RICEWQ: PESTICIDE RUNOFF MODEL FOR RICE CROPS

USERS MANUAL AND PROGRAM DOCUMENTATION
VERSION 1.9.0

Prepared by

W. Martin Williams
Amy M. Ritter
Christienne E. Zdinak
J. Mark Cheplick

Waterborne Environmental, Inc.
897-B Harrison Street, S.E.
Leesburg, VA 20175

4 August 2011

SOFTWARE LICENSE AGREEMENT

DISCLAIMER

MODEL SUPPORT

Waterborne Environmental, Inc., offers a full range of services in support of RICEWQ including:

- User support;
- Model customization;
- Site- and chemical--specific calibration and validation;
- Design, execution, and interpretation of aquatic monitoring studies; and
- Model application and probabilistic exposure assessments.

ACKNOWLEDGEMENTS

Water quality algorithms were derived in part from the lake water-quality model contained within the SWRRBWQ model (Simulator for Water Resources in Rural Basins - Water Quality) by Jeffrey Arnold, Ph.D., U.S. Department of Agriculture, Agricultural Research Service, Grassland, Soil and Water Research Laboratory, Temple, Texas.

We would like to thank the following institutions for providing financial support for components of the model: BASF Corporation, Bayer CropSciences, Dow AgroSciences, DuPont Crop Protection, Syngenta Crop Protection, Università Cattolica del Sacro Cuore, and Valent USA Corp.

We would also like to thank Yuzhou Luo, Ph.D., California Department of Pesticide Regulation, and Mark Grismer, Ph.D., P.E., Professor, Departments of Land, Air, Water Resources and Biological & Agricultural Engineering, University of California, Davis, for providing technical review of the model and documentation.

CONTENTS

1.0 INTRODUCTION

Rice agriculture presents a unique problem with respect to agrochemical runoff because of the high seasonal rainfall, water management practices, and proximity of cropland to surface-water bodies typical of rice-growing areas. The Rice Water Quality Model, RICEWQ is a numerical simulation model that can be used to evaluate the dissipation of a chemical in an aquatic system and to predict the runoff losses of agrochemicals to receiving waters. The model was developed to simulate water and chemical mass balance associated with the unique flooding conditions, overflow, and controlled releases of water that are typical with rice production.

RICEWQ was initially developed and used in 1991 to extrapolate the results of field monitoring studies conducted in Arkansas and Louisiana for rice fungicide. The model was verified against measured concentrations in water and sediment at six rice paddies and the model datasets were then used to estimate potential exposure concentrations in downstream water bodies under varying meteorological conditions, product use rates, and Best Management Practices (BMPs).

Prior to 2003, the model was used almost exclusively by the authors to support risk assessments submitted to the U.S. Environmental Protection Agency for pesticide registration in the United States (e.g., USEPA, 2006, USEPA, 1998). In 2003, the MED-RICE working group in Europe proposed the use of the model for higher-tier pesticide exposure scenarios in Europe (MED-Rice, 2003). At the time of this writing, over 300 copies of the model have been distributed internationally to researchers in Australia, Colombia, Germany, Italy, Japan, the Netherlands, Portugal, Russia, South Korea, Switzerland, United Kingdom, and the U.S. In the past several years, the model has received considerable peer review and use in the scientific community (Capri and Miao, 2002; Christen et al., 2005, 2006a, 2006b; Chung et al., 2008; Ferrari et al., 2005; Infantino et al., 2008; Karpouzas and Capri, 2004; Karpouzas and Capri, 2004, 2006. Karpouzas and Miao, 2008; Karpouzas et al, 2005a, 2005b, 2006a, 2006b, 2006c; Miao et al., 2003a, 2003b, 2004, 7007; Ngoc et al., 2008; Park and Chung; 2008; Ritter and Williams, 2008, Warren et al., 2004).

RICEWQ has been coupled with other models to evaluate the transport of pesticides to ground-water and surface water systems. The model has been used for pesticide leaching assessments by linking it to the Vadose Zone Flow and Transport model (VADOFT) contained within USEPA's Pesticide Root Zone Model, PRZM, (Suárez, 2005) and the HYDRUS-1D model (Šimůnek, et al., 2009). Both PRZM and HYDRUS simulate pesticide fate in the vadose zone before reaching groundwater. Assessments of pesticide transport to surface water systems have been conducted by coupling RICEWQ with the USEPA's Exposure Analysis Modeling System, EXAMS (Burns, 2004) and the River Water Quality model, RIVWQ (Williams et al., 2004).

A Windows modeling platform was developed in 2007 to facilitate the simulation of standardized scenarios with RICEWQ and EXAMS (Williams et al., 2007). The default scenarios in the modeling platform represent predominant rice production practices in California, the Mississippi Delta, and the Gulf Coastal Plain of the U.S. The scenarios emulate the geometry used in USEPA's Tier 2 risk assessment for terrestrial crops with PRZM-EXAMS

(USEPA, 2006) by having a 10-ha field drain into a 20,000 m^3 static receiving water system.

Additional sophistication continues to be incorporated into the model on an "as-needed" basis.

This document presents the governing equations, user's manual, and an example application of the model in predicting pesticide losses in runoff.

2.0 GOVERNING EQUATIONS

Processes represented in RICEWQ are illustrated in Figure 1. Water balance algorithms account for precipitation, evaporation, seepage, irrigation, releases and overflow from various paddy outlet configurations, and controlled drainage prior to harvest. Pesticide application algorithms accommodate a single parent chemical with up to four metabolites, multiple applications, chemical losses from drift, and foliage and water interception. Crop algorithms include plant growth from emergence to maturation, associated pesticide washoff and degradation on foliage, and deposition of pesticide residues of foliage after harvest. Water quality algorithms include dilution, volatilization, partitioning between water and bed sediments, decay in water and sediment, and resuspension from bed sediments.

Model simulation involves mathematically tracking the total mass of chemical residues in the paddy from the point of application in terms of mass balance. The mass balance equation can be expressed by the following:

$$V\frac{\partial C}{\partial t} = \sum M_{in} - \sum M_{out} - \sum M_{react} \quad (1)$$

in which ∂C is the change in concentration over time (∂t), ΣM_{in} and ΣM_{out} are cumulative influx and outflow of chemical mass from the control volume, V (i.e., the rice paddy), and ΣM_{react} is mass transformation from all processes. Using a daily time step, RICEWQ simultaneously tracks mass balance of chemical in three media: rice foliage, water column, and benthic sediments.

Chemical residues on foliage are expressed by the mass balance equation:

$$\frac{\partial M_F}{\partial t} = M_{Fapp} - M_{fdeg} + M_{Ftran} - M_{wash} - M_{harv} \quad (2)$$

in which ∂M_F is the change in chemical mass on foliage over time (∂t), M_{Fapp} is the parent pesticide application intercepted by foliage, M_{Fdeg} is the mass degraded on foliage, M_{Ftran} is the metabolite mass formed by transformation of parent compound, M_{wash} is the mass washed off from foliage, and M_{harv} is the allocation of pesticide mass after harvest (removed from system, left alone and available for washoff, or applied to bed sediment).

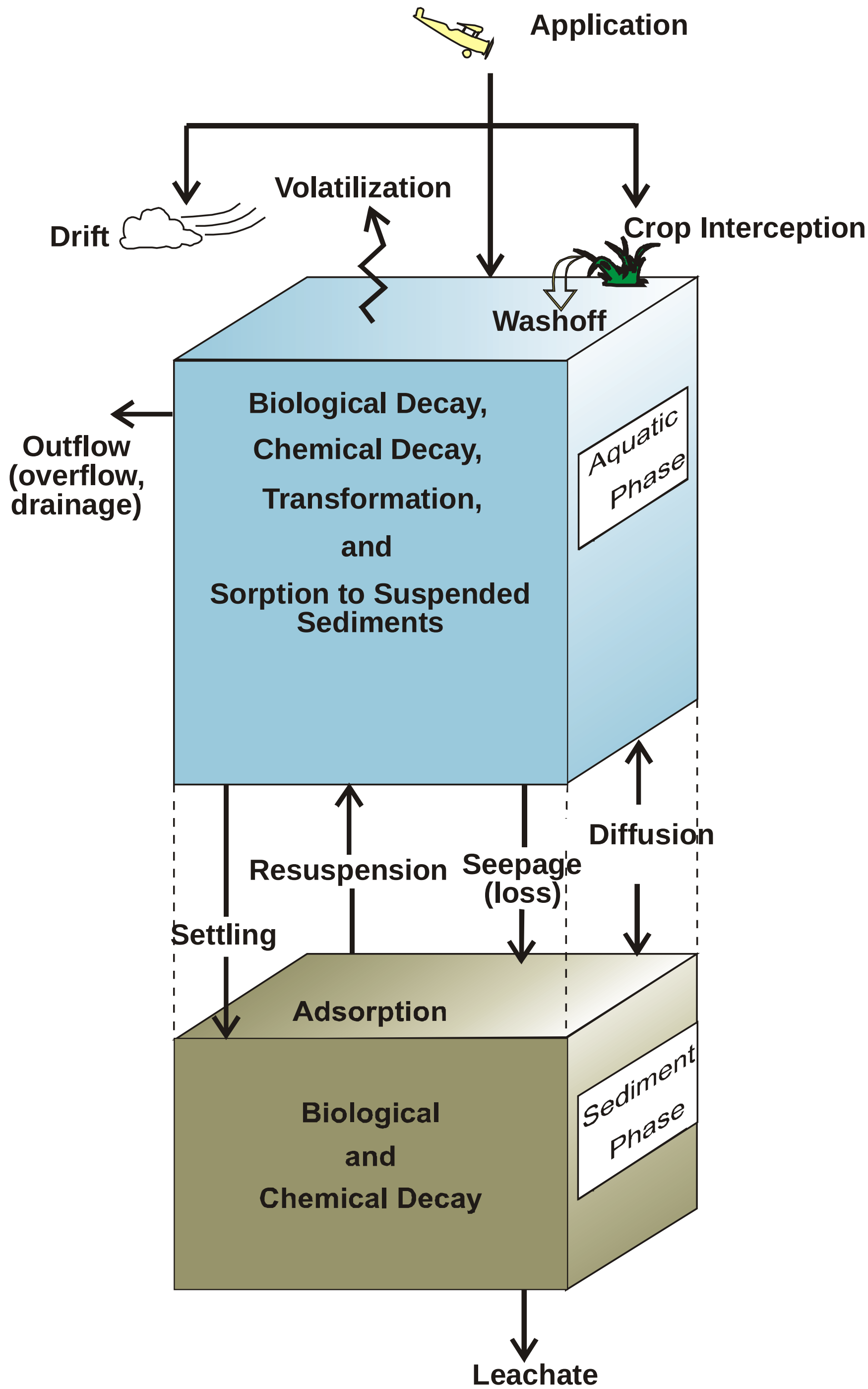

FIGURE 1. Schematic of RICEWQ processes

Chemical residues in water are assumed to be instantaneously diluted (i.e., well mixed in the paddy). The mass balance equation for the water column can be expressed by:

$$\frac{\partial M_W}{\partial t} = M_{Wapp} + M_{Wash} - M_{Wdeg} + M_{Wtran} - M_{volat} - M_{out} - M_{seep}$$
$$-M_{bed} - M_{setl} + M_{resus} \pm M_{diff} \quad (3)$$

in which ∂M_W is the change in chemical mass in water over time (∂t), M_{wapp} is the portion of parent application not lost to drift or intercepted by crop, M_{Wdeg} is the mass degraded in water, M_{Wtran} is the metabolite mass formed by transformation of parent compound, M_{volat} is the mass volatilized across the air-water interface, M_{out} is the mass lost in overflow or drainage, M_{seep} is the mass lost in seepage, M_{bed} is the mass transfer to bed sediment by direct partitioning, M_{setl} is the mass transfer to sediment by particulate settling, M_{resus} is resuspended mass, M_{difus} is the mass diffusion between the water and sediment, and other terms as previously defined.

Chemical residue concentrations in the water are compared to the solubility of the chemical to check that the concentration is less than the solubility. If the chemical residue concentration is greater than the chemical solubility, then the concentration is set equal to the solubility and the difference is added to the sediment mass as precipitate.

Chemical partitioning between the water column and sediment occurs by direct partitioning, diffusion, settling of chemical sorbed to suspended sediment, and resuspension of sorbed sediments:

$$\frac{\partial M_S}{\partial t} = M_{Sapp} - M_{Sdeg} + M_{Stran} + M_{bed} - M_{setl} - M_{resus} \pm M_{diff} \quad (4)$$

in which ∂M_S is the change in chemical mass in sediment over time (∂t), M_{Sapp} is the chemical mass applied to sediment, M_{Sdeg} is the chemical mass degraded in sediment, M_{stran} is the metabolite mass formed by transformation of parent compound, M_{bed} is the mass transfer to bed sediment by direct contact, M_{setl} is the mass transfer to sediment by particulate settling, and M_{resus} is mass reintroduced to the water column via resuspended sediments, M_{difus} is the mass diffusion between the water and sediment, and other terms as previously defined.

Alternately, the user can represent chemical transfer between water and sediment by chemical transfer to sediment by specifying single mass transfer coefficient (MTC) as diffusion and by deactivating direct partitioning, settling, and resuspension.

Pesticide application is allocated to four separate components: (1) losses to drift, (2) interception by unsubmerged rice foliage, (3) interception by water, and/or (4) application to sediment. The percentage loss to drift is specified by the user. The allocation between crop foliage and paddy water is based on the stage of crop simulated by the model at the time of application:

$$M_{Fapp} = M_{app} * (1 - DRIFT) * COVER * SA \quad (5)$$

in which M_{Fapp} is the parent mass intercepted by foliage, M_{app} is the parent application rate per unit area, *DRIFT* is the fraction lost to drift, *COVER* is the interception potential of foliage at the time of application, and *SA* is the surface area of the paddy. Crop cover is calculated through linear interpolation of the date of pesticide application and user-supplied dates for emergence and maturation:

$$COVER = COVMAX \times \frac{IGROW}{JGROW} \quad (6)$$

in which *COVMAX* is the interception potential of foliage at crop maturation, *IGROW* is the number of days since crop emergence, and *JGROW* is the total number of days between emergence and maturation. Both *IGROW* and *JGROW* are calculated internally in the model as a function of simulation day and user defined dates for emergence and maturation. The mass intercepted by water, M_{Wapp}, is the remainder after drift losses and foliar interception:

$$M_{Wapp} = M_{app} \times (1 - DRIFT) \times (1 - cover) \times SA \times \ (1 - SNK) \quad (7)$$

The variable *SNK* is the fraction of the mass of applied pesticide that is intercepted by water and immediately transformed to innocuous product. This feature was included in RICEWQ for a specific study, but would not typically be used (i.e., *SNK* = 0.0 for most simulations).

The mass not intercepted by foliage (eqtn. 7) will be applied to soil (M_{Sapp}) if the paddy is not flooded (*SNK* is not used with applications to dry paddies). Soil incorporation can be represented by specifying a depth of incorporation. If the depth exceeds the active sediment layer, a fraction of the applied mass is removed from model calculations.

$$M_{Sapp} = \ M_{Sapp} \ \times \frac{D_{inc}}{D_{act}} \quad (8)$$

in which D_{inc} is the depth of incorporation and D_{act} is the depth of the active sediment layer.

Slow release formulations (e.g., seed treatments or granular applications) can be represented in the model by the input parameter R_{reac}. R_{reac} is a first order rate constant with units of day^{-1}. Pesticide applications to flooded paddies result in an allocation of 90% of active ingredient formed by slow release in water and 10% in sediment. Slow releases from soil applied applications are allocated 100% to sediment.

The mass of pesticide degraded on foliage, M_{Fdeg}, is calculated by first-order decay:

$$M_{Fdeg} = M_F e^{-Kf*dt} \quad (9)$$

in which M_F is the mass of chemical on foliage and K_f is the foliar decay rate constant in units of day^{-1} and *dt* is the 1-day time interval used in the model. Washoff, M_{wash}, is calculated as a function of precipitation:

$$M_{wash} = M_F\left(1 - e^{-\theta \times P \times dt}\right) \tag{10}$$

in which θ is the foliar extraction coefficient expressed as a washoff fraction per centimeter of precipitation and P is the precipitation for the day. RICEWQ uses a linear crop-growth and pesticide washoff model similar to the U.S. Environmental Protection Agency's Pesticide Root Zone Model (PRZM3) (Suárez, 2005).

The model contains a series of processes that can be controlled by the user to transfer and partition chemical residues between the water column and bed sediment. Processes include direct partitioning from contact with sediment, the mass transfer to sediment by particulate settling, the mass returned to the water column from resuspended sediment, and the mass diffusion between water and sediment.

In the water column, chemical is partitioned between two phases: dissolved and sorbed to suspended sediment.

$$F_{DW} = \frac{1}{1+K_d \times C_{SS}} \tag{11}$$

$$F_{PW} = \frac{K_d \times C_{SS}}{1+K_d \times C_{SS}} \tag{12}$$

F_{DW} is the dissolved fraction in water, F_{PW} is the fraction sorbed to suspended sediment, C_{SS} is the concentration of suspended sediment (mg/m^3), and K_d is the water-sediment partition coefficient (m^3/mg). Concentrations of suspended sediment are held constant in the model, although the fraction of chemical adsorbed to suspended sediment is allowed to settle to the benthic sediments based on the following equation:

$$M_{setl} = \left(K_{setl} \times \frac{F_{PW} \times M_W}{D_W}\right) \times dt \tag{13}$$

in which K_{setl} is a user-specified settling velocity M_w is the mass of chemical in the water column, and D_W is the depth of water in the paddy during a specific time step.

An empirically derived equation is used to calculate the direct partitioning of dissolved residues in the water column from contact with bed sediment:

$$M_{bed} = (K_d \times F_{DW} \times C_W \times V_{bind} \times \rho_b \times SA) \times dt \tag{14}$$

in which C_w is the concentration of chemical in the water column, V_{bind} is an empirical coefficient relating bed water column and bed sediment mixing/contact time, ρ_b is the bulk density of the sediment, and SA is the surface area of the rice paddy. The equation was added to provide a better match to water and sediment concentrations measured in rice paddy field studies. The conceptual rationale for the equation is that dissolved chemical residue in the water column is not entirely in direct contact with bed sediment. V_{bind} can be envisioned as the section of the water column that is in direct contact during the simulation time step. Values on the order of 0.001 to 0.1 cm/day have reproduced observed concentrations in calibrations to aquatic field studies. The equation can be deactivated by the user by specifying a value of zero for V_{bind}.

Degradation in water is represented by first-order decay:

$$M_{Wdeg} = M_W e^{-Kw*dt} \tag{15}$$

in which Kw is the decay rate constant in units of day^{-1}. The user can input decay rates for metabolism, hydrolysis, and/or photolysis. Volatilization is the exchange of chemical across the air-water interface and acts only on the dissolved fraction:

$$M_{volat} = (K_{volat} \times \frac{F_{DW} \times M_W}{D_W}) \times dt \tag{16}$$

in which F_{DW} is the fraction of chemical mass in dissolved phase, K_{volat} is the rate of volatilization (m/day), and D_W is the depth of water in the paddy at a specific time step. Methods for estimating K_{volat} from are provided by Chapra (1997).

The mass lost through seepage, M_{seep}, and outflow, M_{out}, are calculated directly from water losses and associated concentration (M_w/V_w):

$$M_{seep} = \left(Q_{seep} \times SA \times \frac{M_W}{V_W}\right) \times dt \tag{17}$$

$$M_{out} = \left(Q_{out} \times \frac{M_W}{V_W}\right) \times dt \tag{18}$$

in which V_W is the volume of water in the paddy at the specific time step, Q_{seep} is the seepage rate (m/day), and Q_{out} is the flow draining from the paddy in m^3/day. Diffusion is a function of concentration gradients between the water column and bed sediments:

$$M_{difus} = K_{difus} \times SA \times \left(\frac{F_{DS} \times C_S}{\phi} - F_{DW} \times C_W\right) \times dt \tag{19}$$

in which K_{difus} is the rate of diffusion in m/day, SA is the surface area of the paddy in m^2, C_s is the concentration of chemical in sediment, and F_{DS} represents the fraction of chemical residues in dissolved form and within voids in the sediment (i.e., not sorbed to bed sediment particles), and ϕ is the porosity of the sediment. The diffusive mixing velocity, K_{difus}, can be estimated from the empirically derived formula by Chapra (1997):

$$K_{difus} = \frac{69.35}{365} - \phi \times MW^{-2/3} \tag{20}$$

in which ϕ is the porosity of the sediment and MW is the molecular weight of the chemical. The user can represent chemical transfer between water and sediment by chemical transfer to sediment by a single mass transfer coefficient (MTC) in place of K_{difus} and turning off processes related to suspended sediment settling, resuspension, and direct contact by setting K_{setl} and V_{bind} to zero.

F_{DS} is expressed as:

$$F_{DS} = \frac{\phi}{\phi + (K_d \times \rho_b)} \tag{21}$$

in which K_d is the water-sediment partition coefficient (cc/g), ϕ is the porosity of the sediment, and ρ_b is the bulk density of the sediment. Degradation in the sediment is calculated using first-order kinetics:

$$M_{Sdeg} = M_S e^{-Ks*dt} \tag{22}$$

in which M_s is the mass of chemical in sediment, K_s is the decay rate constant in units of day^{-1}. The user can input decay rates for saturated soil (anaerobic aquatic decay rate) and unsaturated soil (aerobic soil decay rate). Resuspension (M_{resus}) occurs when precipitation or other activity suspends particles that have been previously deposited. In RICEWQ resuspension is assumed to be equal to the amount settled out of the system in order to maintain a constant suspended sediment concentration.

The mass lost through seepage, M_{seep}, and outflow, M_{out}, are calculated directly from water losses and the associated concentration (M_W/V_W):

$$M_{seep} = \left(Q_{seep} \times SA \times \frac{M_W}{V_W}\right) \times dt \tag{23}$$

$$M_{out} = \left(Q_{out} \times \frac{M_W}{V_W}\right) \times dt \tag{24}$$

in which V_W is the volume of water in the paddy at the specific time step, Q_{seep} is the seepage rate (m/day), and Q_{out} is the flow draining from the paddy in m^3/day. As a general guide, seepage rates can be assigned the saturated hydraulic conductivity associated with the soil series hydrologic soil group. The hydrologic soil group is an indicator of soil permeability and runoff potential in which A soils are more prone to infiltration than D soils.

Seepage Rates as a Function of Hydrologic Soil Group

Hyd Soil Group	Seepage Rate (cm/day)
A	0.87
B	0.61
C	0.19
D	0.04

Source: USDA, National Engineering Handbook, Volume 4, Table 7.2

The governing equations as described above for mass balance of chemical in rice foliage, water column and benthic sediments are applied for the parent chemical and up to four metabolites. Metabolite mass in rice foliage, water column and benthic sediments is formed by the transformation of the parent to the metabolite and is expressed by the following:

Foliage: $$M_{Ftran} = Y_F \times M_{Fdegp} \tag{25}$$

in which M_{Ftran} is the mass of metabolite formed on foliage by transformation from parent, Y_F is the foliar yield of parent to metabolite or fraction of parent which forms metabolite on foliage and M_{Fdegp} is the mass of parent degraded on foliage as found by Equation 8 where $M_{Fdegp} = M_{Fdeg}$.

Water: $$M_{Wtran} = Y_W \times M_{Wdegp} \tag{26}$$

in which M_{Wtran} is the mass of metabolite formed in water by transformation from parent, Y_W is the aquatic yield of parent to metabolite or fraction of parent which forms metabolite in water and M_{Wdegp} is the mass of parent degraded in water as found by Equation 14 where $M_{Wdegp} = M_{wdeg}$.

Sediment: $$M_{Stran} = Y_S \times M_{Sdegp} \tag{27}$$

in which M_{Stran} is the mass of metabolite formed in sediment by transformation from parent, Y_S is the sediment yield of parent to metabolite or fraction of parent which forms metabolite in sediment and M_{Sdegp} is the mass of parent degraded in sediment as found by Equation 20 where $M_{Sdegp} = M_{Sdeg}$.

The user may specify up to two yields each for foliar, aquatic and benthic formation of each metabolite to simulate each phase of a bi-phase transformation of parent to metabolite.

Water Balance. RICEWQ uses a storage accounting model to calculate the water balance in the paddy:

$$\frac{\partial s}{\partial t} = \sum I - \sum O \tag{28}$$

in which the change in storage, ∂S, over time, ∂t, is equal to the cumulative sum of inflow, ΣI, and outflow, ΣO, sources.

Inflow sources include precipitation, which is read from an external file, and irrigation, which can either be regulated automatically or applied at a fixed volume by the user. The automated option requires the depth of water in the paddy at which irrigation will commence (e.g., minimum water level during periods without rainfall) and the depth at which irrigation will cease once it is initiated. Both options require the pumping rate of the irrigation system.

Outflow is the result of evapotranspiration, seepage, overflow, and controlled drainage. Seepage occurs at a constant rate that is specified by the user. Daily pan evaporation is either read from the external meteorological file or calculated from monthly pan-evaporation rates from the basic input data file. Evapotranspiration is assumed equal to pan evaporation, which is a valid assumption for an aquatic environment (Linsley & Franzini, 1979). Overflow occurs when irrigation and precipitation exceeds the depth of the outlet in the paddy (e.g., weir or riser). Paddy drainage occurs by regulating the height of the drainage outlet.

RICEWQ operates under a user specified time step. For chemicals with rapid degradation (e.g., half-life or DT50 values on the order of hours), a sub-daily time step should be specified. The model uses a proportional correction method for numerical convergence. Calculations are performed for all processes for each time step and if the net mass exchange exceeds the available mass, the exchange is decreased for each process proportionally to the relative influence the process has to competing processes.

.

3.0 USERS MANUAL

RICEWQ operates with two input files and up nine output files (Figure 2). These files are described below:

- RICEWQ.INP. Input file describing the paddy system and pesticide application dates, rates, and physicochemical properties.

- RICEWQ.MET. Input file containing daily precipitation and pan evaporation for the period of simulation. The file format is identical to that used by the U. S. Environmental Protection Agency's Pesticide Root Zone Model, PRZM3.12 (Suárez, 2005).

- RICEWQ.ZZZ. Output file containing an echo of input data. This file should be examined to ensure that input parameters are read correctly.

- RICEWQ.ZZH. Output file containing daily water balance: precipitation, pan evaporation losses, seepage losses, water depth, and whether outflow occurred from overflow or drainage. The file also indicates on which days irrigation occurred.

- RICEWQ.ZP0. Output file containing daily pesticide concentrations in water, sediment and foliage for each chemical in the simulation.

- RICEWQ.ZP(I), I=1,NCHEM. Output files containing daily pesticide mass balance for each chemical simulated: application amounts and losses due to degradation in water and sediment, volatilization, direct binding, settlement, resuspension, seepage and diffusion between the water column and benthos. Daily concentrations in water and sediment are also reported.

- RICEWQ.ZZT. Output file containing time series of pesticide mass and water volumes lost from overflow or drainage. The file can be used as a loading input to receiving water models.

Additional transfer files are created for experienced users of EXAMS, VADOFT, or HYDRUS-1D.

The Windows version of RICEWQ presents the annual maximum series of pesticide concentrations in water predicted by EXAMS for different exposure duration intervals.

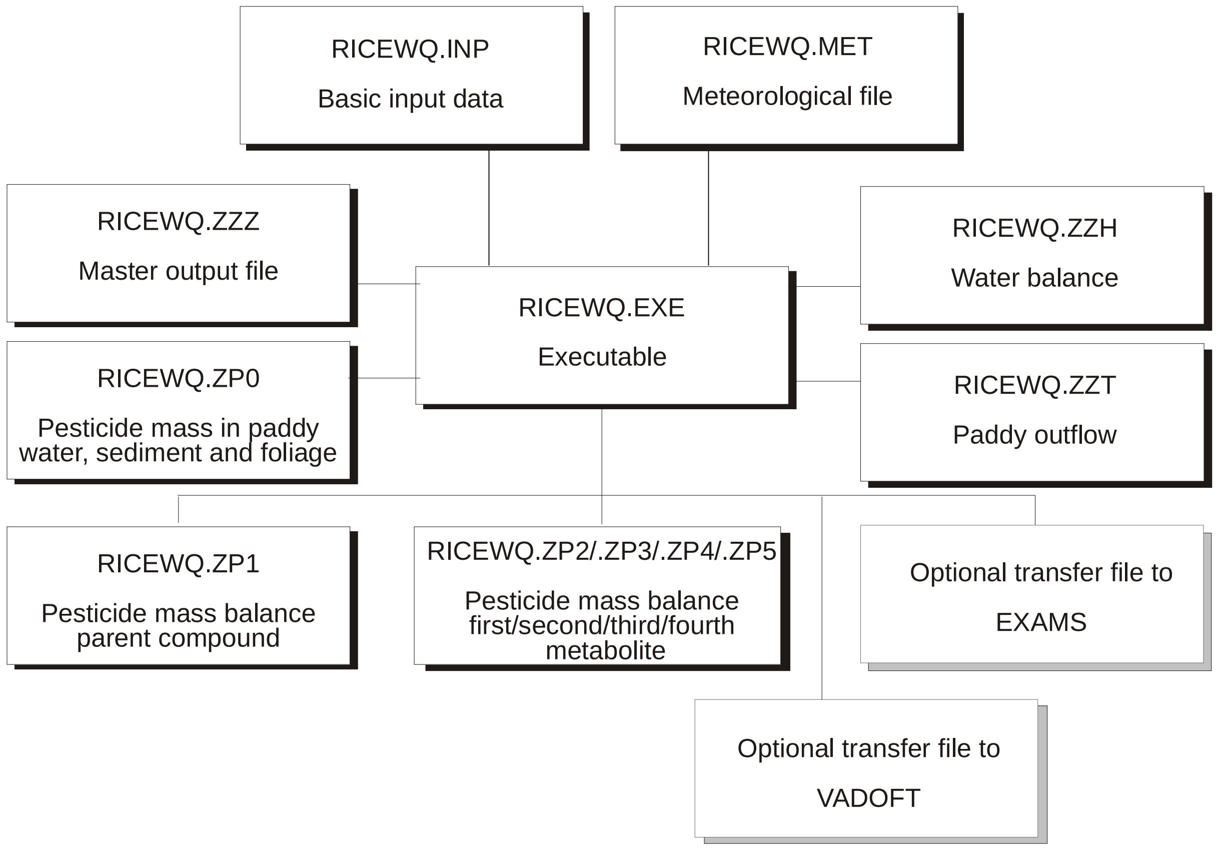

FIGURE 2. Input and Output File Structure

The file names listed above must be used when running the program (i.e., names are "hard-wired" in the program). MS-DOS batch files may be created to copy or rename default file names to and from user names. A sample batch file is provided in the example application (Section 6.0).

Input data requirements for both the basic input file (RICEWQ.INP) and the meteorological file (RICEWQ.MET) are described in the following tables. Each input file consists of "*card groups*" that contain parameter values for a specific category of input. Each *card* in a card group (e.g., 2A or 2B) represents a single line in the file.

Cards contain one or more parameter values which typically must reside within specific columns in the card. Exceptions are cards having *"free"* formats in which variables do not need to reside within specific columns, but must be separated by a comma (",") or space (" "). Card groups, parameter names and descriptions (including units of measure), and required columns are described below. The equivalent FORTRAN format is given in parentheses below column requirements.

METEOROLOGICAL FILE: RICEWQ.MET

Card Group	Columns	Parameter	Description
1A	2 - 3 4 - 5 6 - 7 8 - 17 18 - 27 *(1X, 3I2,, 2F10.2)*	MM MD MY PRECIP EVAP	Month Day Year Total precipitation for the day (cm) Total evaporation for the day (cm). Required only if EVAPM(1) is <0.0 (see card group 4B of RICEWQ.INP).
Note: Repeat card group 1A for every day of simulation JM, JD, JY through KM KD, KY (see card group 2B of RICEWQ.INP)			

BASIC INPUT DATA: RICEWQ.INP

Card Group	Format	Parameter	Description
1	1 - 80 *(A80)*	TITL(I), I=1,3	Title of simulation (3 lines)
2A	1 - 80 *(A80)*	IDUM	Card group identifier (Simulation Control)
2B	free *(*)*	JM JD JY KM KD KY NTSD EXFL	Month to begin simulation Day to begin simulation Year to begin simulation Month to end simulation Day to end simulation Year to end simulation Number of simulation time steps in a day EXAMS Flag 0 = Does not create an EXAMSII transfer file 1 = Creates an EXAMSII transfer file
3A	1-80 *(A80)*	IDUM	Card group identifier (Crop Related Properties)
3B	free *(*)*	JEM JED KMM KMD KHM KHD COVMAX IHFL	Month of crop emergence Day of crop emergence Month of crop maturation Day of crop maturation Month of harvest Day of harvest Maximum areal coverage of crop (fraction) Deposition of pesticide residues at harvest -1 = left alone -2 = foliar residues removed from system 0-100 = tillage (foliar residues added to sediment

Card Group	Format	Parameter	Description
			with IHFL being a user specified percentage in combined residue in active sediment layer - see DACT in card group 9B)
4A	1 - 80 *(A80)*	IDUM	Card group identifier (Irrigation and Drainage Controls)
4B	free *(*)*	NDORF	Number of drainage or irrigation changes
4C	free *(*)*	IDM(I) IDD(I) IRFLAG(I) DIRR1(I) DIRR2(I) IRATE(I) DOUT(I) DR8MAX(I)	Month to drain, irrigate, or stop irrigating paddy Day to drain, irrigate, or stop irrigating paddy Flag for drain/no irrigation (0), automatic irrigation (1), fixed volume irrigation (>1) Depth of water to initiate irrigation (cm) Depth of water to terminate irrigation (cm) Irrigation rate (cm/day) Depth of paddy outlet (cm) Maximum drainage rate (cm/day)
Note: Values for DIRR1 and DIRR2 are ignored unless IRFLAG=1 Note: Repeat card 4C for each drainage or irrigation change (I = 1, NDORF)			
5A	1-80 *(A80)*	IDUM	Card group identifier (Paddy Geometry)
5B	free *(*)*	SA DMAX DLAKE SEEP DACT FC WP SM BD CSS	Surface area of paddy (hectares) Depth of paddy outlet or berm height (cm) Initial depth of water in paddy (cm) Seepage rate (cm/ha/day) Depth of active sediment layer (cm) Field capacity (cm/cm) Wilting point (cm/cm) Initial soil moisture (cm/cm) Bulk density of bed sediment (g/cc) Suspended sediment concentration (mg/L)
6A	1-80 *(A80)*	IDUM	Card group identifier (Monthly Pan Evaporation)
6B	free *(*)*	EVAPM(I), I=1,12	Monthly average pan evaporation for each month of year (cm). Note: If daily pan evaporation will be read from meteorological file, RICEWQ.INP, set EVAPM(1) to -1.
7A	1 - 80 *(A80)*	IDUM	Card group identifier (Pesticide Application)
7B	free *(*)*	NAPP	Number of pesticide applications
7C	free *(*)*	IAM(I) IAD(I) APP(I) DINC(I)	Month pesticide is applied Day pesticide is applied Pesticide application rate (kg/ha) Depth of incorporation (cm)

Card Group	Format	Parameter	Description
		APPEF(I) DRIFT(I)	Application efficiency (fraction) Drift (percent) - used in EXAMSII transfer files
Note: repeat card group 7C for each application (I = 1, NAPP)			
8A	1 - 80 *(A80)*	IDUM	Card group identifier (Pesticide Related Properties)
8B	free *(*)*	NCHEM NPATHS	Number of chemicals in simulation Number of transformation paths for simulating metabolites
9A	1 - 80 *(A80)*	IDUM	Card group identifier (Pesticide Related Properties)
9B	free *(*)*	CNAME(I) CW0(I) CS0(I) CF0(I)	Chemical name Pesticide concentration in water (mg/L) Pesticide concentration in benthic sediments (mg/L) Pesticide concentration in foliage (mg/L)
Note: repeat card group 9B for each chemical (I = 1, NCHEM)			
10A	1 - 80 *(A80)*	IDUM	Card group identifier (Pesticide/Water Related Properties)
10B	free *(*)*	KWM(I) KWH(I) KWP(I) KSW(I) KSD(I) KF(I) WO(I) KD0(I) VVOL(I) VSETL(I) VBIND(I) VMIX(I) SOLUB(I) RREAC(I) SNK(I) BI-P(I)	Metabolism degradation rate in water (1/day) Hydrolysis degradation rate in water (1/day) Photolysis degradation rate in water (1/day) Degradation rate in saturated soil (sediment) (1/day) Degradation rate in unsaturated soil (1/day) Degradation rate on foliage (1/day) Washoff rate per cm of precipitation Water/sediment partition coefficient (cc/g) Volatilization coefficient (m/day) Settling velocity (m/day) Mixing depth to allow direct partitioning to bed (cm) Mixing velocity (diffusion) (m/day) Pesticide solubility in water (ppm) Release rate for slow release formulation (1/day) Fraction of non intercepted chemical immediately lost Flag for bi-phase transformation from parent to metabolite
Note: repeat card group 10B for each chemical (I = 1, NCHEM)			
11A	1 - 80 *(A80)*	IDUM	Card group identifier (Pesticide/Sediment Related Properties)
11B	free *(*)*	Parent(I) Met.(I) YWM(I) YWH(I) YWP(I) YSW(I) YSD(I)	Number corresponding to parent chemical Number corresponding to metabolite chemical Fraction yield in water (metab.), single or 1^{st} phase parent to met. Fraction yield in water (hydro.), single or 1^{st} phase parent to met. Fraction yield in water (photo.), single or 1^{st} phase parent to met. Fraction yield in sed., single or first phase parent to met. Fraction yield in soil, single or first phase parent to met.

Card Group	Format	Parameter	Description
		YF(I) YWM2(I) YWH2(I) YWP2(I) YSW2(I) YSD2(I) YF2(I) JDAT(I)	Fraction yield on foliage, single or first phase parent to met. Fraction yield in water (metabolism), second phase parent to met. Fraction yield in water (hydrolysis), second phase parent to met. Fraction yield in water (photolysis), second phase parent to met. Fraction yield in sediment, second phase parent to met. Fraction yield in soil, second phase parent to met. Fraction yield on foliage, second phase parent to met. Date to start using second phase yield
Note: repeat card group 11B for each transformation path (I = 1, NPATH)			
12A	1 - 80 *(A80)*	IDUM	Card group identifier (EXAMSII Transfer File Properties)
12B	free *(*)*	ENV CHM1 PRNT2 PRNT3 CHM2 NPROC2 RFORM2 YIELD2 CHM3 NPROC3 RFORM3 YIELD3	EXAMSII environment catalog number EXAMSII chemical catalog number for chemical 1 Number corresponding to parent of chemical 2 Number corresponding to parent of chemical 3 EXAMSII chemical catalog number for chemical 2 Signals the type of process transforming from parent to met. Gives the reactive molecular form from parent to met. Product yield from the transformation pathway dimensions of mole of transformation product produced per mole of parent compound reacted EXAMSII chemical catalog number for chemical 3 Signals the type of process transforming from parent to met. Gives the reactive molecular form from parent to met. Product yield from the transformation pathway dimensions of mole of transformation product produced per mole of parent compound reacted
Note: See EXAMSII manual for NPROC and RFORM			

BASIC OUTPUT DATA: RICEWQ.ZZT

Variable	Units	Description
QOUT	m^3	Outflow of paddy
POUT(I)	mg	Mass of pesticide outflux for I= 1, NCHEM

BASIC OUTPUT DATA: RICEWQ.ZZH

Variable	Units	Description
PRECIP	cm	Daily precipitation
EVAP	cm	Daily pan evaporation
SEEP	cm	Daily water loss due to seepage
IDORF	NA	Status of irrigation / drainage flag. 1 = irrigation permitted 0 = irrigation not permitted -1 = drainage permitted.
IRR	cm	Daily irrigation.
DW0	cm	Paddy depth
QOUT	m^3	Outflow of paddy

BASIC OUTPUT DATA: RICEWQ.ZP0

Variable	Units	Description
PW(I)	mg	Pesticide mass in water
PS(I)	mg	Pesticide mass in sediment
PF(I)	mg	Pesticide mass on foliage
Note: output repeated for each chemical (I = 1, NCHEM)		

BASIC OUTPUT DATA: RICEWQ.ZP1

Variable	Units	Description
PWAP	mg	Pesticide application for day to water (Parent only)
PSAP	mg	Pesticide application for day to sediment (Parent only)
PFAP	mg	Pesticide application for day to foliage (Parent only)
PSSR	mg	Daily total formed from slow release (Parent only)
WO	mg	Daily total washoff
DECAYW	mg	Daily total decayed in water
DECAYS	mg	Daily total decayed in sediment
DECAYF	mg	Daily total decayed on foliage
VOLAT	mg	Daily pesticide mass volatilized
SETL	mg	Daily mass of pesticide settled
BIND	mg	Daily mass of pesticide transfer to bed sediment from direct partitioning
SEEP	mg	Daily mass of pesticide lost from water through seepage
SEEPS	mg	Daily mass of pesticide lost from sediment through seepage
RESUS	mg	Daily mass of pesticide resuspended
DIFUS	mg	Daily mass of pesticide diffused between water and sediment
PF	mg	Daily mass on the foliage
PW1	mg	Daily mass of the parent in the water
PS1	mg	Daily mass of the parent in the sediment
PW2	mg	Daily mass of the first metabolite in the water
PS2	mg	Daily mass of the first metabolite in the sediment
PW3	mg	Daily mass of the second metabolite in the water
PS3	mg	Daily mass of the second metabolite in the sediment
PW4	mg	Daily mass of the third metabolite in the water
PS4	mg	Daily mass of the third metabolite in the sediment
CPW	ppm (mg/l)	Daily parent concentration in water
CPS	ppm (mg/kg)	Daily parent concentration in bottom sediments

BASIC OUTPUT DATA: RICEWQ.ZP(I), I=2,NCHEM

Variable	Units	Description
PWAP	mg	Pesticide application for day to water (Parent only)
PSAP	mg	Pesticide application for day to sediment (Parent only)
PFAP	mg	Pesticide application for day to foliage (Parent only)
PSSR	mg	Daily total formed from slow release (Parent only)
WO	mg	Daily total washoff
DECAYW	mg	Daily total decayed in water
DECAYS	mg	Daily total decayed in sediment
DECAYF	mg	Daily total decayed on foliage
VOLAT	mg	Daily pesticide mass volatilized
SETL	mg	Daily mass of pesticide settled
BIND	mg	Daily mass of pesticide transfer to bed sediment from direct partitioning
SEEP	mg	Daily mass of pesticide lost from water through seepage
SEEPS	mg	Daily mass of pesticide lost from sediment through seepage
RESUS	mg	Daily mass of pesticide resuspended
DIFUS	mg	Daily mass of pesticide diffused between water and sediment
PF	mg	Daily mass on the foliage
PW	mg	Daily mass of the pesticide in the water
PS	mg	Daily mass of the pesticide in the sediment
CPW	ppm (mg/l)	Daily parent concentration in water
CPS	ppm (mg/kg)	Daily parent concentration in bottom sediments

5.0 EXAMPLE PROBLEM

The example problem is the same one presented in earlier versions of this manual, except that the formation yields of metabolites have been changed to provide a more illustrative example

Given: Surface area of paddy (ha) = 32.40
1.12 kg/ha will be applied on 6/ 5/91 (Julian day 156).
Application efficiency= 100.0%
Drift= 0.0%

Date simulation begins = 6/ 4/91 (Julian day 155)
Date simulation ends = 7/24/91 (Julian day 205)
Date of crop emergence = 5/16/91 (Julian day 136)
Date of crop maturity = 6/17/91 (Julian day 168)
Date of crop harvest = 7/20/91 (Julian day 201)
Maximum coverage of crop (fraction) = 0.90

Deposition of pesticide residue after harvest = left alone

Berm height of paddy (cm) = 21.00
Depth of paddy outlet (cm) = 20.50
Initial depth of paddy (cm) = 20.00
Seepage rate of paddy (cm/day) = 0.020
Irrigation rate (cm/day) = 15.0
Depth at which irrigation will begin (cm) = 5.00
Depth at which irrigation will cease (cm) = 20.00
Irrigation may be applied up to 5 days of draining
Date to drain paddy = 7/ 3/91 (Julian day 184)
Maximum drainage rate (cm/day) = 5.00
Depth of active sediment layer (cm) = 5.00
Field capacity (cm/cm) = 0.39
Wilting point (cm/cm) = 0.24
Soil moisture (cm/cm) = field capacity
Bulk density of bed sediment (g/cc) = 1.50
Precipitation and pan evaporation will be read from a meteorological file

NOTE: For ease of presentation, the following values were the same for parent and all metabolites for this example. However, the user may enter different values for each chemical simulated.

Initial pesticide concentration (ppm) = 0.0000
Water metabolism decay rate (1/day) = 0.0230
Hydrolysis decay rate (1/day) = 0.0000
Aquatic photolysis decay rate (1/day) = 0.0000
Volatilization coefficient (m/day) = 0.0000
Sediment-water partition coefficient (cc/g) = 15.00
Mixing depth to allow direct partition to bed sediment (cm) = 0.10
Settling velocity (m/day) = 2.00
Mixing velocity (diffusion) m/day) = 0.001
Solubility (ppm) = 1,000,000.00

Initial pesticide conc. in bottom sediments (ppm) = 0.0000
Suspended sediment concentration (ppm) = 50.00
Saturated soil decay rate (1/day) = 0.0230
Unsaturated soil decay rate (1/day) = 0.0230

Release rate for slow release formulation (1/day) =0.00

Washoff rate per cm of precipitation = 0.2
Foliar decay rate (1/day) = 0.0230
Fraction of applied chemical in water immediately transformed to innocuous = 0.0
Fraction of parent degraded in water, sed. and on foliage forming metab. 1= 0.6
Fraction of parent degraded in water, sed. and on foliage forming metab. 2=0.4
Fraction of metab. 2 degraded in water, sed. and on foliage forming metab. 3 =0.7

NOTE: In the input file the parent is chemical 1, metabolite 1 is chemical 2, metabolite 2 is chemical 3 and metabolite 3 is chemical 4.

Files

Input Files
TEST190.INP = Basic input data file
TEST190.MET = Meteorological data

Output Files
TEST190.ZZZ = Input echo
TEST190.ZZH =Hydrologic summary
TEST190.ZP0 = Summary of water, sediment, and foliar mass for each chemical
TEST190.ZP1 = Parent summary
TEST190.ZP2 = Metabolite 1 summary
TEST190.ZP3 = Metabolite 2 summary
TEST190.ZP3 = Metabolite 3 summary

Rr.BAT= MS-DOS batch file to copy input and output files to and from default file names, execute RICEWQ, and delete scratch (temporary files).

To execute, type the following command from the MS-DOS prompt:
RR TEST190 <cr> (in which <cr> is carriage return)

The figure was created by importing columns from TEST190.ZZH, TEST190.ZZ0, TEST190.ZP1, TEST190.ZP2, TEST190.ZP3, and TEST190.ZZT into a spreadsheet.

Results

Results are shown in the attached figures. Concentrations in water and sediment are shown in Figure 3. Several "inflection" points can be seen in the concentration output. The first spike reflects pesticide application to the paddy and the second, smaller spike reflects pesticide washoff from plant foliage. Subtle changes in slope indicate overflow and/or dilution from precipitation events. The results of drainage are evident on Julian day 184. The listings of all input and output files are provided below.

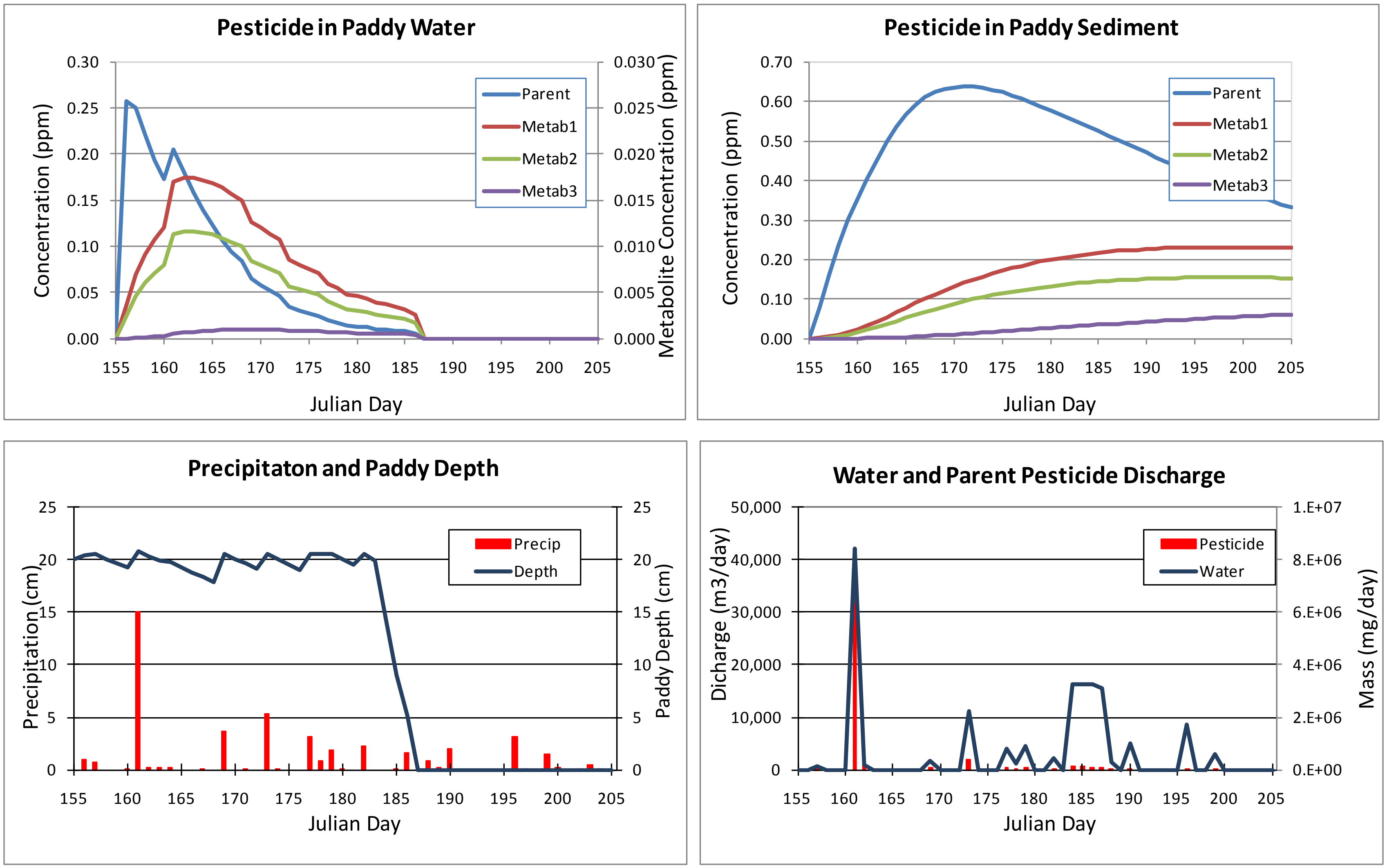

FIGURE 3: RICEWQ Results Using Hypothetical Example

BASIC INPUT DATA FILE: TEST173.INP

```
 TEST190.INP
 Hypothetical simulation of RICEWQ Version 1.90
 Four chemicals. Paths and yields modified compared to previous examples for better example.
**  JM  JD  JY    KM  KD  KY   NTSD EXFL -- Simulation dates / EXAMS flag
    06  04  91   07  24   91    24    0
** JEM JED    KMM KMD  KHM  KHD  COVMAX IHFL -- Crop dates, canopy
    05  16    06  17   07   20    0.90   -1
** IDM IDD IRFLAG  DIRR1  DIRR2 IRATE  DOUT DR8MAX  -- Irrigation & drainage
     3
     6  04     1    5.0   20.3   20.0  20.5    5.0
     6  28     0    5.0   20.3   20.0  20.5    5.0
     7   3     0    5.0   20.3   20.0    0.    5.0
**  SA  DMAX  DLAKE  SEEP  DACT   FC   WP  SM    BD   CSS
  32.4  21.0   20.5  0.02   5.0  .35  .24 .35  1.50   50.
** EVAPM(I),I=-1
    -8.00  8.00  8.00 10.00 12.00 13.00 13.00 12.00 11.00 10.00  8.00  8.00
** IAM IAD     APP   DINC   APPEF   DRIFT -- Appl. rates, efficiency (fraction), incorporation,
drift(%)
     1
    06  05   1.12  0.00   1.00   0.0
**  NCHEM  NPATHS
       4       3
**  CNAME   CW0  CS0  CF0
"Parent"    0.0  0.0  0.0
"Metab-1"   0.0  0.0  0.0
"Metab-2"   0.0  0.0  0.0
"Metab-3"   0.0  0.0  0.0
** KWM  KWH  KWP    KSW    KSD   KF   WO   KD VVOL VSETL VBIND  VMIX SOLUB RREAC  SNK BI-P
  .023 .000 .000   .023   .023 .023  0.2  15.  0.0   2.0   0.1  .001  1.E6  0.00  0.0   0
  .023 .000 .000   .023   .023 .023  0.2  15.  0.0   2.0   0.1  .001  1.E6  0.00  0.0   0
  .023 .000 .000   .023   .023 .023  0.2  15.  0.0   2.0   0.1  .001  1.E6  0.00  0.0   0
  .023 .000 .000   .023   .023 .023  0.2  15.  0.0   2.0   0.1  .001  1.E6  0.00  0.0   0
**PARENT DAUGHTER YWM  YWH  YWP  YSW YSD   YF  YWM2  YWH2  YWP2  YSW2  YSD2  YF2  JDAT
      1         2 0.6  0.0  0.0  0.6 0.6  0.6
      1         3 0.4  0.0  0.0  0.4 0.4  0.4
      3         4 0.7  0.0  0.0  0.7 0.7  0.7
*** ENV CHM1 PRNT2 PRNT3 CHM2 NPROC2 RFORM2 YIELD2 CHN3 NPROC3 RFORM3 YIELD3
      8    5     1     0    6      7      1  70.00    0      0      0  00.00
*** END OF DATA
```

BATCH FILE USED TO RENAME FILES AND EXECUTE RUN: R.BAT

```
echo off
copy %1.inp ricewq.inp
copy %1.met ricewq.met
cls
rice190.exe
copy ricewq.zzz %1.zzz
copy ricewq.zzh %1.zzh
copy ricewq.zzt %1.zzt
copy ricewq.zp0 %1.zp0
copy ricewq.zp1 %1.zp1
copy ricewq.zp2 %1.zp2
copy ricewq.zp3 %1.zp3
copy ricewq.zp4 %1.zp4
copy ricewq.zp5 %1.zp5
:pstrice.exe
:copy ricewq.dt1 %1.dt1
:copy ricewq.dt2 %1.dt2
del ricewq.inp
del ricewq.met
del ricewq.zz?
del ricewq.zp?
del ricewq.dt?
echo on
```

METEOROLOGICAL FILE: TEST173.MET

60391	0.000	0.524	28.900
60491	0.000	0.496	27.800
60591	0.965	0.496	27.600
60691	0.711	0.443	25.900
60791	0.000	0.443	25.200
60891	0.000	0.419	24.700
60991	0.076	0.419	24.400
61091	14.986	0.396	23.500
61191	0.203	0.469	26.100
61291	0.203	0.469	26.600
61391	0.254	0.469	26.600
61491	0.000	0.469	26.700
61591	0.000	0.469	26.700
61691	0.102	0.496	27.400
61791	0.000	0.496	27.600
61891	3.658	0.443	25.100
61991	0.000	0.469	26.100
62091	0.127	0.469	26.600
62191	0.000	0.496	27.200
62291	5.283	0.443	25.200
62391	0.025	0.469	26.800
62491	0.000	0.469	26.700
62591	0.000	0.469	26.600
62691	3.150	0.469	26.300
62791	0.838	0.443	25.800
62891	1.829	0.443	25.500
62991	0.025	0.496	27.200
63091	0.000	0.524	28.900
70191	2.286	0.554	28.500
70291	0.000	0.524	27.200
70391	0.000	0.496	26.900
70491	0.152	0.496	26.900
70591	1.651	0.469	25.500
70691	0.000	0.443	24.900
70791	0.914	0.469	25.300
70891	0.178	0.469	25.700
70991	2.007	0.469	25.000
71091	0.000	0.524	27.400
71191	0.000	0.554	28.000
71291	0.000	0.554	28.400
71391	0.000	0.554	28.400
71491	0.000	0.554	28.700
71591	3.175	0.496	26.900
71691	0.102	0.524	27.300
71791	0.000	0.524	27.900
71891	1.448	0.496	26.800
71991	0.254	0.524	27.100
72091	0.000	0.554	28.200
72191	0.025	0.524	27.400
72291	0.457	0.496	26.100
72391	0.025	0.496	26.900
72491	0.000	0.496	26.100

OUTPUT FILE WITH ECHO OF INPUT: TEST173.ZZZ

```
******************************************************
**       PESTICIDE RUNOFF MODEL FOR RICE CROPS       **
**              Windows Tier 2 Version               **
**               RICEWQ Version 1.90                 **
******************************************************
FILE:  RICEWQ.ZZZ
Simulation started:  8/ 4/  11  10:22:47
TEST190.INP
Hypothetical simulation of RICEWQ Version 1.90
Four chemicals. Paths and yields modified compared to previous examples for bet

Date simulation begins =  6/ 4/91 (Julian day 155)
Date simulation ends   =  7/24/91
Number of simulation time steps per day =   24

Emergence day of crop  =  5/16 (Julian day 136)
Maturity day of crop   =  6/17 (Julian day 168)
Harvest day of crop    =  7/20 (Julian day 201)

Maximum coverage of crop =0.90
Pesticide residues on foliage will be left alone and available for washoff (IHFL = -1).
Beginning  6/ 4 (Julian day 155) irrigation will be applied as necessary
    Depth at which irrigation will begin (cm) =  5.00
    Depth at which irrigation will cease (cm) = 20.30
    Maximum irrigation rate of paddy (cm/day) =   20.0
    Height of drainage outlet =   20.5
    Maximum drainage rate of paddy (cm/day) =   5.00
Beginning  6/28 (Julian day 179) irrigation will be prohibited.
    Height of drainage outlet =   20.5
    Maximum drainage rate of paddy (cm/day) =   5.00
Beginning  7/ 3 (Julian day 184) irrigation will be prohibited.
    Height of drainage outlet =   0.00
    Maximum drainage rate of paddy (cm/day) =   5.00

Surface area of paddy (ha) =  32.4
Depth of paddy outlet (cm) =   21.0
Initial depth of paddy (cm) =   20.5
Seepage rate of paddy (cm/day) =  0.200E-01
Depth of active sediment layer (cm) =  5.000
Field capacity of bed sediment = 0.3500
Wilting point of bed sediment = 0.2400
Initial soil moisture of bed sediment = 0.3500
Bulk density of bed sediment (g/cc) =  1.500
Porosity of bed sediment = 0.4340
Suspended sediment concentration (ppm) =  50.00

Evaporation will be read from meteorological file

1.120 kg/ha will be applied on  6/ 5 (Julian day 156)
Incorporation depth =  0.00 cm. Application efficiency = 1.120 kg/ha (100.00%)

Chemical name = Parent
Initial concentration in water (ppm)      =   0.00
Initial concentration in sediment (mg/kg) =   0.00
Initial mass on foliage (mg/ha)           =   0.00
Aqueous metabolism decay rate (1/day)     =  0.2300E-01
Aqueous hydrolysis decay rate (1/day)     =   0.000
Aqueous photolysis decay rate (1/day)     =   0.000
Saturated sediment decay rate (1/day)     =  0.2300E-01
Unsaturated sediment decay rate (1/day)   =  0.2300E-01
Foliar decay rate coefficient (1/day)     =  0.2300E-01
Washoff coefficient (fraction/cm rain)    =  0.2000
Water-sediment partition coefficient, Kd (cc/g) =   15.00
Volatilization coefficient (m/day) =   0.000
Settling velocity (m/day) =   2.000
Coefficient for direct partition to sediment bed =  0.1000
Mixing velocity (diffusion) m/day) =  0.1000E-02
```

```
Solubility (ppm) =  0.1000E+07
Slow release formulation rate (1/day) =   0.000
Fraction of degraded compound transformed in water to chemical 2    =  0.6000
Fraction of degraded compound transformed in sediment to chemical 2 =  0.6000
Fraction of degraded compound transformed in sediment to chemical 2 =  0.6000
Fraction of degraded compound transformed in foliage to chemical 2  =  0.6000
Fraction of degraded compound transformed in water to chemical 3    =  0.4000
Fraction of degraded compound transformed in sediment to chemical 3 =  0.4000
Fraction of degraded compound transformed in sediment to chemical 3 =  0.4000
Fraction of degraded compound transformed in foliage to chemical 3  =  0.4000

Chemical name = Metab-1
Initial concentration in water (ppm)      =   0.00
Initial concentration in sediment (mg/kg) =   0.00
Initial mass on foliage (mg/ha)           =   0.00
Aqueous metabolism decay rate (1/day)     =  0.2300E-01
Aqueous hydrolysis decay rate (1/day)     =   0.000
Aqueous photolysis decay rate (1/day)     =   0.000
Saturated sediment decay rate (1/day)     =  0.2300E-01
Unsaturated sediment decay rate (1/day)   =  0.2300E-01
Foliar decay rate coefficient (1/day)     =  0.2300E-01
Washoff coefficient (fraction/cm rain)    =  0.2000
Water-sediment partition coefficient, Kd (cc/g) =   15.00
Volatilization coefficient (m/day) =   0.000
Settling velocity (m/day) =   2.000
Coefficient for direct partition to sediment bed =  0.1000
Mixing velocity (diffusion) m/day) =  0.1000E-02
Solubility (ppm) =  0.1000E+07

Chemical name = Metab-2
Initial concentration in water (ppm)      =   0.00
Initial concentration in sediment (mg/kg) =   0.00
Initial mass on foliage (mg/ha)           =   0.00
Aqueous metabolism decay rate (1/day)     =  0.2300E-01
Aqueous hydrolysis decay rate (1/day)     =   0.000
Aqueous photolysis decay rate (1/day)     =   0.000
Saturated sediment decay rate (1/day)     =  0.2300E-01
Unsaturated sediment decay rate (1/day)   =  0.2300E-01
Foliar decay rate coefficient (1/day)     =  0.2300E-01
Washoff coefficient (fraction/cm rain)    =  0.2000
Water-sediment partition coefficient, Kd (cc/g) =   15.00
Volatilization coefficient (m/day) =   0.000
Settling velocity (m/day) =   2.000
Coefficient for direct partition to sediment bed =  0.1000
Mixing velocity (diffusion) m/day) =  0.1000E-02
Solubility (ppm) =  0.1000E+07
Fraction of degraded compound transformed in water to chemical 4    =  0.7000
Fraction of degraded compound transformed in sediment to chemical 4 =  0.7000
Fraction of degraded compound transformed in sediment to chemical 4 =  0.7000
Fraction of degraded compound transformed in foliage to chemical 4  =  0.7000

Chemical name = Metab-3
Initial concentration in water (ppm)      =   0.00
Initial concentration in sediment (mg/kg) =   0.00
Initial mass on foliage (mg/ha)           =   0.00
Aqueous metabolism decay rate (1/day)     =  0.2300E-01
Aqueous hydrolysis decay rate (1/day)     =   0.000
Aqueous photolysis decay rate (1/day)     =   0.000
Saturated sediment decay rate (1/day)     =  0.2300E-01
Unsaturated sediment decay rate (1/day)   =  0.2300E-01
Foliar decay rate coefficient (1/day)     =  0.2300E-01
Washoff coefficient (fraction/cm rain)    =  0.2000
Water-sediment partition coefficient, Kd (cc/g) =   15.00
Volatilization coefficient (m/day) =   0.000
Settling velocity (m/day) =   2.000
Coefficient for direct partition to sediment bed =  0.1000
Mixing velocity (diffusion) m/day) =  0.1000E-02
Solubility (ppm) =  0.1000E+07

RICEWQ TERMINATED PROPERLY
```

OUTPUT FILE WITH HYDROLOGIC SUMMARY: TEST173.ZZH

```
******************************************************
 **       PESTICIDE RUNOFF MODEL FOR RICE CROPS       **
 **              Windows Tier 2 Version               **
 **               RICEWQ Version 1.90                 **
 ******************************************************
 FILE:  RICEWQ.ZZH

 Simulation started:  8/ 4/  11  10:22:47

 TEST190.INP
 Hypothetical simulation of RICEWQ Version 1.90
 Four chemicals. Paths and yields modified compared to previous examples for bet
```

DATE	PRECIP (cm)	EVAP (cm)	SEEP (cm)	SEEPS (cm)	IRRIG	IRRIG (cm)	THETA (cm)	DEPTH (cm)	QOUT (m^3)
6/ 4/91	0.00	0.50	0.02	0.02	1	0.00	0.35	19.98	0.0000E+00
6/ 5/91	0.96	0.50	0.02	0.02	1	0.00	0.35	20.43	0.0000E+00
6/ 6/91	0.71	0.44	0.02	0.02	1	0.00	0.35	20.50	0.5864E+03
6/ 7/91	0.00	0.44	0.02	0.02	1	0.00	0.35	20.04	0.0000E+00
6/ 8/91	0.00	0.42	0.02	0.02	1	0.00	0.35	19.60	0.0000E+00
6/ 9/91	0.08	0.42	0.02	0.02	1	0.00	0.35	19.23	0.0000E+00
6/10/91	14.99	0.40	0.02	0.02	1	0.00	0.35	20.79	0.4216E+05
6/11/91	0.20	0.47	0.02	0.02	1	0.00	0.35	20.24	0.8678E+03
6/12/91	0.20	0.47	0.02	0.02	1	0.00	0.35	19.95	0.0000E+00
6/13/91	0.25	0.47	0.02	0.02	1	0.00	0.35	19.72	0.0000E+00
6/14/91	0.00	0.47	0.02	0.02	1	0.00	0.35	19.23	0.0000E+00
6/15/91	0.00	0.47	0.02	0.02	1	0.00	0.35	18.74	0.0000E+00
6/16/91	0.10	0.50	0.02	0.02	1	0.00	0.35	18.32	0.0000E+00
6/17/91	0.00	0.50	0.02	0.02	1	0.00	0.35	17.81	0.0000E+00
6/18/91	3.66	0.44	0.02	0.02	1	0.00	0.35	20.50	0.1632E+04
6/19/91	0.00	0.47	0.02	0.02	1	0.00	0.35	20.01	0.0000E+00
6/20/91	0.13	0.47	0.02	0.02	1	0.00	0.35	19.65	0.0000E+00
6/21/91	0.00	0.50	0.02	0.02	1	0.00	0.35	19.13	0.0000E+00
6/22/91	5.28	0.44	0.02	0.02	1	0.00	0.35	20.50	0.1119E+05
6/23/91	0.03	0.47	0.02	0.02	1	0.00	0.35	20.04	0.0000E+00
6/24/91	0.00	0.47	0.02	0.02	1	0.00	0.35	19.55	0.0000E+00
6/25/91	0.00	0.47	0.02	0.02	1	0.00	0.35	19.06	0.0000E+00
6/26/91	3.15	0.47	0.02	0.02	1	0.00	0.35	20.50	0.3949E+04
6/27/91	0.84	0.44	0.02	0.02	1	0.00	0.35	20.50	0.1215E+04
6/28/91	1.83	0.44	0.02	0.02	0	0.00	0.35	20.50	0.4426E+04
6/29/91	0.03	0.50	0.02	0.02	0	0.00	0.35	20.01	0.0000E+00
6/30/91	0.00	0.52	0.02	0.02	0	0.00	0.35	19.46	0.0000E+00
7/ 1/91	2.29	0.55	0.02	0.02	0	0.00	0.35	20.50	0.2193E+04
7/ 2/91	0.00	0.52	0.02	0.02	0	0.00	0.35	19.96	0.0000E+00
7/ 3/91	0.00	0.50	0.02	0.02	0	0.00	0.35	14.44	0.1620E+05
7/ 4/91	0.15	0.50	0.02	0.02	0	0.00	0.35	9.08	0.1620E+05
7/ 5/91	1.65	0.47	0.02	0.02	0	0.00	0.35	5.24	0.1620E+05
7/ 6/91	0.00	0.44	0.02	0.02	0	0.00	0.35	0.00	0.1552E+05
7/ 7/91	0.91	0.47	0.02	0.00	0	0.00	0.35	0.00	0.1377E+04
7/ 8/91	0.18	0.47	0.01	0.00	0	0.00	0.29	0.00	0.0000E+00
7/ 9/91	2.01	0.47	0.02	0.00	0	0.00	0.29	0.00	0.4918E+04
7/10/91	0.00	0.27	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/11/91	0.00	0.00	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/12/91	0.00	0.00	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/13/91	0.00	0.00	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/14/91	0.00	0.00	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/15/91	3.17	0.50	0.02	0.00	0	0.00	0.24	0.00	0.8615E+04
7/16/91	0.10	0.12	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/17/91	0.00	0.00	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/18/91	1.45	0.50	0.02	0.00	0	0.00	0.24	0.00	0.3020E+04
7/19/91	0.25	0.26	0.01	0.00	0	0.00	0.24	0.00	0.0000E+00
7/20/91	0.00	0.00	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/21/91	0.03	0.02	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/22/91	0.46	0.44	0.02	0.00	0	0.00	0.24	0.00	0.0000E+00
7/23/91	0.03	0.02	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00
7/24/91	0.00	0.00	0.00	0.00	0	0.00	0.24	0.00	0.0000E+00

OUTPUT FILE WITH PESTICIDE SUMMARY: TEST173.ZP0

```
*******************************************************
**       PESTICIDE RUNOFF MODEL FOR RICE CROPS       **
**              Windows Tier 2 Version               **
**               RICEWQ Version 1.90                 **
*******************************************************

FILE:  RICEWQ.ZP0

Simulation started:  8/ 4/  11  10:22:47

TEST190.INP
Hypothetical simulation of RICEWQ Version 1.90
Four chemicals. Paths and yields modified compared to previous examples for bet

Pesticide Mass (mg)
          1 Parent                        2 Metab-1                       3 Metab-2                       4 Metab-3
              Water   Sediment    Foliage         Water   Sediment    Foliage         Water   Sediment    Foliage         Water   Sediment
Foliage
  6/ 4/91 0.000E+00 0.000E+00 0.000E+00   0.000E+00 0.000E+00 0.000E+00   0.000E+00 0.000E+00 0.000E+00   0.000E+00 0.000E+00 0.000E+00
  6/ 5/91 0.170E+08 0.200E+07 0.164E+08   0.236E+06 0.277E+05 0.225E+06   0.158E+06 0.185E+05 0.150E+06   0.133E+04 0.156E+03 0.125E+04
  6/ 6/91 0.166E+08 0.397E+07 0.139E+08   0.460E+06 0.110E+06 0.382E+06   0.307E+06 0.733E+05 0.255E+06   0.506E+04 0.121E+04 0.415E+04
  6/ 7/91 0.143E+08 0.577E+07 0.136E+08   0.595E+06 0.239E+06 0.561E+06   0.397E+06 0.160E+06 0.374E+06   0.974E+04 0.392E+04 0.911E+04
  6/ 8/91 0.123E+08 0.730E+07 0.133E+08   0.682E+06 0.404E+06 0.732E+06   0.455E+06 0.269E+06 0.488E+06   0.148E+05 0.877E+04 0.158E+05
  6/ 9/91 0.108E+08 0.860E+07 0.128E+08   0.746E+06 0.594E+06 0.881E+06   0.497E+06 0.396E+06 0.588E+06   0.202E+05 0.161E+05 0.238E+05
  6/10/91 0.138E+08 0.977E+07 0.625E+06   0.114E+07 0.810E+06 0.506E+05   0.762E+06 0.540E+06 0.337E+05   0.370E+05 0.263E+05 0.160E+04
  6/11/91 0.118E+08 0.111E+08 0.587E+06   0.114E+07 0.107E+07 0.556E+05   0.761E+06 0.714E+06 0.370E+05   0.431E+05 0.405E+05 0.206E+04
  6/12/91 0.102E+08 0.122E+08 0.551E+06   0.113E+07 0.134E+07 0.597E+05   0.753E+06 0.895E+06 0.398E+05   0.487E+05 0.580E+05 0.253E+04
  6/13/91 0.887E+07 0.130E+08 0.511E+06   0.110E+07 0.162E+07 0.625E+05   0.734E+06 0.108E+07 0.417E+05   0.534E+05 0.786E+05 0.299E+04
  6/14/91 0.764E+07 0.138E+08 0.500E+06   0.105E+07 0.190E+07 0.680E+05   0.702E+06 0.127E+07 0.453E+05   0.567E+05 0.102E+06 0.361E+04
  6/15/91 0.656E+07 0.144E+08 0.488E+06   0.995E+06 0.218E+07 0.732E+05   0.664E+06 0.145E+07 0.488E+05   0.589E+05 0.129E+06 0.428E+04
  6/16/91 0.564E+07 0.148E+08 0.468E+06   0.933E+06 0.245E+07 0.765E+05   0.622E+06 0.164E+07 0.510E+05   0.602E+05 0.159E+06 0.489E+04
  6/17/91 0.482E+07 0.152E+08 0.457E+06   0.864E+06 0.272E+07 0.811E+05   0.576E+06 0.181E+07 0.541E+05   0.604E+05 0.190E+06 0.561E+04
  6/18/91 0.433E+07 0.153E+08 0.215E+06   0.835E+06 0.296E+07 0.410E+05   0.557E+06 0.197E+07 0.273E+05   0.629E+05 0.223E+06 0.305E+04
  6/19/91 0.377E+07 0.154E+08 0.210E+06   0.779E+06 0.320E+07 0.430E+05   0.519E+06 0.213E+07 0.286E+05   0.628E+05 0.258E+06 0.343E+04
  6/20/91 0.328E+07 0.155E+08 0.200E+06   0.723E+06 0.342E+07 0.437E+05   0.482E+06 0.228E+07 0.291E+05   0.622E+05 0.294E+06 0.372E+04
  6/21/91 0.284E+07 0.155E+08 0.196E+06   0.666E+06 0.364E+07 0.454E+05   0.444E+06 0.242E+07 0.303E+05   0.609E+05 0.332E+06 0.411E+04
  6/22/91 0.228E+07 0.154E+08 0.664E+05   0.564E+06 0.382E+07 0.163E+05   0.376E+06 0.255E+07 0.109E+05   0.546E+05 0.370E+06 0.156E+04
  6/23/91 0.199E+07 0.153E+08 0.646E+05   0.522E+06 0.400E+07 0.167E+05   0.348E+06 0.267E+07 0.112E+05   0.533E+05 0.409E+06 0.169E+04
  6/24/91 0.175E+07 0.151E+08 0.631E+05   0.481E+06 0.417E+07 0.172E+05   0.321E+06 0.278E+07 0.115E+05   0.517E+05 0.449E+06 0.183E+04
  6/25/91 0.153E+07 0.150E+08 0.617E+05   0.442E+06 0.433E+07 0.177E+05   0.295E+06 0.289E+07 0.118E+05   0.499E+05 0.489E+06 0.198E+04
  6/26/91 0.131E+07 0.148E+08 0.321E+05   0.398E+06 0.448E+07 0.964E+04   0.265E+06 0.299E+07 0.643E+04   0.470E+05 0.529E+06 0.113E+04
  6/27/91 0.115E+07 0.145E+08 0.265E+05   0.364E+06 0.461E+07 0.833E+04   0.243E+06 0.307E+07 0.555E+04   0.450E+05 0.570E+06 0.102E+04
  Lines removed for brevity
```

OUTPUT FILE WITH PESTICIDE SUMMARY: TEST173.ZP1

```
*******************************************************
**       PESTICIDE RUNOFF MODEL FOR RICE CROPS       **
**             Windows Tier 2 Version                **
**              RICEWQ Version 1.90                  **
*******************************************************
```

FILE: RICEWQ.ZP1

Simulation started: 8/ 4/ 11 10:22:47

TEST190.INP
Hypothetical simulation of RICEWQ Version 1.90
Four chemicals. Paths and yields modified compared to previous examples for bet

ass Balance Summary for Chemical 1 Parent

DATE	PWAP (mg)	PSAP (mg)	PFAP (mg)	PSSR (mg)	WO (mg)	DECAYW (mg)	DECAYS (mg)	DECAYF (mg)	VOLAT (mg)	SETL (mg)	BIND (mg)	SEEP (mg)
6/ 4/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
6/ 5/91	0.159E+08	0.000E+00	0.204E+08	0.000E+00	0.354E+07	0.383E+06	0.220E+05	0.421E+06	0.000E+00	0.121E+06	0.181E+07	0.160E+05
6/ 6/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.216E+07	0.390E+06	0.679E+05	0.348E+06	0.000E+00	0.122E+06	0.183E+07	0.162E+05
6/ 7/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.356E+06	0.112E+06	0.317E+06	0.000E+00	0.114E+06	0.172E+07	0.152E+05
6/ 8/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.307E+06	0.150E+06	0.310E+06	0.000E+00	0.101E+06	0.151E+07	0.134E+05
6/ 9/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.199E+06	0.266E+06	0.183E+06	0.300E+06	0.000E+00	0.892E+05	0.134E+07	0.118E+05
6/10/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.121E+08	0.362E+06	0.211E+06	0.872E+05	0.000E+00	0.836E+05	0.125E+07	0.111E+05
6/11/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.246E+05	0.293E+06	0.239E+06	0.139E+05	0.000E+00	0.933E+05	0.140E+07	0.124E+05
6/12/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.231E+05	0.254E+06	0.267E+06	0.131E+05	0.000E+00	0.820E+05	0.123E+07	0.109E+05
6/13/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.270E+05	0.220E+06	0.290E+06	0.122E+05	0.000E+00	0.718E+05	0.108E+07	0.953E+04
6/14/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.190E+06	0.308E+06	0.116E+05	0.000E+00	0.636E+05	0.954E+06	0.843E+04
6/15/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.163E+06	0.323E+06	0.114E+05	0.000E+00	0.561E+05	0.842E+06	0.744E+04
6/16/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.976E+04	0.140E+06	0.335E+06	0.110E+05	0.000E+00	0.492E+05	0.739E+06	0.653E+04
6/17/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.120E+06	0.345E+06	0.106E+05	0.000E+00	0.434E+05	0.651E+06	0.576E+04
6/18/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.235E+06	0.107E+06	0.351E+06	0.727E+04	0.000E+00	0.329E+05	0.494E+06	0.437E+04
6/19/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.932E+05	0.354E+06	0.489E+04	0.000E+00	0.300E+05	0.450E+06	0.398E+04
6/20/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.521E+04	0.811E+05	0.356E+06	0.471E+04	0.000E+00	0.266E+05	0.398E+06	0.352E+04
6/21/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.704E+05	0.356E+06	0.455E+04	0.000E+00	0.237E+05	0.355E+06	0.314E+04
6/22/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.126E+06	0.604E+05	0.355E+06	0.269E+04	0.000E+00	0.172E+05	0.258E+06	0.228E+04
6/23/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.328E+03	0.491E+05	0.353E+06	0.151E+04	0.000E+00	0.158E+05	0.237E+06	0.210E+04
6/24/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.431E+05	0.350E+06	0.147E+04	0.000E+00	0.142E+05	0.213E+06	0.188E+04
6/25/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.377E+05	0.346E+06	0.144E+04	0.000E+00	0.127E+05	0.191E+06	0.169E+04
6/26/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.286E+05	0.332E+05	0.342E+06	0.103E+04	0.000E+00	0.100E+05	0.150E+06	0.133E+04
6/27/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.490E+04	0.283E+05	0.337E+06	0.670E+03	0.000E+00	0.883E+04	0.132E+06	0.117E+04
6/28/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.805E+04	0.244E+05	0.331E+06	0.502E+03	0.000E+00	0.744E+04	0.112E+06	0.988E+03
6/29/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.888E+02	0.212E+05	0.326E+06	0.408E+03	0.000E+00	0.681E+04	0.102E+06	0.904E+03
6/30/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.189E+05	0.320E+06	0.398E+03	0.000E+00	0.624E+04	0.936E+05	0.829E+03
7/ 1/91	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.621E+04	0.169E+05	0.314E+06	0.309E+03	0.000E+00	0.519E+04	0.778E+05	0.689E+03

Lines removed for brevity

OUTPUT FILE WITH PESTICIDE SUMMARY: TEST173.ZP1 (Continued)

SEEPS (mg)	RESUS (mg)	DIFUS (mg)	PF (mg)	PW1 (mg)	PS1 (mg)	CPW (mg/l)	CPS (mg/kg)
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.181E+03	0.125E+04	-0.796E+05	0.164E+08	0.170E+08	0.200E+07	0.257E+00	0.824E-01
0.530E+03	0.387E+04	-0.787E+05	0.139E+08	0.166E+08	0.397E+07	0.250E+00	0.164E+00
0.860E+03	0.636E+04	-0.721E+05	0.136E+08	0.143E+08	0.577E+07	0.221E+00	0.238E+00
0.115E+04	0.854E+04	-0.616E+05	0.133E+08	0.123E+08	0.730E+07	0.194E+00	0.301E+00
0.139E+04	0.104E+05	-0.526E+05	0.128E+08	0.108E+08	0.860E+07	0.173E+00	0.354E+00
0.161E+04	0.120E+05	-0.477E+05	0.625E+06	0.138E+08	0.977E+07	0.205E+00	0.402E+00
0.183E+04	0.136E+05	-0.531E+05	0.587E+06	0.118E+08	0.111E+08	0.180E+00	0.456E+00
0.203E+04	0.152E+05	-0.445E+05	0.551E+06	0.102E+08	0.122E+08	0.158E+00	0.500E+00
0.220E+04	0.165E+05	-0.369E+05	0.511E+06	0.887E+07	0.130E+08	0.139E+00	0.537E+00
0.234E+04	0.175E+05	-0.307E+05	0.500E+06	0.764E+07	0.138E+08	0.123E+00	0.567E+00
0.246E+04	0.184E+05	-0.251E+05	0.488E+06	0.656E+07	0.144E+08	0.108E+00	0.591E+00
0.255E+04	0.191E+05	-0.201E+05	0.468E+06	0.564E+07	0.148E+08	0.949E-01	0.610E+00
0.262E+04	0.196E+05	-0.159E+05	0.457E+06	0.482E+07	0.152E+08	0.835E-01	0.624E+00
0.266E+04	0.200E+05	-0.865E+04	0.215E+06	0.433E+07	0.153E+08	0.652E-01	0.631E+00
0.268E+04	0.201E+05	-0.656E+04	0.210E+06	0.377E+07	0.154E+08	0.581E-01	0.636E+00
0.270E+04	0.202E+05	-0.421E+04	0.200E+06	0.328E+07	0.155E+08	0.515E-01	0.638E+00
0.270E+04	0.203E+05	-0.226E+04	0.196E+06	0.284E+07	0.155E+08	0.459E-01	0.638E+00
0.270E+04	0.202E+05	0.202E+04	0.664E+05	0.228E+07	0.154E+08	0.343E-01	0.634E+00
0.267E+04	0.201E+05	0.285E+04	0.646E+05	0.199E+07	0.153E+08	0.307E-01	0.629E+00
0.265E+04	0.199E+05	0.381E+04	0.631E+05	0.175E+07	0.151E+08	0.276E-01	0.623E+00
0.262E+04	0.197E+05	0.465E+04	0.617E+05	0.153E+07	0.150E+08	0.247E-01	0.616E+00
0.259E+04	0.194E+05	0.630E+04	0.321E+05	0.131E+07	0.148E+08	0.197E-01	0.607E+00
0.255E+04	0.192E+05	0.689E+04	0.265E+05	0.115E+07	0.145E+08	0.173E-01	0.598E+00
0.251E+04	0.189E+05	0.762E+04	0.180E+05	0.972E+06	0.143E+08	0.146E-01	0.588E+00
0.247E+04	0.185E+05	0.782E+04	0.175E+05	0.868E+06	0.140E+08	0.134E-01	0.578E+00
0.243E+04	0.182E+05	0.799E+04	0.171E+05	0.774E+06	0.138E+08	0.123E-01	0.568E+00
0.238E+04	0.179E+05	0.847E+04	0.106E+05	0.684E+06	0.135E+08	0.103E-01	0.557E+00
0.234E+04	0.175E+05	0.848E+04	0.103E+05	0.617E+06	0.133E+08	0.955E-02	0.547E+00
0.229E+04	0.172E+05	0.849E+04	0.101E+05	0.410E+06	0.130E+08	0.877E-02	0.536E+00
0.225E+04	0.169E+05	0.856E+04	0.958E+04	0.230E+06	0.128E+08	0.781E-02	0.525E+00
0.220E+04	0.165E+05	0.898E+04	0.673E+04	0.104E+06	0.125E+08	0.611E-02	0.514E+00
0.207E+04	0.162E+05	0.904E+04	0.657E+04	0.000E+00	0.122E+08	0.000E+00	0.503E+00
0.420E+03	0.158E+05	0.105E+05	0.535E+04	0.000E+00	0.119E+08	0.000E+00	0.492E+00
0.000E+00	0.155E+05	0.103E+05	0.505E+04	0.000E+00	0.117E+08	0.000E+00	0.481E+00
0.000E+00	0.151E+05	0.101E+05	0.330E+04	0.000E+00	0.114E+08	0.000E+00	0.470E+00
0.000E+00	0.000E+00	0.000E+00	0.323E+04	0.000E+00	0.112E+08	0.000E+00	0.459E+00
0.000E+00	0.000E+00	0.000E+00	0.315E+04	0.000E+00	0.109E+08	0.000E+00	0.448E+00
0.000E+00	0.000E+00	0.000E+00	0.308E+04	0.000E+00	0.107E+08	0.000E+00	0.438E+00

Lines removed for brevity

OUTPUT FILE WITH PESTICIDE SUMMARY: TEST173.ZP2

```
*******************************************************
**       PESTICIDE RUNOFF MODEL FOR RICE CROPS       **
**              Windows Tier 2 Version               **
**               RICEWQ Version 1.90                 **
*******************************************************
```

FILE: RICEWQ.ZP2

Simulation started: 8/ 4/ 11 10:22:47

TEST190.INP
Hypothetical simulation of RICEWQ Version 1.90
Four chemicals. Paths and yields modified compared to previous examples for bet

ass Balance Summary for Chemical 2 Metab-1

DATE	PWAP (mg)	PSAP (mg)	PFAP (mg)	PSSR (mg)	WO (mg)	DECAYW (mg)	DECAYS (mg)	DECAYF (mg)	VOLAT (mg)	SETL (mg)	BIND (mg)
6/ 4/91					0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
6/ 5/91					0.244E+05	0.280E+04	0.212E+03	0.289E+04	0.000E+00	0.880E+03	0.132E+05
6/ 6/91					0.445E+05	0.821E+04	0.148E+04	0.717E+04	0.000E+00	0.257E+04	0.385E+05
6/ 7/91					0.000E+00	0.124E+05	0.394E+04	0.110E+05	0.000E+00	0.398E+04	0.597E+05
6/ 8/91					0.000E+00	0.149E+05	0.734E+04	0.150E+05	0.000E+00	0.490E+04	0.735E+05
6/ 9/91					0.123E+05	0.166E+05	0.114E+05	0.187E+05	0.000E+00	0.557E+04	0.835E+05
6/10/91					0.877E+06	0.276E+05	0.161E+05	0.631E+04	0.000E+00	0.637E+04	0.956E+05
6/11/91					0.217E+04	0.263E+05	0.216E+05	0.123E+04	0.000E+00	0.837E+04	0.126E+06
6/12/91					0.235E+04	0.263E+05	0.277E+05	0.133E+04	0.000E+00	0.849E+04	0.127E+06
6/13/91					0.312E+04	0.258E+05	0.341E+05	0.141E+04	0.000E+00	0.843E+04	0.126E+06
6/14/91					0.000E+00	0.249E+05	0.405E+05	0.150E+04	0.000E+00	0.834E+04	0.125E+06
6/15/91					0.000E+00	0.237E+05	0.470E+05	0.163E+04	0.000E+00	0.813E+04	0.122E+06
6/16/91					0.153E+04	0.223E+05	0.533E+05	0.172E+04	0.000E+00	0.782E+04	0.117E+06
6/17/91					0.000E+00	0.208E+05	0.596E+05	0.182E+04	0.000E+00	0.749E+04	0.112E+06
6/18/91					0.431E+05	0.199E+05	0.654E+05	0.133E+04	0.000E+00	0.613E+04	0.920E+05
6/19/91					0.000E+00	0.186E+05	0.709E+05	0.967E+03	0.000E+00	0.600E+04	0.899E+05
6/20/91					0.110E+04	0.173E+05	0.762E+05	0.998E+03	0.000E+00	0.568E+04	0.852E+05
6/21/91					0.000E+00	0.160E+05	0.812E+05	0.103E+04	0.000E+00	0.539E+04	0.808E+05
6/22/91					0.301E+05	0.146E+05	0.859E+05	0.640E+03	0.000E+00	0.415E+04	0.622E+05
6/23/91					0.828E+02	0.125E+05	0.901E+05	0.380E+03	0.000E+00	0.403E+04	0.604E+05
6/24/91					0.000E+00	0.116E+05	0.942E+05	0.391E+03	0.000E+00	0.381E+04	0.572E+05
6/25/91					0.000E+00	0.107E+05	0.979E+05	0.402E+03	0.000E+00	0.360E+04	0.540E+05
6/26/91					0.837E+04	0.984E+04	0.101E+06	0.301E+03	0.000E+00	0.296E+04	0.445E+05
6/27/91					0.151E+04	0.879E+04	0.105E+06	0.206E+03	0.000E+00	0.274E+04	0.411E+05
6/28/91					0.258E+04	0.791E+04	0.108E+06	0.161E+03	0.000E+00	0.241E+04	0.361E+05

Lines removed for brevity

OUTPUT FILE WITH PESTICIDE SUMMARY: TEST173.ZP2 (Continued)

SEEP (mg)	SEEPS (mg)	RESUS (mg)	DIFUS (mg)	PF (mg)	PW (mg)	PS (mg)	CPW (mg/l)	CPS (mg/kg)
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.117E+03	0.171E+01	0.120E+02	-0.578E+03	0.225E+06	0.236E+06	0.277E+05	0.357E-02	0.114E-02
0.340E+03	0.115E+02	0.844E+02	-0.166E+04	0.382E+06	0.460E+06	0.110E+06	0.693E-02	0.453E-02
0.528E+03	0.304E+02	0.224E+03	-0.250E+04	0.561E+06	0.595E+06	0.239E+06	0.916E-02	0.986E-02
0.650E+03	0.562E+02	0.418E+03	-0.299E+04	0.732E+06	0.682E+06	0.404E+06	0.107E-01	0.166E-01
0.738E+03	0.874E+02	0.651E+03	-0.328E+04	0.881E+06	0.746E+06	0.594E+06	0.120E-01	0.245E-01
0.846E+03	0.123E+03	0.916E+03	-0.364E+04	0.506E+05	0.114E+07	0.810E+06	0.170E-01	0.333E-01
0.111E+04	0.165E+03	0.123E+04	-0.476E+04	0.556E+05	0.114E+07	0.107E+07	0.174E-01	0.441E-01
0.113E+04	0.211E+03	0.158E+04	-0.461E+04	0.597E+05	0.113E+07	0.134E+07	0.175E-01	0.553E-01
0.112E+04	0.259E+03	0.194E+04	-0.433E+04	0.625E+05	0.110E+07	0.162E+07	0.172E-01	0.667E-01
0.111E+04	0.308E+03	0.231E+04	-0.402E+04	0.680E+05	0.105E+07	0.190E+07	0.169E-01	0.782E-01
0.108E+04	0.357E+03	0.267E+04	-0.364E+04	0.732E+05	0.995E+06	0.218E+07	0.164E-01	0.897E-01
0.104E+04	0.405E+03	0.303E+04	-0.319E+04	0.765E+05	0.933E+06	0.245E+07	0.157E-01	0.101E+00
0.993E+03	0.452E+03	0.339E+04	-0.273E+04	0.811E+05	0.864E+06	0.272E+07	0.150E-01	0.112E+00
0.814E+03	0.496E+03	0.372E+04	-0.161E+04	0.410E+05	0.835E+06	0.296E+07	0.126E-01	0.122E+00
0.795E+03	0.538E+03	0.403E+04	-0.131E+04	0.430E+05	0.779E+06	0.320E+07	0.120E-01	0.132E+00
0.753E+03	0.578E+03	0.433E+04	-0.896E+03	0.437E+05	0.723E+06	0.342E+07	0.114E-01	0.141E+00
0.715E+03	0.616E+03	0.462E+04	-0.510E+03	0.454E+05	0.666E+06	0.364E+07	0.107E-01	0.150E+00
0.551E+03	0.651E+03	0.489E+04	0.494E+03	0.163E+05	0.564E+06	0.382E+07	0.850E-02	0.157E+00
0.535E+03	0.683E+03	0.513E+04	0.733E+03	0.167E+05	0.522E+06	0.400E+07	0.805E-02	0.165E+00
0.506E+03	0.714E+03	0.536E+04	0.103E+04	0.172E+05	0.481E+06	0.417E+07	0.760E-02	0.172E+00
0.477E+03	0.743E+03	0.557E+04	0.132E+04	0.177E+05	0.442E+06	0.433E+07	0.716E-02	0.178E+00
0.394E+03	0.769E+03	0.577E+04	0.187E+04	0.964E+04	0.398E+06	0.448E+07	0.599E-02	0.184E+00
0.364E+03	0.793E+03	0.595E+04	0.214E+04	0.833E+04	0.364E+06	0.461E+07	0.549E-02	0.190E+00
0.320E+03	0.815E+03	0.612E+04	0.247E+04	0.589E+04	0.322E+06	0.473E+07	0.484E-02	0.195E+00
0.306E+03	0.835E+03	0.627E+04	0.265E+04	0.597E+04	0.299E+06	0.484E+07	0.461E-02	0.199E+00
0.291E+03	0.854E+03	0.641E+04	0.281E+04	0.607E+04	0.278E+06	0.495E+07	0.440E-02	0.204E+00
0.252E+03	0.871E+03	0.654E+04	0.310E+04	0.390E+04	0.255E+06	0.504E+07	0.383E-02	0.208E+00
0.243E+03	0.887E+03	0.666E+04	0.322E+04	0.395E+04	0.238E+06	0.513E+07	0.369E-02	0.211E+00
0.234E+03	0.902E+03	0.677E+04	0.334E+04	0.400E+04	0.164E+06	0.521E+07	0.351E-02	0.214E+00
0.218E+03	0.915E+03	0.687E+04	0.348E+04	0.393E+04	0.950E+05	0.528E+07	0.323E-02	0.217E+00
0.170E+03	0.927E+03	0.696E+04	0.378E+04	0.285E+04	0.443E+05	0.534E+07	0.261E-02	0.220E+00
0.175E+03	0.897E+03	0.703E+04	0.393E+04	0.287E+04	0.000E+00	0.540E+07	0.000E+00	0.222E+00
0.222E+02	0.191E+03	0.709E+04	0.473E+04	0.241E+04	0.000E+00	0.544E+07	0.000E+00	0.224E+00
0.406E+02	0.000E+00	0.715E+04	0.476E+04	0.235E+04	0.000E+00	0.548E+07	0.000E+00	0.225E+00
0.105E+02	0.000E+00	0.719E+04	0.479E+04	0.158E+04	0.000E+00	0.551E+07	0.000E+00	0.227E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.159E+04	0.000E+00	0.554E+07	0.000E+00	0.228E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.160E+04	0.000E+00	0.556E+07	0.000E+00	0.229E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.160E+04	0.000E+00	0.558E+07	0.000E+00	0.230E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.161E+04	0.000E+00	0.560E+07	0.000E+00	0.230E+00

Lines removed for brevity

OUTPUT FILE WITH PESTICIDE SUMMARY: TEST173.ZP3

```
*******************************************************
**       PESTICIDE RUNOFF MODEL FOR RICE CROPS       **
**              Windows Tier 2 Version               **
**               RICEWQ Version 1.90                 **
*******************************************************

FILE:  RICEWQ.ZP3

Simulation started:  8/ 4/  11  10:22:47

TEST190.INP
Hypothetical simulation of RICEWQ Version 1.90
Four chemicals. Paths and yields modified compared to previous examples for bet

ass Balance Summary for Chemical 3 Metab-2
```

DATE	PWAP (mg)	PSAP (mg)	PFAP (mg)	PSSR (mg)	WO (mg)	DECAYW (mg)	DECAYS (mg)	DECAYF (mg)	VOLAT (mg)	SETL (mg)	BIND (mg)
6/ 4/91					0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
6/ 5/91					0.163E+05	0.187E+04	0.141E+03	0.193E+04	0.000E+00	0.586E+03	0.880E+04
6/ 6/91					0.297E+05	0.547E+04	0.988E+03	0.478E+04	0.000E+00	0.171E+04	0.257E+05
6/ 7/91					0.000E+00	0.824E+04	0.263E+04	0.730E+04	0.000E+00	0.265E+04	0.398E+05
6/ 8/91					0.000E+00	0.993E+04	0.490E+04	0.998E+04	0.000E+00	0.327E+04	0.490E+05
6/ 9/91					0.823E+04	0.111E+05	0.763E+04	0.124E+05	0.000E+00	0.371E+04	0.557E+05
6/10/91					0.584E+06	0.184E+05	0.107E+05	0.421E+04	0.000E+00	0.425E+04	0.637E+05
6/11/91					0.144E+04	0.175E+05	0.144E+05	0.817E+03	0.000E+00	0.558E+04	0.837E+05
6/12/91					0.157E+04	0.175E+05	0.185E+05	0.887E+03	0.000E+00	0.566E+04	0.849E+05
6/13/91					0.208E+04	0.172E+05	0.227E+05	0.940E+03	0.000E+00	0.562E+04	0.843E+05
6/14/91					0.000E+00	0.166E+05	0.270E+05	0.100E+04	0.000E+00	0.556E+04	0.834E+05
6/15/91					0.000E+00	0.158E+05	0.313E+05	0.108E+04	0.000E+00	0.542E+04	0.813E+05
6/16/91					0.102E+04	0.149E+05	0.356E+05	0.115E+04	0.000E+00	0.521E+04	0.782E+05
6/17/91					0.000E+00	0.138E+05	0.397E+05	0.121E+04	0.000E+00	0.499E+04	0.749E+05
6/18/91					0.287E+05	0.132E+05	0.436E+05	0.889E+03	0.000E+00	0.409E+04	0.613E+05
6/19/91					0.000E+00	0.124E+05	0.473E+05	0.645E+03	0.000E+00	0.400E+04	0.600E+05
6/20/91					0.735E+03	0.116E+05	0.508E+05	0.665E+03	0.000E+00	0.379E+04	0.568E+05
6/21/91					0.000E+00	0.107E+05	0.542E+05	0.684E+03	0.000E+00	0.359E+04	0.539E+05
6/22/91					0.200E+05	0.972E+04	0.573E+05	0.427E+03	0.000E+00	0.276E+04	0.415E+05
6/23/91					0.552E+02	0.836E+04	0.601E+05	0.254E+03	0.000E+00	0.269E+04	0.403E+05
6/24/91					0.000E+00	0.772E+04	0.628E+05	0.261E+03	0.000E+00	0.254E+04	0.381E+05
6/25/91					0.000E+00	0.710E+04	0.653E+05	0.268E+03	0.000E+00	0.240E+04	0.360E+05
6/26/91					0.558E+04	0.656E+04	0.676E+05	0.201E+03	0.000E+00	0.198E+04	0.296E+05
6/27/91					0.100E+04	0.586E+04	0.697E+05	0.137E+03	0.000E+00	0.183E+04	0.274E+05
6/28/91					0.172E+04	0.527E+04	0.717E+05	0.107E+03	0.000E+00	0.161E+04	0.241E+05
6/29/91					0.198E+02	0.477E+04	0.735E+05	0.910E+02	0.000E+00	0.153E+04	0.230E+05
6/30/91					0.000E+00	0.443E+04	0.751E+05	0.924E+02	0.000E+00	0.146E+04	0.219E+05
7/ 1/91					0.150E+04	0.413E+04	0.767E+05	0.745E+02	0.000E+00	0.126E+04	0.189E+05
7/ 2/91					0.000E+00	0.379E+04	0.780E+05	0.602E+02	0.000E+00	0.122E+04	0.183E+05
7/ 3/91					0.000E+00	0.311E+04	0.793E+05	0.610E+02	0.000E+00	0.117E+04	0.176E+05
7/ 4/91					0.804E+02	0.200E+04	0.805E+05	0.608E+02	0.000E+00	0.110E+04	0.164E+05

Lines removed for brevity

OUTPUT FILE WITH PESTICIDE SUMMARY: TEST173.ZP3 (Continued)

SEEP (mg)	SEEPS (mg)	RESUS (mg)	DIFUS (mg)	PF (mg)	PW (mg)	PS (mg)	CPW (mg/l)	CPS (mg/kg)
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.778E+02	0.114E+01	0.802E+01	-0.386E+03	0.150E+06	0.158E+06	0.185E+05	0.238E-02	0.761E-03
0.227E+03	0.770E+01	0.562E+02	-0.110E+04	0.255E+06	0.307E+06	0.733E+05	0.462E-02	0.302E-02
0.352E+03	0.202E+02	0.150E+03	-0.167E+04	0.374E+06	0.397E+06	0.160E+06	0.611E-02	0.657E-02
0.433E+03	0.375E+02	0.279E+03	-0.199E+04	0.488E+06	0.455E+06	0.269E+06	0.717E-02	0.111E-01
0.492E+03	0.582E+02	0.434E+03	-0.218E+04	0.588E+06	0.497E+06	0.396E+06	0.798E-02	0.163E-01
0.564E+03	0.819E+02	0.611E+03	-0.242E+04	0.337E+05	0.762E+06	0.540E+06	0.113E-01	0.222E-01
0.740E+03	0.110E+03	0.819E+03	-0.317E+04	0.370E+05	0.761E+06	0.714E+06	0.116E-01	0.294E-01
0.750E+03	0.141E+03	0.105E+04	-0.307E+04	0.398E+05	0.753E+06	0.895E+06	0.116E-01	0.368E-01
0.745E+03	0.173E+03	0.129E+04	-0.288E+04	0.417E+05	0.734E+06	0.108E+07	0.115E-01	0.445E-01
0.737E+03	0.205E+03	0.154E+04	-0.268E+04	0.453E+05	0.702E+06	0.127E+07	0.113E-01	0.521E-01
0.719E+03	0.238E+03	0.178E+04	-0.243E+04	0.488E+05	0.664E+06	0.145E+07	0.109E-01	0.598E-01
0.691E+03	0.270E+03	0.202E+04	-0.213E+04	0.510E+05	0.622E+06	0.164E+07	0.105E-01	0.673E-01
0.662E+03	0.301E+03	0.226E+04	-0.182E+04	0.541E+05	0.576E+06	0.181E+07	0.998E-02	0.746E-01
0.542E+03	0.331E+03	0.248E+04	-0.107E+04	0.273E+05	0.557E+06	0.197E+07	0.838E-02	0.813E-01
0.530E+03	0.359E+03	0.269E+04	-0.872E+03	0.286E+05	0.519E+06	0.213E+07	0.801E-02	0.877E-01
0.502E+03	0.385E+03	0.289E+04	-0.597E+03	0.291E+05	0.482E+06	0.228E+07	0.757E-02	0.939E-01
0.477E+03	0.411E+03	0.308E+04	-0.340E+03	0.303E+05	0.444E+06	0.242E+07	0.716E-02	0.998E-01
0.367E+03	0.434E+03	0.326E+04	0.330E+03	0.109E+05	0.376E+06	0.255E+07	0.566E-02	0.105E+00
0.356E+03	0.456E+03	0.342E+04	0.489E+03	0.112E+05	0.348E+06	0.267E+07	0.536E-02	0.110E+00
0.337E+03	0.476E+03	0.357E+04	0.687E+03	0.115E+05	0.321E+06	0.278E+07	0.507E-02	0.115E+00
0.318E+03	0.495E+03	0.372E+04	0.878E+03	0.118E+05	0.295E+06	0.289E+07	0.477E-02	0.119E+00
0.262E+03	0.513E+03	0.385E+04	0.125E+04	0.643E+04	0.265E+06	0.299E+07	0.399E-02	0.123E+00
0.242E+03	0.529E+03	0.397E+04	0.143E+04	0.555E+04	0.243E+06	0.307E+07	0.366E-02	0.126E+00
0.213E+03	0.543E+03	0.408E+04	0.165E+04	0.393E+04	0.214E+06	0.315E+07	0.323E-02	0.130E+00
0.204E+03	0.557E+03	0.418E+04	0.176E+04	0.398E+04	0.199E+06	0.323E+07	0.307E-02	0.133E+00
0.194E+03	0.569E+03	0.428E+04	0.188E+04	0.405E+04	0.185E+06	0.330E+07	0.293E-02	0.136E+00
0.168E+03	0.581E+03	0.436E+04	0.207E+04	0.260E+04	0.170E+06	0.336E+07	0.256E-02	0.138E+00
0.162E+03	0.591E+03	0.444E+04	0.215E+04	0.263E+04	0.159E+06	0.342E+07	0.246E-02	0.141E+00
0.156E+03	0.601E+03	0.451E+04	0.223E+04	0.267E+04	0.109E+06	0.347E+07	0.234E-02	0.143E+00
0.145E+03	0.610E+03	0.458E+04	0.232E+04	0.262E+04	0.634E+05	0.352E+07	0.215E-02	0.145E+00
0.114E+03	0.618E+03	0.464E+04	0.252E+04	0.190E+04	0.295E+05	0.356E+07	0.174E-02	0.147E+00
0.117E+03	0.598E+03	0.469E+04	0.262E+04	0.192E+04	0.000E+00	0.360E+07	0.000E+00	0.148E+00
0.148E+02	0.127E+03	0.473E+04	0.315E+04	0.161E+04	0.000E+00	0.363E+07	0.000E+00	0.149E+00
0.271E+02	0.000E+00	0.476E+04	0.317E+04	0.156E+04	0.000E+00	0.365E+07	0.000E+00	0.150E+00
0.702E+01	0.000E+00	0.479E+04	0.319E+04	0.105E+04	0.000E+00	0.367E+07	0.000E+00	0.151E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.106E+04	0.000E+00	0.369E+07	0.000E+00	0.152E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.106E+04	0.000E+00	0.371E+07	0.000E+00	0.153E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.107E+04	0.000E+00	0.372E+07	0.000E+00	0.153E+00
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.107E+04	0.000E+00	0.373E+07	0.000E+00	0.154E+00

Lines removed for brevity

OUTPUT FILE WITH PESTICIDE SUMMARY: TEST173.ZP4

```
*******************************************************
**       PESTICIDE RUNOFF MODEL FOR RICE CROPS       **
**              Windows Tier 2 Version               **
**               RICEWQ Version 1.90                 **
*******************************************************
```

FILE: RICEWQ.ZP4

Simulation started: 8/ 4/ 11 10:22:47

TEST190.INP
Hypothetical simulation of RICEWQ Version 1.90
Four chemicals. Paths and yields modified compared to previous examples for bet

ass Balance Summary for Chemical 4 Metab-3

DATE	PWAP (mg)	PSAP (mg)	PFAP (mg)	PSSR (mg)	WO (mg)	DECAYW (mg)	DECAYS (mg)	DECAYF (mg)	VOLAT (mg)	SETL (mg)	BIND (mg)
6/ 4/91					0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
6/ 5/91					0.921E+02	0.110E+02	0.926E+00	0.109E+02	0.000E+00	0.344E+01	0.517E+02
6/ 6/91					0.380E+03	0.715E+02	0.133E+02	0.613E+02	0.000E+00	0.224E+02	0.335E+03
6/ 7/91					0.000E+00	0.172E+03	0.557E+02	0.152E+03	0.000E+00	0.554E+02	0.831E+03
6/ 8/91					0.000E+00	0.286E+03	0.142E+03	0.287E+03	0.000E+00	0.943E+02	0.141E+04
6/ 9/91					0.302E+03	0.408E+03	0.282E+03	0.457E+03	0.000E+00	0.137E+03	0.205E+04
6/10/91					0.249E+05	0.825E+03	0.483E+03	0.179E+03	0.000E+00	0.191E+03	0.286E+04
6/11/91					0.748E+02	0.926E+03	0.764E+03	0.423E+02	0.000E+00	0.295E+03	0.442E+04
6/12/91					0.937E+02	0.107E+04	0.113E+04	0.530E+02	0.000E+00	0.344E+03	0.516E+04
6/13/91					0.141E+03	0.118E+04	0.157E+04	0.637E+02	0.000E+00	0.387E+03	0.580E+04
6/14/91					0.000E+00	0.128E+04	0.208E+04	0.761E+02	0.000E+00	0.428E+03	0.641E+04
6/15/91					0.000E+00	0.134E+04	0.266E+04	0.910E+02	0.000E+00	0.461E+03	0.691E+04
6/16/91					0.939E+02	0.138E+04	0.331E+04	0.106E+03	0.000E+00	0.485E+03	0.727E+04
6/17/91					0.000E+00	0.140E+04	0.402E+04	0.121E+03	0.000E+00	0.504E+03	0.757E+04
6/18/91					0.309E+04	0.144E+04	0.476E+04	0.956E+02	0.000E+00	0.445E+03	0.668E+04
6/19/91					0.000E+00	0.145E+04	0.554E+04	0.747E+02	0.000E+00	0.468E+03	0.702E+04
6/20/91					0.911E+02	0.145E+04	0.636E+04	0.824E+02	0.000E+00	0.474E+03	0.710E+04
6/21/91					0.000E+00	0.142E+04	0.722E+04	0.902E+02	0.000E+00	0.478E+03	0.718E+04
6/22/91					0.279E+04	0.137E+04	0.810E+04	0.594E+02	0.000E+00	0.390E+03	0.585E+04
6/23/91					0.815E+01	0.125E+04	0.898E+04	0.374E+02	0.000E+00	0.401E+03	0.601E+04
6/24/91					0.000E+00	0.121E+04	0.988E+04	0.406E+02	0.000E+00	0.400E+03	0.600E+04
6/25/91					0.000E+00	0.117E+04	0.108E+05	0.439E+02	0.000E+00	0.396E+03	0.595E+04
6/26/91					0.955E+03	0.114E+04	0.117E+05	0.344E+02	0.000E+00	0.342E+03	0.513E+04
6/27/91					0.180E+03	0.106E+04	0.127E+05	0.246E+02	0.000E+00	0.331E+03	0.497E+04
6/28/91					0.322E+03	0.999E+03	0.136E+05	0.201E+02	0.000E+00	0.304E+03	0.456E+04
6/29/91					0.387E+01	0.942E+03	0.145E+05	0.178E+02	0.000E+00	0.303E+03	0.454E+04
6/30/91					0.000E+00	0.910E+03	0.155E+05	0.188E+02	0.000E+00	0.301E+03	0.451E+04
7/ 1/91					0.316E+03	0.881E+03	0.164E+05	0.157E+02	0.000E+00	0.270E+03	0.404E+04

Lines removed for brevity

OUTPUT FILE WITH PESTICIDE SUMMARY: TEST73.ZP4 (Continued)

SEEP (mg)	SEEPS (mg)	RESUS (mg)	DIFUS (mg)	PF (mg)	PW (mg)	PS (mg)	CPW (mg/l)	CPS (mg/kg)
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
0.457E+00	0.744E-02	0.527E-01	-0.226E+01	0.125E+04	0.133E+04	0.156E+03	0.201E-04	0.640E-05
0.297E+01	0.104E+00	0.758E+00	-0.144E+02	0.415E+04	0.506E+04	0.121E+04	0.762E-04	0.497E-04
0.735E+01	0.429E+00	0.317E+01	-0.348E+02	0.911E+04	0.974E+04	0.392E+04	0.150E-03	0.161E-03
0.125E+02	0.109E+01	0.810E+01	-0.574E+02	0.158E+05	0.148E+05	0.877E+04	0.234E-03	0.361E-03
0.181E+02	0.216E+01	0.161E+02	-0.805E+02	0.238E+05	0.202E+05	0.161E+05	0.324E-03	0.662E-03
0.253E+02	0.369E+01	0.275E+02	-0.109E+03	0.160E+04	0.370E+05	0.263E+05	0.549E-03	0.108E-02
0.391E+02	0.582E+01	0.435E+02	-0.167E+03	0.206E+04	0.431E+05	0.405E+05	0.657E-03	0.167E-02
0.456E+02	0.860E+01	0.642E+02	-0.187E+03	0.253E+04	0.487E+05	0.580E+05	0.753E-03	0.238E-02
0.513E+02	0.119E+02	0.893E+02	-0.198E+03	0.299E+04	0.534E+05	0.786E+05	0.835E-03	0.324E-02
0.567E+02	0.158E+02	0.118E+03	-0.206E+03	0.361E+04	0.567E+05	0.102E+06	0.910E-03	0.421E-02
0.611E+02	0.202E+02	0.152E+03	-0.206E+03	0.428E+04	0.589E+05	0.129E+06	0.971E-03	0.531E-02
0.642E+02	0.251E+02	0.188E+03	-0.197E+03	0.489E+04	0.602E+05	0.159E+06	0.101E-02	0.652E-02
0.669E+02	0.305E+02	0.229E+03	-0.184E+03	0.561E+04	0.604E+05	0.190E+06	0.105E-02	0.783E-02
0.591E+02	0.361E+02	0.271E+03	-0.116E+03	0.305E+04	0.629E+05	0.223E+06	0.947E-03	0.918E-02
0.621E+02	0.420E+02	0.315E+03	-0.102E+03	0.343E+04	0.628E+05	0.258E+06	0.968E-03	0.106E-01
0.628E+02	0.483E+02	0.362E+03	-0.744E+02	0.372E+04	0.622E+05	0.294E+06	0.976E-03	0.121E-01
0.635E+02	0.548E+02	0.411E+03	-0.450E+02	0.411E+04	0.609E+05	0.332E+06	0.982E-03	0.137E-01
0.518E+02	0.614E+02	0.461E+03	0.471E+02	0.156E+04	0.546E+05	0.370E+06	0.822E-03	0.152E-01
0.532E+02	0.681E+02	0.511E+03	0.733E+02	0.169E+04	0.533E+05	0.409E+06	0.821E-03	0.168E-01
0.530E+02	0.749E+02	0.562E+03	0.108E+03	0.183E+04	0.517E+05	0.449E+06	0.817E-03	0.185E-01
0.526E+02	0.819E+02	0.615E+03	0.146E+03	0.198E+04	0.499E+05	0.489E+06	0.808E-03	0.201E-01
0.455E+02	0.890E+02	0.668E+03	0.217E+03	0.113E+04	0.470E+05	0.529E+06	0.707E-03	0.218E-01
0.440E+02	0.960E+02	0.720E+03	0.260E+03	0.102E+04	0.450E+05	0.570E+06	0.678E-03	0.235E-01
0.404E+02	0.103E+03	0.773E+03	0.313E+03	0.751E+03	0.414E+05	0.610E+06	0.624E-03	0.251E-01
0.402E+02	0.110E+03	0.826E+03	0.349E+03	0.793E+03	0.401E+05	0.651E+06	0.619E-03	0.268E-01
0.399E+02	0.117E+03	0.879E+03	0.386E+03	0.839E+03	0.387E+05	0.691E+06	0.614E-03	0.284E-01
0.358E+02	0.124E+03	0.932E+03	0.442E+03	0.560E+03	0.369E+05	0.731E+06	0.556E-03	0.301E-01
0.359E+02	0.131E+03	0.985E+03	0.476E+03	0.589E+03	0.358E+05	0.771E+06	0.554E-03	0.317E-01
0.358E+02	0.138E+03	0.104E+04	0.512E+03	0.617E+03	0.255E+05	0.811E+06	0.546E-03	0.334E-01
0.345E+02	0.145E+03	0.109E+04	0.553E+03	0.627E+03	0.153E+05	0.851E+06	0.521E-03	0.350E-01
0.279E+02	0.152E+03	0.114E+04	0.620E+03	0.470E+03	0.737E+04	0.890E+06	0.434E-03	0.366E-01
0.297E+02	0.152E+03	0.119E+04	0.666E+03	0.490E+03	0.000E+00	0.927E+06	0.000E+00	0.382E-01
0.388E+01	0.337E+02	0.124E+04	0.825E+03	0.424E+03	0.000E+00	0.964E+06	0.000E+00	0.397E-01
0.731E+01	0.000E+00	0.129E+04	0.857E+03	0.424E+03	0.000E+00	0.100E+07	0.000E+00	0.411E-01
0.195E+01	0.000E+00	0.133E+04	0.888E+03	0.294E+03	0.000E+00	0.104E+07	0.000E+00	0.426E-01
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.304E+03	0.000E+00	0.107E+07	0.000E+00	0.441E-01
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.314E+03	0.000E+00	0.111E+07	0.000E+00	0.455E-01
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.324E+03	0.000E+00	0.114E+07	0.000E+00	0.469E-01
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.334E+03	0.000E+00	0.117E+07	0.000E+00	0.482E-01
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.343E+03	0.000E+00	0.121E+07	0.000E+00	0.496E-01
0.148E+01	0.000E+00	0.160E+04	0.107E+04	0.187E+03	0.000E+00	0.124E+07	0.000E+00	0.509E-01
0.838E+01	0.000E+00	0.164E+04	0.109E+04	0.187E+03	0.000E+00	0.127E+07	0.000E+00	0.522E-01
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.192E+03	0.000E+00	0.130E+07	0.000E+00	0.535E-01
0.335E+01	0.000E+00	0.172E+04	0.115E+04	0.147E+03	0.000E+00	0.133E+07	0.000E+00	0.547E-01
0.900E+01	0.000E+00	0.176E+04	0.117E+04	0.143E+03	0.000E+00	0.136E+07	0.000E+00	0.559E-01

Lines removed for brevity

OUTPUT FILE WITH TIME SERIES OUTPUT: TEST173.ZZT

```
******************************************************
**       PESTICIDE RUNOFF MODEL FOR RICE CROPS       **
**              Windows Tier 2 Version               **
**               RICEWQ Version 1.90                 **
******************************************************
FILE:  RICEWQ.ZZT
Simulation started:  8/ 4/  11  10:22:47
TEST190.INP
Hypothetical simulation of RICEWQ Version 1.90
Four chemicals. Paths and yields modified compared to previous examples for bet
```

DATE	JULIAN DAY	QOUT (m3)	POUT1 (mg)	POUT2 (mg)	POUT3 (mg)	POUT4 (mg)	POUT5 (mg)
6/ 4/91	155	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/ 5/91	156	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/ 6/91	157	0.586E+03	0.146E+06	0.334E+04	0.223E+04	0.311E+02	
6/ 7/91	158	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/ 8/91	159	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/ 9/91	160	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/10/91	161	0.422E+05	0.734E+07	0.564E+06	0.376E+06	0.170E+05	
6/11/91	162	0.868E+03	0.176E+06	0.147E+05	0.980E+04	0.480E+03	
6/12/91	163	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/13/91	164	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/14/91	165	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/15/91	166	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/16/91	167	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/17/91	168	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/18/91	169	0.163E+04	0.996E+05	0.191E+05	0.128E+05	0.143E+04	
6/19/91	170	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/20/91	171	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/21/91	172	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/22/91	173	0.112E+05	0.378E+06	0.921E+05	0.614E+05	0.873E+04	
6/23/91	174	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/24/91	175	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/25/91	176	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/26/91	177	0.395E+04	0.762E+05	0.229E+05	0.153E+05	0.268E+04	
6/27/91	178	0.122E+04	0.220E+05	0.682E+04	0.455E+04	0.824E+03	
6/28/91	179	0.443E+04	0.674E+05	0.219E+05	0.146E+05	0.276E+04	
6/29/91	180	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
6/30/91	181	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/ 1/91	182	0.219E+04	0.221E+05	0.818E+04	0.545E+04	0.118E+04	
7/ 2/91	183	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/ 3/91	184	0.162E+05	0.149E+06	0.584E+05	0.389E+05	0.894E+04	
7/ 4/91	185	0.162E+05	0.134E+06	0.545E+05	0.363E+05	0.863E+04	
7/ 5/91	186	0.162E+05	0.101E+06	0.426E+05	0.284E+05	0.697E+04	
7/ 6/91	187	0.155E+05	0.848E+05	0.368E+05	0.245E+05	0.622E+04	
7/ 7/91	188	0.138E+04	0.105E+04	0.473E+03	0.315E+03	0.825E+02	
7/ 8/91	189	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/ 9/91	190	0.492E+04	0.168E+04	0.800E+03	0.533E+03	0.148E+03	
7/10/91	191	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/11/91	192	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/12/91	193	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/13/91	194	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/14/91	195	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/15/91	196	0.862E+04	0.162E+04	0.905E+03	0.603E+03	0.197E+03	
7/16/91	197	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/17/91	198	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/18/91	199	0.302E+04	0.111E+04	0.669E+03	0.446E+03	0.156E+03	
7/19/91	200	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/20/91	201	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/21/91	202	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/22/91	203	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/23/91	204	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
7/24/91	205	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	

6.0 REFERENCES

Arnold, J.G., J.R Williams, R. H. Griggs, and N.B. Sammons, 1991. SWRRBWQ: a basin scale model for assessing management impacts on water quality: U.S. Department of Agriculture, Agricultural Research Service, Grassland, Soil and Water Research Laboratory, Temple, Texas, pp. 10-13.

Burns, Lawrence, 2004. Exposure Analysis Modeling System (EXAMS): User Manual and System Documentation. Version 2.98.04.06: EPA/600/R-00/081. Ecologist, Ecosystems Research Division U.S. Environmental Protection Agency, Athens, GA, pp 206. May 2004 (Revision G).

Capri, E. and Z. Miao. 2002. Modeling pesticide fate in rice paddy. Agronomie. 22:363-371.

Chapra, S.C. 1997. Surface Water Quality Modeling. McGraw-Hill, Boston.

Chapra, S.C., 1989. Water Quality Modeling of Toxic Organics in Lakes: CADSWES Working Paper No. 4, University of Colorado, Boulder.

Chung, S. O., K.J. Park, and S.H. Son . 2008. Calibration and sensitivity analysis of the RICEWQ Model. Journal of the Korean Society of Agricultural Engineers. 50(2): 1735-3692.

Christen, E.W., W.C. Quayle, S.O Chung, and K.J Park. 2005. Modeling the fate of molinate in rice paddies of South Eastern Australia using RICEWQ. CSIRO Land and Water Technical Report No. 12/05. CSIRO Land and Water, Griffith Laboratory, NSW 2680, Australia.

Christen E.W., S.O. Chung and W.C. Quayle. 2006a. Simulating the herbicide molinate in rice paddies using the RICEWQ Model. In Zerger, A. and Argent, R.M. (eds) MODSIM 2005 International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2005. ISBN: 0-9758400-2-9.

Christen, E.W., S.O, Chung, and W.C. Quayle. 2006b. Simulating the fate of molinate in rice paddies using the RICEWQ model. Agricultural Water Management 85:38-46.

Ferrari, F., D. Karpouzas, M. Trevisan, and E. Capri, E. 2005. Measuring and predicting environmental concentrations of pesticides in air after application to paddy water systems. Environ. Sci. Technol. 39:2968-2975.

Infantino, A., T, Pereira, C. Ferrero, M.P. Cerejeira, and A. Di Guardo, A. 2008. Calibration and validation of a dynamic water model in agricultural scenarios. Chemosphere. 70(7): 1298-1308.

Lahey Computer Systems, Inc., 2010. Lahey/Fujitsu Fortran 95 Prefessional. Version 7.2.

Karpouzas, D.G., and E. Capri. 2004. Higher tier risk assessment for pesticides applied in rice paddies: filling the gap at European level. Pesticide Outlook, 15:36-41.

Karpouzas, D., E. Capri, and E. Papadopoulou-Mourkidou. 2005a. Application of the RICEWQ-VADOFT model to simulate leaching of propanil in rice paddies in Greece. Agron. Sustain. Dev. 25:35-44.

Karpouzas, D., A Ferraro, F. Vidotto, and E. Capri. 2005b. Application of the RICEWQ-VADOFT model for simulating the environmental fate of pretilachlor in rice paddies. Environ. Toxicology and Chem. 24 (4):1007-1017.

Karpouzas, D.G., and E. Capri. 2006. Risk analysis of pesticides applied to rice paddies using RICEWQ 1.6.2v and RIVWQ 2.02. Paddy Water Environ (2006) 4:29-38.

Karpouzas, D., E. Capri, and E. Papadopoulou-Mourkidou. 2006a. Basin-scale risk assessment in rice paddies: An example based on the Axios River Basin in Greece. Vadose Zone Journal 5: 273-282.

Karpouzas, D., S. Cervelli, H. Watanabe, E. Capri, E, and A. Ferrero. 2006b. Pesticide exposure assessment in rice paddies in Europe: a comparative study of existing mathematical models. Pest Management Science, 62 (7):624-636.

Karpouzas, D.G., C. Ribarbelli, M. Pastori, and E. Capri. 2006c. Landscape risk analysis for pesticides applied to rice paddies. Agron. Sustain. Dev. 26 (2006) 167-177.

Karpouzas, D.G. and Z. Miao. 2008. Higher tier exposure assessments in rice paddy areas: a European perspective. In Capri, E. and Karpouzas, D.G. (eds) Pesticide Risk Assessment in rice paddies: theory and perspective. Elsevier. p 126-167.

Linsley, R.K. and J. B. Franzini, 1979. Water-Resources Engineering: Third Edition, McGraw-Hill Book Company, New York, NY, p 30.

MED-RICE. 2003. Guidance Document for Environmental Risk Assessments of Active Substances used on Rice in the EU for Annex I Inclusion. Document prepared by Working Group on MED-Rice, EU Document Reference SANCO/1090/2000 – rev.1, Brussels, June 2003,108 pp. http://ec.europa.eu/food/plant/protection/resources/med_rice_2003_en.pdf.

Miao, Z., J.M. Cheplick, W.M. Williams, M. Trevisan, L. Padovani, M. Gennari, A. Ferrero, F. Vidotto, and E. Capri. 2003a. Simulating pesticide leaching and runoff in rice paddies with RICEWQ-VADOFT model. J. Environ. Qual. 32:2189-2199.

Miao, Z., L. Padovani, C. Riparbelli, A. Ritter, M. Trevisan, and E. Capri. 2003b. Prediction of the environmental concentration of pesticide in paddy field and surrounding surface waters. Paddy Water Environ. 1:121-132.

Miao, Z., M. Trevisan, E. Capri, L. Padovani, and A.A.M. Del Re. 2004. Uncertainty assessment of the model RICEWQ in northern Italy. J. Environ. Qual. 33:2217-2228.

Miao, Z., L. Padovani, C. Riparbelli, A.M. Ritter, M. Trevisan, and E. Capri. 2007. Prediction of the environmental concentration of pesticide in paddy field and surrounding surface water bodies. Paddy and Water Environment. Volume 1, Number 3, 121-132.

Ngoc, M.N., S. Dultz, and J. Kasbohm. 2008. Simulation of retention and transport of copper, lead and zinc in a paddy soil of the Red River Delta, Vietnam. Agriculture, Ecosystems, and Environment, 129: 8-16.

Park, K.J. and S.O. Chung. 2008. Scenario-based exposure risk assessment of molinate in a paddy plot; (2) Exposure Risk Assessment. Journal of the Korean Society of Agricultural Engineers, 50(4): 17-24.

Ritter, A.M. and W.M. Williams. 2008. Higher tier exposure assessments in rice paddy areas: an American Perspective. In Capri, E. and Karpouzas, D.G. (eds) Pesticide Risk Assessment in rice paddies: theory and perspective. Elsevier. p 215-236.

Šimůnek, J., M. Šejna, H. Saito, M. Sakai, and M. Th. van Genuchten. 2009, The HYDRUS-1D software package for simulating the one-dimensional movement of water, heat, and multiple solutes in variably-saturated media: version 4.08. Department of Environmental Sciences, University of California Riverside, Riverside, California.

Suárez, L.A., 2005. PRZM_3, A Model for Predicting Pesticide and Nitrogen Fate in the Crop Root and Unsaturated Soil Zones: Users Manual for Release 3.12.2, National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, Georgia.

U.S. Department of Agriculture. 1985. National Engineering Handbook, Section 4 - Hydrology. Soil Conservation Service.

U.S. Environmental Protection Agency (USEPA). 2006. Amendment to reregistration eligibility decision (RED) for propanil (March 2006) and the propanil RED (September 2003), Docket ID: EPA-HQ-OPP-2003-0348, Amendment to the propanil RED (March 7, 2006), EPA-HQ-OPP-2003-0348-0024, Propanil RED (September 30, 2003): EPA-HQ-2003-0348-0002. http://www.epa.gov/oppsrrd1/REDs/propanil_red_combined.pdf

U.S. Environmental Protection Agency (USEPA). 1998. FIPRONIL – Report of the FQPA Safety Factor Committee. Memorandum dated 12-May-1998 from Breda Tarplee and Jess Rowland to Melba Morrow. Office of Pesticide Programs, Health Effects Division, FQPA Safety Factor Committee. Docket ID: EPA-HQ-OPP-2005-0206, Document ID: EPA-HQ-OPP-2005-0206-0011. http://www.regulations.gov/search/index.jsp

U.S. Environmental Protection Agency (USEPA), 2006. (P)RZM (E)XAMS model shell, version (5).0 user's manual. Tier two screening model shell for pesticide aquatic exposure assessment. Environmental Fate and Effects Division, Office of Pesticide Programs. http://www.epa.gov/oppefed1/models/water/index.htm#przmexamsshell

Warren, R.L., A.M. Ritter, and W.M. Williams. 2004. A rice herbicide Tier 2 exposure assessment for European rivers based on RICEWQ/RIVWQ. Proceedings of the conference challenges and opportunities for sustainable rice-based production systems. Eds., A. Ferrero and F. Vidotto, Edizioni Mercurio, Torino, Italy.

Waterborne Environmental, Inc. (WEI). 2009. RICEWQ pesticide runoff model for rice crops. http://www.waterborne-env.com/solutions_ricewq.asp

Williams, W.M., A.M. Ritter, and R. Vamshi. 2007. Tier 2 ecological risk assessment for rice. Exposure Modeling Public Meeting, U.S. Environmental Protection Agency, Crystal City, VA, USA, October 30,2007.

Williams, W.M., A.M. Ritter, J.M. Cheplick, and C.E. Zdinak. 2010. RICEWQ: pesticide runoff model for rice crops – user's manual and program documentation, Version 1.7.3. Waterborne Environmental, Inc., Leesburg, Virginia, USA.

Williams, W.M., J.M. Cheplick, A.M. Ritter, C.E. O'Flaherty, and P.S. Singh, 2004. RIVWQ chemical transport model for riverine environments - user's manual and program documentation. Version 2.02 Waterborne Environmental, Inc., Leesburg, Virginia, USA.

APPENDIX A
VARIABLE DEFINITIONS

θ	Foliar extraction coefficient expressed as a washoff fraction per centimeter of precipitation
ρ_b	Bulk density of the sediment
φ	Porosity of sediment
COVER	Interception potential of foliage at the time of application
COVMAX	Interception potential of foliage at crop maturation
C_S	Concentration in sediment
C_{SS}	Concentration of suspended sediment (mg/m^3)
C_W	Concentration in water column
DRIFT	Fraction lost to drift
D_{act}	Depth of active sediment layer (cm)
D_{inc}	Depth of incorporation (cm)
∂t	1-day time interval used in the model
D_W	Depth of water in the paddy during a specific time step
F_{DS}	Fraction of chemical residues in dissolved form and within voids in the sediment
F_{DW}	Fraction of chemical mass in dissolve phase
F_{PW}	Fraction sorbed to suspended sediment
IGROW	Number of days since crop emergence
JGROW	Total number of days between emergence and maturation
K_d	Water- sediment partition coefficient (cc/g)
K_{difus}	Rate of diffusion in m/day
K_F	Foliar decay rate constant (day^{-1})
K_{resus}	Resuspension velocity in m/day
K_{setl}	User-specified settling velocity
K_S	Decay rate constant in sediment (day^{-1})
K_{volat}	Rate of volatilization (m/day)
K_W	Decay rate constant in water (day^{-1})
M_{app}	Parent application rate per unit area
M_{bed}	Mass of pesticide transferred to bed sediment by direct partitioning
M_{difus}	Mass diffusion between the water and sediment
M_F	Mass of chemical on foliage
M_{Fapp}	Parent pesticide application intercepted by foliage
M_{Fdeg}	Mass degraded on foliage
M_{Ftran}	Mass metabolite formed by foliar transformation
M_{harv}	Mass lost due to harvest of crop
M_{out}	Mass lost in overflow or drainage
M_{resus}	Mass reintroduced to the water column via resuspended sediments
M_S	Mass of chemical in water
M_{sdeg}	Chemical mass degraded in sediment
M_{seep}	Mass lost in seepage
M_{setl}	Mass transfer to sediment by particulate settling
$\mathrm{M_{stran}}$	Mass metabolite formed by transformation in sediment
MTC	Cumulative mass transfer coefficient between water and sediment

M_{volat}	Mass volatilized across the air-water interface
M_W	Mass in water column
M_{Wapp}	Portion of parent application not lost to drift or intercepted by crop
M_{wash}	Chemical mass washed off from foliage
M_{Wdeg}	Chemical mass degraded in water
M_{Wtran}	Mass metabolite formed by transformation in water column
P	Precipitation for the day
Q_{out}	Flow draining from the paddy in m^3/day
Q_{seep}	Seepage rate (m/day)
R_{reac}	Release rate for slow-release formulations (day^{-1})
SA	Surface area of the paddy
SNK	Fraction of the mass of applied pesticide that is intercepted by water and immediately transformed to innocuous product
V	Control volume
V_{bind}	Mixing depth for direct contact partitioning between water and sediment (cm/day)
V_W	Volume of water in the paddy at the specific time step
YF	Foliar yield: fraction of parent which transforms to metabolite by foliar degradation
Y_W	Aquatic yield: fraction of parent which transforms to metabolite by aquatic degradation
Y_S	Sediment yield: fraction of parent which transforms to metabolite by degradation in sediment
∂C	Change in concentration over time (∂t)
ΣI	Cumulative sum of inflow
∂M_F	Change in chemical mass on foliage over time (∂t)
ΣM_{influx}	Cumulative influx of chemical mass from the control volume
$\Sigma M_{outflux}$	Cumulative outflow of chemical mass from the control volume
ΣM_{react}	Mass transformation from all processes
∂M_S	Change in chemical mass in sediment over time (∂t)
∂M_W	Change in chemical mass in water over time (∂t)
ΣO	Cumulative sum of outflow
∂S	Change in storage
∂t	Change in time