

WRAP Revisions Since August 2003

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May 2004

WRAP is documented by:

Water Rights Analysis Package (WRAP) Modeling System Reference Manual, TWRI TR-255, August 2003 (Revised December 2003).

Water Rights Analysis Package (WRAP) Modeling System Users Manual, TWRI TR-256, August 2003 (Revised December 2003).

which replaced the previous:

Reference and Users Manual for the Water Rights Analysis Package (WRAP), TWRI TR-180, 1st Edition August 1999, 2nd Edition October 2000, 3rd Edition July 2001.

A listing of model modifications since 1996 is included as Appendix C of the August 2003 Reference Manual. A document dated September 2003 and entitled *Water Rights Analysis Package (WRAP) Modifications* provides a more detailed description of the revisions to the model between the July 2001 and August 2003 versions.

Conditional reliability, daily time step, and salinity features are currently being developed as noted in Chapter 1 of the August 2003 Reference Manual. This work is still in progress. Initial versions of software incorporating these features are still in a developmental stage and have not been released for routine use. The conditional reliability, daily time step, and salinity features will be documented in detail later by a separate manual.

Features incorporated in the May 2004 version of *WRAP-SIM* and *TABLES* that were added between the August 2003 and December 2003 versions and between the December 2003 and May 2004 versions of the model are documented as follows. The *WinWRAP* user interface has also been refined and expanded.

Revisions Between the August 2003 and December 2003 Versions

Dual Simulation Options to Limit Streamflow Depletions

Streamflow depletions are the amounts of water appropriated each month by a water right to maintain reservoir storage and meet diversion requirements. The dual simulation options are based on an initial simulation performed solely to compute streamflow depletions under specified conditions. The streamflow depletions computed during the initial simulation are used as upper limits to constrain streamflow depletions during a subsequent simulation. Dual simulations may be performed automatically during a single execution of *WRAP-SIM*. Alternatively, *WRAP-SIM* may be executed once to develop a set of streamflow depletions, which are then incorporated into a *WRAP-SIM* input file as *TS* records for use in further simulations.

Although other types of applications are possible, dual simulation options were added primarily for situations where multiple water rights with different priorities are associated with the same reservoir or system of multiple reservoirs. Consider a junior diversion right with a year 2003 priority that withdraws water from a reservoir that is also associated with another senior right that allows refilling storage with a 1947 priority. Although the junior diversion right may be modeled with a 2003 priority, without adopting a dual simulation approach, the 2003 priority is effectively almost equivalent to having the 1947 senior priority since the reservoir is refilled with a 1947 priority. The junior right diverts water from storage governed by the 2003 priority in a given month, but the depleted storage is refilled during subsequent months at the 1947 priority. From the perspective of other rights in the basin with priorities ranging between 1947 and 2003, the junior right with a 2003 priority diminished water availability almost the same as if it had a 1947 priority. Preventing inappropriate refilling of reservoirs at the wrong priority is complicated by refilling occurring during future months after reservoir draw-downs. The dual simulation approach deals with this complexity based on repeating the simulation a second time. The initial simulation serves the sole purpose of developing an array of streamflow depletions for the senior rights that refill reservoir storage. These initial streamflow depletions become constraints that limit the amount of water available to these rights during the second simulation.

Options for limiting streamflow depletions already provided by previous versions of *WRAP-SIM* include constant monthly and annual depletion limits activated by fields 3 and 4 of the *SO* record and monthly-varying limits activated by *ML* records. An additional new set of options activated by the new field 14 added to the *SO* record apply limits on water availability for a right in the same manner as the previous options. The only difference is that the limits are determined by computing streamflow depletions in an initial simulation.

The new set of options for placing limits on the streamflow depletions associated with specified water rights involve use of *SO* record field 14, *JD* record field 4, and *TS* records. The following five options may be activated by variable *DUAL* in field 14 of the *SO* record.

- Option 1: The water right is activated only during the initial simulation.
- Option 2: The water right is activated only during the second simulation and is not subject to an initial simulation streamflow depletion constraint.
- Option 3: A dual simulation is automatically performed. Streamflow depletions computed during the first simulation serve as upper limits on water availability during the second simulation. The streamflow depletions computed during the initial simulation are written to the *MSS* file if *ICHECK*=8 on the *JD* record.
- Option 4: The water right is activated only during the initial simulation. A streamflow depletion array is developed. If an option 5 right follows this right, the streamflow depletions serve as upper limits on water availability for the option 5 right during the second simulation. The streamflow depletions are written to the *MSS* file if *ICHECK*=8 on the *JD* record.
- Option 5: A dual simulation is performed with this water right being activated only during the second simulation. The streamflow depletion array from the preceding option 4 right serves as an upper limit on streamflow depletions for this option 5 right.

A second simulation is automatically performed if and only if either option 3 or option 5 is selected for one or more water rights. An option 3 right uses its own streamflow depletion array. If option 5 is activated in the *SO* record field 14 for a particular water right, there must be another right with option 4 activated found in the input file before the option 5 right. The streamflow depletion array assigned to an option 5 right is from the last water right preceding the option 5 right for which a depletion array is generated, based on the sequence order in which the *WR* records are entered in the input file.

Streamflow depletions for water rights flagged with options 3 and 4 in *SO* field 14 store an array of streamflow depletions [*DDEP(DD(wr),year,month)*], that may be written to the message *MSS* file by entering 8 for *ICHECK* in field 4 of the *JD* record. *SO* record Options 3 and 5 automatically perform a second simulation using the array of streamflow depletions regardless of whether the user chooses to write the array to the message file. An option 4 right develops a depletion array during the initial simulation that may be assigned to an option 5 right to limit depletions during the second simulation. Option 4 rights may also be used to write streamflow depletions to the *MSS* file even though the automated second simulation is not of interest. If *ICHECK*=8, streamflow depletions for all option 4 rights are printed to the message file regardless of whether there are associated option 5 rights.

SO Record – Supplemental Water Right Options

field	columns	variable	format	value	Description
14	97-104	DUAL (wr)	I8	1	Right is activated only during the initial simulation. Streamflow depletion array is not recorded.
				2	Right is activated only during the second simulation and is not subject to streamflow depletion constraint.
				3	Right is activated during both simulations. Streamflow depletions during the initial simulation serve as limits during the second simulation.
				4	Right is activated only during the initial simulation. Streamflow depletion array is recorded.
				5	Right is activated only during the second simulation. Streamflow depletions from the preceding option 4 right serve as limits.

JD Record – Job Control Data

field	columns	variable	format	value	Description
4	24	ICHECK	I8	8	Write list of rights with non-zero <i>SO</i> record field 14 and array of initial simulation streamflow depletions for rights with <i>DUAL</i> of 3 or 4 in <i>SO</i> record field 14.

With dual simulations during a single execution of *WRAP-SIM*, the streamflow depletion array generated during the initial simulation is applied internally within the model as depletion constraints during the second simulation. Alternatively, a streamflow depletion array written to the MSS file may be manually inserted into a *WRAP-SIM* input file as a set of *TS* records for use in subsequent executions of the model.

Streamflow Depletion Limits on TS Records

A new option has been added to the *TS* record which is activated by entering SDL (streamflow depletion limit) for variable *TSL* in field 2 of the *TS* record. With SDL entered, the *QTS* values on the *TS* records are defined as upper limits on streamflow depletions used to constrain water availability in the same manner as the other *SO* record streamflow depletion limit options. The SDL option may be used in conjunction with the new DUAL option activated by *SO* record field 14.

TS Record – Target Series

field	columns	variable	format	value	description
1	1-2	CD	A2	TS	Record identifier (required for first year, optional thereafter)
2	3-8	TSL (first record)	3X,A3	blank MAX, max MIN, min ADD, add SUB, sub MUL, mul SDL, sdl	<p style="text-align: center;"><u>Manner of Applying TS Amounts</u></p> <i>TS</i> record targets are the only option used. Maximum of two alternative targets is adopted. Minimum of two alternative targets is adopted. <i>TS</i> record amount is added to preceding target. <i>TS</i> record amount is subtracted from preceding target. <i>TS</i> record amount is multiplied by preceding target. Upper limit on allowable streamflow depletions. <i>TSL</i> is read with just the first year. This field is not read after first record.
3	9-12	TSYR1	I4	-	Beginning year (optional)
4	13-16	TSYR2	I4	+	Ending year (required)
5-16	17-112	QTS (yr,wr,mt)	12F8.0	+	<p style="text-align: center;"><u>Years Covered</u></p> Amounts for each of the 12 months of the year <p style="text-align: center;"><u>Amounts of Targets or Limits</u></p>

Figures to Right of Decimal Point

User Manual Tables 13 and 14 describe output records written to the *WRAP-SIM* OUT file. The format for diversions and diversion shortages have been changed from F9.1 to F9.3 unless the number is too large in which case F9.1 is used. The largest F9.3 diversion or shortage on the water rights and control point output record is 99999.900 and the smallest F9.1 amount is 1000000.0. Instreamflow targets and shortages are now written in F8.2 format for 9999.90 and smaller numbers. Channel loss credits, channel losses, and reservoir releases on CP records are now F7.0, F6.0, and F7.0. *TABLES* has also revised to accommodate new decimal point places.

Addition of Option for Switching Off Channel Losses

A new no-channel-loss-water-right option is activated by entering NOCLWR in field 13 of the SO record. Pages 37 and 38 of the Users Manual are revised as follows.

SO Record – Supplemental Water Right Options

field	columns	variable	format	value	description
					<i>Options to Not Apply Features for this Right</i>
13	89-96	NOTFLAG	A6	blank	Option is not activated.
				NOCLWR	Channel losses are not applied to streamflow depletions and return flows for this water right
				NORFCL	Channel losses are not applied to just return flows.
				IFNOTA	Instream flow <i>IF</i> rights do not restrict this <i>WR</i> right.

Field 13: The term *NOCLWR* results in channel losses not being applied to the streamflow depletions and return flows associated with this water right. Entering *NORFCL* results in channel losses being omitted for just the return flows. These options affect only subroutine *AVALB* where downstream flows are adjusted for the effects of flows leaving or entering the stream at an upstream control point.

The term *IFNOTA* results in the water right not being constrained by instream flow requirements. This option facilitates convenient assessment of the impacts of instream flow requirements on particular *WR* record water rights.

Intermediate Targets Written to Output File

The numbering of intermediate targets selected to be written to the output has been revised a little. The revised numbering is shown below.

SO Record – Supplemental Water Right Options

field	columns	variable	format	value	description
					<i>Targets and Shortages Written to Output File</i>
9	64	ISHT(wr)	I8	blank,0	Last target and shortage computed is in output file.
				1	Target and shortage written to output file based on <i>AMT</i> from <i>WR</i> record field 3 after step 1 described on page 33.
				2	After applying <i>BFIRST</i> backup option (step 2).
				3	After applying drought index (step 3).
				4	After applying options on <i>TO</i> record (step 4).
				5	After <i>TS</i> records (step 5 on preceding page 34).
				6	After applying drought index (step 6).
				7	After applying options on <i>TO</i> record (step 7).

New Options for Setting Targets

Options 11 and 12 have been added to the *TOTARGET* options activated by field 2 of the *TO* record. Target setting options 11&12 are based on diversions of the specified other water right but otherwise are the same as options 6&7 and 8&9.

Options to subtract, multiple, or divide have been added to the *TOCOMB* options activated by field 4 of the *TO* record. These options are similar to the previous ADD option.

The revisions are reflected in the following portion of Users Manual page 39. Page 40 has also been revised accordingly.

TO Record – Target Options

field	columns	variable	format	value	description
					<i>Streamflow at Control Point from Field 7</i>
2	7-8	TOTARGET (n)	I6	1	Target based on same-month naturalized streamflow.
				-1	Target based on prior-month naturalized streamflow.
				2	Target based on same-month regulated streamflows.
				-2	Target based on prior-month regulated streamflows.
				3	Unappropriated streamflows same month.
				-3	Unappropriated streamflows previous month.
					<i>Reservoir Specified in Field 8</i>
				4	Target based on reservoir storage in same month.
				-4	Reservoir storage in previous month.
				5	Target based on reservoir drawdown in same month.
				-5	Reservoir drawdown in previous month.
					<i>Water Right Specified in Field 9</i>
				6	Target based on streamflow depletion that month.
				7	Target based on annual streamflow depletion.
				8	Based on withdrawal from storage that month.
				9	Based on annual withdrawal from storage.
				11	Target based on diversion that month.
				12	Target based on cumulative annual diversion.
					<i>Maximum/Minimum Limits Only</i>
				10	Limits in fields 5 & 6 applied to <i>WR/IF/DI/TS</i> target.
					<i>Combine with Intermediate Target</i>
4	17-24	TOCOMB (n)	A8	blank, SET	This is the target; no preceding intermediate target.
				ADD, SUB	This is added to or subtracted from previous target.
				MUL, DIV	Previous target is multiplied or divided by this target.
				MAX	Maximum of this versus preceding target is adopted.
				MIN	Minimum of this versus preceding target is adopted.
				LIM	<i>AMT</i> from <i>WR/IF</i> field 3 and <i>UC/DI</i> records applied if the target falls within limits of <i>TO</i> fields 5 and 6

Evaporation Depth Added to WRAP-SIM Output File and TABLES Tables

The variables included in the simulation results written to the *WRAP-SIM* output file are listed in Tables 12-15 on pages 65-66 of the Users Manual. Program *TABLES* options read all of the data available in the *WRAP-SIM* output file for inclusion in the tables that it creates. Reservoir net evaporation-precipitation depth has been added as field 10 of the reservoir output record (Table 15). Pages 88, 89, and 90 of the *TABLES* section of the Users Manual have been revised to include the new evaporation-precipitation depth *2EPD* record.

Input data for the *2EPD* and other similar records are outlined on Users Manual page 91. The upper limit for *NUM* entered in field 6 was increased from 32 to 80.

Removal of DL Record

Dynamic dimensioning was adopted with the August 2003 version of *WRAP-SIM* with most of the dimension limits set internally by the model based on counting and reading data from the various input records. However, several limits were fixed but could be changed with the dimension limit *DL* record. However, in the December version these dimensions are also now set within the program based on an initial reading of the input file. The *DL* record is no longer used.

Addition of BES Option 6

The beginning-ending storage (BES) options are activated by *JD* record field 15. A new option 6 has been added that includes information regarding the water rights associated with each reservoir in the listing of reservoirs created. Pages 21-23 of the Users Manual are revised to incorporate this new option.

Removal from IF Record of Water Right Type Field and IFMETH Options

The water right type ($WRNUM(wr,5)$) has been eliminated from the *IF* record because it served no useful purpose and was confusing. $WRNUM(wr,5)$ is now set at 2 internally within the program if reservoirs (*WS* records) are attached to the *IF* record right. The variable only has meaning for an *IF* record right if a *WS* record is attached to provide releases from reservoir storage. However, the reservoir releases can occur only as a type 2 right. *IF* record rights did not refill storage in previous versions of the model and still do not refill storage in the current version.

The type of instream flow computations ($IFMETH(wr)=IFFLAG$) entered on the *IF* record previously included options to (1) ignore the instream flow requirement and (2) compute shortages only with no effect on other rights. These options have been eliminated because they can be easily achieved by other means and potentially could cause problems in the simulation.

The revised page 33 of the Users Manual is reproduced as follows.

IF Record – Instream Flow Requirement

field	columns	variable	format	value	description
1	1-2	CD	A2	IF	Record identifier
2	3-8	CP	A6	AN	Control point identifier
3	9-16	AMT	F8.0	+	Annual instream flow requirement
4	19-24	USE	2x,A6	AN blank	Use type identifier to connect to <i>UC</i> records Default constant uniform distribution over the year
5	25-32	WRNUM(7)	I8	-,0,+	Priority number
<i>Type of Instream Flow Computations</i>					
6	39-40	IFMETH (wr)	I8	blank,0,1 2 -2 3 4 -4	Constraints on water availability during first pass Constraints on water availability during second pass Constraints during both first and second passes Constraints during first pass, reservoir storage used Constraints during second pass, reservoir storage Constraints during both first and second passes
7	44	IFFLAG2 (wr)	I4	blank,0 1,non-zero	Instream flow limit is based on total regulated flow. Reservoir releases for downstream use are excluded.
<i>Drought Index</i>					
8	47-48	DINDEX(wr)	I4	blank,0 +,-	Drought index is not used for this water right. Integer identifier (1,2,3, ...) of drought index. If positive, the drought index is applied as step 3 outlined on page 34. A negative sign switches to applying the drought index as step 6 on page 35.
<i>Water Right Identifier</i>					
9	49-64	WRID(wr)	A16	AN	Water right identifier (optional)

WR and *IF* records may be in any order. The set of all *WR* and *IF* records, with supporting *SO*, *TO*, *TS*, *WS/OR*, *ML*, and/or *SD* records, follow the set of all *CP* records. The set of records for each water right (*WR* record) and instream flow requirement (*IF* record) consists of the *WR* or *IF* record followed in any order by optional *SO*, *TO*, *TS*, *WS/OR*, *ML*, and/or *SD* records.

Field 6: *IFMETH* options 3 and 4 result in releases from storage in reservoirs identified by *WS* records associated with the *IF* record to mitigate instream flow shortages. *IFMETH* options other than options 1 and 3 exist for the sole purpose of partially mitigating the problem of (1) senior *WR*-record rights not having access to water made available by junior *WR*-record rights through either same-month option diversion return flows or same-month option hydropower releases and (2) the contribution of reservoir releases not being credited in meeting instream flow targets at intermediate control points between the dam and diversion site assuming *IFFLAG2* is zero (blank field 7). *IFMETH* options 1 and 3 should be used if this problem is not a concern and perhaps even if this problem is a concern. All the other options involve a possible repeat of the simulation, which is called a second pass through the water rights computation loop. With *IFMETH* options 2 and 4, instream flow requirements are not activated during the first pass, and a second pass with instream flow requirements activated is performed if and only if at least one instream flow shortage occurs during the first pass. Options -2 and -4 mean that the instream flow requirements are activated for the first pass as well as second pass. *PASS2* in *JD* record field 14 forces a second pass in all months regardless of the *IF* record *IFMETH* option. With options 2 and 4, instream flow requirements are not reflected in unappropriated flows for months without a second pass.

New WRAP-SIM Error and Warning Messages

Most of the error and warning messages provided by *WRAP-SIM* are shown in Users Manual Tables 10 and 11. Several new input data checks with error or warning messages have been added since August 2003. Program execution is terminated following an error message but continues with a warning message. Warning messages rather than error messages have been added in some cases to identify questionable input data in old data sets while still allowing the data sets to run. Simulation results can be obtained for comparison before and after input data revisions. Warning messages are printed only for ICHECK=1 in the JD record field 4.

Some of the new error and warning check routines were motivated by the new dynamic dimensioning structure which involves an extra preliminary pass through the input data file to develop counts upon which dimension limits are established internally by the program to set up the numerous arrays. The dynamic dimensioning structure and other modifications in methods for setting up arrays resulted in opportunities for identifying potential problems in existing input data sets. The program has been modified to continue execution with data that may be questionable with warning messages printed to the message file to alert the model user of possible problems.

The following messages are printed to the message file if the new checks identify either definite input errors or questionable data that could potentially cause erroneous simulation results.

ERROR: Subroutine WRAPIN set MAXSWR at ___ but tried to read WR/IF records for at least ___ system rights, indicating a problem with hydropower or multireservoir rights.

ERROR: The number of system reservoirs (WS records) exceeds MAXSYS for right _____

ERROR: IFMETH is ___ but there is no reservoir (WS record) for IF right _____

ERROR: The drought index DINDEX from the WR/IF record is ___ for right _____ but there are only ___ DI records.

WARNING: No WR/IF records have drought indices but there are ___ DI records.

WARNING: ___ rights have drought indices ranging from ___ to ___ and MAXDI is ___

WARNING: The water right and reservoir normally should be at the same control point for a type 1 right. Reservoir: _____ Water right: _____

WARNING: An OR record may be inappropriate for water right _____. OR records are not used with single-reservoir type 1 or hydropower rights or with the first reservoir for these type rights with multiple reservoirs since storage is refilled in the first reservoir.

WARNING: No storage capacity on WS record for reservoir _____, right _____

WARNING: The water right type WRNUM(wr,5) for an IF record right is automatically set at 2, meaning reservoir storage is not refilled. A type of _____ entered on the IF record was changed to 2 for IF right: _____

WARNING: One or more WS record hydropower variable fields 9, 10, or 12 are not blank, but the type is ____, not hydropower for water right _____

WARNING: There is a reservoir (WS record) but IFMETH is not 3 or 4 for IF right _____

WARNING: Inconsistency in water right counts. NWRTS is ____ and MAXWR is ____

WARNING: Inconsistency in control point counts. NCPTS is ____ and MAXCP is ____

WARNING: Inconsistency in reservoir counts. NRES is ____ and MAXWS is ____

WARNING: CPIN repeats IN records from a CP that has no IN records.
Control points CPID and CPIN are _____ and _____.

WARNING: CPEV repeats EV records from a CP that has no EV records.
Control points CPID and CPEV are _____ and _____.

WARNING: The FD record for cp _____ lists upstream cp _____ with INMETHOD _____
Thus, their CP records must be in the correct sequence in the DAT file.

WARNING: The source gage CP identifier of _____ on FD record for CP _____ has an
INMETHOD of ____ on its CP record.

WARNING: INMETHOD = ____ and EWA = 0 from the CP record for FD record ungaged
control point _____

The criteria has been revised for printing the warning message that the maximum number of iterations has been reached in the iterative algorithm for computing evaporation volume and end-of-period storage. The stop criteria used in the actual computations have not been changed, and simulation results are not affected. However, the number of repeats of the warning message is reduced for some data sets. An additional criterion is added that messages are not printed if the last storage change is less than 0.000001 percent between iterations, which represents a negligible storage change.

TABLES Array Dimensioning

The methodologies for dimensioning arrays and transmitting data between modules in the October 2003 and subsequent versions of program *TABLES* has been revised for consistency with the dynamic dimensioning approach adopted in the August 2003 *WRAP-SIM*. Dimension limits are now set internally within *TABLES* based on counting the *CP*, *WR/IF*, and *WS* records for type 1 tables and the data in the 5th record of the *WRAP-SIM* output file for type 2 tables. The user no longer has to be concerned with the size of data sets exceeding dimension limits, and memory requirements are set by the actual size of each individual data set.

Revised Options on 1CPT Records

The limit options activated by 1CPT record fields 4 and 5 have been revised as indicated by page 87 of the Users Manual reproduced on the next page.

1CPT Record – Upstream-to-Downstream Sequencing of Control Points

field	columns	variable	format	value	description
1	1-4	CD	A4	1CPT	record identifier
2	8	KK	I4	blank,0 1 2 3 4 5 6	reproduction of CP records in rearranged order 1 listing of only control point identifiers, CPID(cp,1) 2 listing of cp and next downstream cp identifiers 3 listing of cp and next upstream cp identifiers 4 listing of INMETHOD and CL from CP records 5 option 4 listing with DA from WP records added 6 data from options 2-5 combined: CPID(cp,1), INMETHOD, CL, DA, CPID(cp,2), NUP, upstream cp's
3	16	OO	I8	blank,0,1 2	order based on listing cp before all downstream cp's 2 order based on full-length stream tributaries
4	17-24	LIM	I8	-1, - blank,0,+	list only control points with INMETHOD = 0 or 1 include all control points in the output listing
5	25-32	CPLIM	2x,A6	AN blank	include only cps located downstream of this cp include all control points

The control points are rearranged in upstream-to-downstream order. For order option (OO) of 1 (blank field 3), the sequencing is based on each control point being listed earlier than any other control point located downstream of it. This is the order required by *WRAP-SALT*. With OO = 2, the first sequence goes from a most-upstream control point to the basin outlet, and each subsequent sequence goes from a most-upstream control point to a previously ordered stream. With either option, most-upstream control points are selected in the order they are found in the original *CP* records in the *WRAP-SIM* input file.

The *LIM* option activated by field 4 allows the listing to be limited to only primary control points defined by *INMETHOD* of 0 or 1 in *CP* record field 6 indicating that naturalized flows are input on *IN* records. Entering a control point identifier in field 5 activates the option of limiting the control points considered to only those located downstream of the *CPLIM* control point.

KK in field 2 specifies the information to be included in the output. For KK=0, the *CP* records are reproduced, with only their order being changed. KK option 6 results in a listing of control points with each line having the following variables listed in the order shown below:

CPID(cp,1)	control point identifier (<i>CP</i> record field 2)
INMETHOD	method for obtaining naturalized flows (<i>CP</i> record field 6)
CL(cp)	channel loss factor (<i>CP</i> record field 9)
DA(cp)	drainage area (<i>WP</i> record field 3)
CPID(cp,2)	identifier of next downstream control point (<i>CP</i> record field 3)
NUP(cp)	number of control points located immediately upstream
UPID(cp,L)	listing of identifiers of upstream control points (L=1,NUP(cp))

Options 1-5 provide some but not all of the option 6 data listed above. The drainage area is read from *WP* records in the DIS file. The other data are read from *CP* records in the DAT file.

New Options on TABLES UNIT Records

An option for setting the first month of the year for the headings of tables is activated by UNIT record field 4 as indicated by the revised portion of page 85 reproduced below. Field 5 activates a new option that allows the user to decide whether to include page breaks in the output. Users may prefer to set page breaks themselves when editing the output tables.

UNIT Record – Information for Table Headings

Field	columns	variable	format	value	description
1	1-4	CD	A4	UNIT	record identifier
2	5-9	UNIT	A5	AN blank	Volume units printed in table headings. Without a <i>UNIT</i> record, the default is AC-FT.
3	10-14	UNHP	A5	AN blank	Hydropower units printed in table headings. Without a <i>UNIT</i> record, the default is MW-HR.
4	15-19	MONTH1	A5	blank AN	Default is to begin headings with the month JAN. First month in the table headings may be entered as either JAN (default), FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, or DEC.
5	20-24	NEWPAGE	I5	blank,0,+ -1,-	Each table starts a new page. No page breaks.

Several table headings include volume and/or energy units. If a *UNIT* record is not used, the defaults are:

$$\begin{aligned} \text{UNIT} &= \text{AC-FT} \\ \text{UNHP} &= \text{MW-HR} \end{aligned}$$

If a *UNIT* record is included in the data set with blank entries for *UNIT* and/or *UNHP*, their values are blanks. The units entered on the *UNIT* record are printed in the table headings but do not affect the data in the tables. Program *TABLES* organizes and manipulates data from *WRAP-SIM* input and output files without considering units in its computations.

The listing of months in the table headings is controlled by field 4. If field 4 is left blank, the 12 monthly columns begin with January. The 12-month year may start in any other month as specified by an entry in field 4.

The variable *NEWPAGE* in field 5 is a switch specifying whether or not page breaks are inserted after each table. If *NEWPAGE* is zero (blank field 5) or positive, a page break is placed after each table causing the next table to begin a new page. A negative integer entered in field 5 results in omission of the page breaks.

A *UNIT* record is applicable to all subsequent records in the *TABLES* input data set.

Other Revisions to the Reference and Users Manuals

Reference Manual Table 2-8 on page 27: The example has not changed, but an output file with the 3 new variable fields replaces the old output file from an earlier version of *WRAP-SIM*.

Reference Manual pages 16 and 37: Paragraphs have been added regarding the dual simulation options.

Reference Manual Appendix D variable definitions: The variables *DUAL*, *DD*, *DDEP*, *NDD*, *NDT*, *SIM2*, and *SIM3* were added; the variables *F9*, *RESDAT*, *SYSREL*, and *WRNUM* were revised or expanded; several other variables were deleted, and a few minor editorial revisions were made.

Reference Manual Appendix G Examples: Small revisions were made to input data and simulation results for Examples 4, 5, 6, and 7. The revisions are reflected in the input data files distributed electronically with the package.

Reference Manual page 120: The following paragraph has been added.

With *IFMETH* options 2 and 4, instream flow requirements are imposed only during the second pass through the water rights computation loop. Thus, another problem with options 2 and 4 is that the final unappropriated flows do not reflect instream flow requirements in those months in which all requirements are met without necessitating a second pass.

Users Manual page 23: The following paragraph has been added.

BES options 4 and 5 also address return flows and hydropower releases. With the next-month return flow and next-month hydropower options in effect, BES options 4 and 5 return the return flows at the end of the simulation back to the beginning.

Users Manual page 44: The explanations of *WS* record fields 11 and 13 were revised slightly to emphasize that field 11 is used with the *WS* records attached to diversion rights to specify their impacts on other more junior hydropower rights and that field 13 may be associated with either diversion or hydropower rights.

Users Manual page 45: The explanations for the *OR* record are expanded. The explanation for the *MS* record is revised to indicate that there is no limit on the number of *MS* records.

Users Manual page 48: Notes are added indicating that there is no limit on the number of drought indices (*DI* records), but the variable *NR* on the *DI* record cannot exceed 12. Also, up to 12 storage-index pairs may be specified on *IS/IP* records.

Users Manual pages 65-66: Revised Tables 13 and 14 describing output records show that the format for diversions and diversion shortages have been changed from F9.1 to F9.3 unless the number is too large in which case F9.1 is used. Channel loss credits, channel losses, and reservoir releases on CP record are now F7.0, F6.0, and F7.0. TABLES is also revised.

Users Manual page 86: The options activated by 1SUM record field 2 have been expanded to include an option that prints out only the bottom line totals.

Revisions Between the December 2003 and May 2004 Versions

The May 2004 version of *WRAP-SIM* and *TABLES* reflects the following revisions since the December 2003 version. *WinWRAP* and *WRAP-HYD* have not changed since December 2003. In addition to the revisions outlined below, which may affect simulation results, other minor refinements to the code improve its organization but do not affect simulation results.

Corrections Related to Second Pass Instream Flow Options

The only revision in the February 2004 version of *WRAP-SIM* was a correction related to use of second pass IFMETH options (*IF* record field 7 options 3 and 4) in combination with negative incremental flow option 4 (*JD* record field 8). In certain situations, the negative incremental flow adjustment would be neglected during the second pass.

The May 2004 version of *WRAP-SIM* corrects an error that occurs when the *FY*-record yield-reliability analysis feature was applied to datasets that have second-pass options (*IFMETH* = 2 or 4) activated by *IF* records. In the *FY*-record analysis, shortage volumes and number of shortage months were counted again for each pass, thus double-counting for each month that has a second pass. This error resulted in shortages being too high and reliabilities being too low. Firm yields have zero shortages and thus were not affected. This IFMETH second pass problem occurred only with the yield-reliability feature activated by the *FY* record.

TOTARGET Options 11 and 12

Options 11 and 12 were added to the *TOTARGET* options activated by *TO* record field 2 in the December 2003 *WRAP-SIM*. However, internal error checks prevented the new options from being used. The error checks have been updated to recognize options 11 and 12 as being valid *TOTARGET* options.

Beginning-Ending Storage Option 4

The beginning-ending storage BES feature activated by *JD* record field 15 was added in the August 2003 version of *WRAP-SIM*. An error that prevented BES option 4 from working has been corrected in the May 2004 version.

New Beginning-of-Simulation Storage Table Option

A new feature activated by the new *JD* record field 16 allows creation of a beginning-of-simulation storage BSS table in the BES output file that lists control point identifiers along with the reservoir identifiers, storage capacity, and beginning storage. If the BSS feature is used in combination with BES options 4 or 5, the beginning storage in the BSS table is the beginning storage for the final simulation. This feature was added primarily for use with *WRAP-SALT* but may be useful for other purposes as well.

Addition of Time Series Repeat TSR Record

The new *TSR* record allows the values previously read from a set of time series *TS* records to be repeated. A *TRS* record specifies creation of a time series sequence with amounts Q_{TSR} computed from the values Q_{TS} of the *K*th previously defined sequence as follows.

$$Q_{TSR} = A Q_{TS} + B$$

where *A* and *B* are constants read from *TRS* record fields 4 and 5. The integer *K* is the counter or identifier of time series sequences read from sets of *TR* records or created with a *TRS* record. *K* ranges from 1 for the first sequence read from *TS* records for a particular water right to the total number of time series sequences included in the model dataset.

TSR Record – Target Series Repeat

field	columns	variable	format	value	description
1	1-3	CD	A2,A1	TSR	Record identifier
2	6-8	TSL	2x,A3	blank MAX, max MIN, min ADD, add SUB, sub MUL, mul SDL, sdl	<p style="text-align: center;"><u>Manner of Applying TS Amounts</u></p> <i>TS</i> record amounts are the only targets used. Maximum of two alternative targets is adopted. Minimum of two alternative targets is adopted. <i>TS</i> record amount is added to preceding target. <i>TS</i> record amount is subtracted from preceding target. <i>TS</i> record amount is multiplied by preceding target. Upper limit on allowable streamflow depletions.
3		K	I8	blank,0 +	<p style="text-align: center;"><u>Time Series Sequence to be Repeated</u></p> Use last preceding set of <i>TS</i> or <i>TRS</i> records read. Integer identifier of set of <i>TS</i> records or <i>TRS</i> record from which values are repeated.
4		TSA	F8.0	A	<p style="text-align: center;"><u>Coefficients for $Q_{TSR} = A Q_{TS} + B$</u></p> Multiplier <i>A</i> (default = 1.0)
5		TSB	F8.0	B	Addition factor <i>B</i> (default = 0.0)

Precision in Defining Shortages in Computing Reliabilities

Prior to the December 2004 version of *WRAP*, diversion targets and diversion shortages were written to the *WRAP-SIM* output file to 0.1 unit/month. The TCEQ WAM uses acre-feet for the unit. The December 2004 version records diversion targets and shortages to 0.001 unit/month (acre-feet/month). Thus, depending on the version of *WRAP-SIM*, monthly diversion shortages have to be at least either 0.1 or 0.001 acre-feet to be recognized as a shortage by *TABLES* in developing reliability tables.

In computing period reliabilities in the December 2003 version, *TABLES* counted shortages if the shortage was greater than 0.001 unit but did not count shortages of exactly 0.001 unit. This has

been corrected. *TABLES* now counts any non-zero shortage recorded in the *WRAP-SIM* output file in computing period reliabilities. This includes the shortages of exactly 0.001 unit previously not counted.

The yield-reliability analysis feature of *WRAP-SIM* activated by the *FY* record computes reliabilities directly from the shortages. Prior to the May 2004 version, in computing period reliabilities, a month was considered a failure month if a shortage of any magnitude occurred, using all significant figures recognized by the computer. The *FY*-record routine was changed in the May 2004 version to count only shortages equaling or exceeding 0.0005 unit/month (ac-ft/month) in the computation of period reliability. All shortages continue to be included in the computation of volume reliability.

The *FY*-record *WRAP-SIM* reliabilities are always at least as precise and may be more precise than the *TABLES* reliabilities since *TABLES* uses only values recorded in the *WRAP-SIM* output file to the previously noted level of precision. The *FY*-record volume reliabilities may be more precise in any situation. The *FY*-record period reliabilities may be more precise for groups of water rights, where individual rights have shortages of less than 0.001 but the sum of shortages for all of the rights total to greater than 0.001.

The firm yield iterations in the *FY*-record yield-reliability analysis are controlled by a stop criterion of shortages being less than 0.05 unit/year.

Digits for Recording Net Evaporation Depths

Net evaporation depth was added to the *WRAP-SIM* output file and *TABLES* tables in the December 2003 version. In the May 2004 version, the number of digits at which net evaporation depths were recorded was changed from 0.001 unit to 0.00001 unit (foot in TCEQ WAM datasets).

Warning Messages for Amounts Exceeding Format Limits

The variables included in the *WRAP-SIM* output file records are listed in Tables 13, 14, and 15 of the users manual. A set of warning messages has been added that cites any amount that exceeds the format limits noted in Table 14 for control point output records. The naturalized flow and regulated flow for one month for the Rio Grande activates a warning message.