**Simulation execution phases and times of function evaluation1**

**Simulation time-step start**

Inputs

Start River Operations mode

Run forecasting phase for models which **do not** use functions

Run functions – where evaluation time equals StartOfTimeStep

Run forecasting phase for models which **do** use functions

River Operations: override expressions and forecast values

Plugins: notify of start of time-step

Run functions – where evaluation time equals Resource Assessment (evaluates once per Resource Assessment system2)

Initialise Resource Assessment systems

Process Water Users

For each water user:

 Evaluate “Order Phase” Functions used at water user

 Evaluate and distribute demand for water user

Run Constraint phase

For each network element:

 Evaluate constraints at element and pass constraint(s) downstream

Run Ordering phase

 Evaluate “Order Phase” Functions ***not used*** at a network element

For each network element:

 Evaluate “Order Phase” Functions used at this network element

 Evaluate regulated orders and pass upstream

 Evaluate off allocation orders and pass upstream

Evaluate “Flow Phase” Functions ***not used*** at a network element

For each network element:

Evaluate “Flow Phase” functions used at this network element

Water ownership – pre-timestep phase3

River management - pre-flow phase

Solve the wetland cluster

Execute flow phase

Water ownership – post-timestep phase

River management - post-flow phase

Calculate constraint factors

Constituent modeling

Evaluate “Post Flow Phase” functions

Finalise Resource Assessment

End of constituent management

Format tabular editor according to End of Time Step values

End forecasting phase

Run functions – where evaluation time equals EndOfTimeStep

Run functions – where evaluation time equals PostFunctionEvaluation4 (available for modelled variables only)

Output values written to recorders5

Plugins: notify of end of time-step

**Simulation time-step end**

**Notes:**

1 The relevant Time of Evaluation (ToE) is underlined.

2 If there is no resource assessment systems setup, then no functions will be evaluated here.

3 Ownership is a layer added to the flow phase that tracks the ownership of water. Information needs to be extracted both before and after the flow phase and for this reason, a separate process is executed for both.

4 Post function evaluation is only available for modelled variables. The case where you would use this is if you had a function that needed to be evaluated at the end of the time-step, but you wanted a modelled variable that pointed to this function to be evaluated with the new value – so would set it to “post function evaluation”

5 End of Time Step function evaluation was previously done **after** the application recorded the time step values. This lead to the problem that if you recorded a function that was evaluated at End of Time Step, the recorded value was captured before all the required values had been calculated and was not necessarily what was actually being used in the function at that time of evaluation. Therefore, values are now recorded after all the phases are run and directly before the end of the time-step.

Also, more evaluation times have been added to focus on specific values/requirements.

**Some examples from the Goulburn monthly model:**

1. This function uses the modelled variable ‘Percent Per Share Entitlement’ which is calculated during Resource Assessment (RA) as shown in Figure 1a. Figure 1b compares what the results will be if this same function is evaluated at Start of Timestep (SoT) or End of Timestep (EoT).



Figure 1a: Function set up to evaluate during Resource Assessment



Figure 1b: Time of evaluation (ToE) comparison

While the values recorded at the EoT reflect those calculated during the current RA, the values recorded at the SoT lag by one day because:

1. on the first day no RA has been undertaken yet and the function has not been evaluated, hence a value of 0 on day 1,
2. for the rest of the time series the value at the SoT will be the same as the value the previous day at the EoT. Except for month 7 where this particular function has been set up to re-establish accounts in month 7, but the start of timestep is remembering the value from the day before. This is why it is important to record this function at the right time.
3. This function uses the modelled variable ‘Upstream Flow’ on the ordering network, which is calculated during the Ordering phase (OP) for the Current Iteration of NETLP, as shown in Figure 2a. Figure 2b compares what the recorded results will be if this same variable is evaluated at Start of Timestep (SoT) or End of Timestep (EoT), but retaining ‘Current Iteration’ as the Date Range for evaluation. Since this Date Range (Current Iteration) is only relevant to NETLP, no values are available for recording outside of the Ordering Phase, under this configuration.



Figure 2a: Function set up to evaluate during Ordering Phase, with Date Range ‘Current Iteration’



Figure 2b: Time of evaluation (ToE) comparison