Legend

- Road design strings (May 2018)
- Cadastre
- TUFLOW modelling extent
- Project boundary
- ARR 2016 and Melbourne Water combined Hazard Thresholds
- MWC limiting hazard value (≤ 0.35)
- ARR Classification 2 & 3 (0.35 to 0.6)
- ARR Classification 4 (0.6 to 1.0)
- ARR Classification 5 (1.0 to 4.0)

Coordinate system: GDA 1994 MGA Zone 55

Engineering and Technical Services for Mordialloc Freeway Upgrade

Proposed case conditions 20% AEP peak flood hazard (Velocity X Depth)

Map 4

Scale ratio correct when printed at A3

APPENDIX R

1% AEP FLOOD LEVEL PLOTS – BASE AND PROPOSED CASE CONDITIONS COMPARISON
Centre Dandenong Road @ U/S of culvert crossing
- Flood level (metres AHD, y-axis) versus Time (hours, x-axis)
- 3 hour storm duration
- Base (Tuflow ID BASE) and Proposed (Tuflow ID D203) case conditions
**Lower Dandenong Road @ D/S of culvert crossing**

- Flood level (metres AHD, y-axis) versus Time (hours, x-axis)
- 2 hour storm duration
- Base (Tuflow ID BASE) and Proposed (Tuflow ID D203) case conditions

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**1% AEP (Tuflow ID 01PC) flood event**

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**5% (Tuflow ID 05PC) and 20% (Tuflow ID 20PC) AEP flood events**
Braeside Park @ near The Parkway Road
- Flood level (metres AHD, y-axis) versus Time (hours, x-axis)
- 9 hour storm duration
- Base (Tuflow ID BASE) and Proposed (Tuflow ID D203) case conditions

1% AEP (Tuflow ID 01PC) flood event

5% (Tuflow ID 05PC) and 20% (Tuflow ID 20PC) AEP flood events
Braeside Park @ North of Governors Road

- Flood level (metres AHD, y-axis) versus Time (hours, x-axis)
- 12 hour storm duration
- Base (Tuflow ID BASE) and Proposed (Tuflow ID D203) case conditions
The Waterways @ U/S of existing Wetlands outlet structure

- Flood level (metres AHD, y-axis) versus Time (hours, x-axis)
- 9 hour (1%) 48 hour (5% and 20%) duration storms
- Base (Tuflow ID BASE) and Proposed (Tuflow ID D203) case conditions

1% AEP (Tuflow ID 01PC) flood event

5% (Tuflow ID 05PC) and 20% (Tuflow ID 20PC) AEP flood events
Smythes Drain @ U/S of proposed culvert crossing
- Flood level (metres AHD, y-axis) versus Time (hours, x-axis)
- 72 hour storm duration
- Base (Tuflow ID BASE) and Proposed (Tuflow ID D203) case conditions
**Smythes Drain @ between Springvale Road and Freeway**

- Flood level (metres AHD, y-axis) versus Time (hours, x-axis)
- 72 hour storm duration
- Base (Tuflow ID BASE) and Proposed (Tuflow ID D203) case conditions

1% AEP (Tuflow ID 01PC) flood event

5% (Tuflow ID 05PC) and 20% (Tuflow ID 20PC) AEP flood events
APPENDIX S

CLIMATE CHANGE 2100 SCENARIO – 1% AEP PROPOSED CASE CONDITIONS
Legend
- Road design strings (May 2018)
- Cadastre
- TUFLOW modelling extent
- Project boundary
- Flood level impact (m)
  - Less than -0.01
  - -0.01 - 0.01 (No change)
  - 0.01 - 0.05
  - 0.05 - 0.1
  - Greater than 0.1
  - Was dry now wet
  - Was wet now dry

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Proposed case conditions
Climate Change scenario
1% AEP peak flood level impact
Map 1

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Hi Zaki,

Thank you for your query and the detailed description.

(1) and (2):
The differences between the HPC and Classic of the latest TUFOLOW built are expected. TUFOLOW Classic uses a 2nd order ADI (Alternating Direction Implicit) finite difference matrix solution of the 2D shallow water equations, while the HPC solver uses a 2nd order explicit finite volume TVD (Total Variation Diminishing) solution. Whilst the two schemes both solve the same fundamental equations, the mathematical solutions are quite different and will give different results, usually within 5%. In reply to your query on adaptive timestepping, this would not be the cause of the differences. If you haven’t read Chapter 11 (contents below) of the 2017-09 release notes, please have a read of this chapter for more info.

(2) and (3):
Between the 2010 and 2018 TUFOLOW there have been many enhancements to TUFOLOW, and therefore numerous reasons why different results may occur. For example, some sources of the differences are:

- General improvements to the solution scheme’s ability to handle shocks and steep slopes.
- Default eddy viscosity coefficients have been changed from 0.2, 0.1 in 2010 to 0.5, 0.05 in 2018.
- New features that use GIS attributes previously reserved and unused. If these attributes were not populated with the recommended "reserved" value (usually 0 or blank), then they can cause unpredictable results in later releases.
- Numerous changes to the treatment of the default settings and values. For backward compatibility the "Defaults ==" command is available to run old models on new releases. For example, the default treatment of manholes has changed between 2010 and 2018, so as your model has an extensive pipe network this may be part of the cause.

Generally, there should not be substantial differences between 2010 and 2018 as the fundamental equations being solved are unchanged. If you are getting significant differences (>10% of depth change across the whole model) then it’s most likely due to the last couple of dot points above. To identify the cause(s) for the change, it would probably be best to run the model on the latest build for each release to identify in which release(s) the significant changes occurred. The changes for each release are documented in their release notes, so some idea on the likely causes(s) could be identified. Past releases and release notes are all available from here.

The recommendation is usually for new or reworked models to use the newest build to take advantages of the latest features and enhancements. However, particularly if a model is calibrated, using old builds of TUFOLOW or winding back default settings using "Defaults ==" is reasonable for established models.

Kind Regards,
Hi there,

Hoping you can help me explain, broadly, some observed differences in flood mapping between using different solution schemes, builds and hardware of Tuflow.

- **Background:**
  I've inherited a Tuflow model that was run using an old build – 201010-AC. My client would like to investigate using the latest build of Tuflow with HPC solution scheme in order to reap the benefits of GPU backed simulations.

- **Testing:**
  I have tested the following Tuflow build scenarios, each with identical setup, for my study area:

  1. 2018-03-AB → HPC – GPU hardware
  2. 2018-03-AB → CLA
  3. 2010-10-AC → CLA

  The attached zip folder contains ‘Comparison maps (HPC and CLA)’ contains a flood mapping comparison between (1) and (2) and between (2) and (3). In each case, the setup is identical except of course for the solution scheme and hardware. I also note I am using Tuflow single precision in each case.

- **Result:** There are considerable differences between (2) and (3), i.e. between 2018 and 2010 builds of Tuflow and to a lesser extent between (1) and (2), i.e. between HPC and CPU of the same build.

- **The Queries**
  **Comparison map (1) minus (2): Different solution schemes, same build of Tuflow**
  - The differences in water levels are within a 1 to 100 millimetre range at both inside and outside of main flow paths. I have read section 10.3.2 which states that a recalibration may be required when switching between HPC and CLA. I note that the CLA simulation itself is not calibrated therefore I am not sure whether it is worthwhile calibrating to that solution scheme.
    - I am curious to know if the adaptive time-stepping feature could be a culprit in the observed differences? (GPU average adapted time step 0.55s against CPU fixed timestep 1.0s)
    - Given that we have no stream or actual water level data to work with, would you recommend any calibration at all for the HPC?

  **Comparison map (2) minus (3): Same solution scheme, different builds of Tuflow**
  - I note that I already expected to see differences between 2018 and 2010 classic schemes, however the differences are a lot more significant than originally thought (Up to half a metre as the worst case) – baring in mind the setup is completely identical (TCF/ECF..etc).
    - Could you provide guidance on why the difference in build of Tuflow would influence the mapping output? As much detail as possible would be appreciated.
    - Do you have a recommendation as to what build of Tuflow is ‘more reliable’?

- **Attachments:**
- TCF
- ECF: There is an extensive 1D ESTRY network overall consisting of underground pipes and open channels
- TLF
- TEF (2018)
- 2018 run stats and HPC timestep text files

Any guidance you can provide would be greatly appreciated. Please let me know if you require any further info.

Regards,

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