

# How to use the 1D Simulation Builder?

## Simulation Builder

The Simulation Builder tool allows you to build up a matrix of 1D simulations, i.e. IEF files. The tool utilises user specified event data and TUFLOW model files (for 1D-TUFLOW linked models) to define all permutations and combinations of possible simulations within user specified parameters. Furthermore, the tool allows you to further customise the list of simulations prior to actually “building” them, enabling you to edit durations, timesteps, initial conditions, results destinations, ief filenames and run titles.

This section provides a step by step guide on using the Simulation Builder tool.

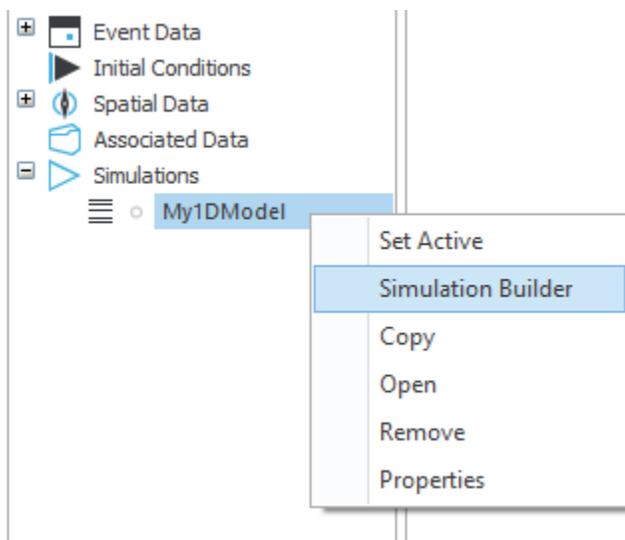
## Using the tool

1. The Simulation Builder requires you to initially specify at least one simulation file (IEF file) that details the number of event files to use in each simulation, e.g. one rainfall event and one development scenario (that modifies an existing structure). Furthermore, it should include a reference to a TUFLOW model file (tcf file) if all of the simulations you are building need to be linked to TUFLOW 2D models.

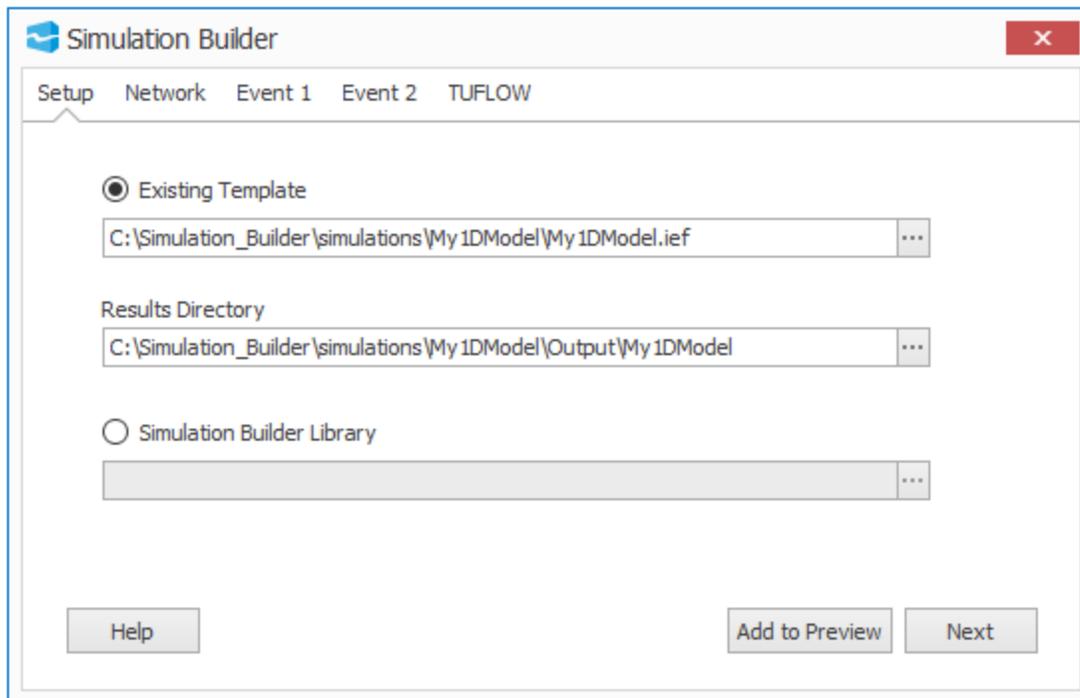
This “master” ief file should also include the required run type, e.g. unsteady, and any advanced parameters to be included in all simulations. This file is referred to as the “template” IEF file in the Simulation Builder.

This ief file can be added to your project if it already exists or defined using the standard 1D simulation tool (i.e. right-click on Simulations in the Project panel and select New 1D Simulation).

2. Right Click on your template 1D simulation within the Simulations section of the Project panel and choose ‘Simulation Builder’ from the context menu.



3. The Simulation builder wizard is displayed with some prepopulated information read from your template IEF.



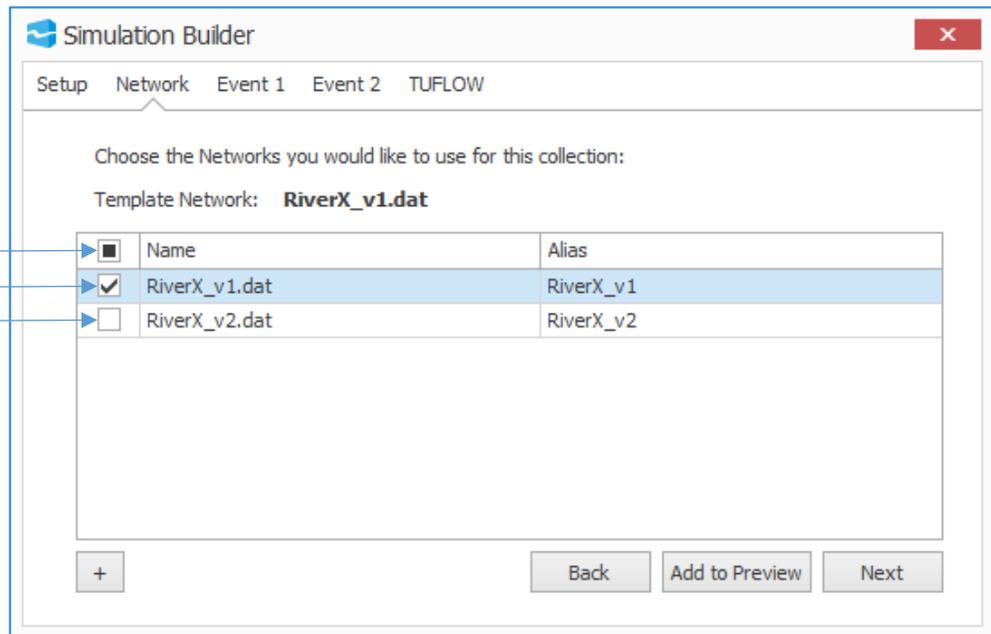
The 'Setup' page allows you to use either an existing IEF (as a template) or specify a Simulation Builder Library file. If using a template IEF, a common 'Results Directory' path can be set for use in all generated IEF files. As default, the 'Results Directory' path will be to a new folder named 'Output' located in the same folder as the simulation IEF file. This can be amended at this point, or later in the 'Preview' dialog. To continue, Press 'Next'.

Note that the 'Next' button moves you through to the next tab; alternatively, click directly on the tab you want to jump to.

4. The 'Network' page allows you to configure which Network the simulations will use. Networks that are loaded within the Flood Modeller Project panel are automatically populated for selection. Each is given an alias: this is the file name without the extension by default. This alias will be used in creating the name of simulations (IEF files). Click on the alias for a network to edit this. You can choose to add additional Networks not currently loaded into the Project panel to the list by selecting the '+' button to browse. Note that at least one network must be specified via check box. The network file specified in the template IEF is selected by default (although you can then deselect the box).

Tick the boxes of one or multiple networks individually, or select the check box at the top of the table to select all networks. To continue, Press 'Next'.

Select here to include/exclude all networks

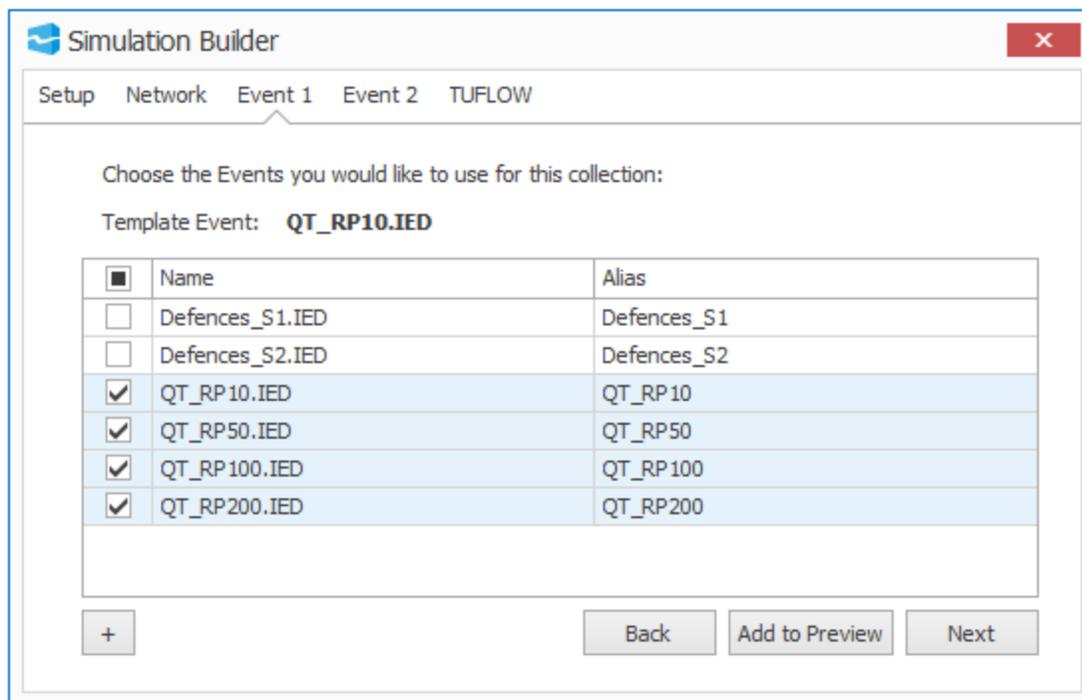


Select networks individually via check boxes

5. The next page (or pages) display the Event data (ied files) associated with the template IEF and allows you to select events to build your matrix of simulations as required. A separate tab in the interface is generated for each event file defined in the specified template IEF, thus allowing you to define combinations of alternatives to utilise for each event separately. Note that at least one event file must be specified via check box to proceed. The event file specified in the template IEF is selected by default (although you can then deselect it).

Events that are loaded within the Flood Modeller Project panel are automatically populated for selection. Each is given an alias (the file name without the extension as default, although this can be edited) Note that every event file will be available under each event tab; the interface does not distinguish between, for example, rainfall events and development scenarios, and it is the responsibility of the user to ensure the relevant events are selected for each tab.

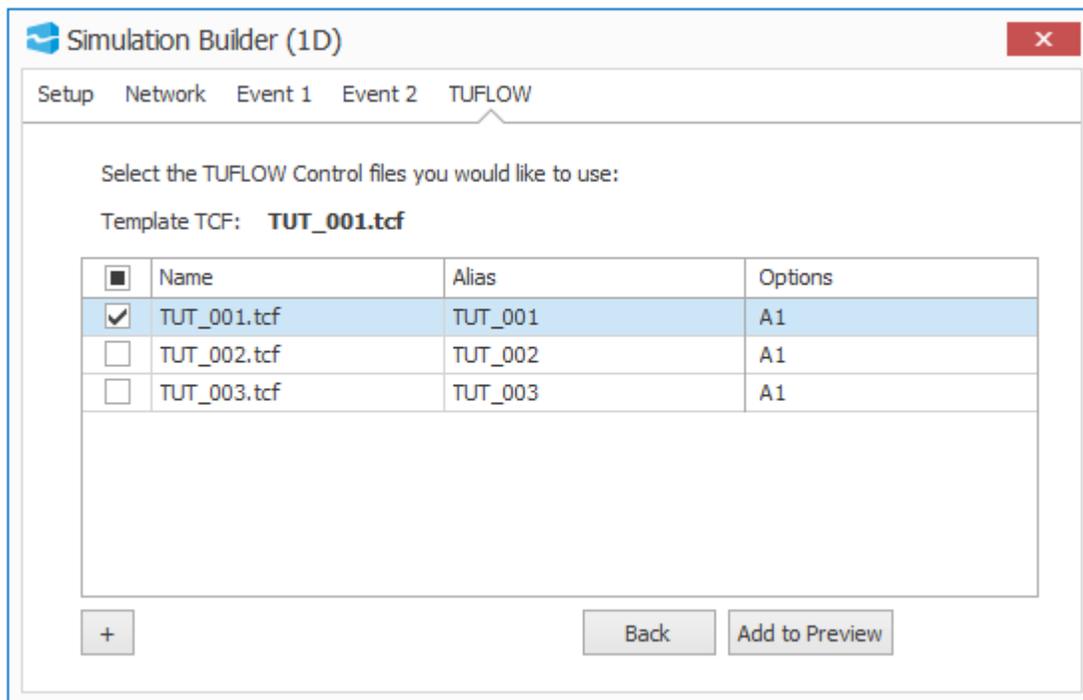
The '+' button allows you to browse to other event files not currently loaded within the Flood Modeller Project panel and the check box at the top of the table automatically selects all events listed. The 'Back' button can be used to return to the network selection tab.



To proceed, Press 'Next' to move to the next event tab (if more than one event is listed) or to move to the 'TUFLOW' tab (if TUFLOW data is associated to the template IEF), or press 'Add to Preview' to view a summary of your simulation selections.

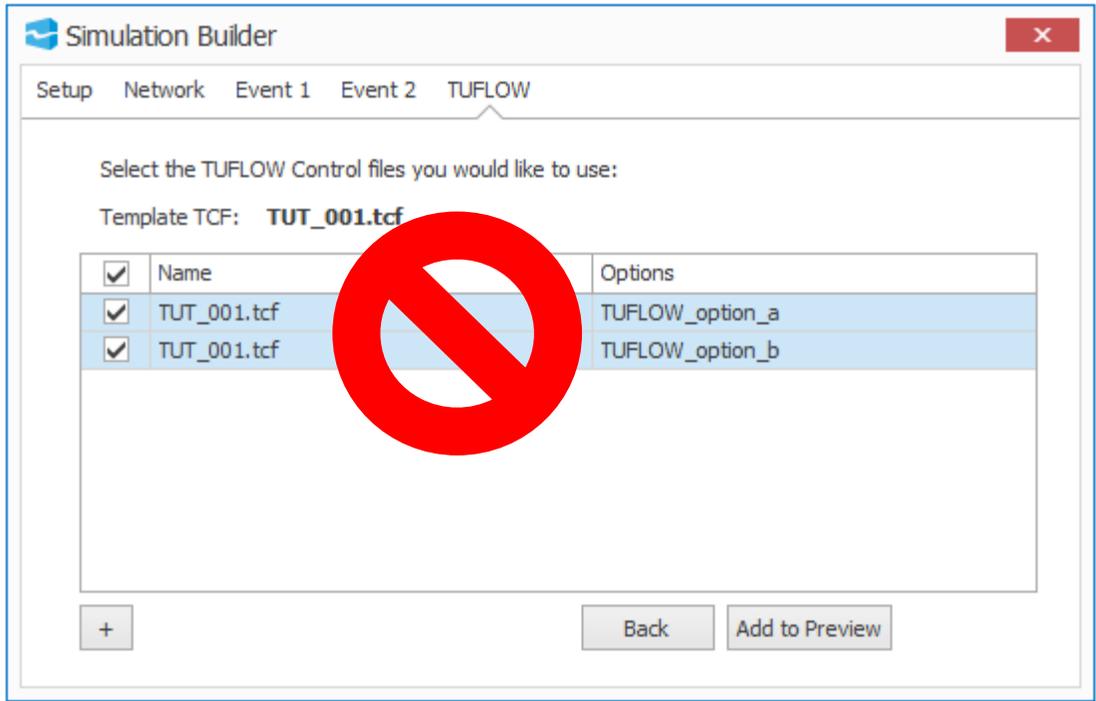
- If TUFLOW data is associated to the template IEF, the 'TUFLOW' tab will be displayed next. Associated data loaded into the Flood Modeller Project panel is automatically populated for selection and each is given a default alias. The data specified in the template IEF is selected by default (although you can deselect it). Note at least one TUFLOW file must be selected to proceed. The '+' button allows you to browse to other TCF files not currently loaded within the Flood Modeller Project panel. As in the event tabs, the check box at the top of the table automatically selects all TUFLOW files listed.

The 'Options' field(s) allows you to enter all or a subset of the run options set in the TUFLOW model files. The run options set in the template IEF file will be given by default, although this can be edited.



Press 'Add to Preview' to summarise your simulation selections.

Note that if you want to build simulations that reference the same TCF file but with different TUFLOW run options, you must select the file and an initial set of TUFLOW run options, and click 'Add to Preview' to continue through to the 'Preview table' at the end of the simulation builder wizard. At this point, you will be able to add the other simulations, selecting the same TCF file (this time with your new TUFLOW run options). Do not add the TUFLOW file using the '+' button and give different options as shown below.



Please also be vigilant regarding filenames if considering the above situation as any simulations that are identical aside from TUFLOW run options will be given the same name unless edited (the TUFLOW run options do not create part of the filename).

- The 'Preview' page appears in a new window. It provides an overall summary of the simulations that will be created from your defined settings:

Id	Name (Event)	Network	Event (1)	Event (2)	TUFLOW Link	TUFLOW Options	Run Type	Initial Conditions	Start Time (hrs)	Finish Time (hrs)	TimeStep (s)	Save Interval (s)	Results Path
1	RiverX_v1-QT_RP10-Defences_S1-TUT_001	RiverX_v1.dst	QT_RP10.BED	Defences_S1.BED	TUT_001.tcf	TUT_001	Unsteady (Fixed Timestep)	Initial_conditions_1.tzs	0	24	20	300	C:\Simulation_Builder\simulations\My IDModel\Output\My IDModel\RiverX_v1-QT_RP10-Defences_S1-TUT_001
2	RiverX_v1-QT_RP10-Defences_S2-TUT_001	RiverX_v1.dst	QT_RP10.BED	Defences_S2.BED	TUT_001.tcf	TUT_001	Unsteady (Fixed Timestep)	Initial_conditions_1.tzs	0	24	20	300	C:\Simulation_Builder\simulations\My IDModel\Output\My IDModel\RiverX_v1-QT_RP10-Defences_S2-TUT_001
3	RiverX_v1-QT_RP10-Defences_S1-TUT_001	RiverX_v1.dst	QT_RP10.BED	Defences_S1.BED	TUT_001.tcf	TUT_001	Unsteady (Fixed Timestep)	Initial_conditions_1.tzs	0	24	20	300	C:\Simulation_Builder\simulations\My IDModel\Output\My IDModel\RiverX_v1-QT_RP10-Defences_S1-TUT_001
4	RiverX_v1-QT_RP10-Defences_S2-TUT_001	RiverX_v1.dst	QT_RP10.BED	Defences_S2.BED	TUT_001.tcf	TUT_001	Unsteady (Fixed Timestep)	Initial_conditions_1.tzs	0	24	20	300	C:\Simulation_Builder\simulations\My IDModel\Output\My IDModel\RiverX_v1-QT_RP10-Defences_S2-TUT_001
5	RiverX_v1-QT_RP100-Defences_S1-TUT_001	RiverX_v1.dst	QT_RP100.BED	Defences_S1.BED	TUT_001.tcf	TUT_001	Unsteady (Fixed Timestep)	Initial_conditions_1.tzs	0	24	20	300	C:\Simulation_Builder\simulations\My IDModel\Output\My IDModel\RiverX_v1-QT_RP100-Defences_S1-TUT_001
6	RiverX_v1-QT_RP100-Defences_S2-TUT_001	RiverX_v1.dst	QT_RP100.BED	Defences_S2.BED	TUT_001.tcf	TUT_001	Unsteady (Fixed Timestep)	Initial_conditions_1.tzs	0	24	20	300	C:\Simulation_Builder\simulations\My IDModel\Output\My IDModel\RiverX_v1-QT_RP100-Defences_S2-TUT_001
7	RiverX_v1-QT_RP200-Defences_S1-TUT_001	RiverX_v1.dst	QT_RP200.BED	Defences_S1.BED	TUT_001.tcf	TUT_001	Unsteady (Fixed Timestep)	Initial_conditions_1.tzs	0	24	20	300	C:\Simulation_Builder\simulations\My IDModel\Output\My IDModel\RiverX_v1-QT_RP200-Defences_S1-TUT_001
8	RiverX_v1-QT_RP200-Defences_S2-TUT_001	RiverX_v1.dst	QT_RP200.BED	Defences_S2.BED	TUT_001.tcf	TUT_001	Unsteady (Fixed Timestep)	Initial_conditions_1.tzs	0	24	20	300	C:\Simulation_Builder\simulations\My IDModel\Output\My IDModel\RiverX_v1-QT_RP200-Defences_S2-TUT_001

Each row in the 'Preview' table represents a new simulation that will be created upon clicking the 'Build' button.

The simulation name is generated from a combination of the Network alias, the event alias(s), and the TUFLOW link name, separated by hyphens, i.e.

my\_network\_alias-my\_first\_event\_alias-my\_second\_event\_alias-my\_tufLOW\_link\_name

These entries can be edited by clicking on the appropriate table cell and typing your alternative name. Right click on a row in the table and select 'edit' as a fast way to add a suffix and/or prefix to the IEF name.

TufLOW options can also be edited in table by clicking on the relevant cell and typing in the revised text. Please be vigilant regarding filenames if considering multiple run options from the same TUFLOW file as any simulations that are identical aside from TUFLOW run options will be given the same name unless edited (the TUFLOW run options do not create part of the filename).

Initial conditions can be edited in the table or via ribbon toolbar (explained below). Note that initial conditions column will only be present if an appropriate file (IIC or ZZS) has been specified in the baseline simulation: if you have chosen to use initial conditions from the Network (DAT) file, the initial conditions will not be shown on the preview page (and cannot be adjusted for new simulations). Please also be vigilant regarding filenames if considering multiple initial conditions as any simulations that are identical aside from initial conditions will be given the same name unless edited (the initial conditions do not create part of the filename).

In addition, the following data in the IEF files can be customised by editing entries in the 'Preview' table:

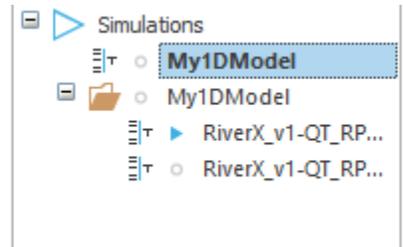
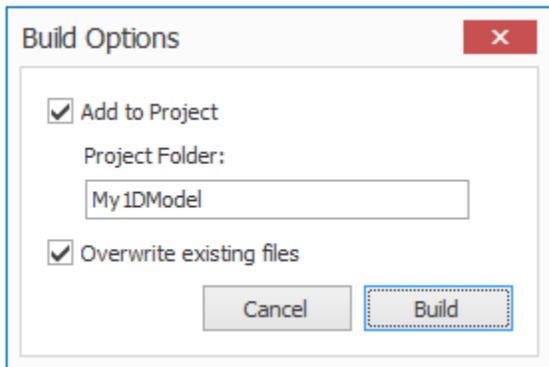
- Start Time
- Finish Time
- Timestep
- Save Interval

These can also be edited by right clicking on the appropriate row in the table and selecting 'edit'. A new window will pop up for you to enter the changes required, and the 'Update' button will be enabled once an edit has been made. Click on 'Update' to apply the edit(s) to the table. To apply the same edits to multiple rows of the table, hold Shift or Ctrl keys whilst clicking with the mouse, i.e. click on row 1 and hold Ctrl whilst clicking on row 7 to highlight rows 1 and 7, click on row 1 and hold Shift whilst clicking on row 7 to highlight rows 1 to 7 inclusive. Right clicking on one of these highlighted rows and selecting 'edit' will then cause a new window to pop up, and typing the changes and clicking on 'Update' will apply the edits made to all highlighted rows.

The Results folder path can also be edited from the table (directly, but not via right clicking and selecting edit).

The preview window includes a ribbon toolbar above the table with various functions to aid the customisation of the IEF files you are building. These functions are described in the section below.

8. When the preview table is specified as required, click the 'Build' button in the toolbar. A prompt box will appear with default settings to 'Add to Project' and 'Overwrite existing files'. Either or both of these can be deselected. The new IEF files will be generated in the specified location(s). If you have chosen 'Add to Project', they will also be added to your current Flood Modeller project in a sub-folder of the Simulation section of the Project panel. This sub-folder will take the name of the template IEF used as default or you can specify your own name.



## 'Preview' Toolbar Ribbon

There are several functions available to further customise your simulations generated in the preview window of the Simulation Builder. These are accessed via buttons on a ribbon bar (shown below), located above the table.



A description of each function is as follows:

### Add

The 'Add' button allows you to add additional rows (IEF files) to the 'Preview' table. When pressed you are returned to the previous wizard dialog which will allow for additional selections or amendments to be made. Once finished press the 'Add to Preview' button to append to the existing 'Preview' table.

### Save

The 'Save' button allows the table data to be saved as a Simulation Builder Library file. You will be prompted to choose a filename and all of the table data will be saved in XML file format.

### Export as CSV

The 'Export as CSV' button allows the table data to be saved in .csv format. You will be prompted to choose a filename. Note that on clicking 'Build', the tool will automatically create a CSV file containing the table data.

### Remove All

The 'Remove All' button allows you to remove all rows from the 'Preview' table. You will be prompted with a confirmation message prior to deletion.

### Remove Selected

The 'Remove Selected' button allows you to choose specific rows to remove by highlighting the rows before pressing the button. You will be prompted with a confirmation message prior to deletion. To highlight multiple rows, hold Shift or Ctrl keys whilst clicking with the mouse, i.e. click on row 1 and hold Ctrl whilst clicking on row 7 to highlight rows 1 and 7, click on row 1 and hold Shift whilst clicking on row 7 to highlight rows 1 to 7 inclusive.

## Highlight Duplicates

The 'Highlight Duplicates' button is a quick way to find any duplicate simulations that will be created during the build process (i.e. with the same combination of networks and event files). When pressed, a background check of the table data will search for duplicate entries by examining each row (and cell) and highlight any duplicate entries (ready for deletion using the 'Remove Selected' function).

Note that the 'Highlight Duplicates' button will only highlight identical duplicates where the network, event 1, event 2, etc. are all identical. The tool cannot distinguish between data for different events, for example the two simulations below would NOT be considered identical by the tool:

ID	Network	Event 1	Event 2
1	River_1	10_year_return_period	Defence_1
2	River_1	Defence_1	10_year_return_period

## Use Relative Paths

The 'Use Relative Paths' button will write relative paths for all file entries when generating the specified IEF files.

## Set Initial Conditions

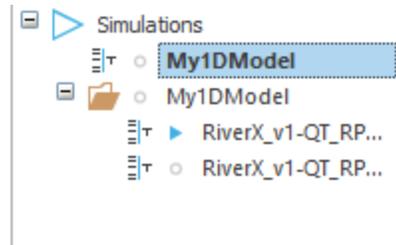
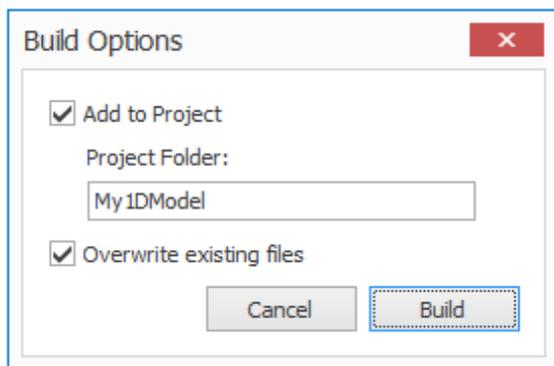
If the template IEF contains an Initial Conditions file then the 'Set Initial Conditions' button will be displayed in ribbon. The listed file can be changed by highlighting a row or rows (hold Ctrl to highlight multiple rows) and pressing the 'Set Initial Conditions' button from the ribbon. This enables you to choose a different initial conditions file and will update all of the selected rows in the table with this file. Note this button will not be visible if the template IEF is using initial conditions from the network (DAT) file. Please be vigilant regarding filenames if considering multiple initial conditions as any simulations that are identical aside from initial conditions will be given the same name unless edited (the initial conditions do not create part of the filename).

## Use Sequential Name

Use the 'Use Sequential Name' button (alternatively 'Use Event Name' button) to toggle between the event-based naming convention described above and the so-called "sequential" naming convention for the simulations. The sequential simulation name is generated from a combination of the Network name and an incremental number, separated by a hyphen, i.e. my\_network-001, my\_network-002. If you have added simulations via the 'Add' button, these will have .dat-2 added after the network in the sequential name, i.e. my\_network.dat-2-003, my\_network.dat-2-004.

## Build

The 'Build' button executes the process of creating your specified IEF files. Each row in the table will be built into a separate IEF file. If chosen via checkbox, the IEF files will be automatically loaded into the 'Simulations' section of the Flood Modeller 'Project' panel inside a sub-folder (named as the template IEF as default, although this can be edited).

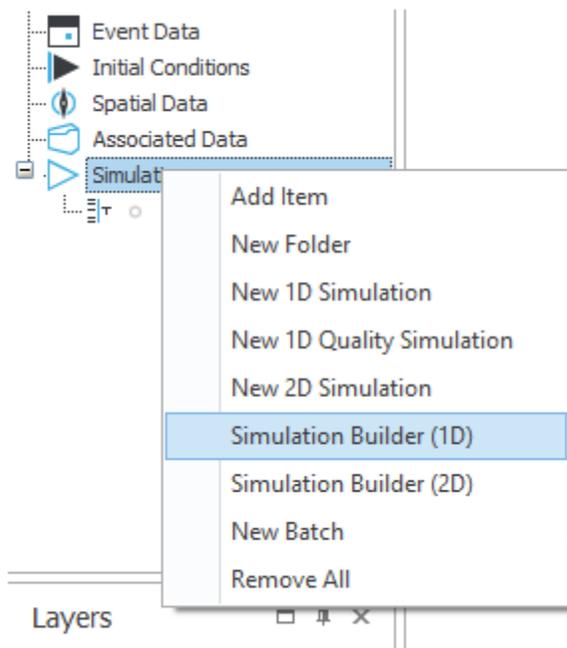


## Using a Simulation Builder Library

The Simulation Builder tool provides an option for you to save your collection of IEF file configurations (for later retrieval in the tool). The save function is provided in the toolbar of the Preview window (described above). The settings data are saved in XML format (so can be viewed in a text editor or specialist XML viewer) and are referred to as a simulation builder library.

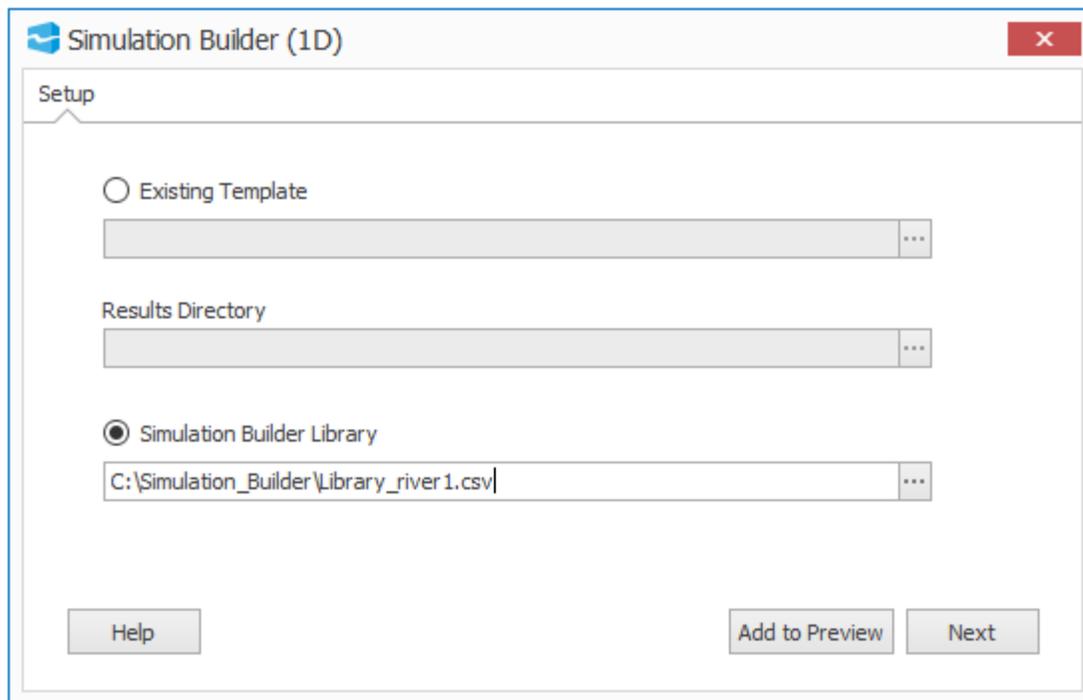
The process of retrieving these data to build new IEF files or edit settings is as follows:

1. Right Click on a 'Simulations' section on the Flood Modeller 'Project' panel and choose 'Simulation Builder (1D)' from the context menu.



2. This will open the initial setup dialog but will allow you to specify a Simulation Builder Library file (selection of 'Simulation Builder Library' via radial button enables you to browse to the CSV or XML file). Note: An XML library file is an extract from a previous Simulation Builder session and is generated from the 'Preview' table when the user presses the 'Save' button from the ribbon. A CSV

can be exported from a Simulation Builder session by clicking the 'Export to CSV' button from the ribbon.



3. Once the library file has been selected, Press 'Preview' to view.
4. The 'Preview' page gives you an overall summary of the simulations that will be created:

Simulation Builder - Preview												
Simulation Builder - Preview												
Menu												
<span>Save</span> <span>Build</span> <span>Add</span> <span>Remove All</span> <span>Remove Selected</span> <span>Highlight Duplicates</span> <span>Use Relative Paths</span> <span>Set Initial Conditions</span>												
ID	Name	Network	Event (1)	Run Type	Initial Conditions	Start Time (hrs)	Finish Time (hrs)	Initial Timestep (s)	Minimum Timestep (s)	Maximum Timestep (s)	Save Interval (s)	Results Path
1	RA_FRC_GB_Carr_v2-1-001	RA_FRC_GB_Carr_v2	1000yr	Unsteady (Adaptive Timestep)	HYDRO_000-003.ic	0	35	0.5	5		30	C:\Simulation_Builder\F_C_NB_1000\RA_FRC_GB_Carr_v2-1-001
2	RA_FRC_GB_Carr_v2-1-002	RA_FRC_GB_Carr_v2	10yr	Unsteady (Adaptive Timestep)	HYDRO_000-003.ic	0	35	0.5	5		30	C:\Simulation_Builder\F_C_NB_1000\RA_FRC_GB_Carr_v2-1-002
3	RA_FRC_GB_Carr_v2-1-003	RA_FRC_GB_Carr_v2	50yr	Unsteady (Adaptive Timestep)	HYDRO_000-003.ic	0	35	0.5	5		30	C:\Simulation_Builder\F_C_NB_1000\RA_FRC_GB_Carr_v2-1-003
4	RA_FRC_GB_Carr_v2-1-004	RA_FRC_GB_Carr_v2	100yr	Unsteady (Adaptive Timestep)	HYDRO_000-003.ic	0	35	0.5	5		30	C:\Simulation_Builder\F_C_NB_1000\RA_FRC_GB_Carr_v2-1-004
5	RA_FRC_GB_Carr_v2-1-005	RA_FRC_GB_Carr_v2	200yr	Unsteady (Adaptive Timestep)	HYDRO_000-003.ic	0	35	0.5	5		30	C:\Simulation_Builder\F_C_NB_1000\RA_FRC_GB_Carr_v2-1-005
6	RA_FRC_GB_Carr_v2-1-006	RA_FRC_GB_Carr_v2	500yr	Unsteady (Adaptive Timestep)	HYDRO_000-003.ic	0	35	0.5	5		30	C:\Simulation_Builder\F_C_NB_1000\RA_FRC_GB_Carr_v2-1-006

## Simulation Builder – generating your output data

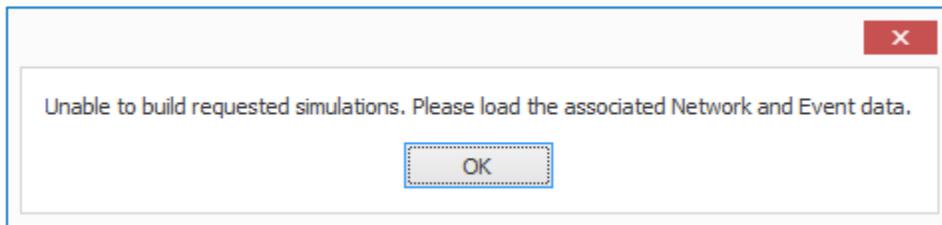
The purpose of the Simulation Builder is to quickly and easily create multiple 1D simulation files based on an existing simulation IEF file. Once the required IEF files are specified as required you can choose to build the simulation files using the button in the 'Preview' window toolbar. This action takes each row in the 'Preview' table and creates an IEF file containing the variables and parameters defined in the 'Preview' table. The output file is named as per the 'Name' column in the table and all new IEF files are created in the same root directory as the original template file.

If chosen at the time of build, once all IEF files have been created, they will be automatically loaded into the Flood Modeller 'Project' panel and displayed in a separate sub-folder within the Simulations section (as default this sub-folder name will be the associated template IEF filename).

## Simulation Builder Validation

Validation checking is built into the Simulation Builder tool to check you can produce simulations based on the input information provided for each new IEF file.

When the 'Build' button is pressed, a validation check is undertaken to ensure that all the prerequisite files referenced are present such as the Network and Event data files. If some or all of these are not present, you will be prompted to load them:



Furthermore, if you have previously associated the Simulation Builder to a Flood Modeller Project file, the tool will prompt you with the Project file name, as shown here:

