V.3.3-CONS_USE   CONSUMPTIVE USE OPERATION

<u>Identifier</u>: CONS_USE

<u>Application</u>: All programs

<u>Description</u>: This Operation accounts for the impacts of surface water irrigation on streamflow.

Crop evapotranspiration (ET) is estimated from input temperatures or potential ET. Mid-month empirical coefficients, irrigation efficiency, return flow rates and minimum flow parameters are specified for the computation of diversions and adjusted streamflow.

A complete description of the Operation is in Section II.4-CONS_USE.

<u>Developed By</u>: Northwest River Forecast Center

<u>Allowable Data Time Intervals</u>: 24 hours

Input and output time series must have 24 hour data time intervals except for the MAT input which is converted from a 6 to 24 hour data time interval.

<u>Time Series Used</u>: Time series used in this Operation are as follows:

<u>General Type</u>	<u>Dimn</u>	<u>Units</u>	<u>Use</u>	<u>Required</u>	Form of Output <u>T.S.</u>	Data Time <u>Interval</u>	Missing Values <u>Allowed</u>
MAT	TEMP	DEGC	I	<u>1</u>/	n/a	6	no
Potential ET	L	MM	I	<u>2</u>/	n/a	24	no
Natural runoff	L3	CMSD	I	yes	n/a	24	no
Adjusted runoff	L3	CMSD	O	yes	replaces	24	no
Diversion flow	L3	CMSD	O	yes	replaces	24	no
Return flow in	L3	CMSD	O	yes	replaces	24	no
Return flow out	L3	CMSD	O	yes	replaces	24	no

General Type	Dimn	Units	Use	Required	Form of Output T.S.	Data Time Interval	Missing Values Allowed
Other losses	L3	CMSD	O	yes	replaces	24	no
Crop demand	L3	CMSD	O	yes	replaces	24	no
Actual ET	L	MM	O	yes	replaces	24	no

1/ IF ET estimation option on Card 1 is 0.

2/ IF ET estimation option on Card 1 is 1.

Input Summary: The card input for this Operation is in free-format and is as follows:

Card	Field	Format	Contents
1	1	A72	General description

2	1	I1	ET estimation option:
			    0 = use temperature (MAT) data
			    1 = use potential ET (MAPE) data

3			Input time series identifiers:
	1	A8	MAT or MAPE time series identifier
	2	A4	MAT or MAPE data type code
	3	A8	Natural runoff time series identifier
	4	A4	Natural runoff data type code
4			Primary output time series:
	1	A8	Adjusted runoff time series identifier
	2	A4	Adjusted runoff data type code
	3	A8	Diversion flow time series identifier
	4	A4	Diversion flow data type code
5			Secondary output time series: (for water balance computations)
	1	A8	Return flow in time series identifier
	2	A4	Return flow in data type code
	3	A8	Return flow out time series identifier

Card	Field	Format	Contents
	4	A4	Return flow out data type code
	5	A8	Other losses time series identifier
	6	A4	Other losses data type code
	7	A8	Crop demand time series identifier
	8	A4	Crop demand data type code
	9	A8	Crop ET time series identifier
	10	A4	Crop ET data type code
6	1	R	Latitude of irrigated area (positive for North and negative South)
	2	R	Irrigated area (units of KM2)
	3	R	Irrigation efficiency (0.00 - 1.00)
	4	R	Minimum streamflow (units of CMSD)
7			Mid-month empirical coefficient for January through June:
	1	R	Jan mid-month empirical coefficient
	2	R	Feb mid-month empirical coefficient
	3	R	Mar mid-month empirical coefficient
	4	R	Apr mid-month empirical coefficient
	5	R	May mid-month empirical coefficient
	6	R	Jun mid-month empirical coefficient
8			Mid-month empirical coefficient for July through December:
	1	R	Jul mid-month empirical coefficient
	2	R	Aug mid-month empirical coefficient
	3	R	Sep mid-month empirical coefficient
	4	R	Oct mid-month empirical coefficient
	5	R	Nov mid-month empirical coefficient
	6	R	Dec mid-month empirical coefficient
9	1	R	Return flow accumulation rate (fraction

Card	Field	Format	Contents
			of diversion flow which goes to return flow storage); must be less than 1 minus the irrigation efficiency specified in field 3 of card 6
	2	R	Return flow storage decay rate (1/day) (similar to LSPK in Operation SAC-SMA)
	3	R	Initial return flow storage contents (units of MM) (similar to LZFPC in Operation SAC-SMA)

Sample Input and Output: Sample input is shown in Figure 1. Sample output from the parameter print routine is shown in Figure 2. There is no execution routine output.

Error and Warning Messages: The error and warning messages generated by this Operation and the corrective measures to take when they occur, are as follows:

   A. Messages that can occur during setup:

   1. Input Format Errors

      ERROR CONSUMPTIVE USE INPUT ERROR
      CARD 1 READ: USER SUPPLIED INFORMATION

      ERROR CONSUMPTIVE USE INPUT ERROR
      CARD 2 READ: OPTION INFORMATION

      ERROR CONSUMPTIVE USE INPUT ERROR
      CARD 3 READ: INPUT TIME SERIES (OPTION 0) INFORMATION

      ERROR CONSUMPTIVE USE INPUT ERROR
      CARD 3 READ: INPUT TIME SERIES (OPTION 1) INFORMATION

      ERROR CONSUMPTIVE USE INPUT ERROR
      CARD 4 READ: PRIMARY OUTPUT TIME SERIES INFORMATION

      ERROR CONSUMPTIVE USE INPUT ERROR
      CARD 5 READ: SECONDARY OUTPUT TIME SERIES INFORMATION

      ERROR CONSUMPTIVE USE INPUT ERROR
      CARD 6 READ: GENERAL IRRIGATION BASIN PARAMETERS

      ERROR CONSUMPTIVE USE INPUT ERROR
      CARD 7 READ: JANUARY-JUNE MID-MONTH EMPIRICAL COEFFICIENTS

      ERROR CONSUMPTIVE USE INPUT ERROR
      CARD 8 READ: JULY-DECEMBER MID-MONTH EMPIRICAL COEFFICIENTS

```
    **ERROR** CONSUMPTIVE USE INPUT ERROR
    CARD 9 READ: RETURN FLOW PARAMETERS

    Action: Check format of input information for the card
    specified in the error message.
```

2. Error in Parameter Values

```
    **ERROR** THE IRRIGATION EFFICIENCY MUST BE BETWEEN 0.00 AND
    1.00

    Action:  Change the irrigation efficiency so that it is
    between 0.00 and 1.00.

    **ERROR** THE RETURN FLOW ACCUMULATION RATE IS GREATER THAN
    ITS MAXIMUM ALLOWED, 1 - EFFICIENCY

    Action:  Change the return flow accumulation rate so that it
    is less than "1 - irrigation efficiency."
```

Punched Card Rules: When punching input cards for this Operation,
the following rules are applicable:

1. The format of punched cards is identical to those described in
   the Input Card Summary of this documentation.

2. No checks are made for the validity of the parametric data
   during the punching process.

```
                 Figure 1. Sample card input for Operation CONS_USE


CONS_USE    PIHI1
PORTNEUF R AT POCATELLO -- DIVERSIONS
0
PIHI1L MAT PIHI1 SQME
PIHI1A SQME PIHI1D SQME
RFIN SQME RFOUT SQME OL SQME CD SQME CE MAPE
42.70 225. 0.60 1.50
0.00 0.00 0.00 0.45 0.60 0.70
0.70 0.65 0.60 0.40 0.00 0.00
0.15 0.003  50.
```

```
          Figure 2. Sample output from Operation ?OPNAME? print parameter
                          routine



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 CONS_USE OPERATION     NAME=PIHI1

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          CONSUMPTIVE USE - VERSION    1
          PORTNEUF R AT POCATELLO -- DIVERSIONS


          OPTION  0    ET ESTIMATION WITH TEMPERATURE


          INPUT TIME SERIES                               ID        CODE
             MEAN AREAL TEMPERATURE                       PIHI1L    MAT
             POTENTIAL EVAPORATION                        NONEN     ONE
             MEAN DAILY NATURAL FLOW                      PIHI1     SQME

          PRIMARY OUTPUT TIME SERIES
             MEAN DAILY ADJUSTED FLOW                     PIHI1A    SQME
             MEAN DAILY DIVERSION FLOW                    PIHI1D    SQME

          SECONDARY OUTPUT TIME SERIES
             MEAN DAILY RETURN FLOW IN                    RFIN      SQME
             MEAN DAILY RETURN FLOW OUT                   RFOUT     SQME
             MEAN DAILY OTHER LOSSES                      OL        SQME
             MEAN DAILY CROP DEMAND                       CD        SQME
             CROP EVAPOTRANSPIRATION                      CE        MAPE

          GENERAL IRRIGATION BASIN PARAMETERS

          LATITUDE (+NORTH/-SOUTH, DEGREES)     42.70
          IRRIGATED AREA (KM^2)                 225.
          IRRIGATION EFFICIENCY (0-1)            .65
          MINIMUM STREAMFLOW (CMSD)             1.50

          MID-MONTH EMPIRICAL COEFFICIENTS

           JAN     FEB     MAR     APR     MAY     JUN
           ----    ----    ----    ----    ----    ----
           .00     .00     .00     .35     .65     .70


           JUL     AUG     SEP     OCT     NOV     DEC
           ----    ----    ----    ----    ----    ----
           .70     .65     .60     .30     .00     .00


          RETURN FLOW PARAMETERS

          RETURN FLOW ACCUMULATION RATE          .25
          RETURN FLOW DECAY RATE (1/DAY)        .0070
          RETURN FLOW STORAGE (MM)             100.
```