Q&A Webinar: How to benchmark your hydraulic solver

Question #	Question	Answer(s)
1	What's the easiest way to setup the channel to run super critical flow?	For supercritical flow, the downstream boundary must have a water level that is equal to or less than the theoretical water level for the given flow rate, channel width, and bed friction. This can be done by setting either a constant stage, or using a stage-discharge relationship. The upstream boundary should be fixed flow.
2	Shouldn't the task of benchmarking be the task of the software provider, not the modeller?	All software providers should be benchmarking their products, but it is still useful for modellers to do their own benchmarking. It represents an excellent way to understand the strengths and limitations associated with particular software. You'll most likely learn a lot about the sensitivity of various inputs into your models too. With that knowledge you will find your project modelling will become more efficient, because you have a better understanding hydraulics, and a better understanding of the tool you're using.
		Software developers should carry out the bulk of the benchmarking, particularly the numerical solution. However, the magnitude of potential dependencies like cell size/shape/orientation/timestepping can be model specific, so modellers should be tuned into whether these dependencies exist, especially if it's an uncalibrated model.
3	How do we convey the uncertainties inherent in our flood modelling results to decision makers?	Great question, particularly as some decision makers don't want to recognise that there are any uncertainties! There are a range of causes for uncertainty in model results (e.g. accuracy of input topographical data, boundary conditions, model schematisation and parameters). Undertaking sensitivity testing and presenting these is one way convey the model response to uncertainty in various parameters, e.g. inflows +-20%, hydraulic roughness +-20%, structure blockages. The Australian Rainfall and Runoff Project 15 (2D modelling) has a section on accuracy and uncertainty of model results which you may also like to have a look at.
4	How could we take manning's coefficient for a boulder stage river?	You can find guidelines that recommend Manning's n values for rivers/pounds with boulders. For example, the Brisbane City Council's Manning's Roughness Guideline (https://www.brisbane.qld.gov.au/sites/default/files/ncd_appendixc_part3.pdf) suggests values with some photos of rivers to assist you to choose the value.
		Also, when the roughness length scale becomes similar to, or greater than, the water depth, then bed-friction is no longer well described by Manning's equation with a constant coefficient. You may wish to consider a depth-depended Manning's coefficient, or else using a log-law roughness bed friction model.
5	Is benchmarking for timestep as crucial for a solver like TUFLOW HPC that uses adaptive timestepping?	It is still a worthwhile task. Under some highly energetic circumstances, such as Dam failure, a smaller timestep than the default may be recommended. You can reduce the HPC timestep using the command, Control Number Factor == Here's some useful information on HPC timestepping https://wiki.tuflow.com/HPC_Adaptive_Timestepping
		If you're running with HPC's 4th order temporal solution (the default) it's rare that there is any timestepping dependency, so it's not senstivity tested as often as cell size dependency. However, if you switch to the 1st or 2nd order temporal solution substantial dependencies can occur in higher energy flows. Other solvers may, of course, present different behaviours.
6	If you have a flexible mesh model aligned along a meandering channel, are the results still valid during very large floods if the flow short-circuits the channel or other conditions where the flow changes direction at different flowrates?	If you want to build a mesh for all flow conditions (small and large floods), the mesh needs to include the potential short-circuits as well. At locations where the flow is expected to change directions, you can configure the mesh close to regular square or equiangular triangle shapes, so that the mesh is not 'biased' to any flow direction.
7	How does the spatial order 2 affect the accuracy across different geographical regions?	Wherever you are in the world, the dependency remains the same. The key factor that affects the accuracy is the hydraulic behaviour. The more energetic and complex the flow, with significant gradients in water level and velocity, the more necessary a 2nd order spatial scheme will be. The more benign the flow conditions, the higher chance a 1st order solution may be fine.
9	More of a comment than a question :) If you turn on 3D in TUFLOW FV for the u-bend channel the energy losses and secondary flows associated with helicoidal currents are captured and a good match to super-elevation is achieved.	Thanks Mitch - very good point. We'll have to do an in-depth 3D benchmarking webinar! :)
10	Any schematic flow chart to carry out a guided bencharking based on your experience? Top to bottom priority structure. Of course will depend on what you are modelling. Regards	I'm not aware of any flow chart, but I quite like that idea. Definitely something worth considering for the future.
11	would the same solver result in different benchmarking result depending on the software that is used for simulation?	Yes, there are many small details other than spacial order, timestep, turbulence scheme and etc that goes into a SWE code. However, the difference should be reasonably small if these key features discussed by Bill/Greg are the same in both software.
12	Are the model calibration recommendations within ARR2019 adequate or is there alternative literature that may be better to follow?	The calibration recommendations in the ARR Project 15 document are definitely recommended https://downloads.tuflow.com/_archive/Australian_Rainfall_Runoff_Project15_TwoDimensional_Modelling_DraftReport.pdf Some additional practical guidance was included in our Calibration webinar: https://www.tuflow.com/library/webinars/#202104_cal

| 13 | What is the limit of sensitibity tests? It is time consuming and cost effective, but results should be provided promptly to decisions makers. Any rule of a thumb approach from the experts? | What is the potential cost to your business if it is discovered that your final delivered results were substantially wrong? In the same way that a project costing may include perhaps a 10% contingency allowance, it would not be unreasonable to budget a few percent of a project to run some quick checks for sensitivities during the early stages of model development. |