINCIPAL SPILLWAY
(Not to Scale)

NOTES:
1. All welds and heat damaged areas to be thoroughly wire brushed and painted with two coats of zinc dust-zinc oxide primer conforming to Fed. Spec. TT-P-64I, type III.
2. See KS-EN 304 for pipe-support details.
5. The pipe shall be firmly and uniformly bedded so the lower one-sixth of the circumference will bear against original or compacted fill.

C.M. CANOPY INLET

DETAIL OF CANOPY INLET
RODDED BAND FOR 12" THRU 48" DIA. C.M. PIPE

NOTES:
1. Use 3/8" thick, 6" minimum width neoprene gasket, 1/4" thick, 6" minimum width asphalt tape or asphalt mastic between pipe and coupling band.
2. Coupling bands shall be the next gauge lighter than the pipe being connected but not less than 16 gauge.
3. Coupling bands shall have the same coating specified for the pipe being used.

DETAILS OF METAL ANTI-SEEP COLLAR

NOTES:
1. Collars shall have the same coating as pipe.
2. Unassembled collars shall be marked by painting or tagging to identify matching pairs.
3. Use asphalt mastic at the time of installation between the half sections and between the pipe and connecting bands.
4. Fabrication dimensions are minimum dimensions and are stated to the nearest full inch.

SLOTTED FLANGE FOR 6", 8", 10", 8-1/2" DIA. PIPE

Punch 6 slots for 3/8" dia. carriage bolts.

Weld all around

ANTI-SEEP COLLAR FOR 6", 8", 10", 8-1/2" DIA. HELICAL PIPE

42" x 42", 16 ga. galvanized flat sheet
SPECIFICATIONS
POND (EMBANKMENT)

1. **SCOPE**

   The work shall consist of all construction operations and furnishing all materials as required by the drawings and specifications for the complete installation of the works.

2. **LOCATION**

   The location of the embankment, borrow area, emergency spillway, and appurtenant structures shall be as specified on the drawings.

3. **SITE PREPARATION**

   **Foundation Area:** The foundation area shall be cleared of all trees, logs, stumps, roots, boulders, sod, and rubbish. Channel banks and breaks shall be sloped no steeper than 1 horizontal to 1 vertical. Topsoil containing substantial amounts of organic matter shall be stockpiled for later placement on the dam, spillway, and borrow areas located outside the pool area.

   Stream channels in the foundation area shall be deepened and widened as necessary to remove stones, gravel, sand, stumps, roots, mud, or other objectionable material and to accommodate compaction equipment.

   The foundation area will be thoroughly scarified to a minimum depth of 4 inches (.10 m) before placement of the fill material and moisture added, if necessary, so the first layer of fill material can be bonded to the foundation.

   **Waste Material:** Waste material from the construction operation such as rocks, frozen soil, mud, stumps, trees, logs, roots, or rubbish shall be disposed of by piling, burying, or burning at locations outside the dam area or as directed by the inspector. Burning shall comply with Kansas State Department of Health and Environment Regulation No. 28-19-45 through 28-19-47 (Open Burning Policy).

4. **EXCAVATION**

   To the extent they are suitable and approved by the inspector, excavated materials are to be used as fill materials.

   **Cutoff and Principal Spillway Trenches:** These trenches shall be excavated to the lines, grades, and widths shown on the drawings or as revised by the inspector for depth adjustment during excavation.
ILLEGIBLE DOCUMENT

THE FOLLOWING DOCUMENT(S) IS OF POOR LEGIBILITY IN THE ORIGINAL

THIS IS THE BEST COPY AVAILABLE
The trenches shall be kept free of standing water during backfill operations.

Backfill shall be made with selected impervious material approved by the inspector and be placed in the same manner as specified for earth fill.

Emergency Spillway and Outlet Channel: These excavations shall conform to the lines, grades, bottom width, and side slopes shown on the drawings or as staked in the field.

Borrow: The location, extent, and depth of the borrow area shall be as shown on the drawings. The borrow pits shall be stripped of all vegetation and tosoil containing substantial amounts of organic matter. This stripped material will be stockpiled for use to tosoil areas disturbed by the construction, embankment slopes, emergency spillway, and other required tosoil areas.

Borrow pits will be excavated and dressed in a manner to eliminate steep or unstable side slopes or other hazardous conditions. Side slopes shall be no steeper than 3:1. Surfaces of the borrow pits not covered by permanent water shall be graded and shaped to prevent the ponding of water.

5. PRINCIPAL SPILLWAY

The materials and manufacture of the pipe, anti-seep collars, coupling bands, coatings, and other appurtenances shall be as shown on the drawings and shall conform to the appropriate federal or ASTM specifications suitable for the intended purpose.

The pipe shall be laid to the line and grades shown on the drawings, be placed in original earth or properly compacted earth fill, and be uniformly bedded to the depth and in the manner specified.

Selected, impervious backfill material shall be placed around the conduit and appurtenances in layers not more than 4 inches (.10 m) thick before compaction and each layer shall be thoroughly compacted by hand tamping, manually directed power tampers, or plate vibrators to the density of the surrounding material. The height of fill shall be increased at approximately the same rate on all sides of the structure. Heavy equipment shall not be operated within 2 feet (.61 m) of any structure.

6. PLACEMENT OF EARTH FILL

The material placed in the fill shall be free of sod, roots, frozen soil, stones over 6 inches (.15 m) in diameter, and other objectional material.

The placing and spreading of fill material shall be started at the lowest point of the foundation and the fill brought up in horizontal
layers of such thickness that the required compaction can be obtained. The fill shall be constructed in continuous horizontal layers except where openings or sectionalized fills are called for. In those cases the slope of the bonding surfaces between embankment in place and embankment to be placed will not be steeper than 3 horizontal to 1 vertical. The bonding surface is to be treated the same as that specified for the foundation so as to insure a good bond with the new fill.

The distribution and gradation of materials shall be such that there will be no lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. Where it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the center and upstream portions of the fill. Where zoned fills are specified of substantially differing materials, the zones shall be placed according to lines and grades shown on the drawings.

The completed work shall conform to the lines, grades, and elevations shown on the drawings or as staked in the field.

Stockpiled topsoil stripplings will be placed on the outer portion of the embankment as a part of each lift. Topsoil shall not be less than 5 inches (.15 m) nor more than 2 feet (.61 m) thick measured vertically and shall be compacted concurrently with the earth fill.

7. MOISTURE CONTROL

The moisture content of the fill material shall be such that the required compaction can be obtained. Material that is too wet shall be dried to meet this requirement, and material that is too dry shall have water added and mixed until the requirement is met. Moisture requirements will be as shown on the drawings or in the Construction Detail section of this specification.

8. COMPACtion

The construction equipment shall be operated over the areas of each lift of earth fill in a way that will result in the required compaction. Special equipment will be used when the required compaction cannot be obtained without it. Compaction requirements will be as shown on the drawings or in the Construction Detail section of this specification.

9. FOUNDATION AND EMBANKMENT DRAINS

Foundation and embankment drains, when required, will be placed to the line and grade as shown on the drawings. Gradation requirements for drain fill and filter material and material requirements for
pipe will be as shown on the drawings or as specified in the Construction Details section of this specification.

10. CONCRETE

Concrete shall be Class 3000M with a maximum net water content of 6½ gallons/bag and a minimum cement content of 6 bags/cu. yd.

Portland cement shall be Type I or II. Air entraining admixture shall be used to provide an air content of 5 to 8 percent of the volume of concrete.

Coarse aggregate shall be hard, free from dirt and organic materials, and shall consist of gravel, crushed stone, or other suitable materials larger than 1/4 inch (6.4 mm). Maximum size shall be 1¼ inches (38.1 mm).

Fine aggregate shall consist of natural or manufactured sand with particle gradation ranging from coarse (1/4 inch (6.4 mm) to fine (#200 sieve).

Mixing water shall be clean and free from oil, alkali, or acid.

The proportions of the aggregates shall be such to produce a concrete mixture that will work readily into the corners and angles of the forms and around steel reinforcement when consolidated. The slump of the time of placing shall be 2 to 4 inches (51 to 102 mm).

Forms shall be wood, plywood, steel, or other approved materials and shall be mortar tight. The forms shall be unyielding and shall be constructed so that the finished concrete conforms to the specified dimensions and contours.

Prior to placement of concrete, the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings.

Concrete shall be conveyed from the mixer to the forms as rapidly as practical by methods that will prevent segregation of the aggregates and loss of mortar. Concrete shall not be dropped more than 5 feet (1.5 m) vertically except where suitable equipment is used to prevent segregation.

Immediately after the concrete is placed in the forms, it shall be consolidated by spading, hand tamping, or vibration as necessary to insure smooth surfaces and dense concrete.

Forms shall be removed in such a way to prevent damage to the concrete.
All exposed surfaces of the concrete shall be accurately screeded to grade and then wood floated.

Concrete shall be prevented from drying for a curing period of at least 7 days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period or until curing compound is applied.

Concrete shall not be mixed nor placed when the atmospheric temperature is less than 40° F (4° C) or more than 90° F (32° C) unless facilities are provided to prevent freezing or for cooling as required.

11. VEGETATION

A protective cover of vegetation shall be established on all exposed surfaces of the embankment, spillway, outlet channel, and borrow area. Seedbed preparation, seeding, fertilizing, mulching, or other vegetation shall be as specified in the Construction Details.

12. FENCING

The embankment and spillway shall be fenced to protect the vegetation, when specified in the Construction Details. Fencing shall comply with appropriate standards and specifications.

13. MEASUREMENT

**Earth Fill in Dam**: The volume of earth fill completed as specified will be determined from the design dimensions as staked in the field.

The design dimensions shall be the measured surface of the foundation prior to stripping and the specified neat lines of the settled fill surface. Volume will be computed to the nearest cubic yard. No reduction in volume will be made for embedded conduits and appurtenances.

**Earth Fill in Cutoff Trench**: The volume of earth fill will be computed from the measured surface of the foundation prior to stripping and the bottom of the excavated cutoff trench.

**Emergency Spillway and Outlet Channel**: No volume measurement will be made for these excavations.

**Other Component Parts**: Unless otherwise specified in the Construction Detail, measurement shall be to the units shown in the bid schedule and/or the drawings.
Owner: Turner & Son
Operator: Turner
County: Perry

1. Seeding Mix and Fertilizer: See back side of this field sheet.
2. Seedbed Preparation: Kind of Seedbed [Clean (clean, stubble, mulched, etc.)]
   For stubble show: Kind [ ] Row Spacing [ ] Height [ ]
   For mulched show: Kind [ ] Tons/Acre [ ]
   Satisfactory: Yes [ ] Or No [ ]
3. Method Seeding: [ ]

Legal Description

Liverpool Sec. 24 T. 8 R. 5

SCS Representative

Layout by: Robertson
Date: 6-2-81
Checked by: [ ]
Date: [ ]

(Apply Field No. to Sketch)

Method of Determining Acreage:
1) Planned:
2) Applied:

Location Map, Scale [ ]
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<th>Variety</th>
<th>1 lb. PLs/Acre</th>
<th>% of Mix</th>
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**SEED: PLANS**

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<tr>
<th>Kind</th>
<th>Rate per Acre (Available)</th>
<th>Acres</th>
<th>Total lbs. Fertilizer (Available)</th>
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</thead>
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**APPLICATIONS**

<table>
<thead>
<tr>
<th>(8) Bulk Lbs. Seeded</th>
<th>(9) PLs Seeded</th>
<th>(10) Total Lbs./PLs Seeded</th>
<th>Acres</th>
<th>Remarks</th>
</tr>
</thead>
</table>

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* PLs (pure live seed) from seed tag or (% Germ. + % Firma Seed) x Purity

1. To be obtained from specifications.
2. May be obtained from Plant Materials Technical Notes.
3. To be obtained from specifications.
4. To be obtained from specifications after on-site investigation of needs.
5. Multiply columns 3 and 4 and enter in column 5.
6. Acres to be seeded.
7. Multiply columns 5 and 6 and enter in column 7.
8. Enter bulk pounds actually seeded (columns 9 and 10 are not needed when double the rate of bromes and fescue are used in lieu of a seed test).
9. Multiply columns 8 and 9 and enter in column 10. (Column 10 should equal or exceed column 7 or an appropriate adjustment made in the mixt.
DATA U/0.47,0.47,0.39,0.39,0.39,0.39,0.39,0.37,0.35,0.35,0.31,0.31,0.28,
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DATA DT/1.5,1.6,1.7,0.8,0.9,1.0,1.1,1.2,1.3,0.4,0.5,1.0,
DATA PDW,SMAXL,SMUZR,SMPREV,EPRI/32.5,2.2,3,2.5,12.6,0.5,0.3,
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#RCROP,MRRT,EFFIAR
NAMELIST/BETA,NPLOTS,MMAX,INOST,LTAREA,NSTART,S,STORM,M,YENG,
#YSTART,DARCE,ROTYR,BYPASS,DOSEPT,MPGFOM
NAMELIST/SEED/MODEL,*PCT
C
C
C *** READ PROGRAM IDENTIFIERS
READ(5,5) NAME,OF,CITY,AND,STATE
5 FORMAT(2X,54A)
READ(5,10) HEATH,MODI,MODEL
10 FORMAT(1X,4A4)
READ(5,15) IN,FLOW,TO,STCR,AGE,PON0
15 FORMAT(1X,6A4)
C
C *** READ WEATHER MODIFICATION, FEEDLOT, POND AND PLOT PARAMETERS
READ(5,SEED)
READ(5,ALPHA)
READ(5,BETA)
PREVR=YSTART
C
C *** READ THE MONTHLY AVERAGE METEOROLOGICAL DATA
READ(5,20) (PSUN(I),KMD(I),RA(I),WIND(I),WMAT(I),I=1,12)
20 FORMAT(2X,F2.2,F2.2,F2.2,F2.2,F2.2,F2.2)
C
C *** READ INPUTS FOR SOIL TYPE, CROP AND AREA FOR EACH PLOT
C
C
C *** MRRT : INDICATES A SORT OF ROTATION MODEL
C *** MRRT=1 ; DON'T USE SUBROUTINE ROTATN
C *** MRRT=2 ; CROP ROTATION SYSTEM SHOULD BE ESTABLISHED IN ROTATN
IF(MRRT.EQ.2) GO TO 41
READ(5,25) (AREA(I),J=1,2),I=1,NPLOTS
25 FORMAT(2X,I2,2X,12)
READ(5,30) (AREA(I),I=1,NPLOTS)
30 FORMAT(1X,F6.0)
C
C *** READ INPUTS FOR PLAN IMPLEMENTATION AND CROP ROTATION
READ(5,35) (PLAN(I),J=1,NPLOTS)
C
C *** READ INPUTS FOR DARCYS EQUATION AND MUNICIPAL DISPENSAL
IF(DARCE.EQ.1) READ(5,45) (CONDUZ(I),CONDILI(I),CONDILW(I),MUL(I),
1 HLZ(I),HWG(I),I=1,NPLOTS)
45 FORMAT(3F10.2,3E10.4)
(1,F10.2,3E10.4) READ(5,50) (UNOINS(I),J=1,12)
50 FORMAT(F10.2)
C
C *** RUNOFF CURVE NUMBERS FOR SOIL AND CROP TYPES
DO 55 K=1,7
RCN(1,K)=CNS1(K)
RCN(2,K)=CNS1(K)
RCN(3,K)=CNS3(K)
RCN(4,K)=CNS3(K)
RCN(5,K)=CNS5(K)
RCN(6,K)=CNS5(K)
RCN(7,K)=CNS5(K)
RCN(8,K)=CNS5(K)
RCN(9,K)=CNS5(K)
RCN(10,K)=CNS5(K)
RCN(11,K)=CNS5(K)
RCN(12,K)=CNS12(K)

55 RCN(12,K)=CNS12(K)

C*** SIZING POND VOLUME ROUTINE
A1=L*W
A2=S*(L+W)
A3=A4=S**2
A4=2.*A2
A5=4.*S**2

C*** VOLMAX IS THE MAXIMUM VOLUME HELD BY THE STORAGE FACILITY

C*** PSAREA IS THE DIRECT RECEIVING AREA OF THE FACILITY
PSAREA=((A4+2.*S*HMAX)**1.5)/(L+2.*S*HMAX)/43560.

C*** CALCULATE THE CROP COEFFICIENTS
IF(MORDT.EQ.2) GO TO 61
DO 60 K=1,NPLOTS
MGSB=MGSBP(K)
DGSB=DGSBP(K)
MGSE=MGSPP(K)
DGSE=DGSPP(K)
CROP=PSAREA(K,1)
CALL CROP(CROP, MGSB, DGSB, MGSE, DGSE, K, RDIM, HMAX)
[NCRCP(K)]=###AREA(K,1)###

60 CONTINUE
61 CONTINUE

C*** INITIALIZE VARIABLES
DO 70 I=1,25
DO 65 J=2,9
IF(I.EQ.4) PREC(I,J)=0.0
65 PREC(I,J)=0.0
60 CONTINUE
SEPSUM=0.
PONDRY=0.
DO 70 J=1,12
70 CONTINUE
DO 75 I=1,NPLOTS
TPARE=PSAREA*AREA(I)
75 CONTINUE
EXI(I)=0.0
IATT(I)=0.0
IADD(I)=0.0
DISYOL(I)=0.0
DAYSOL(I)=0.0
DSRADD(I)=0.0
AINTER(I)=0.0
AAETRS(I)=0.0
ACHSDF(I)=0.0
CHSRG(I)=0.0
SMLZII(I)=9.35
SMZII(I)=3.25
IF(MONTH.LT.8)STAND.WANTED.YEAR.EQ.,YSTART.L900) GO TO 240
ACTIRR=0.0
JDAEMP=0
JDAFLO=0
OSDAY=0
NDIM(2)=29
IF(NM.EQ.2.AND.TMAX(29).LT.900) NDIM(2)=29
NDAYS=NDIM(NM)

***** ENTER DAILY LOOP *****

C
GO 300  NQ=1,NDAYS
C
C*** THE FOLLOWING STATEMENTS CORRECT FOR MISSING DATA ON INPUT TAPE
C IF(TMAX(ND).GT.250.0) TMAX(ND)=PDT+100.0
C IF(TMIN(ND).GT.250.0) TMIN(ND)=PDT+100.0
C IF(PREC(ND).GT.99.97) PREC(ND)=0.0
C
C*** TAVG IS THE AVERAGE DAILY AIR TEMPERATURE, DEGREE FAHRENHEIT
C TAVG(ND)=(TMAX(ND)+TMIN(ND))/2.0+140.0
C
C*** SUBROUTINE ASHRMD ADJUSTS THE PRECIPITATION RESULTING FROM
C SEEDING CLOUDS
C CALL ASHRMD(PREC(ND),NM,MODEL,IPCTNT)
C
C*** THE FOLLOWING CARD EVALUATES WHETHER THE 24 HOUR DESIGN STORM
C HAS BEEN EXCEEDED.
C IF(PREC(ND).GT.STORM/1.14) WRITE(6,260) NM,NQ,YEAR,PREC(ND)
260 FORMAT(2D12,1A1,12X,12X,12X,12X,12X,12X,' CRITICAL EVENT EXCEEDED ','
12X,1'D2.4 INCH STORM ',')
C
C*** CALCULATION OF POTENTIAL EVAPOTRANSPIRATION BY MEANS OF
C PENMAN EQUATION ***
C
R=RCROP
C
C*** THE FOLLOWING CARD CHECKS FOR SNOW COVER
C IF(PACK.GT.0.1) R=0.70
C
C*** THE NEXT TWO CARDS CONVERT TAVG TO ABSOLUTE, DEGREE KELVIN
C CENT=(TAVG(ND)-32.0)*1.0/1.0
C ABST=CENT+273.16
C
C*** ES IS THE DAILY CALCULATED SATURATED VAPOR PRESSURE, IN MILLIBARS
C ES=33.9*(1.0*0.77*CENT+0.8)*0.00019*ABS(1.8*CENT+46)
C IF(ES.LE.0.1) ES=0.0
C
C*** ESA IS THE DAILY CALCULATED ACTUAL VAPOR PRESSURE, IN MILLIBARS
C ESA=ES*RHOD(ND)/100.0
C
C*** RN IS THE CALCULATED DAILY NET RADIATION, IN MM OF WATER
C RN=1.25*RA(NM)*(0.22+0.54*PSUN(NM)-0.01*QST**4)
C 1.098*(1.-BRUNTA-BRUNTB*SQRT(ESA)))*0.1*0.9*PSUN(NM)
C IF(RN.LT.0.0) RN=0.0
C
C*** WINDM IS THE MONTHLY AVERAGE WINDRUN, MILES/DAY AT 2 METERS HEIGHT
C WINDM=1.0*(0.05+0.95*WINDM(NM))/2.0+0.55
C
C*** EA IS THE CONVEKTIVE LOSSES, MM WATER
C EA=0.26*(E+0.01*WINDM)*ES(ESA)
C EA=LAKE=0.26*(EPRM+0.01*WINDM)*ES(ESA)
C IF(TAVG(ND)) 270,270,280
C
270 DELTA=0.3
C GO TO 290
280 DELTA=3.099*ZAVG(ND)**0.675
290 GAMMA=1-DELTA
C
C*** PET IS THE CALCULATED DAILY POTENTIAL EVAPOTRANSPIRATION, INCHES
DO 160 I=1,13
DO 150 J=1,14
DO 140 K=1,NPLOTS
140 IF(J.LE.9) SMACCT(I,J,K)=0.0
150 POACCT(I,J)=0.0
160 CONTINUE

C** ESTABLISH CROP ROTATIONS
IF(MOROT.EQ.2) GO TO 195
DO 170 K=1,NPLOTS
170 IF(AREA(K,1).EQ.1) INCROP(K)
IF(ROTA¥R.EQ.1) GO TO 190
DO 180 J=1,NPLOTS
IF(FARE(A,J,1).EQ.1) GO TO 180
IF(ROTA¥T(J).EQ.2) GO TO 180
AREA(J,1)=7
180 CONTINUE
ROTA¥=1
GO TO 200
190 ROTA¥=2
195 CONTINUE

C** INITIALIZE VARIABLES
200 IDISA=0.0
MAXVOL=0.0
LKEVPT=0.0
VOLIRR=0.0
IF(INY.GT.1) MSTART=1
IF(MOROT.EQ.2) GO TO 215
WRITE(6,210)
210 FORMAT(’1’+6X,’***** ANNUAL SUMMARY *****’)
215 CONTINUE

C**

***** ENTER MONTHLY LOOP *****

DO 840 NM=MSTART,12
C**
C** ESTABLISH CROP ROTATIONS FOR WHEAT
IF(MOROT.EQ.2) GO TO 235
DO 230 1=1,NPLOTS
IF(INCROP(1).NE.1) GO TO 230
IF(ROTA¥T(1).EQ.2) GO TO 230
IF(ROTA¥T(1).EQ.2) GO TO 230
IF(INM.GT.MSSEP(1)) AREA(1,1)=7
GO TO 230
220 IF(INM.GT.MSSEP(1)) AREA(I,1)=7
IF(INMN.GT.MSSEP(I)) AREA(I,1)=INCROP(I)
230 CONTINUE
GO TO 240
C** CALL ROUTINE RGTAN TC ESTABLISH ROTATION SYSTEM FOR MODEL TWO
C** CROP MANAGEMENT
C**
235 CALL RGTAN (NY,NM,MMAT,NDIM,KCROP,AREA,NPLOTS,KNP,PLAN,MSTART,
LOSRATE,PAYLU,RCYCLE,NACROP,DOUBBLE,YACRP,AREA,IFAL\$)
C** READ MONTHLY METEOROLOGICAL DATA
240 READ(1,250,END=1250) KAN,STIMD,YEAR,MONTH,(PEN(I),I=1,31),
11(TMAX(I),I=1,31),(TMIN(I),I=1,31)
250 FORMAT(12,14,212,31F4.2,62F3.0)
IF(STIND.NE.99ST) GO TO 240
IF(YEAR.LT.YSTART-1900) GO TO 240
IF(YEAR.GT.YEND-1900) GO TO 240
SMGHWZ(I)=6.30
80 SMPO(I)=4.4LZ(I)+SMUZ(I)
YEND=YEND+YSTART+1
C
DOSR=DSR/ER/SR
C
C
PRINT INPUT PARAMETERS
WRITE(6,95) NAME, OF, CITY, AND, STATE, YSTART, YEND, WEATH, MODI, MODN, EL
1, IN, FLOW, TO, STORE, POND, LT, AREA, STORM, L, R, S, R, MAX, VOL, MAX, PS, AREA,
20, SEPRF, EFFRR
85 FORMAT('1',/,'10X','STATION:', '3X', '5A4', '10X', 'I4', '10X', 'MODEL:', '1', 'A44', '/','18X', '6X44', '18X', 'FEEDLOT AREA=', '1', 'F6.2', ' ACRE
25/', '10X', 'SIZE OF CRITICAL EVENT:', '1', 'F4.2', '/','10X', 'POND VARIABLES:
3/', '25X', '(A) BASE DIMENSION=', '1', 'F7.2', ' FEET BY', '1', 'F7.2', ' FEET', '1', 'F25X', '4(1) SIDE SLOPE', '1', 'F3.0', ': 1', '1', 'F25X', '5(1) MAXIMUM DEPT
5/', '10X', 'MAXIMUM POND VOLUME=', '1', 'F9.2', ' ACR
6E-', 'INCHES', '1', '25X', 'E', 'DIRECT RECEIVING AREA (FOR PRECIPITATION')
7 ', 'F8.2', ' ACRES', '1', '25X', 'I', 'DAILY SEEPAGE RATE=', '1', 'F10.3', ' INCHES/
80DAY', '/','10X', 'AREA VARIABLES:', '1')
IF(MOBST,EQ,2) GO TO 135
D0 130 J=1,NPLOTS
PLAREA=AREA(J)
CROP=AREA(J,1)
SOIL=AREA(J,2)
PAVL=PAVLU
IF(PLAN(J),EQ,1) PAVLU=0.0
WRITE(6,901) J,PLAREA,KRCP(CROP),SOIL,DSR,PAVL
90 FORMAT(15X,'PLOT',/,'10X', '(A) AREA=', '1', 'F6.2', ' ACRE', '1', '25X', 'I', 'SCS SOIL TYPE
1', '10X', 'IRrigation Rate=', '1', 'F5.2', ' INCHES/DAY', '1', '25X', '(E) Irriga
2', '10X', 'Management', '1', 'F5.2', ' FIELD C', '1', '25X', '(G) Crop Rotation
3', '10X', 'WRITE(6,951)
IF(PLAN(J),EQ,1) WRITE(6,100)
IF(PLAN(J),EQ,2) WRITE(6,110)
IF(PLAN(J),EQ,3) WRITE(6,110)
95 FORMAT(25X,'F PLAN IMPLEMENTED', '1', 'RUNOFF
100 FORMAT(25X,'F PLAN IMPLEMENTED', '1', 'RUNOFF AND IRRIGATION
110 FORMAT(25X,'F PLAN IMPLEMENTED', '1', 'IRRIGATION
120 FORMAT(25X,'G CROP ROTATION WITH -- FALLOW
PAVL=PAVLU
130 CONTINUE
135 CONTINUE
C
D0 990 KK=1,NPLOTS
RRJAN(KK)=0.0
RRJFA(KK)=0.0
RRMFR(KK)=0.0
RRPDI(KK)=0.0
RRMAY(KK)=0.0
RRPUN(KK)=0.0
RRRUL(KK)=0.0
RRSAP(KK)=0.0
RRSEP(KK)=0.0
RRIOCT(KK)=0.0
RRIND(KK)=0.0
9000 RRDEC(KK)=0.0
C
C
C
**** ENTER YEARLY LOOP *****
C
D0 990 NY=1,YEARS
\[
\text{PET} = ((\Delta t \times RN) + (\text{GAMMA} \times \text{EA})) / 25.4
\]

C

*** CALCULATE LAKE AND BARE SOIL EVAPOTRANSPIRATION ***

RN = ((1.0 - 0.20) / (1.0 - R))
RLAKE = ((1.0 - 0.3) / (1.0 - R))
PETBS = ((\Delta t \times RN) + (\text{GAMMA} \times \text{EA})) / 25.4
LAKES = ((\Delta t \times RNLAKE) + (\text{GAMMA} \times \text{EA}LAKES)) / 25.4
P = TAVG(N)
Q300 = M = 1, NPLLOTS
AA = [\text{AET}(M) - \text{PET}]
B = [\text{PRECH}(M) - \text{PET}]

C

*** SUBROUTINE SNOWRT CALCULATES THE MOISTURE ADDED TO THE DISPOSAL SITE DUE TO SNOWMELT ON THE AREA ***

*** EVALUATION OF SOIL MOISTURE AND CALCULATION OF ACTUAL EVAPOTRANSPIRATION ***

STRVOL = 0.0
RUNMDS = 0.0
 JJ = 0
 NNN = 0
NNN = NNN + 1
IF (NNN .GT. NPLLOTS) GO TO 650
STRVOL = 0.0
 JJ = JJ + 1
NPLLOTS = NPLLOTS - 1
C

 *** CALCULATE SURFACE RUNOFF VOLUME BY SCS METHOD ***

IF (RAIN .LE. 0.0) GO TO 370
C

*** MODIFY RUNOFF CURVE NUMBER TO CONDITION I ANTECEDENT MOISTURE ***

R = (SOIL, CROP) = R = (SOIL, CROP) + 0.39 * EXP(0.0063 * RCN(SOIL, CROP))
GO TO 390
C

*** MODIFY RUNOFF CURVE NUMBER TO CONDITION III ANTECEDENT MOISTURE ***

R = (SOIL, CROP) = R = (SOIL, CROP) + 1.95 * EXP(-0.0063 * RCN(SOIL, CROP))
GO TO 390
C

IF (RAIN .LE. 0.0) GO TO 370
IF (RAIN .LE. 0.0) GO TO 370
IF (RAIN .LE. 0.0) GO TO 370
IF (RAIN .LE. 0.0) GO TO 370
IF (RAIN .LE. 0.0) GO TO 370
[FISMLZ(JJ),LE,0.3*(AVLFCL(SOIL))+PWLZ(SOIL)] GO TO 470
500 IF(DARCEQ,GE,1.0) GO TO 605
IF(PERC,SMAXU) 510, 520, 520
C
C==Evaluate soil moisture
510 SMUZ(JJ)=SMUZ(JJ)+PERC-AETUZ-EXCESS
SMUZ(JJ)=SMLZ(JJ)-AETLZ-EXCESS
GO TO 610
520 SMUZ(JJ)=SMUZ(JJ)+SMAXU-EXCESS-AETUZ
530 SMAXL=0.9*FCL(SOIL)+SMLZ(JJ)
IF(PERC-EXCESS-SMAXL) 540, 540, 550
540 SMLZ(JJ)=SMLZ(JJ)+PERCL-EXCESS-SMAXL
DPERC=PERC-EXCESS-SMAXL
GO TO 610
550 SMLZ(JJ)=SMLZ(JJ)+SMAXL-AETLZ
DPERC=PERC-EXCESS-SMAXL
GO TO 520
C==Calculate evaporation from bare soil surface (SEVAP) for months October through March or when the disposal area is fallow
560 AETUZ=0.0
AETLZ=0.0
IF(PACK,GT,0.0) GO TO 590
[FISMUZ(JJ),LT,(FCU(SOIL)-U(SOIL))] GO TO 370
EO(JJ)=FCU(SOIL)-SMUZ(JJ)
[FISMUZ(JJ),GE,(FCU(SOIL))] EO(JJ)=0.0
C==Calculate stage 1 soil evaporation
UZEVAP=PETS
EO(JJ)=EO(JJ)+UZEVAP
IF(EO(JJ),GT,0.0) UZEVAP=EO(JJ)-U(SOIL)
T(JJ)=0.0
GO TO 580
C==Calculate stage 2 soil evaporation
570 TJJ(JJ)=T(JJ)+
IF(SMUZ(JJ),GT,0.5)=C(SOIL)*(T(JJ)-1)**0.5
580 IF(UZEVAP,GT,0.0) UZEVAP=PETS-AETUZ
IF(UZEVAP,LT,0.0) UZEVAP=0.0
IF(SMUZ(JJ),GT,0.0) UZEVAP=0.0
UZEVAP=UZEVAP*PDUZ(SOIL)
LT(UZEVAP)=UZEVAP*PDUZ(SOIL)
GO TO 630
590 UZEVAP=0.0
600 IF(DARCEQ,LT,1.0) PERC=0.0
IF(DARCEQ,LT,0.91) EXCESS=0.0
SMUZ(JJ)=SMUZ(JJ)-UZEVAP*PERC-EXCESS
IF(SMUZ(JJ),LE,PWPUZ(SOIL)) SMUZ(JJ)=PWPUZ(SOIL)
IF(DARCEQ,GT,1.0) GO TO 530
620 SMUZ(JJ)=SMUZ(JJ)-AETUZ
SMLZ(JJ)=SMLZ(JJ)-AETLZ
610 IF(SMLZ(JJ),LT,PWPLZ(SOIL)) AETLZ=AETLZ+(PWPLZ(SOIL)-SMLZ(JJ))
IF(SMLZ(JJ),LE,PWPLZ(SOIL)) SMLZ(JJ)=PWPLZ(SOIL)
IF(DARCEQ,GT,1.1) GO TO 620
DPERC=SMLZ(JJ)-0.9*FCL(SOIL)
IF(DPERC,LT,0.0) DPERC=0.0
IF(SMLZ(JJ),GT,0.9*FCL(SOIL)) SMLZ(JJ)=0.9*FCL(SOIL)
620 AETUZ=AETUZ-UZEVAP
C==SM is the soil moisture in the growing zone, t k acres
SML(JJ)=SMUZ(JJ)+SMLZ(JJ)
SMACCT(NM,9,JJ)=SM(JJ)
[IAET(JJ)=IA+IADD(JJ)
AET(JJ)=AETUZ
AETL(JJ)=AETLZ
N DPERC(JJ)=DPERC
NIA(JJ)=1A]
NROF(JJ)*RNOF
IF (IPLAN(JJ)-LE.2) STRNCF = RNOF
STRVOL = STRVOL + STRNCF*AREA(JJ)
GO TO 330
CONTINUE

*** EVALUATION OF VOLUME USED AS IRRIGATION ***

T1 IS THE PREVIOUS DAY'S AVERAGE TEMPERATURE, IN FAHRENHEIT
T2 IS THE AVERAGE TEMPERATURE OF THE DAY TWO DAYS
PRIOR TO TODAY

VOLDIS = 0.0
JDISDA = 0
NCNT = 0
JEMPDA = 0
DO 655 MS = 1, NPLGTS
DISVOL(MS) = 0.0
IF (BYPASS .NE. 1) GO TO 655
MCROP = AREA(MS) + 1
IF (MCROP .LT. MCROP, NM) .EQ. 0.1 GO TO 660
CONTINUE
TF(IPLAN(MS), EQ. 1) GO TO 660
TAWMED = TAVG(ND) + T1 + T2
FREEZE = TAVG(ND) + T1
T2 = T1
T1 = TAVG(ND)
IF (FREEZE .LT. 64.0) FREEZE = 1
IF (TAWMED .LT. 61.0) FREEZE = 0

WHEN FREEZE EQUALS 1 THE SOIL IS CONSIDERED TO BE FROZEN IT IS THAWED
WHEN FREEZE EQUALS 0 IT IS NOT

SMUZ IS THE SOIL MOISTURE IN THE TOP 12 INCHES OVER EACH
PLOT; AVLFUZU IS THE AVAILABLE WATER CAPACITY OF THAT SOIL.
IRRIGATION WILL OCCUR ON DAYS THAT THE SOIL MOISTURE IS 
A LEVEL GREATER THAN THAT OF THE PERCENTAGE OF AVAILABLE WATER
SPECIFIED BY THE VARIABLE PAVLU.

SOIL = AREA(MS) / 2
IF (SMUZ(MS) .LT. PAVLU*AVLFUZU(SOIL)) GO TO 660
JDISDA = JDISDA + 1
NCNT = NCNT + 1
IF (PONVOL .LT. PONVMAX .LE. VOLMAX) GO TO 660
DISVOL(MS) = O Output
CALL IROPT(MS, ND, NOAIS, AMS, PAVLU, AREA, ORATE, MCROP,
X Bypass, DISVOL, SMACCT)

IF THE POND VOLUME IS LESS THAN THE VOLUME REQUIRED FOR ONE FULL
DAY OF IRRIGATION, IT WILL BE ASSUMED THAT NO IRRIGATION WILL OCCUR
ON THAT DAY.

PONVOL = PONVOL - DISVOL(MS)
IF (PONVOL .LT. PONVMAX .LE. VOLMAX) JEMPDA = 1
IF (PONVOL .EQ. 0.0) GO TO 670
DISVOL(MS) = DISVOL(MS) + PCNVOL
PONVOL = 0.0
GO TO 670

DISVOL(MS) = 0.0
SMACCT(NM, 3, MS) = SMACCT(NM, 3, MS) + DISVOL(MS) / AREA(MS)
VOLDIS = VOLDIS + DISVOL(MS)
IF (DISVOL(MS) .GT. 0.0) DAYS(MS) = DAYS(MS) + 1.0
CONTINUE

IF (NCNT .EQ. 0) JDISDA = JDISDA + JDISDA / NCNT
RNOF=ER**2/(RAIN+0.8*S1)
GO TO 420
C*** EVALUATE INTERCEPTION STORAGE
   420 RNOF=0.0
   IA=0.0
   GO TO 430
   410 RNOF=0.0
   420 IA=0.1
   IF(IA.GT.RAIN) IA=RAIN
   IF(IA+IAADD(JJ)).GE.0.1) IA=0.1-IAADD(JJ)
C
C*** EVALUATE INFILTRATION INTO THE UPPER ZONE
   430 PERC=RAIN-RNOF-IA
   UEVAP=0.0
   IF(DACEQ.EQ.2) GO TO 435

C*** SUBROUTINE DARCRT EVALUATES THE FLOW WITHIN THE SOIL PROFILE
C*** BY APPLYING THE ONE-DIMENSIONAL DARC EQUATION
CALL DARCRT(PERC,FCU(SOIL),SMUZ(JJ),FCL(SOIL),SMLZ(JJ),FCUW(SOIL),
LMGW(JJ),OPERC,CONDZU(JJ),CONOLZ(JJ),CONDGW(JJ),HZU(JJ),HLZ(JJ),
2GW(JJ),PNPZU(SOIL),PNPLZ(SOIL),PWG(SOIL))
GO TO 450
C*** CALCULATE PRESENT STORAGE AVAILABLE IN UPPER ZONE
   435 SSHMAX=0.95*SHSATU(SOIL)-SMUZ(JJ)
C*** EVALUATE WATER CASCADED TO LOWER ZONE FOR STORAGE
   PERCL=PERC-SSHMAX
   IF(PERC.GT.SSHMAX) PERC=SSHMAX
   IF(PERC.LT.0.0) PERCL=0.0
   IF(SMUZ(JJ).GT.PCU(SOIL)) GO TO 440
   EXCESS=0.0
   GO TO 450
C*** EVALUATE GRAVITATIONAL WATER IN UPPER ZONE
   440 EXCESS=SMUZ(JJ)-PCU(SOIL)
C
C*** IF THE CROP IS DORMANT OR THE SOIL LIES FALLOW, SOIL
C*** EVAPORATION IS EVALUATED
   450 IF(KCROP*ICROP,NM).LE.0.0) GO TO 560
   TJJ=0.0
C*** MODIFY PET BY THE PLANT CONSUMPTIVE USE COEFFICIENT
   AET=KCROP*ICROP,NM*PET
   IF(PET.LE.(AET(JJ)) AET=0.0
C*** CHECK WHETHER SOIL MOISTURE LIMITS AET FROM THE UPPER ZONE
   IF(SMUZ(JJ).LT.(0.3*(AVLFCU(SOIL)))+PWPZU(SOIL))) 460,460,470
C*** CALCULATE AET FROM THE UPPER ZONE WHEN LIMITED BY SOIL MOISTURE
   460 AVALU=SMUZ(JJ)-PWPZU(SOIL)
   IF(AVALU.LE.0.0) AVALU=0.0
   AETU=0.7*AET*(AVALU/(10.3*AVLFCU(SOIL)))
C*** EVALUATE AVAILABLE WATER IN THE LOWER ZONE
   AVALL=SMLZ(JJ)-PNPLZ(SOIL)
   IF(AVALL.LE.0.0) AVALL=0.0
C*** CHECK WHETHER SOIL MOISTURE LIMITS AET FROM THE LOWER ZONE
   IF(SMLZ(JJ).LT.(0.3*(AVLFCU(SOIL)))+PNPZU(SOIL))) 470,470,470
C*** CALCULATE AET FROM THE LOWER ZONE WHEN LIMITED BY SOIL MOISTURE
   470 AETLZ=0.3*AET*(AVALL/(10.3*AVLFCU(SOIL)))
   GO TO 500
   480 AETLZ=AET-AETU
   GO TO 500
C*** EVALUATE AET FROM BOTH ZONES UNDER WET CONDITIONS
   490 AETUZ=0.7*AET
   AETL=0.3*AET
   AVAL=SMLZ(JJ)-PNPLZ(SOIL)
C*** COMPLETE UPDATE DISPOSAL DAY ACCOUNT
   IF(VOLDIS.0) DSAY=DSAY+1
C*** UPDATE DAYS NOT TO MEET IRRIGATION DEMAND
   JDAEMP=JDAEMP+JEMPDA
   IF(BYROASS.NE.1) GO TO 680
   RUNOFF=0.0
   GO TO 730
C*** SUBROUTINE STORAG CALCULATES ADDITIONAL LOADING TO THE STORAGE
C*** POND DUE TO FEEDLOT RUNOFF OR MUNICIPALITY DISPOSAL
   CALL STORAG(P1,P2,P3,PRECIP,SNOW,FROZEN,MNTH,GROW,DOM,RUNOFF,MUN
   DUSIMM,RUNMOS)
C
C
C *** CALCULATION OF SURFACE AREA AND DETERMINATION OF SURFACE
C *** EVAPORATION FROM STORAGE FACILITY ***
C
C*** THE FOLLOWING CALCULATION EX presses THE VOLUME OF WATER IN THE
C*** STORAGE FACILITY IN CUBIC FEET.
   IF(PONVOL.LE.0.0) GO TO 750
   V=V+PONVOL*3630
C*** THE FOLLOWING CALCULATIONS DETERMINE THE SURFACE AREA OF THE STORAGE
C*** FACILITY AS A FUNCTION OF STORAGE VOLUME. AREA IS IN SQUARE FEET
C*** VOLUME IS IN CUBIC FEET. THE STORAGE FACILITY IS SHAPED LIKE AN IN VERTO
C*** FRUSTUM OF A PYRAMID. INPUT PARAMETERS TO SIZE THE FACILITY ARE LENGTH
C*** (L) OF THE BASE IN FEET, WIDTH OF THE BASE(W) IN FEET AND SLOPE OF
C*** THE POND DOES NOT LEAK. INPUTS TO THE STORAGE WILL BE NATURAL
C*** INSIDE EMBANKMENTS GIVEN AS A RATIO OF RUN TO RIS(S). IT IS ASSUMED
C*** RUNOFF, FEEDLOT RUNOFF, MUNICIPALITY DISPOSAL AND PRECIPITATION.
C*** LOSSES FROM THE POND INCLUDE EVAPORATION AND DISPOSAL VOLUME.
C*** 82 IS THE AREA OF THE SURFACE LIQUID IN SQUARE FEET.
   HAPRX=1*(PONVOL/VOLMAX)*HMAX
   V=V-VC
   DV=V/VC
   HDV=1+4*HAPRX+AS*HAPRX**2
   H=HAPRX+DV/DVD
   IF(ABS(H-HAPRX).LT.0.1) GO TO 750
   HAPRX=H
   GO TO 740
C***
   IF (1.0.0.EQ.0) H=HMAX
   B2=(L+2.,5.)*H
   IF(FROZEN.EQ.1) LAKEP=0.0
   LKEVPT=LKEVPT+LKEVP
   SEVAP=0.0
   LKEVP=LKEVP+LKEVP
   LKEVP=LKEVP+LKEVP
   GO TO 750
C*** SEVAP IS THE VOLUME OF WATER EXTRACTED FROM THE STORAGE FACILITY BY
C*** FREE SURFACE EVAPORATION.
   CALL SEEPGE(8.0,PONVOL,JASEEP,JOSEPT)
C
C*** THE VOLUMES OF CALCULATED RUNOFF, FEEDLOT RUNOFF, MUNICIPALITY
C*** DISPOSAL, AND PRECIPITATION FALLING ON THE FACILITY ARE ADDED
C*** TO THE VOLUME OF WATER IN THE STORAGE FACILITY (ACRE-IN).
   PONVOL=PONVOL+RUNOFF+LTAPE+PRECIP+PSAREA+STRVOL+RUNMOS
C*** THE VOLUME OF WATER REMAINING AT THE END OF THE DAY IS EXPRESSED
C*** IN ACRE-IN.
C
C*** THE FOLLOWING STATEMENTS DETERMINE WHETHER THE STORAGE FACILITY HAS
C*** OVERFLOWED AND IF SO, THE QUANTITY DISCHARGED
IF(NRNOF(K,J)$GT.0.0) CNTR=1.0
790 IF(NRNOF(K,J)$GT.FREQ[I]) CNTF[I,K]=CNTF[I,K]+1.0
795 IF(PREC[I,D].GT.FREQ[I].AN0.CNTR.EQ.1.0) CTPR[I]=CTPR[I]+1.0
NPLOTS=IPLLOT
300 CONTINUE

***** EXIT DAILY LOOP *****

****** UPDATE ACCOUNTS ******
POAACC(NM,1)=AMONTH(NM)
POAACC(NM,2)=SMACCT(NM,2,1)*PSAREA
POAACC(NM,3)=SDAY
POAACC(NM,7)=JDAMAP
POAACC(NM,8)=ACTIRR
POAACC(NM,9)=JDAFLO
DO 810 J=2,14
IF(J.EQ.13) GO TO 810
POAACC(L3,J)=POAACC(L3,J)+POAACC(NM,J)
810 CONTINUE
DO 820 J=1,8
20 SMACCT(L3,J,MP)+SMACCT(NM,J,MP)
SMACCT(NM,1,MP)=AMONTH(NM)
300 SMACCT(L3,1,MP)=AMONTH(L3)
POAACC(L3,1)=AMONTH(L3)
VOLIRR=VOLIRR+ACTIRR
CALL HITEMP(TMAV,TVG,NDAYS,NM)
400 CONTINUE

****** EXIT MONTHLY LOOP ******

SMACCT(L3,9,MP)=SMACCT(L2,9,MP)
DSNOW=PACK-PAKPY
PAKPY=PACK
PACKY=PACK
PCW=PACCT(L3,2)+POAACC(L3,1)+POAACC(L3,4)+POAACC(L3,5)+POAACC(L3,10)-POAACC(L3,11)
POAACC(L3,11)=POAACC(L3,2)+POAACC(L3,3)+POAACC(L3,3)+POAACC(L3,4)+POAACC(L3,10)
2CT(L3,911)=100.
VOSTIR=VOSTIR+PCW
SEPSTM=SEPSTM+POAACC(L3,11)
PONDY=PODNY+POAACC(L3,7)
POAACC(L3,13)=POAACC(L2,13)
DC 850 KT=1,NPLGTS
DSNFFF(KT)=DSNFFF(KT)+SMACCT(L3,5,KT)
AINTEL(KT)=AINTEL(KT)+SMACCT(L3,4,KT)
AAMETRS(KT)=AAMETRS(KT)+SMACCT(L3,7,KT)
ACHOM(KT)=ACHOM(KT)+SMACCT(L3,8,KT)
500 OSPERK(KT)=OSPRLK(KT)+SMACCT(L3,8,KT)
IRRSM=IRRSM+VOLIRR
TPREC=TPREC+SMACCT(L3,2,1)
IF(YEAR.LT.1980) YSTART=1970.0
IF(MACCT(L3,2,1).GT.0.0) KET=SMACCT(L3,2,1)
IF(MACCT(L3,2,1).LE.0.0) DRY=SMACCT(L3,2,1)
C
C *** PRINT POND ACCOUNT
IF(YPODM.EQ.1) GO TO 750
APITE(5,36) YEAR
460 Form('10',12,7x) "WATER ACCOUNT FOR STORAGE FACILITY I11: ACRE-
LINCHES) = 15',12/4x,'----------
WRITE(6,370) ((PDACCT(I,K),K=1,13),I=1,13)
370 FORMAT(5X,A4,F7.1,FL0.1,2F8.1,F9.1,3X,'1',F9.1,2X,'1'),F10.1,F12.1,
1FL1.1,FL0.1,F11.1,F8.1)
GO TO 1800
1850 CONTINUE
WRITE(6,3860) YEAR
3860 FORMAT('0',28X)  \* WATER ACCOUNT FOR STORAGE FACILITY \(IN\) ACRE-
1 INCHES -- 19',12/10X,---------------------
2--3X,'/13X,'INFLOWS',40X,'OUTFLOWS'/9X,'/2X,'MONTH PR
5SECT. RUNOFF IRR. DAYS/(PGNO EMPTIED) IRR. VGL. SURFACE EVAP.
6 DISCHARGE SEEPAGE VGL. CHANGE HEIGHT DISCH. DAYS)
70  I=1,13
80  JPDACT(I,6)=PDACCT(I,6)
90  JPDACT(I,7)=PDACCT(I,7)
100 JPDACT(I,14)=PDACCT(I,14)
110 JPDACT(I,11)=PDACCT(I,11),PDACCT(I,12),PDACCT(I,5),JPDACCT(I,6),JPDACCT(I,
12),PDACCT(I,13),PDACCT(I,14)
120 JPDACCT(I,8)=PDACCT(I,8),PDACCT(I,9),PDACCT(I,10),PDACCT(I,11),PDACCT(I
1,2),PDACCT(I,13),PDACCT(I,14)
130 FORMAT(3X,A4,F7.1,F9.1,19) / (16,15) 'F9.1,2F13.1,F10.1,
1L1.1,F9.1,19)
1350 CONTINUE
1390 CONTINUE
C*** PRINT SOIL MOISTURE ACCOUNTS
DO 50 JM=1,NPLOTS
10 JM=1,NPLOTS
20 IF(MNRT=.EQ.1) CRDP=AREA(JM,1)
30 IF(MNRT=.EQ.2) CRDP=LYRCP(JM)
40 JM=1,NPLOTS
50 IF(MNRT=.EQ.3) CRDP=AREA(JM)
WRITE(6,386) JM,KROP(CRDP),SOIL,AREA(JM)
580 FORMAT('0',28X)  \* PLOT NO. -- 13X,'CRDP',2X,'SOIL TYPE-
1 INCHES,'ACRES')
680 FORMAT('0',28X)  \* 'PLOT NO. -- 13X,'CRDP',2X,'SOIL TYPE-
1 INCHES,'ACRES')
WRITE(6,390) YEAR
390 FORMAT('0',35X)  \* WATER BALANCE \(IN\) THE PLOT AREA \= 14',
112/10X,---------------------
2--3X,'/13X,'INOUT',3X,'/12X,'---------------------
4--3X,'/3X,'INPUTS',3X,'OUTFLOWS'/12X,---------------------
5--3X,'/3X,'MUN',3X,'/3X,'HUM',1X,'/3X,'IRRTN',1X,'/3X,'INTCPN',1X,'/3X,'RUNOFF',1X,
6X,'PERC',1X,'ET',1X,'/3X,'CHANGE IN SM',1X,'/3X,'SM')
WRITE(6,900) ((SMACCT(I,JM),K=1,9),I=1,13)
900 FORMAT(6X,A4,8F13.2)
910 CONTINUE
PCRDIS=100.-PCWH
WRITE(6,920) PCDIS
920 FORMAT('0',12X,'PERCENT OF RUNOFF DISCHARGED \OUT\ OF POND\=\',F10.2)
WRITE(6,930) (DISDA
930 FORMAT('0',10X,'POTENTIAL \(IRR\) \=\,14)
WRITE(6,940) PACK,3SNOW
DO SC HirG=0.0
IF (PONVOL VOLMAX) 780, 780, 760
760 DSC HirG=PONVOL-VOLMAX
JDAFLU=JDAFLU+1
OSCVRG=OSCVRG+DSC HirG

C*** VOLUME CALCULATIONS TO INCREASE THE POND SIZE
CONTRL = 1.0
PCNTRL = CONTRL*100.0
VOLCHG = CONTRL*PCNTRL-VOLMAX+VOLCHG
VOLMX1 = VOLMAX+VOLCHG
VGB = 2.0 * S * HMAX
VCC = (14.*3.)*S**2) - (VOLMX1*3630./HMAX)
VCL = SQRT(VCC)
DIM = 0.001-VCL/VGB
IF (DIM=0.001) GO TO 770
WRITE(6,770) NM,ND,YEAR,DSCHRG,VOLMX1,PCNTRL,DIM
770 FORMAT(/,1X,12,/,12,/,12,/,12,/) = DISCHARGE OF 'F7.2,' ACRE-IN REQ
CREASE VOLUME OF 'F9.2,' ACRE-IN FOR 'F6.2,' CONTROLE WHERE L =
Z = 0.001/12.0
775 CONTINUE
PONVOL=VOLMAX
IF (DSCHRG=DSCHRG) PEAK=DSCHRG
IF (YEN,GT,PREVYR,DR.CM,LT,1.0) MM=MM+1
PREVYR=YEAR
CM=CM+1.0
780 CONTINUE

C*** UPDATE SOIL MOISTURE ACCOUNT FOR EACH PLOT
DO 785 K=1,NPLT
SMACCT(NM,2,K)=SMACCT(NM,2,K)+PRECP
SMACCT(NM,4,K)=SMACCT(NM,4,K)+N(A(K))
SMACCT(NM,5,K)=SMACCT(NM,5,K)+NRNGF(KI)
SMACCT(NM,7,K)=SMACCT(NM,7,K)+AEFL(KI)
SMACCT(NM,8,K)=SMACCT(NM,8,K)+SMK(KI)
785 SMPD(KI)=SMK(KI)

C*** UPDATE POND ACCOUNT
ACTIRR=ACTIRR+VULDIS
PAACCT(NM,3)=PAACCT(NM,3)+RUNMDS
PAACCT(NM,4)=PAACCT(NM,4)+RUNOFF*LTAKEA
PAACCT(NM,5)=PAACCT(NM,5)+STRAVL
PAACCT(NM,9)=PAACCT(NM,9)+SEVAP/360
PAACCT(NM,10)=PAACCT(NM,10)+DSCHRG
PAACCT(NM,11)=PAACCT(NM,11)+DASEEP
PAACCT(NM,12)=PAACCT(NM,12)+(PONVOL-PONVOL)
IF (ND.EQ.NOAYS) PAACCT(NM,13)=H
PONVOL=PONVOL
IF (PONVOL=MAXVOL) MAXVOL=PONVOL

C*** STATISTICAL PRECIPITATION AND RUNOFF FREQUENCY DATA
IF (PRECN0.GT.0.0) CTDPAY = CTDPAY+1.0
NPLT=NPLT
IF (NPLT.NE.4) NPLT=4
DO 795 I=1,25
IF (PRECNI.GT.FREQII) CTPI=CTPI+1.0
795 CNTR=0.0
DO 790 K=1,NPLT
IF (NRNGF(KI).GT.3.0) AND K.EQ.4 CTPGAY(KI)=CTP(KI)+1.0
940 FORMAT('O',1X,'PACK ON DECEMBER 31 = ',F5.2,1X, 
'CHANGE IN SNOW STORAGE = ',F5.2) 
WRITE(6,950) 
950 FORMAT('O',1X,'INPUTS-OUTPUTS-CHANGE IN SNOW STORAGE=CHANGE IN 
SOIL MOISTURE') 
MAXVOL=MAXVOL*100.0/VOLMAX 
WRITE(6,960) MAXVOL 
960 FORMAT('O',1X,'PERCENT OF MAXIMUM POND VOLUME REQUIRED = ',F7.2) 
EVAPLK=EVAPLK+LKEVPT 
WRITE(6,970) LKEVPT 
970 FORMAT('O',1X,'ESTIMATED LAKE EVAPORATION, INCHES = ',F5.2) 
DO 7000 KK=1,NPLOTS 
   IF(PLAN(KK).EQ.1.OR.DSRATE.EQ.0) GO TO 7000 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(2,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(3,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(4,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(5,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(6,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(7,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(8,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(9,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(10,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(11,3,KK) 
   RRIFEB(KK)=RRIFEB(KK)+SMACCT(12,3,KK) 
7000 CONTINUE 
C C C *** EXIT YEARLY LOOP *** 
980 CONTINUE 
1520 CONTINUE 
C C C *** CALCULATE AVERAGE ANNUAL VALUES 
EVAP=EVAPLK/YEARS 
CMNEW=CM 
IF(AM.EQ.0) MM=1 
COUNT=CM/MM 
IF(COUNT.EQ.0) MM=0 
IF(CM.EQ.0) CM=YEARS 
DSCRG=DSCVCL/C 
CM=CMNEW 
CONTROL=MASTK/YEARS 
DARVOL=IRRSUM/YEARS 
APREC=TPREC/YEARS 
AVDOR=PONDOR/YEARS 
AVSEEP=SEPSUM/YEARS 
RANGE=WET-DRY 
AVGMO=EVAP-APREC 
DO 1000 J=1,NPLOTS 
   DSRERC(J)=DSRERC(J)/YEARS 
   DSRNNF(J)=DSRNFF(J)/YEARS 
   ACHSNM(J)=ACHSNM(J)/YEARS 
   AIMTER(J)=AIMTER(J)/YEARS 
   AAETRS(J)=AAETRS(J)/YEARS 
1000 JAYSOS(J)=JAYSOS(J)/YEARS 
   IF(NPLOTS.GT.4) NPLOTS=4 
DO 1200 J=1,23 
   PREC(J,J)=CTP(J) 
   I(FCTPDAY.GT.1.0) CTP(J)=CTP(J)/CTPDAY*100.0 
   PREC(J,1)=ASTAT(J) 

5267 FORMAT(25X, '(B) CROP -- ',A48)
WRITE(6,5268) SOIL, CROP, PAVLU

5268 FORMAT(25X, '(C) SOIL TYPE -- ',A13, ' (SCS SOIL TYPE) /25X, '(D) I
IRRIGATION RATE -- ',F5.2, ' INCHES/DAY /25X, '(E) IRRIGATION MANA
agement -- IRRIGATION BELOW -- ',F5.2, ' FIELD CAPACITY')
IF(IPLAN,J,EQ.1) WRITE(6,5270)
IF(IPLAN,J,EQ.2) WRITE(6,5280)
IF(IPLAN,J,EQ.3) WRITE(6,5290)

5270 FORMAT(25X, '(F) PLAN IMPLEMENTED -- RUNOFF')

5280 FORMAT(25X, '(F) PLAN IMPLEMENTED -- RUNOFF AND IRRIGATION')
IF(ICYCLE(J,EQ.1) WRITE(6,5300)

5300 FORMAT(25X, '(G) CROP MANAGEMENT -- NO CROP ROTATION')

5290 FORMAT(25X, '(F) PLAN IMPLEMENTED -- IRRIGATION')
IF(ICYCLE(J,EQ.2) WRITE(6,5310) NR

5310 FORMAT(25X, '(G) CROP MANAGEMENT -- CROP ROTATION WITH ** 1, IL, '
1 YEAR REPEITION')
IF(DOUBLE(J,EQ.1) WRITE(6,5325)
IF(DOUBLE(J,EQ.2) WRITE(6,5320)

5320 FORMAT(25X, '(H) SINGLE CROP MANAGEMENT')
IF(PAVLU=PAVLU
5325 FORMAT(25X, '(H) SINGLE CROP MANAGEMENT WITH WINTER WHEAT BETW
EEN CROPS MENTIONED IN PART (B)')
5330 CONTINUE
1095 CONTINUE

C*** PRINT FINAL SUMMARY
WRITE(6,1090)
1090 FORMAT(/,47X, '***** FINAL SUMMARY *****')
WRITE(6,1100)
1100 FORMAT('O',10X,'METEOROLOGICAL SUMMARY')
WRITE(6,1110)
1110 FORMAT('O',25X,'AVERAGE ANNUAL LAKE EVAPORATION=',F6.2, ' INCHES')
WRITE(6,1120)
1120 FORMAT('O',25X,'AVERAGE ANNUAL PRECIPITATION=',F6.2, ' INCHES')
WRITE(6,1130)
1130 FORMAT('O',25X,'PRECIPITATION RANGE=',F6.2, ' INCHES (FROM A LOW '
10F),F6.2,' INCHES TO A HIGH OF ',F6.2, ' INCHES')
WRITE(6,1140)
1140 FORMAT('O',25X,'AVERAGE ANNUAL MOISTURE DEFICIT=',F6.2, ' INCHES')
WRITE(6,1150)
1150 FORMAT('O',10X,'SUMMARY OF POND OPERATIONS')
WRITE(6,1160)
1160 FORMAT('O',25X,'NO. OF YEARS HAVING A DISCHARGE=',I6, '')
WRITE(6,1170)
1170 FORMAT('O',25X,'AVERAGE NO. CF DISCHARGES / YEAR HAVING A DISCHARG '
10F),F6.2)
WRITE(6,1180)
1180 FORMAT('O',25X,'AVERAGE DISCHARGE=',F6.2, 'X, ACRE-INCHES')
WRITE(6,1190)
1190 FORMAT('O',25X,'AVERAGE PERCENT OF DISCHARGE CONTROLLED BY EVAPORA'
10TION AND IRRIGATION=',F6.2)
WRITE(6,1200)
1200 FORMAT('O',25X,'TOTAL DISCHARGE VOLUME=',F9.2, ' ACRE-INCHES')
WRITE(6,1210)
1210 FORMAT('O',25X,'TOTAL NO. OF DISCHARGES=',F4.0)
WRITE(6,1220)
1220 FORMAT('O',25X,'MAXIMUM DISCHARGE=',F12.2, ' ACRE-INCHES')
WRITE(6,1230)
1230 FORMAT('O',25X,'AVERAGE ANNUAL VOLUME OF IRRIGATED WATER TO THE FI'
10EILD=',F6.2, ' ACRE-INCHES')
WRITE(6,1235) AVSEEP
1235 FORMAT('O',25X,'AVERAGE ANNUAL VOLUME OF SEEPAGE LOSS=' ,F10.2,' AC
1RE=INCHES')
WRITE(6,1236) AVPDRY
1236 FORMAT('O',25X,'AVERAGE NO. OF DAYS NOT TO MEET IRRIGATION DEMAND=
1',F6.1)
WRITE(6,1240)
1240 FORMAT('O',10X,'SUMMARY OF IRRIGATION PLOTS')
GO TO 1320 J=1,NPLOTS
WRITE(6,1250) J
1250 FORMAT('O',15X,'PLOT ',I1)
WRITE(6,1260) OSRNFF(J)
1260 FORMAT('O',25X,'AVERAGE ANNUAL IRRIGATION AREA RUNOFF=' ,F6.2,' IN
1CHES')
WRITE(6,1270) OSPERC(J)
1270 FORMAT('O',25X,'AVERAGE ANNUAL IRRIGATION AREA PERCOLATION=' ,F6.2,
1'INCHES')
WRITE(6,1280) DAYSDS(J)
1280 FORMAT('O',25X,'AVERAGE ANNUAL NO. OF IRRIGATION DAYS=' ,F6.1)
WRITE(6,1290) AINTER(J)
1290 FORMAT('O',25X,'AVERAGE ANNUAL IRRIGATION AREA INTERCEPTION=' ,F6.2,
1'INCHES')
WRITE(6,1300) AAEERS(J)
1300 FORMAT('O',25X,'AVERAGE ANNUAL IRRIGATION AREA EVAPOTRANSPIRATION=
1',F6.2,'INCHES')
WRITE(6,1310) ACHSCH(J)
1310 FORMAT('O',25X,'AVERAGE ANNUAL IRRIGATION AREA CHANGE IN SOIL MOIS
TURE=' ,F6.2,'INCHES')
IF(PLAN(J),LT,2) GO TO 1320
IRRIG(J)=SSRATE*DAYSDS(J)
WRITE(6,1315) IRRIG(J)
1315 FORMAT('O',25X,'AVERAGE ANNUAL WATER VOLUME APPLIED TO THE IRRIGAT
1ICH AREA=' ,F6.2,'INCHES')
1320 CONTINUE
WRITE(6,1330)
1330 FORMAT('O',10X,'SUMMARY OF STATISTICAL DATA')
WRITE(6,1340)
1340 FORMAT('O',10X,'PRECIPITATION FREQUENCY DATA',/27X,'INTENSITY',5X
1,'FREQUENCY',5X,'FREQUENCY',5X,'RUNOFF FREQUENCY',/20X,'IN.1',1DX,'IN.
2'),9X,'(DAYS1)',10X,'(DAYS1)',/)
WRITE(6,1350) (PRECACI(J),J=1,4),I=1,25)
1350 FORMAT(29X,4G4,F15.2)
WRITE(6,1360)
1360 FORMAT('O',//60X,'RUNOFF FREQUENCY DATA',/27X,'INTENSITY',3X,'F
REQUENCY (X)',5X,'FREQUENCY (DAYS1)',/25X,'(IN.1)',1DX,'PLCT 1 PLG
3T 2 PLCT 3 PLG 4',3X,'PLCT 1 PLCT 2 PLCT 3 PLCT 4',/)
WRITE(6,1370) ((RUNACC(J),J=1,9),I=1,25)
1370 FORMAT(29X,4G4,4F9.2)
GO TO 3000 J=1,NPLOTS
IF(PLAN(J),EQ,0) GO TO 3000
ARR11(J)=RR(JAN(J),Y)EARS
ARR12(J)=RR(FEB(J),Y)EARS
ARR13(J)=RR(MAR(J),Y)EARS
ARR14(J)=RR(APR(J),Y)EARS
ARR15(J)=RR(MAY(J),Y)EARS
ARR16(J)=RR(JUN(J),Y)EARS
ARR17(J)=RR(JUL(J),Y)EARS
ARR18(J)=RR(AUG(J),Y)EARS
ARR19(J)=RR(SEP(J),Y)EARS
ARR10(J)=RR(DEC(J),Y)EARS
PRECA(J, 2) = CTP(J)
PRECA(J, 4) = CTPR(J)
DO 1010 I = 1, NPLOTS
INUMI = 5 + I
RUNACC(J, INUMI) = CTP(J, I)
IF (CTRDAY(I), 1000, 0) CTR(J, I) = CTR(J, I) / CTRDAY(I) = 1000.0
INUMJ = 1
1010 RUNACC(F, INUMJ) = CTR(F, J)
1020 RUNACC(I, 1) = ASTAT(J)
NPLOTS = 1PLGT

C++ Print input parameters
WRITE(6, 1300) J, PLAREA, KROP(J, CROP), SOIL, DSRATE, PAVLU
1300 FORMAT(15X, 'PLOT', J, /25X, 'AREA' -- ', F5.3,' ACRES' // 25X, 'I8')
1030 FORMAT(15X, 'CROP-- ', '2A8'/25X, 'SOIL TYPE-- ', 'I5', '(SCS SOIL TYPE)'/ 2/25X, 'DRAINAGE MANAGEMENT-- ', 'I5', 'inches/day' // 25X, 'EIRRI
GATION MANAGEMENT-- ', 'I5', 'FIELD CAPACITY')
IF (PLPLAN(J), 1) WRITE(6, 1040)
IF (PLPLAN(J), 2) WRITE(6, 1050)
IF (PLPLAN(J), 3) WRITE(6, 1060)
1040 FORMAT(15X, 'F PLAN IMPLEMENTED -- RUNOFF')
1050 FORMAT(15X, 'F PLAN IMPLEMENTED -- RUNOFF AND IRRIGATION')
1060 FORMAT(15X, 'F PLAN IMPLEMENTED -- IRRIGATION')
IF (IRROTATE(J), 1) WRITE(6, 1070)
1070 FORMAT(15X, 'G CROP ROTATION WITH -- FALLOW')
PAVL = PAVLU
1080 CONTINUE
GO TO 1095
1085 CONTINUE
DO 5230 J = 1, NPLOTS
PLAREA = AREA(J)
SOIL = AREA(J, 2)
PAVL = PAVLU
IF (PLPLAN(J), 1) PAVLU = 0.0
NR = RCycle(J)
WRITE(6, 5260) J, PLAREA
5260 FORMAT(15X, 'PLOT', J, /25X, 'AREA' -- ', F5.3,' ACRES')
IF (NR, 1) WRITE(6, 5261) KROP(NRCROP(J), 1)
IF (NR, 2) WRITE(6, 5262) (KROP(NRCROP(J), K), K = 1, 2)
IF (NR, 3) WRITE(6, 5263) (KROP(NRCROP(J), K), K = 1, 3)
IF (NR, 4) WRITE(6, 5264) (KROP(NRCROP(J), K), K = 1, 4)
IF (NR, 5) WRITE(6, 5265) (KROP(NRCROP(J), K), K = 1, 5)
IF (NR, 6) WRITE(6, 5266) (KROP(NRCROP(J), K), K = 1, 6)
IF (NR, 7) WRITE(6, 5267) (KROP(NRCROP(J), K), K = 1, 7)
5261 FORMAT(15X, 'B CROP-- ', '2A8)
5262 FORMAT(15X, 'B CROP-- ', '2A8)
5263 FORMAT(15X, 'B CROP-- ', '2A8)
5264 FORMAT(15X, 'B CROP-- ', '2A8)
5265 FORMAT(15X, 'B CROP-- ', '2A8)
5266 FORMAT(15X, 'B CROP-- ', '2A8)
 Continuation of the provided code:

```
1380 FORMAT(1X,'SUMMARY OF MONTHLY DISTRIBUTION OF IRRIGATION (IN CM)
1390 WRITE(6,1390)
1400 FORMAT(1X)
1410 FORMAT(8X, 'PLOT=', I1, I11(F6.2, 4X), F6.2)
1420 CONTINUE
STOP
END
```

The subroutine `ROTA2N` is used to determine cropping management. It includes routines for single-cropping, a specific farm plot continuous through simulation periods, or a certain set of different crops with a specified rotating cycle. The subroutine can be used to manage crops on a plot, combining with winter wheat, such as wheat-corn-fallow or soybean-wheat-sorghum, etc. Particularly, it is possible to grow one crop for each year for the first three years and then the other crop for the next two years. The subroutine also includes routines for cropping management, and area of each plot. The code includes input and output routines for crop types, planting and harvesting dates.
170 IWT(I,NY)=7
   IWT(I,NY)=1
   GO TO 220
180 IWT(I,NY)=IWT(I,NY-2)
   IWT(I,NY)=IWT(I,NY-2)
   GO TO 220
C*** BEGINNING WITH FALLOW
190 IF(NY.EQ.1) GO TO 200
 IF(NY.EQ.2) GO TO 210
 IF(NY.GE.3) GO TO 215
200 IWT(I,NY)=7
   IWT(I,NY)=1
   GO TO 220
210 IWT(I,NY)=1
   IWT(I,NY)=7
   GO TO 220
215 IWT(I,NY)=IWT(I,NY-2)
   IWT(I,NY)=IWT(I,NY-2)
   GO TO 220
220 CONTINUE
   IF(I(M,LT,MGSBP(I,J)) AREA(I,J)=IWT(I,NY)
   IF(I(N,M,GSEP(I,J)) AREA(I,J)=IWT(I,NY)
   IF((N,M,GE,MGSBP(I,J)) AND(M,MLE,GSEP(I,J)) GO TO 230
   GO TO 240
230 IYCRP(I)=ITEMP(I,MM,NN)
   AREA(I,J)=IYCRP(I)
240 CONTINUE
250 CONTINUE
C
C*** PRINT DISPOSAL AREA VARIABLES
C
   IF(I(M,GT,START,OR,NN,GT,1) GO TO 340
   GO 330 J=1,NPLOTS
   PLAREA=AREA(I,J)
   SQI=IAREA(I,J,2)
   RPAVL=PAVLU
   IF(I(PLAN(J),EQ,1) PAVLU=0.0
   NR=RCYCLE(J)
   WRITE(6,260) J,PLAREA
260 FORMAT(/15X,'PLOT ',11/25X,'(A) AREA-- ',F5.2,' ACRES')
   IF(NR.EQ.1) WRITE(6,261) KROP(IYCRP(J,N))
   IF(NR.EQ.2) WRITE(6,262) KRUP(KIYCRP(J,N))
   IF(NR.EQ.3) WRITE(6,263) KROPI(YCRP(J,N))
   IF(NR.EQ.4) WRITE(6,264) KROP(KIYCRP(J,N))
   IF(NR.EQ.5) WRITE(6,265) KROP(KIYCRP(J,N))
   IF(NR.EQ.6) WRITE(6,266) KROP(KIYCRP(J,N))
   IF(NR.EQ.7) WRITE(6,267) KROP(KIYCRP(J,N))
261 FORMAT(15X,'(B) CROP-- ',A8)
262 FORMAT(15X,'(C) CROP-- ',A4)
263 FORMAT(15X,'(D) CROP-- ',A4)
264 FORMAT(15X,'(E) CROP-- ',A4)
265 FORMAT(15X,'(F) CROP-- ',A4)
266 FORMAT(15X,'(G) CROP-- ',A4)
267 FORMAT(15X,'(H) CROP-- ',A4)
   WRITE(6,268) SQIL,DSKAT,EAVL
268 FORMAT(15X,'(C) SCIL TYPE-- ',I3) (SCS SCIL TYPE)'/23X,'(C) (IRRIGATION RATE-- ',F5.2,' INCHES/DAY '/25X,'(E) IRRIGATION RATE)
   IF(I(PLAN(J),EQ,1) WRITE(5,270)
   IF(I(PLAN(J),EQ,2) WRITE(5,280)
**DO 30 K=1, NMM**

**C*** **READ PLANTING AND HARVESTING DATES**

**READ((5,21)) NRNCROP((J,K)), MGSB((J,K)), DGSB((J,K)), MGSE((J,K)), DGSE((J,K))**

**20 FORMAT(2X,11,4(1X))**

**30 CONTINUE**

**40 CONTINUE**

**C*** **CALCULATE CROP COEFFICIENTS**

**IF(NY.EQ.1, CRN, NM, GT, NSTART) GO TO 90**

**DO 80 K=1, NPLOTS**

**MM=MRCYCLE(K)**

**DO 70 J=1, MM**

**MGSB=MGSB(K,J)**

**DGSB=DGSB(K,J)**

**MGSE=MGSE(K,J)**

**DGSE=DGSE(K,J)**

**CROP=NRNCROP(K,J)**

**CALL CRPCAL(CROP, MGSB, DGSB, MGSE, DGSE, KCRP, NOIM, MMAT)**

**70 CONTINUE**

**80 CONTINUE**

**90 CONTINUE**

**C*** **CALCULATE CROP COEFFICIENT FOR WHEAT OF DOUBLE CROPPING**

**C*** **READ PLANTING AND HARVESTING DATES FOR WHEAT SHOULD BE READ**

**C*** **ACCORDING TO THE PLAN OF DOUBLE CROPPING IF ANY, I.E., IF TWO PLOTS**

**C*** **CONSIDERED TO BE DOUBLE CROPPED, TWO CARDS OF SAME DATA SHOULD BE**

**C*** **INPUT**

**DO 100 I=1, NPLOTS**

**IF(DOUBLE(I), NE, 2) GO TO 100**

**READ((5,35)) MGSB*(, DGSB*(, MGSE*(, DGSE*(**

**35 FORMAT(5X,4(1X))**

**MGSB=MGSBw**

**DGSB=DGSBw**

**MGSE=MGSEw**

**DGSE=DGSEw**

**CROP=1**

**CALL CRPCAL(CROP, MGSB*, DGSB*, MGSE*, DGSE*, KCRP*, NOIM, MMAT)**

**100 CONTINUE**

**110 CONTINUE**

**C*** **ESTABLISH CROP ROTATION SYSTEM FOR MODEL TWC**

**C*** **DO 250 I=1, NPLOTS**

**MM=MRCYCLE(1)**

**C*** **SINGLE CROPPING EACH YEAR**

**DO 240 J=1, MM**

**IF(NY.GE.MM+1) GO TO 120**

**ITEMP(I, MM+NY)=NRNCROP(I, NY)**

**GO TO 130**

**120 ITEMP(I, MM+NY)=ITEMP(I, MM, NY-MM)**

**GO TO 130**

**130 IF(DOUBLE(I), NE, 2) GO TO 230**

**C*** **DOUBLE CROPPING**

**NNN=IALW(T(I))**

**GO TO (150, 190, NNN)**

**C*** **BEGINNING WITH WHEAT**

**150 IF(NY.EQ.1) GO TO 160**

**IF(NY.EQ.2) GO TO 170**

**IF(NY.EQ.3) GO TO 190**

**160 [WT(I, NY)=1**

**[WT(I, NY)=7**

**GO TO 220**
C## MGSE1=TEMPORARY STORAGE FOR MGSE
C## PCGS1=TEMPORARY STORAGE FOR PCGS
MGSB1=MGSB-
MGSE1=MGSE
IF(MGSB.GT.MGSE) GO TO 10
   GO TO 20
C## WHEN MGSB IS GREATER THAN MGSE SUCH AS IN WINTER WHEAT THE
C## SUBROUTINE "SHIFTS" OR ADDS 1 TO MGSB AND MGSE UNTIL MGSB = 13
C## WHICH CORRESPONDS TO JANUARY. THIS SHIFT WAS NECESSARY TO
C## FACILITATE PROGRAM LOOPING. AFTER CALCULATIONS ARE MADE THE
C## CROP COEFFICIENTS ARE "SHIFTED" BACK TO THEIR ORIGINAL MONTHS.
C##********************************************************************
C##********************************************************************
C##********************************************************************
C##********************************************************************

C## CAUTION TO USER - THIS ROUTINE WILL NOT WORK IF THE
C## GROWING SEASON EXCEEDS ONE YEAR.
C##********************************************************************
C##********************************************************************
C##********************************************************************
C##********************************************************************

10 SHIFT=13-MGSB
   MGSE=MGSE+SHIFT
   MGSB=1
20 NPLUS=MGSB+1
   NMINUS=MGSE-1
   MID(MGSE)=((NMINUS(MGSB)-DGSB)/2.)*DGSB
   DO 30 N=NPLUS,NMINUS
30 MID(N)=NMINUS(N)/2.0
   MID(MGSE)=DGSB
   DO 40 N=NPLUS,NMINUS
40 DMO1(MGSE)=MID(MGSE)-DGSB
   DO 40 N=NPLUS,NMINUS
   DMO2(MGSE)=NMINUS(MGSE-1)*MID(MGSE-1)+DGSB
   ACC(MGSB)=DMO2(MGSE)
   DO 50 N=NPLUS,MGSE
50 ACC(N)=ACC(N-1)+DMO2(N)
   ACC(MGSE)=ACC(MGSE)-MID(MGSE)
   DO 60 N=MGSB,MGSE
60 PCGS(N)=(ACC(N)*100.)/(ACC(MGSE)+MID(MGSE))
   IF(MGSB1.LE.MGSE1) GO TO 100
   DO 80 N=1,12
60 WR=SHIFT
   IF(NN.LE.0) NN=NN+12
   IF(NN.GT.MGSE1.AND.NN.LT.MGSB1) GO TO 70
   PCGS1(NN)=PCGS(N)
   GO TO 80
70 PCGS1(NN)=0.0
80 CONTINUE
   DO 90 N=1,12
90 PCGS(N)=PCGS1(N)
100 MGSB=MGSB1
   MGSE=MGSE1
170 CONTINUE
GO TO 230
180 KCROP(6,1)=0.63
KCROP(6,2)=0.73
KCROP(6,3)=0.86
KCROP(6,4)=0.99
KCROP(6,5)=1.08
KCROP(6,6)=1.13
KCROP(6,7)=1.11
KCROP(6,8)=1.03
KCROP(6,9)=0.99
KCROP(6,10)=0.91
KCROP(6,11)=0.78
KCROP(6,12)=0.64
DO 190 J=1,12
KCROP(6,J)=KCROP(6,J)*K(J)
190 IF (PCGS(J).LE.0.0) KCROP(CROP,J)=0.0
GO TO 230
200 $\bar{x}$=90.
A=0.
B=0.
C=0.
D=0.
E=0.
210 DO 220 J=1,12
Z=PCGS(J)-$\bar{x}$
KCROP(CROP,J)=(A+B*Z+C*Z**2+D*Z**3+E*Z**4)*K(J)
IF (PCGS(J).LE.0.0) KCROP(CROP,J)=0.0
220 CONTINUE
230 CONTINUE
C*** SINCE THE MAIN PROGRAM APPLIES THE CROP COEFFICIENT (KCRP) TO
C*** THE ENTIRE MONTH, THE KCFOP WAS PROPORTIONED ACCORDINGLY TO
C*** COMPENSATE FOR THIS. THE NEXT TWO CARDS DO THIS.
KCROP(CROP,MGB)=KCRP(CROP,MGB)*(NCIM(MGB)-DG50+1)/NDIM(MGB)
KCRP(CROP,MGE)=KCRP(CROP,MGE)*DG50/NDIM(MGE)
RETURN
END
SUBROUTINE WTRMOD(PRECIP,MONTH,MODEL,WPCNT)
C*** SUBROUTINE WTRMOD ADJUSTS THE PRECIPITATION RESULTING FROM
C*** SEEDING CLOUDS
C*** MODEL=1: NO PRECIPITATION MODIFICATION
C*** MODEL 2: INCREASE PRECIPITATION DURING MARCH THROUGH SEPTEMBER BY
C*** THE FOLLOWING PERCENTAGES - 75% FOR RAINFALLS < 0.10 IN;
C*** 30% FOR RAINFALLS < 0.50 IN, 10% FOR RAINFALLS < 1.0 IN;
C*** -10% FOR RAINFALLS > 1.0 IN
C*** MODEL 3: INCREASE ALL RAINFALLS DURING EVERY MONTH BY A SPECIFIED
C*** PERCENTAGE, WPCENT
C*** MODEL 4: INCREASE PRECIPITATION DURING MARCH THROUGH SEPTEMBER BY
C*** THE FOLLOWING PERCENTAGES - 75% FOR RAINFALLS < 0.10 IN;
C*** 30% FOR RAINFALLS < 0.50 IN, 10% FOR RAINFALLS < 1.0 IN;
C*** NO ADJUSTMENT FOR RAINFALLS > 1.0 IN
C IF (MODEL.EQ.1) GO TO 40
IF (MONTH.LT.3) GO TO 10
IF (MONTH.GT.9) GO TO 10
ADJ=1.75
IF (PRECIP.GT.0.10) ADJ=1.30
IF (PRECIP.GT.0.50) ADJ=1.1
IF (MODEL.EQ.4) GO TO 20
IF (PRECIP.GT.1.0) ADJ=0.50
GO TO 30
10 ADJ=1.0
IF (MODEL.EQ.3) ADJ=WPCT
GO TO 30
20 IF (PRECIP.GT.1.0) ADJ=1.0
30 PRECIP=PRECIP*ADJ
40 RETURN
END
SUBROUTINE SNOWRT (PRECIP, WATER, PACK, PET, TMAINF, SNOWM)
**
** *** CALCULATION OF MOISTURE ADDED TO DISPOSAL AREA DUE TO
** SNOWMELT ON THE AREA ***
**
** REAL H, MA, MR
H=0.0
IF (PACK.GT.0.1) SNOWM=PET
PACK=PACK-SNOWM
IF (SNOWM.GT.0.0) PET=0.0
IF (TMAINF=32.1 10, 10, 20
10 IF (PRECIP) 70, 70, 30
20 IF (PACK) 90, 90, 40
30 PACK=PACK+PRECIP
WATER=0.0
GO TO 90
C*** MA IS SNOWMELT DUE TO ATMOSPHERIC CONDITIONS
40 MA=0.05*(TMAINF=32.1)
IF (MA.LT.0.01) MA=0.0
IF (PACK=MA) 00, 60, 50
C*** MR IS SNOWMELT DUE TO RAIN
50 MR= (PRECIP*(TMAINF=32.1))/144
H=MR+MA
60 IF (PACK=MR) 60, 70, 70
MP=PACK
PACK=0.0
GO TO 90
70 PACK=PACK-M
80 WATER=WATER+PRECIP
90 RETURN
END
SUBROUTINE DARCRT (PERC, FCL, SMUZ, FCL2, SMLZ, FCGH, SGNWZ, DPERC, CONDZH, CONDH, HZ, HLZ, HGH, PWL, PWL, PW)
DIMENSION H(3), HZ, SMLZ, FCGH, HGH, DEP(3), QLZ(3)
DATA DEP*ACHGS*EXCESS, RC, MG/R/3U, 89144, 60096, 30.0
**
** *** DISTRIBUTION OF WATER ADDED TO EACH PLOT
**
** EXCESS=0.0
IF (PERC.LE.0.0) GO TO 10
SMUZ=FCU=SMUZ
IF (SMUZ.GT.0.0) SMUUZ=0.0
EXCESS=PERC-SMUUZ
IFIEXCESS.LT.0.0) EXCESS=0.0
SMUZ=SMUZ+PERC-EXCESS
SMUZ2=FCU2-SMLZ
IFI(SMALZ.GT.0.0) SMALV=0.0
EXTRA=EXCESS
EXCESS=EXCESS-SMALVZ
DO 110 J=1,12
C*** KT IS A CLIMATIC COEFFICIENT APPLIED TO THE CROP GROWTH
C*** COEFFICIENT. IT IS CALCULATED BY THE FOLLOWING EQUATION:
   KT(J)=.3173*MMAT(J)-.314
   IF(MMAT(J).LT.36.)* KT(J)=.3
110 CONTINUE
C*** CROP=1 FOR WHEAT
C*** CROP=2 FOR SORGHUM
C*** CROP=3 FOR CORN
C*** CROP=4 FOR SOYBEANS
C*** CROP=5 FOR PASTURE
C*** CROP=6 FOR ALFALFA
C*** CROP=7 FOR FALLOW
GO TO (120,130,140,150,160,180,200), CROP
120 XBAR=50.
   A=1.39093399
   B=-.00366838
   C=-.00004976
   D=-.000000233
   E=0.000000004
   GO TO 210
130 XBAR=50.
   A=1.05528355
   B=0.30198600
   C=-.00005177
   D=0.00000549
   E=0.00000111
   GO TO 210
140 XBAR=50.
   A=1.02305328
   B=0.0080046
   C=-.00003199
   D=-.00000194
   E=0.0000007
   GO TO 210
150 XBAR=50.
   A=0.74790430
   B=3.147196
   C=-.000013486
   D=-.00000443
   E=0.
   GO TO 210
C*** FOR PERENNIAL CROPS SUCH AS ALFALFA AND PASTURE, VALUES OF THE
C*** CROP COEFFICIENTS ARE BEST PLOTTED ON A MONTHLY BASIS THEREFORE
C*** EQUATIONS WERE NOT DEVELOPED. MONTHLY VALUES WERE INTEGRATED
C*** WITHIN THE ROUTINE FOR PASTURE AND ALFALFA.
160 KCP=1(5,1)=0.49
   KCP=1(5,2)=0.57
   KCP=1(5,3)=0.73
   KCP=1(5,4)=0.85
   KCP=1(5,5)=0.90
   KCP=1(5,6)=0.92
   KCP=1(5,7)=0.92
   KCP=1(5,8)=0.91
   KCP=1(5,9)=0.87
   KCP=1(5,10)=0.79
   KCP=1(5,11)=0.67
   KCP=1(5,12)=0.55
   DO 170 J=1,12
      KCP(5,J)*KCP(5,J)*K(J)
      PASTURE
IF(EXCESS.LT.0.0) EXCESS=0.0
SMLZ=SMLZ+EXTRA-EXCESS
SMAVGW=FGFW-SMGW
IF(SMAVGW.LT.0.0) SMAVGW=0.0
EXTRA=EXCESS
EXCESS=EXCESS-SMAVGW
IF(EXCESS.LT.0.0) EXCESS=0.0
SMGW2=SMGW2+EXTRA-EXCESS
RCHGR=EXTRA-EXCESS
IF(RCHGR.LT.0.0) RCHGR=0.0

C
C*** MOISTURE REDISTRIBUTION USING THE ONE-DIMENSIONAL Darcy EQUATION
C*** FOR UNSATURATED FLOW
C
10 LCOUNT=1
DTIME=0.1,607
IF(PERC.LE.0.0) DTIME=1.0
IF(PERC.LE.0.0) LCOUNT=6
OPREC=EXCESS
W[1]=PWU/12,
W[2]=PNL/36,
W[3]=PWG/24,
SM[1]=SM[1]/12,
SM[2]=SM[2]/36,
SM[3]=SMG/24,
DO 20 K=1,3
C
C*** CALCULATE SOIL MOISTURE TENSION IN CM
H[1]=SM[1]-HIZ
DO 30 K=1,3
H[K]=EXP(H[L[K]])
IF(H[K].LT.1500) H[K]=1500.
IF(H[K].LT.0.3) H[K]=0.3
XXX=SMO[K]-W[1*K]
IF(XXX.LT.0.001) SMO[K]=W[1*K]+0.001
C
C*** CALCULATE UNSATURATED HYDRAULIC CONDUCTIVITY IN CM PER DAY
IF(K.EQ.2) COND[K]=CONDLZ[EXP(75.395*SMO[K])]/(SMO[K]-W[1*K])
IF(K.EQ.3) COND[K]=CONDGW[EXP(70.393*SMO[K])]/(SMO[K]-W[1*K])
30 IF(COND[K].LT.1.0E-07) COND[K]=1.0E-07
C
C*** CALCULATE GLOISTURE FLOW, IN INCHES
40 DO 50 K=1,2
50 Q[K]=Q[K]+J[K]*0.34
SMLZ=SMLZ-Q[K]
SMLZ=SMLZ-Q[K]
SMLZ=SMLZ-Q[K]
SMLZ=SMLZ-Q[K]
RCHGS=RCHGS+Q[K]
LCOUNT=LCOUNT+1
IF(LCOUNT.LE.6) GO TO 40
OPREC=OPREC+RCHGS+RCHGR
RETURN
END
SUBROUTINE STORAG(P1,P2,P3,PRECIP,SNOW,FROZE,M,GRW,DORM,RUNOFF
IF(MINPT,RCNFL)

*** CALCULATION OF FEEDLOT RUNOFF ***

IF(BYPASS.EQ.3) GO TO 60
C***
C*** CALCULATE 3 DAY ANTECEDENT MOISTURE
C***
AM=P1+P2+P3
P1=P2
P2=P3
P3=PRECP
IF(SNOW.GT.0.0.AND.FROZE.EQ.0.0) GO TO 10
IF(PRECIP.LE.0.0) GO TO 50
IF(FROZE.GE.0.1) GO TO 40
IF(AM.LE.0.05.AND.PRECIP.LE.0.5) GO TO 50
C***
C*** MODIFICATION OF THE SCS METHOD
C***
10 AMT=AM+PRECP
PRESIP=PRECP+SNOW
RC=97.0
IF(MONTH.LT.4.OR.MONTH.GT.10) GO TO 20
IF(AMT.LT.0.75) RC=91.0
IF(AMT.GT.GRW.AND.PRECIP.GT.GRW) PRESIP=GRW
GO TO 30
20 IF(AMT.LT.0.5) RC=91.0
IF(SNOW.GT.0.0) RC=97.0
IF(AMT.GT.GRW.AND.PRECIP.GT.DORM) PRESIP=0.0
30 CS=1000.0/RC-10.0
RUNOFF=PRECP+PRECP+SNOW
GO TO 50
35 SNOW=SNOW

50 SNOW=SNOW+PRECP
55 RUNOFF=0.0
IF(BYPASS.EQ.2) GO TO 70
60 RUNOFF=MINT/(3630*7.48)
70 RETURN
END
SUBROUTINE WTMTPL(MAV,TAVG,NOAYS,AM)
C***
C*** THIS SUBPROGRAM CALCULATES THE AVERAGE MONTHLY TEMPERATURE
C*** FOR LATER CALCULATIONS IN SUBPROGRAM YIELDS
C***
C***
C***
C***
DIMENSION MAV(12),TAVG(31)
TSUM=0.0
DO 5 ND=1,NOAYS
5 TSM=TSUM+TAVG(ND)
TSMAX=TSUM/NOAYS
RETURN
END
SUBROUTINE PRPOMTN(NO,NOAYS,AM,PRECI,AREA,DRITR,HCOP,
X,BYPASS,DISVOL,SMACCT)
THIS SUBROUTINE OPTIMIZES THE AMOUNT OF IRRIGATION WATER
APPLIED SINCE TOO MUCH WATER AT THE WRONG TIME OF THE
GROWING SEASON CAN REDUCE THE CROP YIELDS

MCWND=MONTH CROP WATER NEED FOR MAXIMUM YIELD
XMCWND = MCWND
XND = NUMBER OF DAY IN MONTH
XNORDAYS = NUMBER OF DAYS IN MONTH
CWND = CROP WATER NEED
AVWT = AVAILABLE WATER IN FIELD

RUSSELL W. LAFORCE  FEBRUARY 7, 1980

REAL MCWND
DIMENSION SMACCT(13,9,9),AREA(9),DISVOL(9)
DIMENSION XMCWND(12,7)
IF (XNORDAYS.GT.11) GO TO 999
DO 5  I=1,12
DO 5  J=1,7
5 XMCWND(I,J)=0.0
XMCWND(5,1)=4.60
XMCWND(6,1)=4.27
XMCWND(7,1)=3.83
XMCWND(8,1)=3.42
XMCWND(9,1)=3.03
XMCWND(10,1)=2.65
XMCWND(11,1)=2.28
XMCWND(12,1)=1.91
XMCWND(5,2)=4.96
XMCWND(6,2)=4.74
XMCWND(7,2)=4.53
XMCWND(8,2)=4.33
XMCWND(9,2)=4.13
XMCWND(10,2)=3.93
XMCWND(11,2)=3.73
XMCWND(12,2)=3.53
XMCWND(5,3)=6.15
XMCWND(6,3)=5.96
XMCWND(7,3)=5.77
XMCWND(8,3)=5.59
XMCWND(9,3)=5.42
XMCWND(10,3)=5.25
XMCWND(11,3)=5.09
XMCWND(12,3)=4.94
XMCWND(5,4)=6.15
XMCWND(6,4)=6.06
XMCWND(7,4)=5.96
XMCWND(8,4)=5.86
XMCWND(9,4)=5.76
XMCWND(10,4)=5.65
XMCWND(11,4)=5.55
XMCWND(12,4)=5.45
XMCWND(5,5)=6.6
XMCWND(6,5)=6.4
XMCWND(7,5)=6.2
XMCWND(8,5)=5.9
XMCWND(9,5)=5.6
XMCWND(10,5)=5.3
XMCWND(11,5)=5.0
XMCWND(12,5)=4.7
XMCWND(5,6)=6.6
XMCWND(6,6)=6.4
XMCWND(7,6)=6.2
XMCWND(8,6)=5.9
XMCWND(9,6)=5.6
XMCWND(10,6)=5.3
XMCWND(11,6)=5.0
XMCWND(12,6)=4.7
XMCWND(5,7)=6.6
XMCWND(6,7)=6.4
XMCWND(7,7)=6.2
XMCWND(8,7)=5.9
XMCWND(9,7)=5.6
XMCWND(10,7)=5.3
XMCWND(11,7)=5.0
XMCWND(12,7)=4.7
IF (MCWND .LE. 0.0) GO TO 50
XN1 =MCWND
XNORDAYS=XN1
CAVTD=SMACCT(NM,2,MS)+SMACCT(NM,3,MS)+PRECP+DSRATE
CWND =MCWND *XN1
AVWT =CAVTD *XNORDAYS
IF (CWND .LT. AVWT) GO TO 50
DISVOL(MS) =DSRATE * AREA(MS)
GO TO 999
50 DISVOL(MS)=0.0
999 CONTINUE
RETURN
END

SUBROUTINE SEEPGE(B2, PNCVOL, JASEEP, DSEPRT)
JASEEP=82*DSEPRT/3560
IF (JASEEP .GE. PNCVOL) JASEEP=PNCVOL
RELIABILITY OF SUPPLEMENTAL
IRRIGATION SYSTEMS

by

Baxter Vieux

B.S., University of Kansas, 1978

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of

the requirements for the degree

MASTER OF SCIENCE

Department of Civil Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

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ABSTRACT

Reliability of a supplemental irrigation system in Riley County, Kansas is evaluated. A computer model continuously simulates the system using historic weather data. Irrigation application rates of 1.0 inch/day and 1.5 inch/day yield reliabilities of 58.6% and 55.2%, respectively. Computations using average annual yield and net irrigation requirements indicates a 49% reliability. Through management of irrigation application rates, the system's reliability is improved.